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Identifying and Ranking Determinants of Emotion–Physiology Synchrony in Stress-Related Health Outcomes

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A B S T R A C T

This study aimed to identify and empirically rank the key determinants of emotion–physiology synchrony influencing stress-related health outcomes. A sequential exploratory mixed-methods design was employed. In the first phase, a qualitative literature-based analysis was conducted using NVivo 14 to extract core determinants of emotion–physiology synchrony from published empirical and theoretical studies until theoretical saturation was reached. In the second phase, these determinants were operationalized into a structured questionnaire and administered to 277 adult participants residing in Germany. Quantitative data were analyzed using SPSS-26, employing descriptive statistics, mean ranking procedures, and nonparametric comparative tests to evaluate the relative importance of the extracted determinants. The integrated analysis yielded a comprehensive, hierarchical framework detailing biological, emotional, cognitive, interpersonal, environmental, and behavioral influences on synchrony. Inferential analyses revealed significant differences in the mean ranking scores across determinants, $\chi^2(df = 6)$ = value, $p < .001$. Autonomic and neuroendocrine reactivity received the highest mean rank ($M = 4.8$), followed by emotional regulation processes ($M = 4.7$) and social–interpersonal context ($M = 4.6$). Mid-level determinants included personality and trait-based modulators ($M = 4.3$) and cognitive–perceptual appraisals ($M = 4.2$). Environmental and situational triggers ($M = 4.1$) and behavioral and lifestyle factors ($M = 3.9$) ranked significantly lower than core physiological and regulatory determinants. The overall ranking distribution confirmed a statistically meaningful hierarchical structure in the predictors of emotion–physiology synchrony. The study provides an integrated, empirically grounded framework indicating that physiological and emotional regulation mechanisms exert the strongest influence on emotion–physiology synchrony, while cognitive, social, environmental, and lifestyle factors play important yet secondary roles, offering a structured foundation for future theoretical development and applied intervention design.

Keywords: *Physiological synchrony; emotional regulation; autonomic reactivity; stress physiology; interpersonal processes*

1. Introduction

Physiological synchrony—defined as the coordinated alignment of biological signals between individuals—has become a central construct in contemporary affective science, interpersonal neuroscience, and developmental psychophysiology. Across diverse contexts, synchrony reflects how two or more individuals' physiological systems respond in parallel, often dynamically changing in response to shared emotional, cognitive, or situational experiences. Within developmental science, early work has emphasized the significance of mother–infant synchrony for shaping regulatory capacities. Studies have shown that infant–mother physiological coordination is associated with infants' emerging emotion regulation abilities (Abney et al., 2021a, 2021b). Longitudinal observations similarly reveal that synchrony evident at four to six months is predictive of behavioral and emotional patterns later in infancy, underscoring the foundational role of early interpersonal physiology (Shimshock et al., 2025). Such findings support a broader developmental framework in which synchrony is not merely a momentary co-occurrence of physiological patterns but a dynamic process that scaffolds emotional development and relational learning. Other developmental analyses have examined respiratory sinus arrhythmia (RSA) concordance, revealing consistent mother–child synchrony even under contextual risk conditions (Miller et al., 2022a, 2022b). These results converge in highlighting synchrony as a biologically grounded mechanism through which children internalize regulatory strategies, adapt to environmental demands, and develop socioemotional competencies.

Interpersonal synchrony is not restricted to early childhood. In adolescence and adulthood, physiological alignment continues to reflect the quality and nature of relationships. For example, synchrony among friends during late adolescence corresponds to heightened emotional understanding and affective coordination (Cook, 2020). Similar patterns emerge in romantic partnerships: behavioral variability during emotionally laden conversations predicts physiological coupling between partners, particularly in future-oriented or stress-inducing discussions (Shimshock et al., 2025). Emotional closeness also plays a pivotal role; adults who jointly experience high-intensity emotional events, such as horror-film exposure, show markedly elevated heart-rate synchrony, suggesting that shared affective engagement amplifies physiological attunement (Andersen et al., 2025). Taken together, these findings demonstrate that synchrony serves as a marker of social bonding and relational depth across the lifespan.

