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Hypnotic Induction and the Autonomic Nervous System Indexed by Heart Rate Variability: A Secondary Data Analysis

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Abstract

Hypnotic induction is widely employed to facilitate focused attention, deep relaxation, and dissociation from the environment, yet its underlying physiological mechanisms remain debated. This secondary analysis aimed to assess changes in heart rate variability (HRV) as an index of autonomic nervous system (ANS) activity shifts during formal hypnotic induction. Therefore, forty-four participants (35 female, 9 male; M_{age} = 19.93 years) with medium-to-high hypnotizability (M = 8.273, range 5 – 11 on a 0 – 12 scale) underwent a hypnotic induction (M = 743 s) within a larger experiment on the causal role of affect sharing in vicarious fear learning. During the hypnotic induction, participants received suggestions for focused attention, relaxation, eye closure, and state deepening, delivered by a female hypnotist. Electrocardiogram (ECG) recordings were preprocessed and analyzed using an open-source HRVTool in MATLAB. Results indicated no significant changes in HRV indices (LF/HF, HR, SDNN, RMSSD) between the first and last five minutes of hypnotic induction, and hypnotizability did not significantly moderate this relationship. These findings suggest that, under the present neutral hypnotic induction procedure, ANS activity remains stable. This supports the view that formal hypnosis does not necessarily entail a distinct autonomic pattern and underscores the need to clarify under which conditions physiological modulation may emerge.

Keywords: hypnosis, hypnotic induction, autonomic nervous system, ANS, electrocardiography, ECG, heart rate variability, HRV

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Introduction

Hypnosis is a mind-body treatment that has been used for various physical and psychological conditions since early human history (Geagea et al., 2023). It has shown promising effects on various mental and somatic health outcomes (Rosendahl et al., 2024). However, the underlying mechanisms of hypnotic phenomena across biological, psychological, and social domains remain complex and under active discussion (Jensen et al., 2015). In addition to top-down cognitive mechanisms (Oakley & Halligan, 2013), the autonomic nervous system (ANS) and the reduction of psychophysiological arousal during hypnosis are part of recent hypnosis research (De Benedittis, 2024). By ensuring flexible regulation in response to both internal and external demands, the ANS plays a crucial role in maintaining homeostasis (Wehrwein et al., 2016). A growing body of evidence highlights the close relationship between hypnosis and the ANS, especially in treating psychological and medical conditions associated with ANS dysfunctions (Häuser et al., 2016). Nevertheless, while understanding the role of the ANS in symptom treatment, the physiological mechanisms of neutral hypnosis (i.e., hypnotic induction), independent of explicit suggestions, are yet a small field of interest (Cardeña et al., 2013). While findings remain inconclusive (Fernandez et al., 2021), this thesis aims to shed light on the underlying dynamics of hypnotic inductions´ autonomic modulation and its relationship with the individual's ability to get hypnotized (i.e., hypnotizability) as indexed by heart rate variability (HRV).

Hypnosis

Hypnosis can be understood in two terms: as a process and a product (Peter, 2015). The process refers to hypnotic induction and aims to induce a specific hypnosis state (i.e., the product). Throughout this work, the term hypnosis will be used in its meaning as process, while the product will be referred to as hypnotic state.

Usually, hypnosis is suggested by another person (i.e., heterohypnosis) and consists of instructions that identify the process as hypnosis[1], enhance the receptiveness towards the spoken words by diminishing the attention to environmental stimuli, and promote relaxation (Terhune & Cardeña, 2016). Further to that, targeted suggestions and termination of the hypnotic state constitute the other classic phases of hypnosis (Kihlstrom, 2008). While targeted suggestions differ in terms of research and clinical goals, aiming to trigger sensory, behavioral,

[1] Labeling an induction procedure 'hypnosis' produces a modest increase in suggestibility compared to the label 'relaxation' (Gandhi & Oeakley, 2005).

or cognitive hypnotic responses, hypnotic induction is understood as *neutral*, simply aiming to enhance hypnotic depth (Cardeña et al., 2013; Peter, 2015). Therefore, in this work, the terms "hypnotic induction" and "neutral hypnosis" are used interchangeably to refer to the same procedure. The hypnotic depth seems to increase over time of hypnosis (Diamond et al., 2008; Oakley et al., 2007). Enhanced hypnotic depth results in the product of hypnosis described as a specific "state of consciousness" (Elkins et al., 2015, p. 6), often referred to as a hypnotic state or trance (Peter, 2015). Although the existence of a distinct hypnotic state remains debated, it is typically described as involving hypnotic phenomena such as enhanced absorption, dissociation, and suggestibility (Spiegel, 1991).

Understanding the mechanisms underlying these hypnotic phenomena is addressed by various theories (for review, see Geagea et al., 2024; Montgomery, 2025; Zahedi et al., 2024). The most prominent approaches rely on either state theories or non-state theories (e.g., socio-cognitive theory), both addressing the ongoing debate on hypnotic state being an "altered state of consciousness" or not.

State theorists understand the hypnotic state as a distinct and unique qualitative state beyond normal wakefulness and relaxation. The hypnotic phenomena are products of altered consciousness, allowing unusual cognitive processes outside ordinary psychological functioning. Hypnotized individuals are assigned a more passive role of hypnosis (Kihlstrom, 1997; Woody & Sadler, 2008). Non-state theorists question the altered state of consciousness idea and understand hypnosis as a voluntary and goal-oriented procedure, explainable by ordinary psychological concepts. The hypnotized individual forms the hypnotic state more actively. Socio-cognitive theories, as a specific branch of non-state theories, argue that individuals' expectations, attitudes, and motivations towards hypnosis impact the intensity and perception of hypnotic phenomena (Lynn et al., 1990; Lynn et al., 2008; Spanos, 1991). Further to that, the social context and interpersonal connection between the hypnotist and the individual play an important role. In recent years, more integrative models have been developed, focusing on a variety of empirically based influencing factors (e.g., biological, psychological, social), rejecting the dichotomic ground and integrating various explanation approaches (Jensen et al., 2015; Lynn & Green, 2011; Lynn et al., 2015).

