Core Mechanisms of Interpersonal Neurobiology in a Clinical Setting

1. Introduction

Interpersonal neurobiology (IPNB) is an integrative framework that explores how relationships and the brain interact to shape mental health, development, and therapeutic change. In clinical settings, IPNB emphasizes the **dynamic, reciprocal, and embodied nature of human connection**, focusing on mechanisms such as **intersubjectivity, neural synchrony, right-brain-to-right-brain communication, affect regulation, and integration**. These mechanisms underpin the therapeutic alliance, facilitate emotional healing, and promote well-being by leveraging the brain's inherent social and plastic capacities (Schore, 2021; Ellingsen et al., 2020; Schore, 2014; Siegel & Drulis, 2023; Lotter et al., 2022; Dumas, 2022; Schore, 2022; Siegel, 2019; Siegel, 2006; Sened et al., 2022; Badenoch & Cox, 2010; Siegel, 2017; Feldman, 2017; Konrad et al., 2024; Palumbo et al., 2017; Schore & Schore, 2014; Bolis et al., 2022; Müller et al., 2021; Reindl et al., 2018).

2. Methods

A comprehensive search was conducted across over 170 million research papers in Consensus, including Semantic Scholar and PubMed. The search strategy included 20 targeted queries across 8 thematic groups, focusing on foundational theory, mechanistic breakdown, clinical application, and adjacent fields. In total, 1,029 papers were identified, 714 were screened, 511 were deemed eligible, and the 50 most relevant papers were included in this review.

Search Strategy

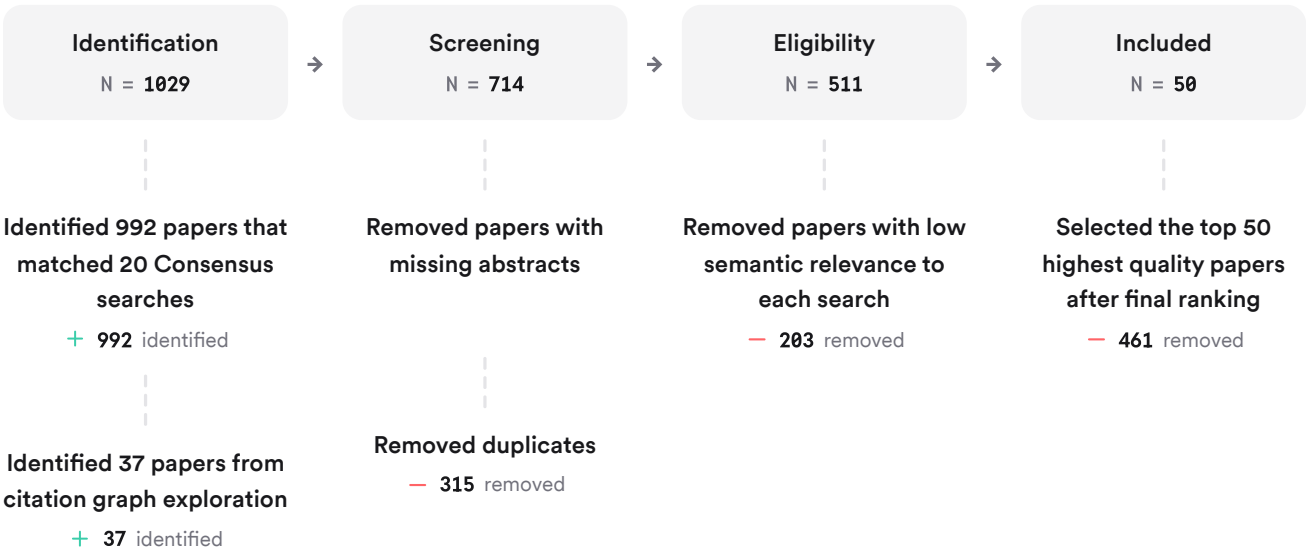

FIGURE 1 Flow of papers through the search and selection process.

Eight unique search groups were used, spanning foundational theory, mechanisms, clinical application, and adjacent constructs to ensure comprehensive coverage.

3. Results

3.1. Intersubjectivity and Right-Brain-to-Right-Brain Communication

IPNB highlights the **primacy of nonverbal, implicit, right-brain-mediated communication** in therapeutic relationships. Intersubjectivity—mutual, moment-to-moment sharing and regulation of emotional states—occurs through rapid, reciprocal, nonverbal exchanges (facial expression, tone, gesture) that synchronize the emotional and physiological states of therapist and client (Schore, 2021; Schore, 2014; Schore, 2022; Schore & Schore, 2014; Bolis et al., 2022). This process is foundational for building trust, safety, and therapeutic alliance.