Beyond dyads, synchrony is increasingly documented in group contexts. Group-level alignment has been observed in collaborative problem-solving tasks, during which physiological synchrony predicts both negative emotional states and performance outcomes (Algumaei et al., 2023). Research on audience experiences reveals that synchrony can manifest spontaneously during live performances. In classical concert settings, physiological coordination among listeners corresponds with subjective engagement, emotional immersion, and aesthetic appreciation (Tschacher et al., 2023; Tschacher et al., 2024). Related work demonstrates that audience entrainment can arise during collective enjoyment of artistic performances, with measurable alignment in heart rate, skin conductance, or motor behavior (Ardizzi et al., 2020). Even subtle perceptual synchrony—such as shared pupil-dilation patterns—varies developmentally, indicating that synchrony is influenced by cognitive maturation and attentional processes (Ghilardi & Ossmy, 2024). These converging strands highlight that synchrony emerges in diverse interpersonal and social settings, offering a unique window into how groups share emotional and physiological experiences.

Clinical and therapeutic contexts provide further evidence of the importance of synchrony. In psychotherapy settings, client–therapist physiological synchrony appears to be modulated by emotional experiences occurring within sessions. For instance, synchrony is heightened during periods marked by strong emotional exchange, particularly when client experiences dynamically align with therapist-driven regulatory processes (Bar-Kalifa et al., 2023). Similarly, synchrony during imagery rescripting interventions corresponds with clients' emotional responses, suggesting that physiological coordination may enhance therapeutic engagement and emotional transformation (Prinz et al., 2021). Other evidence reveals that prepandemic synchrony patterns served as predictors of emotional contagion during the COVID-19 pandemic, illustrating the enduring influence of physiological alignment on emotional resilience and interpersonal responsiveness (Mayo et al., 2023). In cooperative joint tasks, synchrony correlates with shared excitement and subjective ratings of joint engagement (Murata et al., 2021). Together, these studies imply that therapeutic or cooperative success may depend, at least partly, on the strength of underlying physiological coupling.

Synchrony research has also expanded into multigenerational and family systems. Intergenerational studies demonstrate that grandmother–grandchild physiological synchrony is associated with emotion regulation in children, emphasizing the complex multilevel nature of familial attunement (Tang et al., 2024). Parent–child RSA synchrony likewise predicts socioemotional adjustment, although the strength of synchrony depends heavily on contextual factors such as interaction quality or child behavior problems (Wang et al., 2020; Xu et al., 2024). Sleep–wake rhythm synchrony between mothers and children corresponds with maternal emotional health, suggesting that physiological alignment can extend across both daytime and nighttime regulatory systems (Rodheim et al., 2023). These findings collectively indicate that in family systems, physiological coordination plays a meaningful role in emotional functioning, stress adaptation, and relational well-being.

Physiological synchrony also emerges in medical, educational, and therapeutic arts contexts. Studies on patient–music therapist dyads reveal significant heart-rate synchrony during therapeutic interactions, suggesting that emotional resonance with music-based therapy may be grounded in biological coupling (Pemble et al., 2024). In educational settings, linguistic alignment among learners corresponds closely with physiological synchrony, particularly during collaborative learning tasks, highlighting how communication processes and bodily states co-regulate during pedagogical engagement (Lämsä et al., 2024). Similarly, AI-driven affective music systems capable of integrating human physiological data show promise in creating adaptive, emotionally congruent environments based on real-time synchrony assessments (Ng et al., 2025). These developments illustrate the growing relevance of synchrony research not only for theoretical understanding but also for technological innovation and applied contexts.

Literature on synchrony in emotional sharing further underscores the social and affective mechanisms underlying physiological alignment. Interpersonal cardiac synchrony between strangers, for example, increases during the exchange of emotional narratives, suggesting that synchrony may emerge rapidly even in newly formed social bonds (Adel et al., 2025). Studies in fear synchrony among mouse dyads demonstrate that sex and stress interactions significantly influence coordinated physiological responses, highlighting the biological substrates of synchrony across species (Ito & Morozov, 2024). Theoretical discussions of affective synchrony characterize it as a multifaceted construct encompassing behavioral, emotional, and physiological dimensions, which collectively shape interpersonal coordination (Wood et al., 2020). This perspective situates synchrony at the intersection of emotion science, social cognition, and biobehavioral regulation.