Not entirely agreed upon the origin, most researchers argue in favor of a specific ability to follow and experience the alterations suggested during hypnosis, so-called hypnotizability (Elkins et al., 2015). On the one hand, state theorists and early research understood hypnotizability as a stable trait variable (Piccione et al., 1989). On the other hand, non-state theorists and recent studies question the stability and highlight the possibility of modification within a single day (Green et al., 2015) and between sessions (Fassler et al., 2008; Batty et al., 2006). Despite that, hypnotizability is considered a normally distributed variable with 70-80 percent of the population being medium hypnotizable, and 10-15 percent each falling into the low- and high-hypnotizable groups (Barnier et al., 2022; De Pascalis et al., 2000). Standardized scales, such as the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C; Weitzenhoffer & Hilgard, 1962) and the Harvard Group Scale of Hypnotic Susceptibility, Form A (HSGHS:A; Shor & Orne, 1962), are frequently used to assess an individual hypnotizability score with different test-suggestions, although both scales have been critically reviewed lately (Acunzo & Terhune, 2021).

The Autonomic Nervous System (ANS)

The human nervous system has two divisions: the central nervous system (brain and spinal cord) and the peripheral nervous system. One part of the peripheral nervous system is the visceral peripheral nervous system, also called the involuntary, autonomic nervous system (ANS; Bear et al., 2016). By regulating the heart (including its cardiac muscle and pacemaker cells), gland cells, and various smooth muscles like those in the bladder and blood vessels, the ANS supports homeostasis and maintains essential bodily functions without conscious effort (Wehrwein et al., 2016).

The ANS consists of two principal branches[2]: the parasympathetic nervous system (PNS) and the sympathetic nervous system (SNS). These branches differ in their anatomical, functional, and physiological characteristics (O'Donnell & Glasgow, 2011). Although often described as having antagonistic effects (Berntson et al., 1991), the PNS and SNS interact continuously in a dynamic equilibrium, commonly referred to as sympatho-vagal interaction (Malliani et al., 1991; Malliani et al., 1994; Task Force, 1996). A balanced interaction represents a hallmark of healthy physiological functioning, with parasympathetic activity dominating during rest (Shaffer et al., 2014).

Both branches include autonomic nerve fibers that transmit afferent sensory signals to the brain and spinal cord and carry efferent signals from the central nervous system (CNS) to target organs (Bear et al., 2016; O'Donnell & Glasgow, 2011).

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[2] The enteric nervous system as third major division of the ANS (Wehrwein et al., 2016) lays outside the scope of this master‘s thesis.

The PNS primarily operates during relaxed states, both physically and mentally, eliciting a "rest-and-digest" response. This physiological condition usually involves a decrease in heart rate, muscle relaxation, and increased digestive and intestinal motility (Karemaker, 2017, Table 1). The PNS is often referred to as the vagal branch, because the vagus nerve (the 10th cranial nerve) carries a large part of efferent fibers and represents the dominant output pathway of the PNS (Berntson et al., 2003). Acetylcholine (ACh) is the primary neurotransmitter of the PNS, released at both preganglionic and postganglionic synapses (Wehrwein et al., 2016).

In contrast, the SNS is activated primarily in response to physically or mentally stressful situations, producing the "fight-or-flight" response (O'Donnell & Glasgow, 2011). This response increases heart rate, enhances blood flow to the muscles, and reduces digestive system activity (Karemaker, 2017, Table 1). Unlike the PNS, the SNS utilizes more complex disynaptic pathways via the ganglia of the sympathetic chain (Bear et al., 2016). ACh is used at the preganglionic synapse, whereas norepinephrine (NE) serves as the primary sympathetic neurotransmitter at the postganglionic synapse connecting the SNS to target organs.

The ANS and the Heart

Both branches profoundly influence heart rate (HR), defined as the number of heartbeats per minute (bpm). The heart's intrinsic pacemaker is the sinoatrial (SA) node, a small cluster of specialized cardiac cells (Pham et al., 2021). These cells depolarize spontaneously, generating action potentials that initiate rhythmic depolarization and repolarization of cardiac muscle cells, ultimately producing a heartbeat (Clifford, 2002).

The vagus nerve of the PNS exerts direct inhibitory effects on the SA node. ACh binds to muscarinic, cholinergic receptors on the SA node cells, increasing potassium conductance. This slows the pacemaker depolarization, lengthens the interval between heartbeats, and consequently decreases HR, a phenomenon known as the bradycardic effect (Karemaker, 2017; Wehrwein et al., 2016). This vagal effect occurs rapidly, typically within one second (Berntson et al., 1997; Clifford, 2002).

In contrast, sympathetic activation increases HR. NE binds to specific β-adrenergic receptors on SA node cells, initiating a second messenger cascade of intercellular signals that accelerates pacemaker depolarization. The result is an increase in HR, known as tachycardia (Karemaker, 2017; Wehrwein et al., 2016). Because this process requires secondary messenger activation, the sympathetic effect is slightly slower but more persistent, becoming apparent within 1-2 seconds (Berntson et al., 1997).