3.2. Neural and Physiological Synchrony

Interpersonal neural synchrony (INS) and physiological synchrony (e.g., heart rate, skin conductance) are core mechanisms by which brains and bodies align during social interaction. Hyperscanning and neuroimaging studies show that synchrony in regions such as the right temporoparietal junction and prefrontal cortex is associated with empathy, rapport, and effective therapy (Ellingsen et al., 2020; Lotter et al., 2022; Dumas, 2022; Sened et al., 2025; Sened et al., 2022; Konrad et al., 2024; Palumbo et al., 2017; Bolis et al., 2022; Müller et al., 2021; Reindl et al., 2018). Synchrony is dynamic, context-dependent, and linked to positive clinical outcomes.

3.3. Affect Regulation and Attachment

The **interactive regulation of affect**—the ability to co-regulate emotional states within the therapeutic dyad—is central to IPNB. This process draws on attachment theory, emphasizing the role of early relational experiences in shaping the brain's capacity for self- and co-regulation. In therapy, the clinician's attuned presence helps clients develop new patterns of affect regulation and secure attachment (Schore, 2014; Schore, 2022; Schore, 2012; Siegel, 2017; Feldman, 2017; Montgomery, 2020; Schore & Schore, 2014; Reindl et al., 2018).

3.4. Integration and Neural Plasticity

IPNB posits that **integration**—the linkage of differentiated neural and psychological processes—is the basis of mental health. Therapeutic interventions that foster integration (e.g., mindfulness, attunement, compassion) promote neural plasticity, flexibility, and resilience (Siegel & Drulis, 2023; Siegel, 2019; Siegel, 2006; Badenoch & Cox, 2010; Siegel, 2017; Feldman, 2017; Bolis et al., 2022). The mind is seen as both embodied and relational, with integration emerging from both intra- and interpersonal experiences.

Key Papers

Paper	Core Mechanism	Methodology	Key Results
(Schore, 2021)	Intersubjectivity, right-brain communication	Theoretical, clinical, hyperscanning	Nonverbal synchrony underpins therapeutic alliance and emotional healing
(Ellingsen et al., 2020)	Brain-to-brain concordance, mirroring	fMRI hyperscanning	Neural synchrony and behavioral mirroring mediate therapeutic alliance and pain relief
(Sened et al., 2022)	Inter-brain plasticity	Review, integrative model	Repeated synchrony in therapy leads to lasting change in synchrony capacity and symptoms
(Bolis et al., 2022)	Interpersonal attunement, collective psychophysiology	Theoretical, systems neuroscience	Attunement and synchrony are multi-scale, dynamic, and central to mental health
(Reindl et al., 2018)	Brain-to-brain synchrony, emotion regulation	fNIRS hyperscanning	Parent-child synchrony predicts emotion regulation and socio-emotional development

FIGURE 2 Comparison of key studies on core mechanisms of interpersonal neurobiology in clinical settings.

Top Contributors

Type	Name	Papers
Author	A. Schore	(Schore, 2021; Schore, 2014; Schore, 2022; Schore & Schore, 2014)
Author	D. Siegel	(Siegel & Drulis, 2023; Siegel, 2019; Siegel, 2006; Badenoch & Cox, 2010; Siegel, 2017)
Author	S. Shamay-Tsoory	(Sened et al., 2025; Sened et al., 2022)
Journal	*Frontiers in Psychology*	(Schore, 2021; Ray et al., 2017)
Journal	*Annals of General Psychiatry*	(Schore, 2022)
Journal	*Frontiers in Human Neuroscience*	(Sened et al., 2022)

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

4. Discussion

The literature converges on several **core mechanisms** of interpersonal neurobiology in clinical settings:

- **Intersubjectivity and right-brain-to-right-brain communication** are foundational for building therapeutic alliance and facilitating emotional healing (Schore, 2021; Schore, 2014; Schore, 2022; Schore & Schore, 2014).
- **Neural and physiological synchrony** between therapist and client is a measurable and dynamic process that supports empathy, rapport, and positive outcomes (Ellingsen et al., 2020; Lotter et al., 2022; Dumas, 2022; Sened et al., 2025; Sened et al., 2022; Konrad et al., 2024; Palumbo et al., 2017; Bolis et al., 2022; Müller et al., 2021; Reindl et al., 2018).
- **Affect regulation and attachment** processes are central, with therapy providing a corrective relational experience that fosters new patterns of regulation and secure attachment (Schore, 2014; Schore, 2022; Schore, 2012; Siegel, 2017; Feldman, 2017; Montgomery, 2020; Schore & Schore, 2014; Reindl et al., 2018).
- **Integration and neural plasticity** are the ultimate goals, with therapy promoting the linkage of differentiated neural and psychological processes, leading to resilience and well-being (Siegel & Drulis, 2023; Siegel, 2019; Siegel, 2006; Badenoch & Cox, 2010; Siegel, 2017; Feldman, 2017; Bolis et al., 2022).