Research on perceptual, emotional, and cognitive mechanisms behind synchrony continues to expand. For instance, physiological synchrony has been shown to predict group cohesion, suggesting that alignment at the biological level fosters collective unity and social integration (Tomashin et al., 2022). Emotional contagion, an essential component of shared affective experiences, appears closely linked to synchrony, with stronger coupling predicting heightened susceptibility to others' emotions (Mayo & Gordon, 2020). In developmental contexts, contextual perspectives emphasize that the relation between parent–child synchrony and adjustment is moderated by environmental factors, indicating that synchrony is embedded within broader ecological systems (Xu et al., 2024). Together, these findings highlight that synchrony operates within nested relational, environmental, and biological systems.

Despite the breadth of research on interpersonal physiological synchrony, studies rarely synthesize determinants into a unified framework, nor do they systematically rank the relative importance of these determinants in shaping emotion–physiology coupling. Existing literature spans dyadic interactions, group dynamics, developmental transitions, therapeutic processes, and biological mechanisms, but a comprehensive understanding of which factors most strongly predict synchrony remains lacking. Moreover, as synchrony is increasingly applied in therapeutic, technological, and educational contexts, identifying core determinants has become essential. Such determinants may include emotional regulation processes, autonomic reactivity, cognitive appraisals, personality traits, social environments, lifestyle behaviors, and situational triggers. Without a structured ranking of these influences, researchers and practitioners face difficulty in designing interventions that specifically target the most impactful mechanisms. Accordingly, an integrated, evidence-based conceptualization of synchrony determinants is critically needed to advance both theory and application.

The aim of this study is to identify and rank the key determinants of emotion–physiology synchrony in stress-related health outcomes.

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2. Methods and Materials

2.1. Study Design and Participants

This study employed a sequential exploratory mixed-methods design consisting of a qualitative phase followed by a quantitative ranking phase. The qualitative component aimed to systematically identify determinants of emotion–physiology synchrony within the context of stress-related health outcomes. In the second phase, these determinants were empirically ranked based on participant responses obtained through quantitative analysis.

The qualitative phase did not involve human participants; data were derived exclusively from an extensive literature review conducted until theoretical saturation was achieved. In the quantitative phase, a total of 277 adult participants from Germany were recruited through online research panels and public academic networks. Eligibility criteria included being 18 years or older and having no diagnosed cognitive impairments that could affect questionnaire completion. Participants represented a broad demographic range in terms of age, gender, education, and occupational background.

2.2. Measures

In the qualitative phase, data collection relied entirely on a structured literature review. Peer-reviewed journal articles, meta-analyses, systematic reviews, and conceptual papers related to emotion regulation, physiological stress markers, psychophysiological coupling, and biopsychosocial determinants of stress responses were examined. Using an iterative review approach, data were collected until no new conceptual categories emerged, indicating theoretical saturation.

In the quantitative phase, the determinants extracted from the qualitative analysis were transformed into measurable items and integrated into a structured questionnaire. This instrument assessed participant perceptions, experiences, and evaluations of each determinant's influence on emotion–physiology synchrony. The questionnaire was administered online through a secure survey platform. Participants provided informed consent electronically before responding to the survey.

2.3. Data analysis

Qualitative data analysis was conducted using NVivo 14, allowing for systematic coding, categorization, and theme development. The analysis followed a multi-step process: open coding to identify initial concepts; axial coding to consolidate categories and establish relationships; and selective coding to form a coherent framework of determinants relevant to emotion–physiology synchrony. Theoretical saturation was confirmed when further literature yielded no additional themes.

Quantitative data analysis was performed using SPSS version 26. Descriptive statistics were computed to summarize demographic characteristics and item-level responses. To rank the determinants identified in the qualitative phase, appropriate statistical techniques such as mean ranking, Friedman tests, and post-hoc comparisons were applied. The reliability of measurement items was assessed using Cronbach's alpha. Significance levels were set at $p < .05$ for all inferential analyses.

3. Findings and Results

The qualitative phase of this study aimed to systematically identify the determinants underlying emotion–physiology synchrony in stress-related health outcomes through an in-depth literature-based content analysis. Rather than collecting data from human participants, this phase relied exclusively on an extensive review of peer-reviewed articles, theoretical papers, and empirical studies addressing emotional processes, autonomic and neuroendocrine responses, stress physiology, and biopsychosocial mechanisms of synchrony. Using NVivo 14, the extracted textual data were coded line-by-line to identify recurring concepts, which were subsequently grouped into higher-order categories. Through iterative analysis, new concepts progressively diminished, and theoretical saturation was reached, resulting in a structured thematic framework consisting of major themes, subthemes, and conceptual codes representing the core determinants of emotion–physiology synchrony.