Heart Rate Variability (HRV)

Heart Rate Variability (HRV) signal is obtained from electrocardiographic (ECG) recordings and seems to mirror ANS activity (Ernst, 2017). ECG recordings capture typical waveforms with a P-wave, followed by QRS complex (Q-wave, R-wave, and S-wave), and a final T-wave, as shown in figure 1 (Eguchi & Aoki, 2023; Clifford, 2002). The QRS complex reflects ventricular depolarization, initiating cardiac muscle contraction, which we can sense as a heartbeat (Quigley et al., 2024). The time between each heartbeat is called the interbeat interval (IBI) or R-R interval (RRI; Quigley et al., 2024). HRV reflects fluctuations in these time intervals of ongoing cardiac cycles (Task Force, 1996). As discussed above, parasympathetic activity is faster, due to the more rapid ACh neurotransmission, and therefore can affect the cardiac cycle immediately, which leads to an overall increased R-R variation. On the other side, the release of sympathetic NE is slower and, due to the second messenger cascade, acts more slowly at the heart, affecting the variability of IBIs less frequently, resulting in a lower HRV (Russo et al., 2017). An optimal level of HRV is an indicator of psychological and behavioral flexibility and adaptability to social and environmental changes and cardiovascular health (Shaffer et al., 2014; Thayer et al., 2009). The level of HRV is associated and interacts with various physiological, behavioral, and external factors, like gender, alcohol consumption, and respiration pattern (Sammito et al., 2024). Abnormal beats reflect various physiological cardiac dysfunctions, such as ectopic beats or arrhythmias, whose origin lies outside normal cardiac rhythm and display cardiac influences despite SA node depolarization (Shaffer & Ginsberg, 2017). Temporal cardiac dysfunctions can be present in healthy subjects and are experienced by almost everyone (Peltola, 2012).

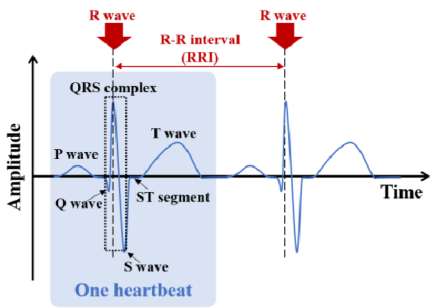

Figure 1. This figure illustrates typical ECG components of a regular heartbeat and a R-R interval (RRI) between two consecutive heartbeats. Reprinted from “Practical R-R Interval Editing for Heart Rate Variability Analysis Using Single-Channel Wearable ECG Devices,” by K. Eguchi and R. Aoki, 2023, *IEEE Engineering in Medicine and Biology Society Section, 11,* p. 25544.

Frequency-Domain Analysis

Different analytical approaches are used to assess HRV and quantify metrics. The most common ones are categorized into time-domain, frequency-domain, and nonlinear methods. Since the frequency-domain method is recommended for short-term ECG recordings ($\leq$ 5 minutes), this master's thesis focuses on spectral components provided by the frequency-domain method.

As mentioned, due to their signaling mechanisms and timing differences, PNS and SNS modulate the HR and HRV in diverse ways. Indices of frequency-domain analysis reflect the ratio of influence across different frequency bands (Pham et al., 2021). Three frequency bands are distinguished within the literature for short-term recordings (Task Force, 1996): high frequency (HF, 0.15-0.4 Hz), low frequency (LF, 0.04-0.15 Hz), and very low frequency (VLF, 0.0033-0.04 Hz). Since the VLF component is influenced by heterogeneous and less well-understood physiological mechanisms, the interpretation of LF and HF for short-term recordings is recommended and widely used (Kleiger et al., 2005). LF and HF are either captured in absolute values of power (in ms^2) or in normalized units (n.u.), as a relative value to the total power (Task Force, 1996). Since this master's thesis focuses on the shift in ANS activity, in this work, HF and LF will be employed in their meanings as relative values (HFnu, LFnu).

For a long time, HF and LF were interpreted as reflecting parasympathetic and sympathetic influences, since the two branches were understood as opposing and differing in activation speed (Shaffer et al., 2014; Shaffer & Ginsberg, 2017). According to that, a third index quantifying the proportional relationship between PNS and SNS activity (i.e., sympatho-vagal balance) was proposed (Malliani et al., 1994): the ratio of LF to HF (LF/HF). It is assumed that an increase in LF/HF reflects a shift towards sympathetic dominance, whereas a decrease corresponds to parasympathetic takeover. However, recent literature emphasizes a more complex and dynamic interaction (Goldstein et al., 2011; Reyes del Paso et al., 2013). In particular, the extent to which LF/HF reflects sympathetic modulation remains debated (Billman et al., 2013), as does the influence of respiratory pattern on this metric (Brown et al., 1993).

Despite ongoing controversies surrounding its interpretation, the LF/HF remains a widely accepted index for assessing sympatho-vagal balance in short-term HRV recordings and facilitates comparison with previous studies (Heathers, 2014). Accordingly, this thesis employs

LF/HF to investigate potential shifts in autonomic activity during hypnotic induction, while acknowledging its methodological limitations.

To complement LF/HF as the primary index, additional time-domain metrics are included for exploratory analyses to capture further aspects of short-term autonomic variability. These include HR (in bpm), standard deviation of Normal-to-Normal (NN) intervals (SDNN, in ms), and the square root of the mean squared differences of successive NN intervals (RMSSD, in ms), which are all commonly used for short-term HRV analysis. RMSSD is strongly correlated with absolute HF HRV ($r = 0.93$) and is considered a robust indicator of vagal tone (Goedhart et al., 2007). Moreover, RMSSD appears less sensitive to ectopic beats and respiratory pattern variability, thereby addressing some of the methodological concerns associated with LF/HF (Quigley et al., 2024; Task Force, 1996).

