

*Full-length article***Music as a biological signal of safety: A polyvagal perspective on compassionate musician–patient interaction in healthcare**Peter Shannon¹, Stephen W. Porges²¹ American Institute for Music and Healing, Martin, United States² Indiana University, Bloomington, United States**Abstract**

Healthcare environments present significant environmental and psychological stressors that can trigger a patient's autonomic threat-detection systems, resulting in sustained sympathetic arousal that impairs recovery and emotional regulation. While live music is widely recognized as a comforting intervention in clinical settings, it is often framed merely as subjective entertainment, obscuring the neurophysiological mechanisms through which musical encounters may influence patient regulation. This perspective paper establishes a theoretical framework combining compassion science and Polyvagal Theory (PVT) to explain how live musical encounters may function as potent cues of environmental safety capable of supporting autonomic regulation and co-regulation. By examining the training curriculum of the American Institute for Music and Healing (AIMH) 'Awakening the Inner Gift' program, we illustrate how live musician–patient interactions may function as stabilizing regulatory processes within healthcare environments. These encounters demonstrate patterns consistent with Polyvagal Theory that are interpreted through anecdotal observations from patients and musicians. To ground this theoretical framework in clinical reality, we present anecdotal narrative feedback from 18 patients and performing musicians in an outpatient cancer center. These brief clinical observations demonstrate experiential themes of emotional regulation, autobiographical memory activation, and relational reciprocity. Ultimately, This paper suggests that a foundational understanding of Polyvagal Theory should form part of the education of music-in-health practitioners, equipping musicians with a neurophysiological framework for understanding how compassionate musical interactions may support autonomic regulation and patient wellbeing.

Keywords: *Polyvagal Theory, Compassion Science, Music and health, Arts and health, Music in healthcare, Music and wellbeing*

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Introduction

Healthcare environments are often characterized by uncertainty, vulnerability, pain, unfamiliar procedures, and reduced personal control. For many patients, these conditions evoke heightened physiological and emotional stress responses associated with the involuntary recruitment

of defensive autonomic states. Grounded in Polyvagal Theory (PVT), these defensive physiological states—often characterized by sympathetic activation and reduced regulatory flexibility—are associated with negative effects on emotional regulation, immune functioning, recovery, and overall wellbeing within medical contexts.[1] Under such high-stress clinical conditions, introducing explicit cues of environmental safety may play a critical role in supporting autonomic regulation and facilitating physiological states associated with safety, social engagement, and restoration.[2]

Live musical performance represents a highly dynamic, yet underutilized, mechanism for communicating these cues of safety. While music is commonly described in healthcare settings as comforting or uplifting, such descriptions often remain confined to the realm of subjective entertainment. Framing music primarily as simply supportive risks overlooking the profound neurophysiological mechanisms through which musical encounters may influence human wellbeing. When delivered by professional musicians trained in compassion

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science, live performance introduces relational and acoustic cues—through vocal prosody, melodic structure, pacing, and direct interpersonal engagement—that may help attenuate defensive autonomic responses associated with threat and uncertainty. From a polyvagal perspective, these acoustic and relational features may influence autonomic state through neuroception, the nervous system's ongoing evaluation of safety and danger occurring outside conscious awareness.

This perspective paper establishes a theoretical framework at the intersection of compassion science and Polyvagal Theory to articulate how live music may facilitate autonomic co-regulation within healthcare environments. To illustrate the real-world application of this framework, we draw upon anecdotal narrative feedback gathered from patients and musicians during a live music initiative in an outpatient cancer center. By placing neurophysiology and compassion at the forefront, this paper aims to move the discourse beyond subjective descriptions of musical comfort toward a biologically informed model of regulation and relational care. Accordingly, this article is presented as a theoretical perspective paper supported by illustrative clinical observations rather than as an empirical outcome study.

Background

Human health is deeply embedded within social relationships. Increasing evidence from neuroscience, psychology, psychoneuroimmunology, and public health demonstrates that social connection plays a central role in emotional regulation, resilience, autonomic regulation, and physical health outcomes. Former U.S. Surgeon General Vivek Murthy has emphasized that social connection should be understood as a fundamental biological necessity rather than a luxury, describing loneliness and social isolation as major public health concerns with measurable effects on mortality and wellbeing.[3]

Evidence from studies of institutionalized Romanian orphans during the Ceaușescu era provides stark *in vivo* insight into the consequences of relational deprivation. Many children raised in environments lacking consistent human interaction exhibited diminished self-regulation, cognitive impairment, and long-term health difficulties.[4] While these findings are often discussed in terms of disrupted attachment, they also point to a more fundamental principle: human beings require stable co-regulatory relationships for healthy development and physiological regulation. The absence of relational engagement can therefore be understood not merely as a social deficit, but as a condition with significant biological and health consequences. Conversely, environments that

foster interpersonal connection may help support autonomic regulation, emotional stability, resilience, and wellbeing.