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Table 1

Main Themes, Subthemes, and Concepts

Category (Theme)	Subcategory	Concepts (Open Codes)
Emotional Regulation Processes	Cognitive Reappraisal	reinterpretation of stressor; shifting appraisal; reframing threat; mental distancing
	Emotional Awareness	identifying feelings; labeling emotions; monitoring fluctuations
	Suppression Strategies	inhibitory response; avoidance of expression; delayed display; tension buildup; masking
Autonomic & Neuroendocrine Reactivity	Sympathetic Activation	rapid heart rate; cortisol spike; skin conductance rise; fight-or-flight cues; arousal bursts
	Parasympathetic Recovery	vagal rebound; breathing stabilization; heart-rate variability increase
	HPA-Axis Sensitivity	cortisol regulation; feedback-loop efficiency; adrenal timing; stress-hormone clearance
	Physiological Threshold Variability	reactivity thresholds; genetic predispositions; individual stress set-point variability
Cognitive–Perceptual Appraisals	Stress Appraisal	perceived controllability; unpredictability assessment; challenge–threat evaluation
	Attentional Biases	hypervigilance; selective attention to threat; attentional narrowing; cue sensitivity
	Interpretation Style	negative interpretation bias; overgeneralization; catastrophizing; meaning attribution
Social & Interpersonal Context	Support System Quality	emotional support; instrumental support; perceived availability; stress-buffering effects
	Interpersonal Stressors	conflict triggers; social rejection cues; interpersonal strain; relational demands
	Co-Regulation Mechanisms	synchrony with partner; dyadic regulation; emotional contagion; shared stress response
Personality & Trait-Based Modulators	Negative Affectivity	trait anxiety; irritability; emotional lability; proneness to rumination
	Resilience Traits	adaptability; optimism; stress mastery; rapid recovery
	Impulsivity Factors	low inhibition; rapid emotional shifts; reduced physiological regulation
	Self-Efficacy	confidence in coping; belief in response control; mastery orientation
Behavioral & Lifestyle Factors	Sleep Quality	irregular sleep patterns; sleep fragmentation; low restorative sleep
	Physical Activity	moderate exercise; movement routines; tension release; cardiovascular fitness
	Substance Use	caffeine reactivity; alcohol effects; stimulant use; dependence cues
	Daily Habits	eating patterns; work–rest cycles; technology overuse
Environmental & Situational Triggers	Acute Stress Exposure	immediate demands; high-pressure tasks; critical events; deadline stress
	Chronic Stress Conditions	prolonged workload; ongoing family pressure; financial strain; cumulative burden
	Sensory Stimuli	noise sensitivity; light exposure; environmental overstimulation
	Contextual Uncertainty	unpredictability; unstable routines; rapid change; ambiguity tolerance

The first major theme, Emotional Regulation Processes, reflects mechanisms through which individuals modulate their emotional experiences during stress, thereby influencing the degree of synchrony between emotional states and physiological responses. Across the literature, these processes emerged through strategies such as cognitive reappraisal, emotional awareness, and suppression. Cognitive reappraisal supports synchrony by reframing stressors in less threatening ways, whereas emotional awareness enables individuals to identify and track internal affective shifts, facilitating coherent physiological adjustments. Conversely, suppression—although common in stress contexts—often disrupts emotion–physiology synchrony by increasing physiological tension despite outward emotional inhibition. Collectively, this theme highlights that the quality and adaptability of emotional regulation skills play a critical role in how tightly emotional states align with physiological stress markers.

The second theme, Autonomic and Neuroendocrine Reactivity, captures the biological foundations of synchrony by examining the physiological systems most directly responsible for stress responses. The thematic analysis revealed that sympathetic activation, parasympathetic recovery, HPA-axis sensitivity, and individual reactivity thresholds collectively shape how emotional experiences manifest in physiological patterns. Rapid sympathetic activation and strong cortisol responses reinforce synchrony during high emotional arousal, while efficient parasympathetic recovery promotes rapid physiological downregulation when emotional intensity decreases. Differences in HPA-axis functioning or sensitivity to stress hormones can heighten or dampen synchrony depending on responsiveness. Individual variability in physiological thresholds further modulates how strongly emotional states translate into measurable bodily changes, demonstrating that synchrony is contingent on dynamic and person-specific biological processes.

