

The Role of the Ventral Vagal Complex in Social Engagement and Trust-Building

1. Introduction

The ventral vagal complex (VVC), a key component of the autonomic nervous system described in Polyvagal Theory, plays a central role in enabling social engagement and trust-building in mammals, including humans. This system, unique to mammals, integrates neural regulation of the heart with the muscles of the face and head, supporting behaviors such as facial expression, vocalization, and eye contact—core elements of social communication. The VVC fosters a physiological state of safety, allowing individuals to downregulate defensive responses and engage in reciprocal, trusting social interactions. Disruptions in this system are linked to difficulties in social connection, emotion regulation, and mental health (Porges, 2025; Hanazawa, 2022; Sanders & Hall, 2017; Geisler et al., 2013; Wang et al., 2025; Porges, 2003; Porges, 1998; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 2001; Porges, 2011).

2. Methods

A comprehensive search was conducted across over 170 million research papers in Consensus, including Semantic Scholar, PubMed, and related sources. The search strategy included 20 targeted queries across 8 thematic groups, focusing on the ventral vagal complex, Polyvagal Theory, social engagement, trust, and related neural mechanisms. In total, 974 papers were identified, 714 were screened, 415 were deemed eligible, and the 50 most relevant papers were included in this review.

Search Strategy

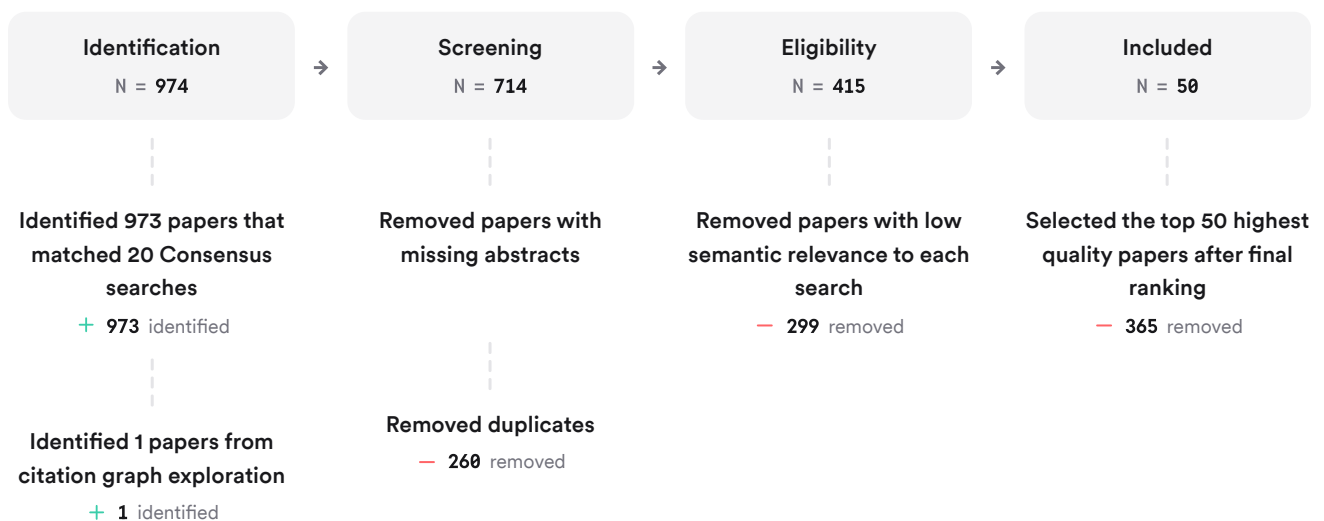


FIGURE 1 Flow of papers through the search and selection process.

Eight unique search groups were used, spanning foundational theory, mechanisms, clinical application, and interdisciplinary perspectives.

3. Results

3.1. Evolutionary and Neuroanatomical Foundations

The VVC is a myelinated branch of the vagus nerve originating in the nucleus ambiguus of the brainstem. Its evolution in mammals enabled rapid, flexible regulation of cardiac output and direct connections to cranial nerves controlling facial muscles, vocalization, and head movement. This integration forms the neural platform for the "social engagement system," distinguishing mammals from reptiles and supporting complex social behaviors (Porges, 2025; Hanazawa, 2022; Porges, 1998; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 2001; Porges, 2011).