On an even more fundamental level, evidence for the evolutionary roots of prosocial behavior further supports the centrality of relational engagement in human functioning. Studies have shown that even very young children exhibit spontaneous helping behaviors, assisting adults with simple tasks such as retrieving dropped objects, and that these cooperative tendencies have also been observed in chimpanzees, suggesting that helping behavior may reflect an evolutionarily conserved capacity for social cooperation.[5]

The importance of relational signals for emotional and physiological regulation emerges early in human development. One of the most widely cited demonstrations of this phenomenon is the 'Still-Face Experiment' conducted by Edward Tronick and colleagues.[6] In this paradigm, infants interacting with a responsive caregiver display engagement and emotional regulation. However, when the caregiver suddenly becomes emotionally unresponsive, infants rapidly exhibit distress, attempt to re-engage the caregiver, and when re-engagement fails, demonstrate escalating physiological and emotional dysregulation. These observations illustrate how emotional and physiological regulation depend heavily upon relational cues of responsiveness and safety.

Experimental work extending the Still-Face paradigm has further demonstrated the biological importance of prosodic communication in re-establishing regulation following social disruption. Kolacz and colleagues reported that greater maternal vocal prosody was associated with enhanced calming and reductions in infant heart rate, supporting the role of affiliative acoustic cues in autonomic regulation and co-regulation.[7] These findings are consistent with Polyvagal Theory's proposal that humans are biologically predisposed to respond to acoustic features associated with affiliative vocal communication and that cues of safety are fundamentally biologically regulating rather than merely psychologically reassuring.

Into adulthood, the negative effects of emotions such as anxiety as well as the benefits of positive affect on the immune system have undergone rigorous research and have been well documented since the early days of psychoneuroimmunology.[8] Alongside research on music and wellbeing, a parallel body of work has emerged examining the biological foundations of compassion. Scholars across psychology, neuroscience, and evolutionary biology have increasingly investigated the motivations that support caregiving, cooperation, and social bonding. As summarized in the *Oxford Handbook of Compassion Science*, these interdisciplinary studies demonstrate that compassion is a biologically rooted process with measurable implications

for emotional regulation and wellbeing.[9] Polyvagal Theory further proposes that compassion is physiologically dependent upon autonomic states supporting safety and social engagement rather than defensive mobilization.[10]

Polyvagal Theory provides a neurophysiological framework through which these findings may be interpreted. Central to this framework is the concept of neuroception, the nervous system's ongoing evaluation of safety and danger occurring outside conscious awareness.[2,11] Through neuroception, nervous systems continuously evaluate relational and environmental cues—including facial expression, gesture, vocal prosody, rhythm, and acoustic features—for signals associated with safety or threat. Importantly, Polyvagal Theory that feelings of safety are emergent properties of autonomic state organization rather than purely subjective psychological experiences.[12]

Although music is frequently described as comforting or uplifting within healthcare environments, such descriptions provide limited insight into the neurophysiological mechanisms through which musical encounters influence patient wellbeing. In clinical settings such as cancer centres, where illness, uncertainty, and medical intervention may place the nervous system in defensive autonomic states organized around threat and vulnerability, live music may function as more than an aesthetic experience. As Sue Carter has written: “Compassion for others and social support have survival value and health benefits (p. 173)”.[13]

Interpreted through the lens of Polyvagal Theory, musical interaction may therefore be understood as a biologically meaningful relational signal capable of engaging neural circuits associated with the social engagement system and supporting autonomic co-regulation through cues of safety conveyed in sound and interpersonal presence. The patient responses observed in this paper—including expressions of encouragement, hope, joy, peacefulness, and autobiographical memory—may reflect shifts toward physiological states associated with emotional regulation, affiliative connection, and increased autonomic accessibility to social engagement.