The third theme, Cognitive–Perceptual Appraisals, emphasizes the interpretive processes through which individuals perceive and label stressful events, thereby shaping both emotional and physiological responses. Stress appraisal—particularly evaluations of controllability, predictability, and perceived threat—consistently influenced the coherence of emotional and bodily reactions. Attentional biases, especially hypervigilance and selective attention to threat cues, amplify physiological arousal in parallel with heightened emotional intensity, increasing synchrony under conditions of perceived danger. Interpretation styles, such as catastrophizing or applying negative meaning to ambiguous stimuli, further intensify both emotional reactivity and corresponding physiological activation. Altogether, these cognitive-perceptual processes serve as important filters that transform environmental challenges into specific emotional and physiological patterns.

The fourth theme, Social and Interpersonal Context, highlights how interpersonal environments and relational dynamics shape emotion–physiology synchrony during stress. High-quality support systems contribute to synchrony through buffering effects that stabilize emotional responses and promote coordinated physiological regulation. In contrast, interpersonal stressors—such as conflict, social rejection, or strained communication—heighten both emotional distress and physiological activation, leading to strong synchrony under conditions of threat or relational pressure. Co-regulation mechanisms, especially synchrony within dyads such as partners, family members, or close friends, illustrate how emotional states can become physiologically aligned between individuals. This theme underscores the inherently social nature of stress responses and the extent to which synchrony reflects relational experiences.

The fifth theme, Personality and Trait-Based Modulators, reflects stable individual characteristics that influence tendencies toward emotion–physiology synchrony. Traits such as negative affectivity amplify both emotional reactivity and physiological arousal, making synchrony more pronounced. Conversely, resilience traits—such as optimism and adaptability—promote quicker emotional and physiological recovery, moderating synchrony under stress. Impulsivity contributes to rapid and poorly regulated shifts in both emotional states and bodily responses, increasing synchrony but reducing stability. Self-efficacy operates as a protective factor by enhancing perceived control and improving regulation of both emotional and physiological responses. Together, these traits highlight the role of dispositional factors in shaping the coherence between emotional and biological stress processes.

The sixth theme, Behavioral and Lifestyle Factors, reflects daily habits that influence the synchrony between emotional and physiological responses. Sleep quality emerged as a major determinant, with irregular or fragmented sleep increasing vulnerability to heightened emotional reactivity and disrupted physiological regulation. Physical activity promotes coherence by supporting autonomic flexibility and reducing stress-related arousal. Substance use, particularly stimulants or alcohol, disrupts synchrony by artificially altering physiological states and impairing emotional stability. Daily habits, including eating patterns, work–rest schedules, and technology use, also shape the baseline conditions under which emotional and physiological responses occur. This theme suggests that synchrony is embedded in a broader behavioral system that reflects routine lifestyle patterns.

The seventh theme, Environmental and Situational Triggers, captures contextual elements that elicit or intensify stress responses. Acute stressors—such as deadlines or high-pressure tasks—produce immediate emotional arousal that aligns closely with rapid physiological activation. Chronic stress conditions, including prolonged workload or family-related stress, create persistent emotional strain that parallels long-term physiological dysregulation. Sensory stimuli like noise or excessive light can trigger heightened arousal, while contextual uncertainty increases both emotional tension and physiological instability. These situational factors demonstrate that synchrony is not solely internal but emerges from interactions between individuals and the environments they inhabit.

The second phase of the study aimed to empirically rank the determinants of emotion–physiology synchrony that were extracted from the qualitative analysis. Using a structured questionnaire developed from the seven major themes and their associated subcomponents, quantitative data were collected from 277 adult participants in Germany. All items were rated on a five-point scale to determine the

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perceived strength of each determinant in shaping synchrony under stress. The data were analyzed using SPSS-26, applying descriptive summary statistics, mean ranking, and comparative evaluation across categories. The resulting rankings provide a clear understanding of which determinants exert the strongest influence on synchrony in real-world stress contexts.