Hypnosis and the ANS

Having outlined the theoretical foundations of hypnosis, the ANS, and HRV as an indicator of autonomic modulation, the following section integrates these perspectives into a coherent psychophysiological framework that explains underlying mechanisms of hypnosis and summarizes empirical findings.

According to the neurovisceral integration (NVI) model proposed by Thayer and Lane (2000), the CNS and ANS are interconnected via the central autonomic network (CAN; Bear et al., 2016). This central-peripheral integration enables both top-down and bottom-up feedback processes. The CAN exerts its influence via preganglionic sympathetic and parasympathetic neurons that innervate the heart, and this output appears to be directly associated with HRV (Thayer & Lane, 2000). Within this theoretical approach, the components of hypnotic induction, namely focused attention, relaxation, and controlled breathwork (Terhune & Cardeña, 2016), can be understood as modulators of autonomic activity (Taylor et al., 2010). First, promoted focused attention may inhibit sympathetic activity by enhancing prefrontal inhibitory control over limbic and hypothalamic regions involved in sympathetic arousal (Oakley & Halligan, 2013). Second, muscle relaxation is thought to reduce afferent bottom-up arousal cascades, thereby decreasing sympathetic and increasing parasympathetic activity, as described in the relaxation response model (Benson et al., 1974). Third, controlled, slow breathing influences vagal tone via baroreceptor activation and interoceptive homeostatic processes (Laborde et al., 2022). In summary, the theoretical frame supports the idea of a shift towards parasympathetic dominance during hypnosis. Building on this, the relationship between hypnosis and autonomic modulation has been investigated for over three decades and remains a topic of ongoing research (Fernandez et al., 2021; De Benedittis, 2024). Numerous studies have examined ANS activity following targeted suggestions (for review, see Fernandez et al., 2021). While many of these works focus on the efficacy of hypnosis, relatively little attention has been paid to the underlying mechanisms of the hypnotic state itself. Nevertheless, some studies have examined so-called neutral hypnosis, which involves formal induction procedure without specific suggestions.

The available evidence on ANS modulation during neutral hypnosis is mixed. For instance, studies comparing neutral hypnosis to baseline conditions (Aubert et al., 2009; Emdin et al., 1996), reported significant reductions in mean LF/HF following prolonged neutral hypnosis (≥ 25 min). Similarly, De Benedittis et al. (1994) observed a significant decrease in LF/HF medians after approximately 10 minutes of neutral hypnosis. In contrast, a more recent study (Callara et al., 2023) did not find any condition effects on the mean LF/HF of a 10-minute pre-recorded neutral hypnosis procedure compared to baseline and rest. Further, Chen and colleagues (Chen et al., 2017) did not report significant condition effects of mean LF/HF between the resting and inducing state. Based on these previous findings, the current evidence for significant LF/HF modulation during neutral hypnosis conditions remains mixed. Comparing the end of neutral hypnosis to a baseline condition provides insight into how the hypnotic state may differ from normal wakefulness in terms of autonomic regulation. However, only one study has investigated the temporal dynamics of autonomic activity during hypnotic induction itself, reporting no significant differences in LF/HF between the first and last three minutes of induction (Callara et al., 2023).

Exploratory analyses of other HRV parameters also yield inconsistent findings. Regarding HR, recent studies failed to detect significant differences between baseline and neutral hypnosis (Aubert et al., 2009; Boselli et al., 2018), challenging the notion of a shift towards parasympathetic dominance. Earlier work, however, reported a significant bradycardia effect (Emdin et al., 1996). For SDNN, one study provided descriptive results without statistical testing, showing no difference between conditions (Yüksel et al., 2013), and similar findings were reported for RMSSD. Other studies found no significant changes in RMSSD during hypnotic induction as well (Callara et al., 2023; Laborde et al., 2018).

Beyond condition-level associations, recent research has increasingly focused on individual differences, particularly hypnotizability, as a potential moderator of the described relationship.

Hypnosis, hypnotizability, and the ANS

To examine differences in autonomic activity in response to hypnosis, studies have investigated the individual levels of hypnotizability as a between-subject factor. In particular, the comparison between high and low hypnotizable individuals represents a prominent area of research. Findings seem mixed, with some studies showing no main effect of hypnotizability on HRV indices (Callara et al., 2023; Minonzio et al., 2020; Ray et al., 2000), while earlier research reported a significant difference in LF/HF depending on hypnotizability level (De Benedittis et al., 1994). Specifically, highly hypnotizable individuals tend to show a greater decrease in LF/HF from waking to hypnosis than those with low hypnotizability.

Research gap

As previously discussed, while most studies compared pre- and post-hypnosis states, little is known about the temporal evolution of autonomic indices during the hypnotic induction itself. This gap limits our understanding of the autonomic modulation occurring during the transition into hypnosis. By continuously measuring changes in ANS activity throughout the hypnotic induction process, it may be possible to gain insights into the dynamics and physiological mechanisms underlying the still-debated hypnotic state. In addition, as highlighted by De Benedittis (2024), most hypnosis studies are based on small sample sizes (typically $N < 30$; see also Fernandez et al., 2021), which restricts statistical power and generalizability. Moreover, the influence of individual hypnotizability levels remains unclear, particularly within the medium range, despite this group representing the majority of the population (De Pascalis et al., 2000).

To address these research gaps and limitations, the present secondary data analysis aims to investigate the relationship between autonomic modulation and hypnotic induction in a larger sample ($N > 30$), including medium- to highly hypnotizable healthy students with a score of at least 5 on the HGSHS:A (Shor & Orne, 1962).

The following research questions and hypotheses focus on LF/HF, given the mathematical dependence of the power components (LFnu, HFnu) and a theory-driven expectation of a shift toward parasympathetic dominance during hypnosis:

RQ1: How does heart rate variability (LF/HF) change during exposure to a standardized, auditory hypnotic induction in healthy students scoring at least 5 on the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A)?