At the same time, this interpretation has reciprocal implications. If musical encounters operate through these neurophysiological and co-regulatory mechanisms, musicians working in healthcare environments may benefit from training that cultivates awareness of how musical sound, prosody, pacing, and compassionate interpersonal engagement communicate safety and support regulatory processes linked to patient wellbeing.

Theoretical Synthesis

Feelings of safety and compassionate responsiveness are grounded in the neurophysiological processes of the

autonomic nervous system. According to Polyvagal Theory, the experience of compassion is first and foremost grounded in autonomic neurophysiological processes, whereby the nervous system detects cues of safety and modulates defensive responses to support social engagement, emotional regulation, and prosocial connection. Polyvagal Theory describes three functional subsystems within the autonomic nervous system: the ventral vagal system supporting social engagement and calm states, the sympathetic system supporting mobilization in response to threat, and the dorsal vagal system associated with immobilization in life-threatening conditions.[2] When cues of safety are detected in the environment, the ventral vagal system down-regulates defensive responses and supports physiological states conducive to social interaction, emotional regulation, and restorative bodily processes. According to this model, the ventral vagal complex supports states of calm engagement and social connection. When individuals detect cues of safety in the environment, this system facilitates emotional regulation, communication, and social interaction. ‘However, in response to environmental demands, homeostatic processes are compromised, and the autonomic nervous system supports increased metabolic output to deal with these external challenges by vagal withdrawal and sympathetic excitation’ [2(p137)].

When considering Polyvagal Theory and constructs such as compassion, it is important to recognize that the nervous system operates predominantly in a “bottom-up” manner. Approximately 80% of vagal fibers are afferent, continuously conveying information about visceral organ function from the body to the brain. From this perspective, feelings of safety and compassion emerge from the interplay between bodily state and social cues, enabling openness, connection, and care. In healthcare settings, interventions such as live music performed by trained musicians may support compassionate states by signaling safety, engaging social engagement systems, and facilitating autonomic regulation through vagal pathways linking brain and body.

Central to Polyvagal Theory is the concept of “neuroception”, the nervous system's ongoing evaluation of risk and safety through neural processes that occur outside conscious awareness.[11] Neuroception involves the integration of cues arising both from within the body and from the external environment to regulate autonomic state and adaptive behavior. When cues of safety are detected, ventral vagal pathways support physiological states associated with social engagement, emotional openness, and autonomic regulation. Within healthcare settings, acoustic environments may play an important role in shaping these physiological and behavioral responses.

Excessive or unpredictable noise has been associated with ‘negative outcomes in patients, including

postoperative infections and anxiety, whereas one demonstrated that low-level noise stimulation could beneficially improve postoperative delirium and pain in patients'.[14] From a polyvagal perspective, such sound environments may be interpreted by the nervous system as cues of threat. In contrast, acoustic signals containing prosodic and melodic features associated with affiliative communication—such as music—may function as cues of safety that support parasympathetic regulation enhancing health and social engagement.

Polyvagal Theory places particular emphasis on acoustic signals in communicating safety. Prosodic features of human vocalization—including variations in pitch, rhythm, and tone—are important cues through which the nervous system detects emotional intent.[2] Music shares many of these acoustic characteristics. Melodic contour, rhythmic patterning, and tonal variation resemble the prosodic features of human speech that signal warmth and affiliative intent:

'Most studies of music and health look for simple links between music and response—thus bypassing any intervening psychological processes. We shall argue that this [separating the psychological from the physiological] is a mistake that seriously limits the applicability of findings from studies of music and health'.[15]

Understanding the mechanisms underlying such encounters may help broaden the conceptualization of music as a health-relevant intervention. Polyvagal Theory offers one potential framework through which the relational and physiological effects of live music in healthcare environments can be interpreted.

Clinical Context and Anecdotal Observations

Intervention Design and Musician Training

Professional orchestral musicians underwent training in the American Institute for Music and Healing (AIMH) 'Awakening the Inner Gift' program. [16] This workshop gives musicians a comprehensive understanding of contemporary research on music in a healthcare setting, the mind-body connection, and compassion science. They are

educated on issues such as repertoire choices, ethics, and spatial awareness. They had no training in Polyvagal Theory.

Musicians, typically 2 string players (violin and viola) or violin and a woodwind instrument (flute, clarinet), played for patients in the infusion areas of an outpatient cancer center. All patients present were offered the opportunity to select one or more pieces of music from a curated repertoire list divided into various genres, including Film Music, Religious Music (hymns), TV themes, Folk Songs, Pop Songs, Classical Music, and Irish music, and given 5–10 minutes time to browse the list.