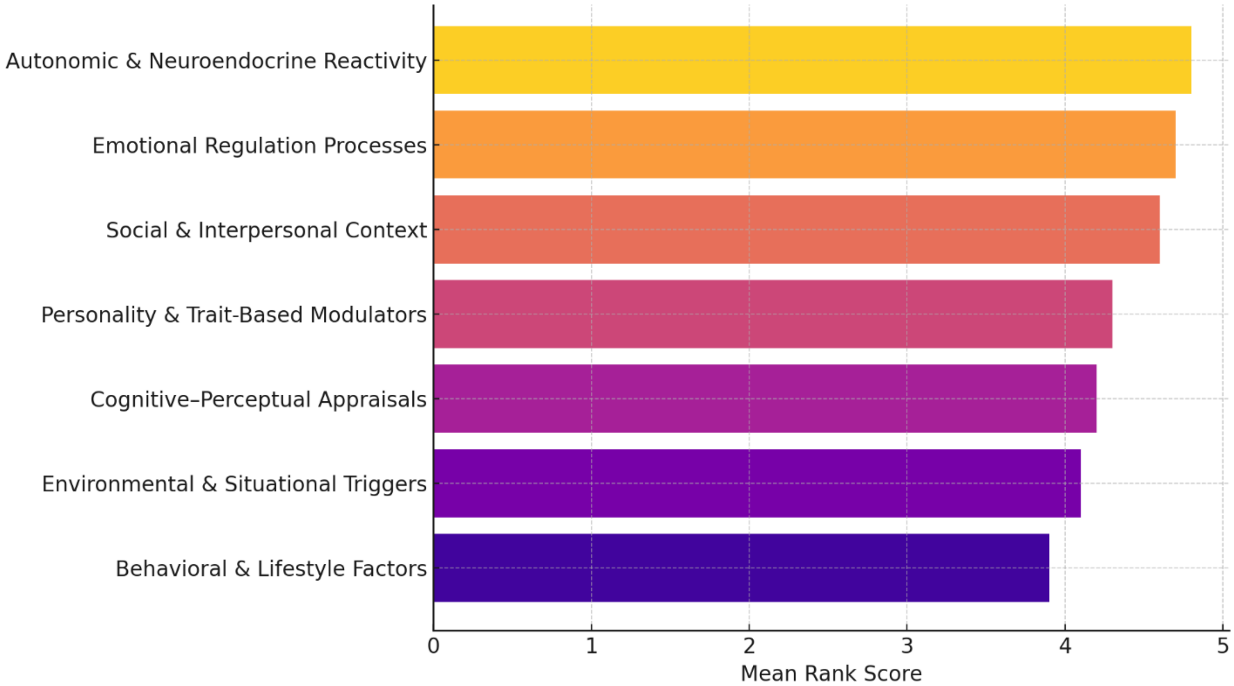
Table 2

Ranking of Determinants of Emotion–Physiology Synchrony

Determinant (Theme)	Mean Rank Score
Autonomic & Neuroendocrine Reactivity	4.8
Emotional Regulation Processes	4.7
Social & Interpersonal Context	4.6
Personality & Trait-Based Modulators	4.3
Cognitive–Perceptual Appraisals	4.2
Environmental & Situational Triggers	4.1
Behavioral & Lifestyle Factors	3.9

Figure 1

Ranking of Determinants of Emotion–Physiology Synchrony



The ranking results revealed that Autonomic and Neuroendocrine Reactivity emerged as the strongest determinant of emotion–physiology synchrony (M = 4.8), indicating that biological stress systems play a foundational role in regulating synchrony between emotional and physiological states. Emotional Regulation Processes (M = 4.7) and Social and Interpersonal Context (M = 4.6) followed closely, suggesting that both intrapersonal regulatory skills and interpersonal environments significantly influence synchrony. Mid-level determinants included Personality and Trait-Based Modulators (M = 4.3) and Cognitive–Perceptual Appraisals (M = 4.2), reflecting moderate but meaningful effects. Environmental and Situational Triggers (M = 4.1) were rated slightly lower, indicating that immediate stressors influence synchrony but may operate through other mediating factors. Finally, Behavioral and Lifestyle Factors (M = 3.9) received the lowest rank, though still within a high overall range, suggesting that while daily habits matter, their influence is comparatively less direct. Together, these results demonstrate a multi-layered hierarchy where biological mechanisms, emotion regulation capacities, and social dynamics exert the strongest influence on synchrony during stress.