H1: *The LF/HF of heart rate variability will significantly decrease from the first 5 minutes to the last 5 minutes of the hypnotic induction procedure.*

RQ2: Does hypnotizability, as measured by the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A), moderate the relationship between a standardized, auditory hypnotic induction and heart rate variability (LF/HF) in healthy students scoring at least 5 on the HGSHS:A?

H2: *Higher hypnotizability is associated with greater changes in the LF/HF of heart rate variability from the first 5 minutes to the last 5 minutes of the hypnotic induction procedure.*

In addition, exploratory analyses on HR, SDNN, and RMSSD will be conducted to provide a broader understanding of overall autonomic variability and absolute parasympathetic activity.

Methods

Study background

This master's thesis consists of an analysis of pre-existing data collected within a 2022 study conducted by Müllner-Huber and colleagues. The study investigated the causal role of affect sharing in vicarious fear learning and was carried out within the Social, Cognitive and Affective Neuroscience Unit of the Department of Cognition, Emotion, and Methods in Psychology at the University of Vienna, in cooperation with the Department of Clinical Neuroscience at Stockholm Karolinska Institute (Müllner-Huber et al., 2022). All experimental procedures were approved by the ethics committee of the Medical University of Vienna and adhered to the current revision of the World Medical Association Declaration of Helsinki (October 2013). Participants completed a vicarious Pavlovian fear conditioning paradigm under two hypnotic conditions designed to induce either a high or low affect-sharing state. Skin conductance level (SCL), eye movements, and self-report data were analyzed. Electrocardiogram (ECG) data were also recorded but lay outside the scope of the original study analysis and form the basis of the present thesis.

Procedure

Participants provided written informed consent to participate in the study. They were seated on a recliner, facing a computer monitor. Before receiving the procedural instructions, participants were prepared for physiological measurements. Participants were advised that they might receive between 0 to 4 uncomfortable, non-painful electric shocks to their right hand during the hypnotic procedure. Importantly, no shocks were administered throughout the experiment.

Following the instructions, participants underwent a formal hypnotic induction in the German language administered by the same trained clinical hypnotist (L. A-B.), who was seated next to the participants. The induction procedure lasted between 625 s and 850 s (M = 743 s, 12 min 23 s), with individual variation attributed solely to the hypnotist's speaking speed, as confirmed by audio recordings. The induction procedure followed a structured, multi-stage protocol designed to elicit a hypnotic trance state, including sequential suggestions for focused attention, relaxation, and deepening. A detailed description of the induction protocol is provided in appendix A. For statistical analysis, the first five minutes of the induction (t1) were characterized by suggestions promoting external and internal focus and physical relaxation, while the final five minutes (t2) primarily focused on dissociation suggestions and included a numerical deepening procedure. Instructions for eye closure were given between these two segments.

After induction, participants received the suggestions for either increased or reduced affect sharing and completed the learning and test phases of the vicarious fear conditioning paradigm under both conditions. Participants returned to normal wakefulness at the end of the experiment, with the hypnotist counting backward from 20 to 0.

Participants

A total of N = 410 first- and second-year Bachelor Psychology students of the University of Vienna were initially screened for their hypnotizability in groups of 5-10 using the German version of the Havard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A; Shor & Orne, 1962). Individuals scoring ≥ 5 on a scale ranging from 0 to 12 were eligible for participation. Additional exclusion criteria were a "history of chronic pain, acute pain on the day of the experiment, previous experience with experimental electrical pain stimuli, a history of substance abuse or psychiatric or severe organic disease, and chronic or recent use of opiates" (Müllner-Huber et al., 2022, p. 3).

Ultimately, N = 49 students were recruited and provided written informed consent to participate in the study. Participants were compensated with student credits for the screening and with 45€ for participation in the experiment. Due to technical issues, the ECG signal of one participant was not properly recorded and was therefore excluded from analysis, resulting in a sample size of N = 48 (38 female, 10 male; mean age 19.95 years, range 18–24 years) for preprocessing. Following preprocessing (for additional details, see section *Preprocessing*), four additional participants were excluded due to poor overall ECG signal quality, yielding a final sample of N = 44 participants (35 female, 9 male; mean age 19.93 years, range 18–24 years) for statistical analysis.

Measures

Electrocardiogram (ECG)

Electrocardiogram data were recorded using an 8-channel bioamplifier (Mobi8-BP; TMSi B.V., Enschede, the Netherlands) at a sampling rate of 256 Hz. Skin preparation involved gentle abrasion with a clean paper towel and water. Three disposable electrodes were then placed on the body and secured with adhesive tape to ensure optimal conductivity between the skin and the electrode. Specifically, one electrode was placed on each lower leg, with the ground electrode attached to the right leg, and one on the right arm. The measurement was performed using a 1-lead ECG in the LEAD II configuration. While an ECG was recorded throughout the entire experimental procedure, the focus of this master's thesis is specifically on the ECG data acquired during the hypnotic induction.

Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A)

The internal consistency of the German version of the HGSHS:A, as applied in this study, ranges between .52 (Staudacher et al., 2012) and .67 (Peter et al., 2014). HGSHS:A is applied in group settings. Groups of 5 to 10 individuals participated in the standardized group hypnosis session, which followed the hypnotic procedure consisting of hypnotic induction, twelve test suggestions, and termination. Participants completed the twelve test items, including different motor tasks suggestions, hallucination instructions, and an amnesia test at the end. For each item completed with the suggested behavioral response, participants received one point. The total scores range from 0 to 12 for each participant, representing the participant's final hypnotizability score. Most commonly, to discriminate between participants, cut-offs of 0-4 for low (n = 0), 5-8 for medium (n = 25), and 9-12 for high hypnotizability (n = 19) are used (Peter et al., 2014; Zahedi et al., 2024). For the final sample included in statistical analysis (N = 44), HGSHS:A scores ranged from 5 to 11 (M = 8.273, SD = 1.633), representing medium-to-high hypnotizability levels.