Data Collection and Analysis

Following the musical interaction, participants who consented were invited to take part in a brief semi-structured interview. The interview comprised three open-ended questions:

1. What piece would you like to hear today?
2. Can you tell us why you chose this particular song/piece?
3. Do you have anything else you would like to share about the experience?

Data were collated by a third party to reduce potential researcher bias. Because the data consisted of brief 1–2 phrase responses collected in a high-stress clinical environment, this initiative was conducted as a qualitative program evaluation rather than a controlled research study.

Ethical Review

Prior to data collection, the project protocol and the specific survey instruments were submitted to the institutional review body at the Cancer Center for formal evaluation. Following administrative review, the initiative was officially designated as a non-invasive quality improvement (QI) initiative and programmatic evaluation rather than regulated human subjects research. Accordingly, formal full-board Institutional Review Board (IRB) oversight was deemed unnecessary, and administrative approval was granted to administer the questionnaire. All feedback was collected anonymously to protect patient privacy.

Illustrative Case Observations

Participant Session Demographics			Selected Piece & Citation	Patient Feedback
01	Visit 1	Female, 30s	<i>Ave Maria</i> (Franz Schubert)	"Speaks to my soul. Thank you for making my day."
02	Visit 1	Female, 40s	<i>My Heart Will Go On</i> (Celine Dion / James Horner)	"Titanic is one of my husband's favorite movies. You guys have really lifted my spirits."
03	Visit 1	Male	<i>Summertime</i> (George Gershwin)	"Love Porgy and Bess. I went to see the opera in New York and those were good times."

04	Visit 1	Female, 50s	<i>Morning Has Broken</i> (Cat Stevens / Trad.) / <i>Great Is Thy Faithfulness</i> (William M. Runyan)	"Church music has always helped me through tough times."
05	Visit 1	Male, 80s	<i>Seventy-Six Trombones</i> (Meredith Willson)	"I used to play trombone back in high school. Good memories."
06	Visit 1	Female, 50s	<i>Edelweiss</i> (Rodgers & Hammerstein)	"I love The Sound of Music. I really think I feel better after hearing this music."
07	Visit 1	Male, 70s	<i>The Entertainer</i> (Scott Joplin)	"I like ragtime. Used to play piano."
08	Visit 1	Female, 50s	<i>Amazing Grace</i> (John Newton / Trad.)	"I love hymns. They give me encouragement and hope."
09	Visit 1	Male, 30s	<i>O Danny Boy</i> (Traditional Irish)	"I like the old songs."
10	Visit 1	Female, 40s	<i>Can't Help Falling in Love</i> (Elvis Presley)	"It was played at my wedding and brings back happy memories."
11	Visit 2	Male, 70s	<i>Tennessee Waltz</i> (Pee Wee King / Redd Stewart)	"My wife and I danced to this at our wedding. Good memories."
12	Visit 2	Female, 40s	<i>Mamma Mia</i> (ABBA)	"Love this movie. Thanks for spreading joy."
13	Visit 2	Male, 80s	<i>Ode to Joy</i> (Ludwig van Beethoven)	"I love Beethoven. I used to play piano."
14	Visit 2	Male, 70s	<i>Red River Valley</i> (Traditional Folk)	"I used to play guitar."
15	Visit 2	Female, 60s	<i>Memory</i> (Andrew Lloyd Webber)	"The song reminds me of good memories with my late husband."
16	Visit 2	Female, 30s	<i>A Whole New World</i> (Alan Menken / Tim Rice)	"I just saw Aladdin with my kids."
17	Visit 2	Male, 40s	<i>O Danny Boy</i> (Traditional Irish)	"My father used to sing this to me."
18	Visit 2	Male, 60s	<i>Amazing Grace</i> (John Newton / Trad.)	"Brings comfort at this time in our life."