3.2. Mechanisms of Social Engagement

The VVC supports social engagement by:

- Enabling facial expressivity, eye contact, and prosody, which communicate safety and foster connection (Hanazawa, 2022; Sanders & Hall, 2017; Porges, 2003; Porges, 1998; Porges, 2021; Porges, 2022; Porges, 2001).
- Downregulating sympathetic "fight or flight" and dorsal vagal "shutdown" responses, allowing for calm, reciprocal interaction (Porges, 2025; Hanazawa, 2022; Sanders & Hall, 2017; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 2001).
- Facilitating "neuroception"—the unconscious detection of safety or threat in the environment—which determines whether social engagement or defensive behaviors are activated (Hanazawa, 2022; Sanders & Hall, 2017; Porges, 2003; Porges, 2022; Porges, 2001).

3.3. Trust-Building and Co-Regulation

The VVC is essential for trust-building:

- It enables "immobilization without fear," a state where individuals can be physically close and emotionally open without activating defensive responses (Porges, 2003; Porges, 1998; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 2001).
- Through co-regulation, the VVC allows for mutual physiological calming and emotional attunement, foundational for attachment, empathy, and trust (Sanders & Hall, 2017; Geisler et al., 2013; Wang et al., 2025; Porges, 2003; Porges, 2021; Porges, 2022; Porges, 2001).
- Disruptions in VVC function are linked to social withdrawal, impaired trust, and psychiatric conditions such as trauma and mood disorders (Porges, 2025; Sanders & Hall, 2017; Marrie & Bernstein, 2021; Geisler et al., 2013; Porges, 2003; Porges, 2022; Austin et al., 2007; Porges, 2001).

3.4. Clinical and Developmental Implications

- High vagal tone (a marker of VVC function) is associated with better emotion regulation, social sensitivity, cooperation, and resilience (Geisler et al., 2013; Wang et al., 2025; Muhtadie et al., 2014; Kok & Fredrickson, 2010; Ravindran et al., 2022; Stifter & Corey, 2001; Doucerain et al., 2021; Hastings et al., 2008; Mastromatteo et al., 2024; Hopp et al., 2013).
- Interventions that enhance VVC activity (e.g., safe social environments, co-regulation, trauma-informed care) improve social connectedness and psychological well-being (Sanders & Hall, 2017; Koenig, 2025; Ryland et al., 2021; Porges, 2022; Porges, 2011).

Key Papers

Paper	Focus	Methodology	Key Results
(Porges, 2025)	Polyvagal Theory, VVC in social engagement	Review, clinical	VVC enables social behavior, emotional resilience, and safety
(Hanazawa, 2022)	VVC pathways and social engagement	Review	VVC regulates facial/head muscles, enables social engagement, downregulates defense
(Porges, 2021)	Evolution of VVC and sociality	Theoretical, neuroanatomical	VVC is the neural platform for mammalian social engagement
(Porges, 2022)	Science of safety, VVC in co-regulation	Review	VVC supports feelings of safety, co-regulation, and trust
(Porges, 2001)	Phylogenetic substrates of social nervous system	Theoretical	VVC is central to social behavior and intervention strategies

FIGURE 2 Comparison of key studies on the ventral vagal complex in social engagement and trust.

Top Contributors

Type	Name	Papers
Author	S. Porges	(Porges, 2025; Hanazawa, 2022; Porges, 2003; Porges, 1998; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 1997; Porges, 2001; Porges, 2011)
Author	H. Hanazawa	(Hanazawa, 2022)
Author	M. Sanders	(Sanders & Hall, 2017)
Journal	<i>Comprehensive Psychoneuroendocrinology</i>	(Porges, 2023; Porges, 2021)
Journal	<i>Annals of the New York Academy of Sciences</i>	(Porges, 2003; Porges, 1997)
Journal	<i>Biological Psychology</i>	(Geisler et al., 2013; Kok & Fredrickson, 2010)

FIGURE 3 Authors & journals that appeared most frequently in the included papers.