Preprocessing

ECG recordings of the hypnotic induction phase were segmented into two 5-minute segments (first and last, i.e., t1 and t2) following the guidelines recommended by the Task Force (1996) to ensure uniformity and interpretability of short-term ECG recordings. To account for participant-specific individual temporal variations in the administration of the hypnotic induction, the corresponding audio recordings were analyzed to ensure uniform evaluation of the selected time intervals. For those participants without a personalized audio file (n = 9), due to experimental procedure deviation, the mean time of all the other participants was used (M = 743s).

ECG recordings were preprocessed using the HRVToolbox developed by Marcus Vollmer of the University of Greifswald (Vollmer, 2015; Vollmer, 2019). Given the sensitivity of short-term HRV analyses to artifacts (Task Force, 1996), the preprocessing of R-R intervals is critical (Eguchi & Aoki, 2023; Peltola, 2012; Quigley et al., 2024). Automatic artifact and exceptional beats detection and filtering of abnormal R-R intervals were performed. The default filter setting of HRVToolbox was applied, which filters out IBIs differing by more than 20% from the preceding interval, as recommended by the guidelines of the Task Force (1996). Non-used R-R intervals were marked as *NaN* (Not a Number). After automatic filtering, a manual inspection of ECG recordings was performed (A.K.), with particular attention to automatically flagged NaN-IBIs. Furthermore, irrelevant points detected as QRS complexes (i.e., false positives), and overlooked QRS complexes (i.e., false negatives) were detected (Eguchi & Aoki, 2023). Consistent with established best practices for ECG data editing to minimize data loss, artifacts, and exceptional beats were corrected using interpolation of degree zero to replace non-normal R-R intervals with new interpolated R-R intervals to preserve the initial number of samples. This method substitutes an abnormal R-peak with an average value of its two neighboring regular R-R-peaks (Peltola, 2012) and performs better than the deletion method (Salo et al., 2001). Given the sensitivity of short-term HRV analyses, a conservative cutoff of 90% regular IBIs in total was applied (Peltola, 2012). Consequently, up to 5% of exceptional beats per induction phase were corrected with interpolation of degree zero. Four participants (3 female, 1 male) did not meet the overall quality requirement and had to be excluded from statistical analysis.

The toolbox facilitates spectral analysis of IBIs via Fast Fourier Transformation (FFT). The HF and LF power bands are displayed in normalized units (nu; Vollmer, 2020), which are calculated by dividing each component by the total spectral power (= 100 %) excluding the

ULF and VLF components. Absolute values are not displayed. Consequently, HFnu and LFnu always sum to 100 %. Thus, HFnu and LFnu are linearly dependent on each other, and this perfect negative correlation is fully captured by the LF/HF over time. As a result, inferential statistical tests of HFnu and LFnu do not provide additional information beyond what is reflected in the LF/HF. However, descriptive values of HFnu and LFnu are reported for completeness.

Statistical analysis

Statistical analysis was performed with JASP (JASP Team, 2025). In order to test the first hypothesis (H1), a two-tailed paired sample t-test was conducted. Assumption of normal distribution for the differences between paired samples was assessed using the Shapiro-Wilk test and visual inspection of Q–Q plots. Given the skewed distribution of LF/HF, a natural log transformation of data was carried out (LF/HF_{log}), as a best practice approach (West, 2022). To investigate the moderator effects of hypnotizability on the relationship of hypnotic induction and LF/HF (H2), repeated measures analysis of variance with HGSHS:A scores as a continuous covariate (ANCOVA) and hypnotic induction time as the within-subjects factor was performed. Gender was not included as a between-subjects factor owing to the limited number of males ($n = 9$). Assumption checks, including linearity and normality of residuals, were assessed through visual inspection of scatter plots and Q-Q plots. The assumption of sphericity was met because the within-subjects factor had only two levels. Exploratory analyses on HR, SDNN, and RMSSD for both research questions followed the same statistical procedures described. Assumption of normality was assumed for the indices due to statistical robustness for $N > 30$. All tests were carried out with a significance level set at $\alpha = .05$.

Results

Research Question 1

All descriptive and statistical results are displayed in table 1. Statistical test revealed no significant decrease in LF/HF_{log} from t1 ($M_{log} = 0.298$, $SD_{log} = 0.792$) to t2 ($M_{log} = 0.432$, $SD_{log} = 1.055$) stage of hypnotic induction ($t(43) = -1.207$, $p = .234$, d = - 0.182). LF/HF_{log} showed a slight trend in the opposite direction of the hypothesized effects over time, although it remained non-significant (see figure 2).

Table 1

Descriptives of Frequency-Domain Variables and Paired-Samples t-Test on LF/HFlog in Early and Late Hypnosis Conditions

HRV parameters	t1		t2		t(43)	p	d [95 % CI]
	M	*SD*	*M*	*SD*			
HFnu	43.527	17.380	42.008	21.160			
LFnu	56.473	17.380	57.992	21.160			
LF/HFlog	0.298	0.792	0.432	1.055	-1.207	.234	-0.182 [- 0.479, 0.117]

Note. The table displays mean values (M) and standard deviation (SD) of frequency-domain HRV measures observed in the early and late phases of hypnotic induction. Student's t-test examining differences in descriptives between the two time slots was calculated for LF/HFlog only, due to mathematical dependence. No significant difference was observed ($t(43) = -1.207$, $p = .234$). Effect size (d) was calculated as Cohen's d = t / $\sqrt{N}$.