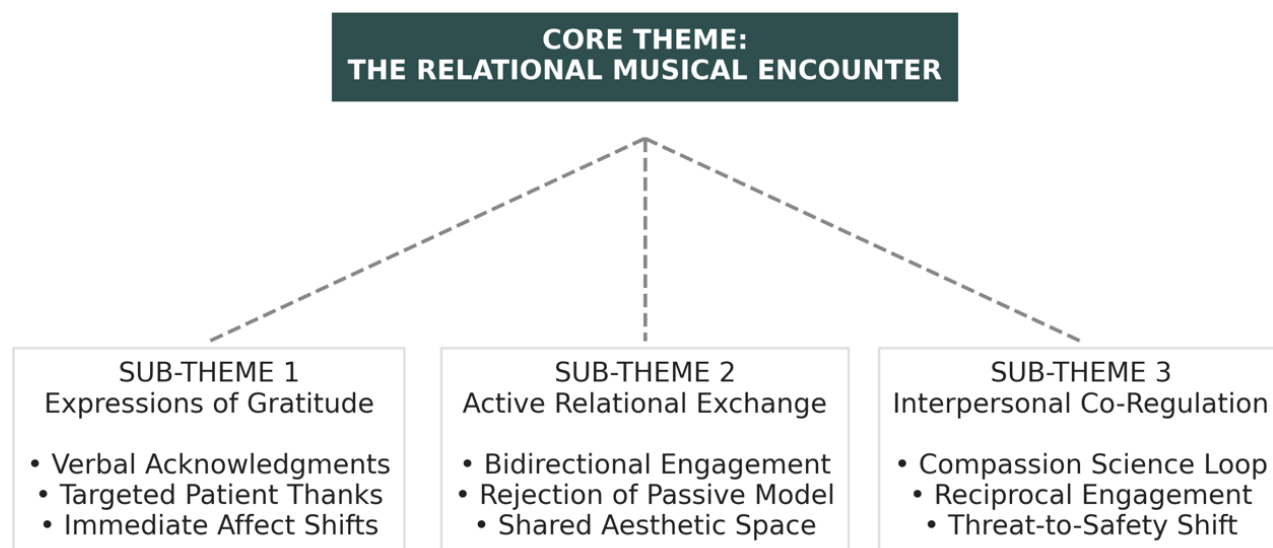
Three themes emerged from participants' responses: (a) emotional shifts and regulation, (b) autobiographical memory and identity, and (c) gratitude, compassion, and co-regulation. These themes were broadly consistent with processes described in Polyvagal Theory, particularly its emphasis on neuroception, autonomic state regulation, social engagement, and co-regulatory processes.

The first theme, emotional shifts and regulation, was reflected in participants' descriptions of changes in affect following the musical encounter. Statements such as "you lifted my spirits," "speaks to my soul," and "brings comfort" suggested experiences of increased emotional comfort and well-being. From a polyvagal perspective, these responses may be consistent with movement toward physiological states associated with safety, calm engagement, and social connection rather than states organized around defense. Such experiences may reflect increased accessibility to ventral vagal regulation following the neuroception of safety, supporting emotional regulation and social engagement.

The second theme, autobiographical memory and identity, reflected participants' tendency to connect the music with meaningful personal experiences, relationships, and life events. Although autobiographical memory is not itself a construct of Polyvagal Theory, the theory proposes that access to reflective, self-referential, and socially

meaningful experiences is influenced by autonomic state. Defensive states prioritize physiological resources toward protection and survival, whereas states characterized by greater ventral vagal regulation support social engagement, emotional accessibility, and reflective processing. From this perspective, the recollection of meaningful memories and experiences may reflect increased accessibility to autobiographical reflection and continuity of identity within a physiological state characterized by greater feelings of safety and connection.

The third theme, gratitude, compassion, and co-regulation, was evident in participants' expressions of appreciation toward the musicians and acknowledgment of the emotional significance of their presence. These responses suggest that the encounter functioned as more than a passive musical experience and may have involved reciprocal interpersonal processes. Polyvagal Theory emphasizes that cues communicated through facial expression, vocal prosody, gesture, presence, and responsiveness contribute to the neuroception of safety and support co-regulation between individuals. Within this framework, expressions of gratitude and appreciation may reflect participants' responses to a relational experience characterized by social connection, caregiving cues, and co-regulatory engagement.

Figure 1. *Conceptual Framework of the Relational Musical Encounter*

Polyvagal Theory similarly proposes that social engagement systems operate within interpersonal contexts. When cues of safety circulate within interactions, they may influence multiple nervous systems simultaneously. Consequently, the presence of live music may shape not only the internal experience of the patient, but also the broader relational environment involving caregivers, family members, musicians, and clinical staff who share the space. This perspective suggests that the therapeutic potential of live music may extend beyond the acoustic stimulus itself, with the relational context of the encounter playing an equally important role.