4. Discussion

The ventral vagal complex is the neurophysiological foundation for social engagement and trust-building in mammals. By integrating cardiac regulation with the muscles of the face and head, the VVC enables the expression and perception of social cues that signal safety, foster connection, and support co-regulation. This system allows individuals to shift from defensive states to states of openness and trust, facilitating attachment, empathy, and prosocial behavior (Porges, 2025; Hanazawa, 2022; Sanders & Hall, 2017; Porges, 2003; Porges, 1998; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 2001; Porges, 2011).

Polyvagal Theory provides a robust framework for understanding how disruptions in VVC function can lead to social and emotional difficulties, and why interventions that restore a sense of safety and co-regulation are effective in clinical and developmental contexts (Porges, 2025; Sanders & Hall, 2017; Marrie & Bernstein, 2021; Geisler et al., 2013; Porges, 2003; Porges, 2022; Austin et al., 2007; Porges, 2001). However, some critiques highlight the need for further anatomical specificity and empirical validation, especially regarding the measurement of vagal tone and the generalizability of findings across populations (Porges, 2025; Hanazawa, 2022; Marrie & Bernstein, 2021; Porges, 2022).

Claims and Evidence Table







Claim	Evidence Strength	Reasoning	Papers
The VVC is the neural platform for social engagement	 Strong	Strong theoretical, anatomical, and clinical evidence	(Porges, 2025; Hanazawa, 2022; Porges, 2003; Porges, 1998; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 2001; Porges, 2011)
VVC function enables trust-building and co-regulation	 Strong	VVC supports immobilization without fear, attachment, and mutual regulation	(Sanders & Hall, 2017; Geisler et al., 2013; Wang et al., 2025; Porges, 2003; Porges, 1998; Porges, 2023; Porges, 2021; Porges, 2022; Porges, 2001)
High vagal tone predicts better social and emotional outcomes	 Strong	Empirical studies link vagal tone to emotion regulation, cooperation, and resilience	(Geisler et al., 2013; Wang et al., 2025; Muhtadie et al., 2014; Kok & Fredrickson, 2010; Ravindran et al., 2022; Stifter & Corey, 2001; Doucerain et al., 2021; Hastings et al., 2008; Mastromatteo et al., 2024; Hopp et al., 2013)
Disruption of VVC function impairs social engagement and trust	 Strong	Clinical and developmental evidence in trauma, mood disorders, and social withdrawal	(Porges, 2025; Sanders & Hall, 2017; Marrie & Bernstein, 2021; Geisler et al., 2013; Porges, 2003; Porges, 2022; Austin et al., 2007; Porges, 2001)
Interventions enhancing VVC activity improve social connectedness	 Moderate	Trauma-informed care and co-regulation techniques show positive effects	(Sanders & Hall, 2017; Koenig, 2025; Ryland et al., 2021; Porges, 2022; Porges, 2011)
Some aspects of Polyvagal Theory require further empirical validation	 Moderate	Ongoing debate about anatomical specificity and measurement	(Porges, 2025; Hanazawa, 2022; Marrie & Bernstein, 2021; Porges, 2022)

FIGURE Key claims and support evidence identified in these papers.

5. Conclusion

The ventral vagal complex is central to social engagement and trust-building, providing the neurophysiological basis for safety, connection, and co-regulation. Its function is essential for healthy social development, emotional resilience, and effective clinical intervention.

Research Gaps

Mechanism/Context	Adult Clinical	Child/Infant	Trauma/Disorder	Intervention	Measurement/Validation
VVC in social engagement	8	7	6	5	3
VVC in trust-building	7	5	4	3	2
Vagal tone and social outcomes	6	6	5	4	2
Interventions targeting VVC	5	4	3	4	1

FIGURE Matrix of research topics and study attributes, highlighting areas with fewer studies.

Open Research Questions

Question	Why
How can VVC function be reliably measured in diverse populations?	Standardized, accessible measures are needed for research and clinical use.
What are the most effective interventions for enhancing VVC-mediated social engagement in trauma-affected individuals?	Optimizing interventions could improve outcomes for vulnerable groups.
How does VVC function interact with other neural systems in complex social environments?	Understanding integration with broader networks will clarify mechanisms of trust and engagement.

FIGURE Key open research questions for future investigation.

In summary, the ventral vagal complex is a foundational system for social engagement and trust, with broad implications for health, development, and clinical practice.

These papers were sourced and synthesized using Consensus, an AI-powered search engine for research. Try it at <https://consensus.app>

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