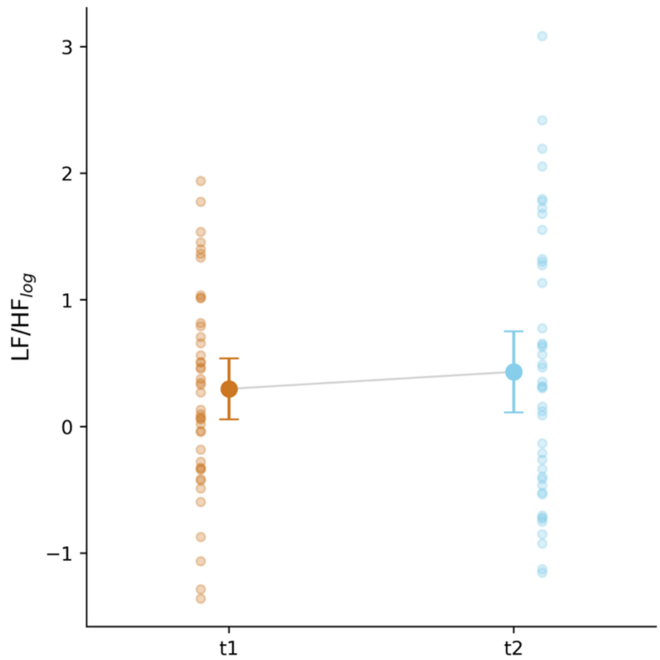

Figure 2. Plots illustrating the LF/HFlog distribution for the two time conditions (t1 = first five minutes, t2 = last five minutes). The plot indicates the mean (large dot) and 95% confidence

intervals. Individual data points for each time point are also depicted. Student's t-test indicated no statistically significant time differences (p = .883). The figure was created using Google Colaboratory (Google, 2025).

Research Question 2

H2 predicted a linear moderating effect of hypnotizability on the relationship between hypnotic induction phase and LF/HF (see figure 3). As displayed in table 2, the repeated measures ANCOVA showed no significant main effects of time ($F(1, 42) = 1.618$, $p = .210$, $\eta^2_p = .037$) and hypnotizability ($F(1, 42) = 2.634$, $p = .112$). No significant interaction of time and hypnotizability was observed ($F(1, 42) = 2.358$, $p = .132$, $\eta^2_p = .053$). Therefore, H2 was not supported.

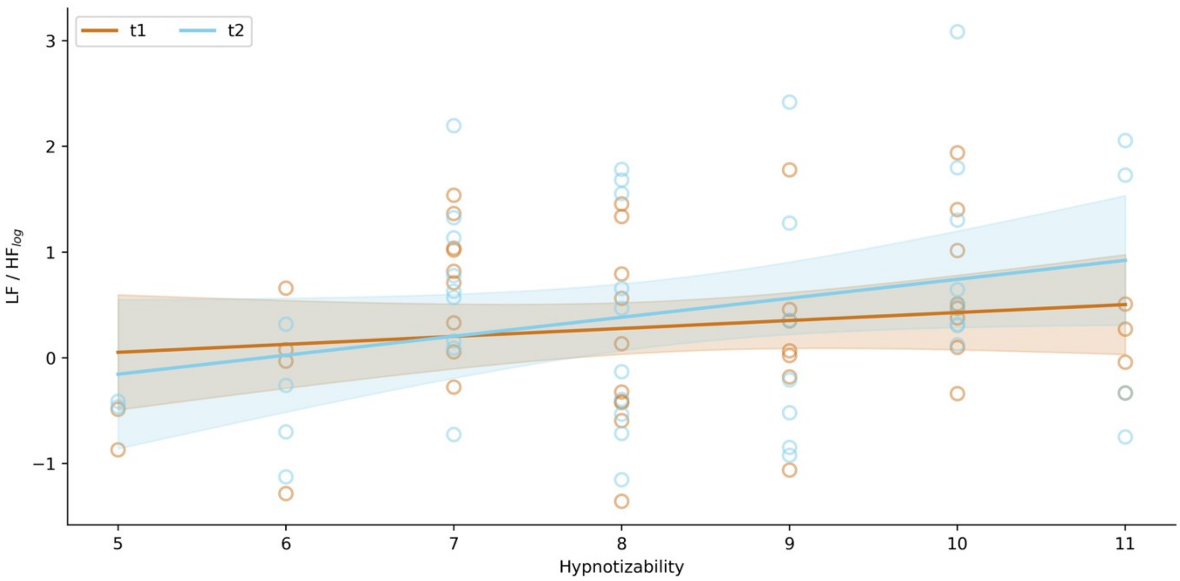

Figure 3. This plot illustrates the linear interaction between hypnotizability scores and hypnotic phase on the LF/HFlog. Individual data points for each time point are also depicted. Shaded ribbon represents 95% confidence intervals. The figure was created using Google Colaboratory (Google, 2025).

Table 2

Repeated Measures Analyses of Covariance (ANCOVA) on Time and Hypnotizability (HA) on LF/HF_{log}, HR, SDNN, and RMSSD

HRV	Effect	df	F	p	η^2_p
LF/HF_{log}	Time	1, 42	1,618	.210	.037
	HA	1, 42	2,634	.112	
	Time x HA	1, 42	2,358	.132	.053
HR	Time	1, 42	1.799	.187	.041
	HA	1, 42	4.767	.035*	
	Time x HA	1, 42	2.144	.151	.049
SDNN	Time	1, 42	1.144	.291	.027
	HA	1, 42	0.367	.548	
	Time x HA	1, 42	1.057	.310	.025
RMSSD	Time	1, 42	1.852	.181	.042
	HA	1, 42	1.437	.237	
	Time x HA	1, 42	1.586	.215	.036

Note. The table displays partial eta squared (η^2_p) values for repeated measures effects (Time), covariate effects (HA), and interaction effects (Time x HA). Results showed a significant main effect of hypnotizability in HR ($p = .035$). No additional significant main effects or interaction effects were observed across the measurements. *$p < .05$.