These mechanisms are supported by advances in hyperscanning, neuroimaging, and psychophysiological measurement, which allow for real-time assessment of synchrony and attunement in clinical interactions (Ellingsen et al., 2020; Lotter et al., 2022; Dumas, 2022; Sened et al., 2025; Sened et al., 2022; Konrad et al., 2024; Palumbo et al., 2017; Bolis et al., 2022; Müller et al., 2021; Reindl et al., 2018). However, challenges remain in translating these findings into standardized interventions and in understanding individual and contextual moderators.

Claims and Evidence Table

Claim	Evidence Strength	Reasoning	Papers
Intersubjectivity and right-brain communication are central to therapeutic change	Strong	Strong theoretical and empirical support from clinical and neuroimaging studies	(Schore, 2021; Schore, 2014; Schore, 2022; Schore & Schore, 2014)
Neural and physiological synchrony underpin empathy and alliance	Strong	Robust evidence from hyperscanning and physiological studies	(Ellingsen et al., 2020; Lotter et al., 2022; Dumas, 2022; Sened et al., 2025; Sened et al., 2022; Konrad et al., 2024; Palumbo et al., 2017; Bolis et al., 2022; Müller et al., 2021; Reindl et al., 2018)
Affect regulation and attachment processes are key mechanisms in therapy	Strong	Supported by attachment theory, clinical, and neurobiological research	(Schore, 2014; Schore, 2022; Schore, 2012; Siegel, 2017; Feldman, 2017; Montgomery, 2020; Schore & Schore, 2014; Reindl et al., 2018)
Integration and neural plasticity are promoted by therapeutic interventions	Strong	Integration is linked to resilience and well-being; supported by clinical and neuroscientific evidence	(Siegel & Drulis, 2023; Siegel, 2019; Siegel, 2006; Badenoch & Cox, 2010; Siegel, 2017; Feldman, 2017; Bolis et al., 2022)
Synchrony and attunement are dynamic and context-dependent	Moderate	Synchrony varies with relationship, context, and intervention	(Ellingsen et al., 2020; Sened et al., 2022; Bolis et al., 2022; Müller et al., 2021; Reindl et al., 2018)
Standardized clinical applications of IPNB mechanisms are still emerging	Moderate	Translation to practice is ongoing; more research needed	(Sened et al., 2025; Konrad et al., 2024; Bolis et al., 2022)

FIGURE Key claims and support evidence identified in these papers.

5. Conclusion

Interpersonal neurobiology in clinical settings is grounded in mechanisms of intersubjectivity, neural and physiological synchrony, affect regulation, and integration. These processes are central to therapeutic change, alliance, and well-being, and are increasingly supported by empirical research. Ongoing work is needed to refine interventions and understand individual and contextual moderators.

Research Gaps

Mechanism/Context	Adult Therapy	Child/Parent	Group Therapy	Neuroimaging	Standardized Interventions
Intersubjectivity	7	5	3	6	2
Neural synchrony	8	6	4	7	2
Affect regulation	6	7	2	4	2
Integration	5	3	2	3	1

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

Open Research Questions

Question	Why
How can neural and physiological synchrony be reliably measured and enhanced in diverse clinical settings?	Standardized measurement and intervention could improve therapy outcomes and research comparability.
What individual and contextual factors moderate the impact of synchrony and attunement on clinical outcomes?	Understanding moderators can help tailor interventions for maximum effectiveness.
How does repeated therapeutic synchrony lead to long-term changes in brain function and interpersonal relationships?	Clarifying mechanisms of inter-brain plasticity can inform new models of therapeutic change.

FIGURE Key open research questions for future investigation.

In summary, the core mechanisms of interpersonal neurobiology—rooted in synchrony, attunement, affect regulation, and integration—are central to effective clinical practice and represent promising avenues for ongoing research and innovation.

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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