Prosody plays a central role in the communication of emotional intent within Polyvagal Theory. Prosody refers to the rhythmic, melodic, and dynamic features of vocalization that communicate affective meaning beyond the semantic content of speech. Variations in pitch, melodic contour, rhythm, and timing resemble prosodic characteristics of human vocal communication associated with warmth, soothing, and caregiving intent.[17] When detected by the nervous system, these acoustic features may support transitions toward physiological states associated with safety and emotional regulation.

The mammalian social engagement system is highly sensitive to these cues because they rapidly communicate safety, neutrality, or potential threat. The biological importance of prosody is reflected in clinical observations that impairments in prosodic expression are frequently associated with neurological disorders affecting emotional communication, including Alzheimer's disease, Parkinson's disease, and Primary Progressive Aphasia.[18]

Within healthcare settings, prosodic communication may emerge not only through musical performance itself, but also through the spoken interaction surrounding the encounter. The tone of greeting, pacing of speech, vocal warmth, responsiveness, and interpersonal timing of the musician all contribute to the relational cues shaping neuroception. While instrumental music may share certain acoustic characteristics with vocal prosody, the communicative impact of live musical encounters likely emerges through the integration of sound, relational presence, and interpersonal engagement. Collectively, these cues may support shifts toward physiological states associated with social engagement, emotional regulation, and compassionate connection.

Musicians' Observations

An additional observation frequently reported in arts-in-health practice is that musicians who seek to soothe or support patients often describe experiencing a sense of emotional restoration themselves. At face value, this appears counterintuitive, as performing in clinical environments—particularly in contexts such as oncology wards—could reasonably be expected to function as a psychological stressor. Within the framework of Polyvagal Theory, however, this phenomenon can be interpreted through the principle of 'co-regulation'. Rather than operating unidirectionally, autonomic regulation in social contexts is understood as a reciprocal process in which interacting nervous systems influence one another. The following reports offered by two professional musicians

trained by the AIMH reveal co-regulation in a healthcare setting:

Musician 1: ‘Today I played by myself at the hospital. While I was still at the lobby playing, a gentleman approached me and asked if I could come meet his 80 year old mother who is a church pianist and organist and who started learning violin at the age of 60. I told him I would love to meet her and that I would come up to her room to play for her. He helped me carry my stand and told me stories about her on our way up to her room. When I arrived at the room she was so excited to see me with an instrument. She requested that I played hymns. As I played she and her son started to sing every single hymn I played. She smiled and was so grateful for the music. She said that the music made her want to get out of that hospital to get back on her organ bench. As I left, her son wanted to escort me back to the lobby and carry my stand again. Before he left, he gave me a long and strong hug as he cried and thanked me for what I had done.’

Musician 2: ‘As we knocked and entered the room, it was completely quiet, as though it was empty. In point of fact, there were 3 people inside, but they all seemed to be just marking time. The elderly man on the hospital bed lay with his eyes closed, various IV lines and monitors surrounding him. A middle-aged couple were in chairs that faced the man’s bed and they just sat and looked at the man. I thought that since the patient appeared to be sleeping, we would just quietly move to the next room, but the couple didn’t think that he was actually sleeping, and they decided that they wanted us to play something anyway. Sometimes family members pick music that they know or think the patient likes, and sometimes they pick music for themselves. Sometimes it’s hymns or classical music to bring a calming peace and sometimes it’s a jig or something fast that can get the heart pumping and the face smiling. I can’t honestly remember what this couple chose to hear first, but I’ll never forget what happened while we played. As we started playing, I looked at the elderly man to see if we were bothering him and might need to play softer. Apparently, we needed to play louder! It’s a good thing that I knew whatever tune we played by memory, because at that point I couldn’t take my eyes off the patient. The man I had assumed was headed to hospice, started tapping his feet to the music. I wasn’t done being shocked however. When we reached the chorus line, I started hearing an extra humming type noise in the room. I looked at the couple listening politely and determined that the murmur wasn’t coming from them. It wasn’t coming from the monitors. The machines were all quiet still and no one new had entered

the room while we played. Instead, I looked into the patient’s face, and I saw his lips moving. No, he didn’t miraculously jump from the bed cured and dancing a waltz (although I have seen and heard some incredible things). Instead, he opened his smoky grey cataract-laden eyes and the vision before me made my heart leap as I watched as well-worn lines of joy and happiness cracked his age weathered face.’