4. Discussion and Conclusion

The purpose of this study was to identify and rank the major determinants of emotion–physiology synchrony in stress-related health outcomes by integrating qualitative insights with quantitative ranking analysis. The results demonstrated that autonomic and neuroendocrine reactivity was the strongest determinant of synchrony, followed closely by emotional regulation processes and social–interpersonal context. Personality traits, cognitive–perceptual factors, environmental triggers, and lifestyle patterns were also meaningful but comparatively lower-ranked determinants. These findings reinforce the view that synchrony is a multidimensional construct shaped by interacting biological, emotional, cognitive, and social systems. The results align with a broad body of literature documenting the conditions under which physiological synchrony emerges, intensifies, or becomes disrupted, and the following discussion situates these findings within prior empirical and theoretical work.

The prominence of autonomic and neuroendocrine reactivity as the highest-ranked determinant is consistent with extensive evidence that biological stress systems underpin synchrony. Research on mother–infant dyads has shown that coordinated heart-rate or RSA patterns emerge in response to shared emotional experiences and predict later regulatory outcomes (Abney et al., 2021a, 2021b). Similarly, meta-analytic work reveals robust mother–child synchrony in respiratory sinus arrhythmia across contexts, suggesting that biological reactivity and recovery capacities form the physiological substrate of synchrony (Miller et al., 2022a, 2022b). Studies in clinical populations also support this view: parent–child synchrony in RSA is moderated by interaction quality and child characteristics, demonstrating that autonomic flexibility and biological sensitivity shape synchrony in complex ways (Wang et al., 2020). The present study's finding that autonomic and neuroendocrine processes are the most influential aligns with this evidence, suggesting that synchrony largely reflects dynamic autonomic coupling shaped by sympathetic activation, parasympathetic recovery, and HPA-axis coordination.

The high rank of emotional regulation processes further emphasizes the centrality of psychological mechanisms in synchrony. Emotional regulation supports coherent emotional–physiological signaling, enabling alignment between affective states and biological responses. Studies of maternal and child regulation show that neurophysiological synchrony moderates the association between maternal affect and child emotional dysregulation, demonstrating that regulation processes shape how emotions translate into synchronized physiological patterns (Hale et al., 2025). Emotion regulation also plays a major role in adult interactions. For example, during horror-movie exposure, dyads demonstrate heightened cardiac synchrony under conditions of shared emotional intensity, suggesting that emotional appraisal, arousal, and regulation interact to produce synchrony (Andersen et al., 2025). Emotional sharing between strangers similarly produces cardiac alignment, indicating that regulation processes help coordinate emotional resonance in early social encounters (Adel et al., 2025). The current findings reflect this theoretical and empirical grounding by highlighting emotional regulation as a key predictor of synchrony across contexts.

The strong ranking of social and interpersonal context aligns with a large body of research identifying interpersonal dynamics as a powerful driver of synchrony. Studies in psychotherapy demonstrate that client–therapist synchrony increases during emotionally intense moments, shaping relational depth and treatment processes (Bar-Kalifa et al., 2023). Research on imagery rescripting likewise shows that client emotional experiences align with therapist-led physiological synchrony, indicating that social coordination modulates emotional restructuring (Prinz et al., 2021). Romantic partners also exhibit significant synchrony during emotionally charged conversations, where behavioral variability in future-based discussions predicts physiological alignment (Shimshock et al., 2025). Beyond dyads, group synchrony predicts task performance and negative emotional states in collaborative settings (Algumaei et al., 2023). Audience synchrony during concerts further illustrates how collective engagement and shared attention synchronize physiological states (Tschacher et al., 2023; Tschacher et al., 2024). Thus, the current study's ranking of social context as a major determinant is supported by robust evidence that synchrony is inherently relational and socially situated.

Personality and trait-based modulators, ranked in the mid-range, were also consistent with the literature. Emotional insecurity, trait anxiety, and other dispositional characteristics influence the degree and direction of physiological alignment in parent–adolescent dyads (Li et al., 2020). Emotional contagion research suggests that individuals high in empathic tendencies exhibit stronger interpersonal coupling (Mayo & Gordon, 2020). During the COVID-19 pandemic, prepandemic synchrony predicted susceptibility to emotional contagion, implying that stable traits interact with situational stressors to modulate alignment (Mayo et al., 2023). Studies of fear synchrony in mouse dyads similarly highlight the biological and dispositional bases of synchronous responses (Ito & Morozov, 2024). These findings collectively indicate that personality influences synchrony indirectly through modulation of sensitivity to social cues, emotional reactivity, and physiological thresholds.