Polyvagal Theory proposes that physiological state may be stabilized through co-regulatory social engagement with others whose cues communicate safety and affiliative connection. Within such contexts, engaging in supportive or calming interactions may simultaneously recruit regulatory processes within the person offering support—in this case, the musician. The narratives presented here suggest that musical encounters in healthcare settings may involve reciprocal processes of emotional engagement and co-regulation rather than a purely unidirectional delivery of care. From a polyvagal perspective, the restorative and emotional effects reported by the musicians may reflect the co-regulatory dynamics characteristic of compassionate interpersonal interaction.[19]

Scope, Limitations, and Reflexivity

Several boundaries of this perspective paper must be acknowledged. The sample size of clinical observations is small, and the data are qualitative and anecdotal in nature. No physiological measures, such as heart rate variability (HRV) or respiratory sinus arrhythmia (RSA), were collected. As a result, interpretations of these observations through a polyvagal framework remain theoretically informed and suggestive rather than directly empirically confirmed.

Additionally, this paper examines one primary explanatory framework and does not isolate which specific features of the live musical encounter—such as acoustic properties, interpersonal proximity, visual engagement, or the musicians’ spoken interaction—are most influential in shaping patient responses. Future multidisciplinary research integrating direct physiological measurement, larger patient cohorts, and controlled clinical designs will be necessary to clarify the autonomic and co-regulatory mechanisms involved in live musical encounters within healthcare settings.

Conclusion

A growing body of research demonstrates that music can influence physiological and psychological processes relevant to health, including reductions in anxiety, analgesic effects, and improvements in patient experience within clinical settings. While this evidence has established music as a

valuable component of healthcare environments, the mechanisms through which live musical encounters influence autonomic regulation and emotional accessibility remain incompletely understood.

The clinical observations presented in this paper suggest that interactions between musicians and patients engage relational processes extending far beyond the acoustic stimulus alone. Interpreted through the lens of Polyvagal Theory, patient reports involving comfort, encouragement, autobiographical memory, peacefulness, and gratitude may reflect visible shifts toward physiological states associated with ventral vagal regulation, social engagement, and emotional regulation. From this perspective, music functions not merely as an aesthetic experience, but as a biologically meaningful relational signal capable of influencing autonomic state organization. The musical encounter may involve a dynamic, bidirectional process of co-regulation and compassionate engagement between musician and patient that can extend outward into the broader environment of care.

Importantly, the relationship between theory and practice is reciprocal. Polyvagal Theory offers a neurophysiological framework through which the regulatory effects of live musical interaction may be interpreted, while arts-in-health musical encounters provide ecologically valid settings in which mechanisms described by the theory—including neuroception, prosody, affiliative acoustic signaling, and interpersonal co-regulation—may be observed in action.

Although these specific clinical encounters did not include direct physiological measurements, converging evidence from psychophysiology, compassion science, and psychoneuroimmunology suggests that autonomic stabilization and ventral vagal regulation are associated with improved emotional regulation, resilience, social accessibility, and health-related physiological processes. Within this broader framework, compassionate musical encounters may contribute to regulatory processes supporting patient wellbeing.

These insights also carry practical implications for musicians working within healthcare environments as part of arts-in-health initiatives. Training programs such as the ‘Awakening the Inner Gift’ curriculum developed by the American Institute for Music and Healing (AIMH) provide an important foundation by preparing professional musicians to work safely and effectively within clinical settings.[16] By understanding how elements of musical performance—including tone, phrasing, pacing, facial expression, and interpersonal presence—function as biologically meaningful cues communicating safety and affiliative intent, musicians may become increasingly aware of how their interactions influence patient regulation and co-regulation. Integrating polyvagal-informed perspectives

into arts-in-health practice may therefore help musicians more fully realize the therapeutic and regulatory potential of live music within healthcare environments, supporting compassionate connection, emotional regulation, and the broader relational environment of care.

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Biographical Statement

Peter Shannon is an international professional orchestral conductor and health humanities scholar whose work integrates artistic excellence with clinical innovation. As founder of the *American Institute for Music and Healing* (AIMH), his work integrates professional music practice with the Health Humanities, developing scientifically grounded programs that support healthcare professionals and train musicians to work effectively in clinical environments, contributing to interdisciplinary approaches to wellbeing, resilience, and compassionate care.

Stephen W. Porges is Distinguished University Scientist at Indiana University and founding director of the Trauma Research Consortium. He developed Polyvagal Theory, a theoretical framework examining the role of autonomic regulation in social behaviour, emotional processes, and health.