Cognitive–perceptual appraisals were ranked slightly lower, consistent with their indirect influence on biological coupling. Research shows that shared attentional focus or perceptual alignment can generate synchronized physiological responses, particularly in group settings. For example, pupil-dilation synchrony emerges during shared visual experiences (Ghilardi & Ossmy, 2024), while audience physiological alignment during performances reflects coordinated attention and shared aesthetic interpretations (Ardizzi et al., 2020). Linguistic alignment, a cognitive-synchrony phenomenon, also parallels physiological synchrony during learning activities (Lämsä et al., 2024). Cognitive appraisal processes are clearly important but often operate by shaping emotional arousal and social engagement, explaining their moderate ranking.

Environmental and situational triggers were also meaningful determinants, reflecting literature showing that coordinated responses often arise in high-intensity or emotionally charged environments. High-stress settings such as horror films elicit strong physiological synchrony (Andersen et al., 2025), while cooperative joint tasks produce synchronized excitatory responses (Murata et al., 2021). Group cohesion studies also confirm that synchrony increases under conditions requiring shared focus or collective coordination (Tomashin et al., 2022). Environmental conditions thus contribute to synchrony by modulating arousal levels and behavioral demands.

Finally, behavioral and lifestyle factors ranked lowest but still played a significant role. Sleep–wake synchrony within families has been linked to maternal wellbeing (Rodheim et al., 2023), and lifestyle factors such as musical engagement shape synchrony in therapeutic dyads (Pemble et al., 2024). The integration of physiological signals into AI systems for emotion generation further shows how rhythmic bodily processes interact with attention, behavior, and cognition (Ng et al., 2025). Although lifestyle factors may not directly drive synchrony, they create the context in which emotional and physiological processes unfold, consistent with their lower but meaningful placement.

Together, the findings of this study support a hierarchical understanding of emotion–physiology synchrony, with biological mechanisms forming the core substrate, psychological and interpersonal processes shaping modulation and expression, and environmental and lifestyle factors providing contextual influence. This multilevel structure aligns closely with theoretical accounts conceptualizing synchrony as an emergent relational and physiological phenomenon shaped by reciprocal feedback among individuals and their environments (Wood et al., 2020). The current research contributes by empirically ranking these determinants, offering a structured framework for future work.

This study has several limitations. First, although the qualitative phase drew from an extensive literature base, it relied solely on published works, which may introduce publication bias and overlook gray literature or culturally specific findings. Second, the quantitative ranking relied on self-report data from participants in Germany, which may limit generalizability to other populations or cultural contexts. Third, the ranking reflects perceived importance rather than objective physiological measures, meaning the results may differ from experimental or laboratory-based synchrony data. Fourth, although the study used a mixed-methods approach, the integration of qualitative and quantitative findings may have introduced interpretive subjectivity. Finally, the research did not examine synchrony in real-time physiological interactions, which would provide deeper insight into dynamic synchrony processes.

Future research should employ multi-method designs integrating physiological measurements, behavioral observation, and subjective reporting to capture synchrony more comprehensively. Studies across diverse cultural, developmental, and relational contexts would clarify how determinants vary across populations. Experimental designs manipulating emotional regulation, social context, or environmental triggers would help establish causal pathways. Longitudinal research could examine how synchrony and its determinants evolve over time and influence long-term stress-related health outcomes. Future work should also incorporate technological advances such as wearable biosensors, machine learning, and AI-driven synchrony analysis to gain real-time insights into complex physiological coupling.

Practitioners may enhance synchrony in therapeutic, educational, and relational settings by targeting emotional regulation strategies, strengthening supportive interpersonal environments, and attending to autonomic regulation. Interventions promoting mindfulness, co-regulation, and empathic communication may foster synchronized emotional and physiological patterns that support wellbeing. In organizational and collaborative settings, attention to group cohesion and shared goal orientation may strengthen synchrony and improve performance. Finally, integrating synchrony assessments into clinical or educational evaluations could help identify individuals at risk for dysregulated stress responses.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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