Exploratory Analyses

Exploratory analyses on the first research question revealed no significant changes in HR from the first to the last five minutes (see figure 4A; $t(43) = 0.494$, $p = .624$, d = 0.074). Paired samples t-test for SDNN showed no significant differences between the two time points (see figure 4B; $t(43) = 0.317$, $p = .753$, d = 0.048), as well as results on RMSSD showed no significance (see figure 4C; $t(43) = 0.647$, $p = .521$, d = 0.098).

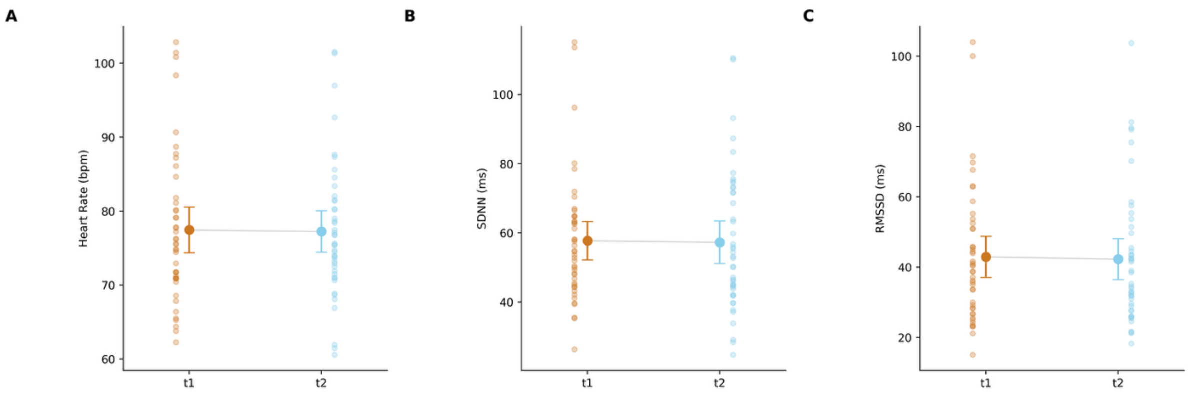

Figure 4. Plots illustrating the (A) HR (in bpm), (B) SDNN (in ms), and (C) RMSSD (in ms) distribution for the two time conditions (t1 = first five minutes, t2 = last five minutes). The plot indicates the mean (large dot) and 95% confidence intervals. Individual data points for each time point are also depicted. The figure was created using Google Colaboratory (Google, 2025).

Results of exploratory analyses for the second research question are displayed in table 2. Repeated measures ANCOVA showed no significant main or interaction effects for the three measurements, except for a significant main effect of hypnotizability regarding HR ($p = .035$). Correlation analysis revealed a small-to-moderate positive correlation ($r = .319$) between X_{HR} and Hypnotizability, shown in figure 5.

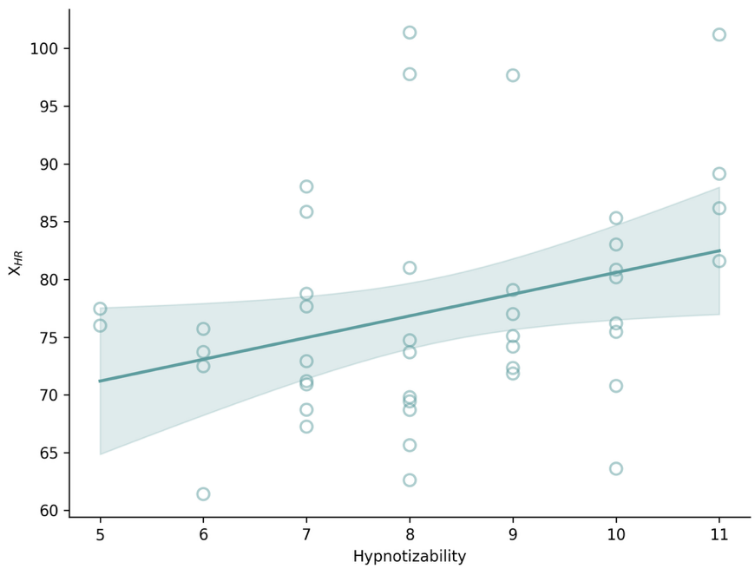

Figure 5. This plot visualizes the correlation found between X_{HR} and hypnotizability. $X_{HR} = HR_{t2} + HR_{t1} /2$ was calculated for each participant. Shaded ribbon represents 95% confidence intervals. The figure was created using Google Colaboratory (Google, 2025).

Discussion

The aim was to determine whether formal hypnosis is associated with changes in autonomic nervous system (ANS) activity, and if so, whether this relationship is moderated by hypnotizability. To this end, a formal hypnotic induction was administered in medium-to-high hypnotizable individuals. We assessed the relative shift in autonomic tone using heart rate variability (HRV), focusing primarily on the LF/HF, with exploratory analyses of HR, SDNN, and RMSSD to capture additional facets of short-term autonomic variability.

Results of the paired-sample t-test, used to evaluate the first hypothesis, indicated no significant decrease in LF/HF between the first and last five minutes of hypnotic induction. This observation aligns with prior research (Boselli et al., 2018; Callara et al., 2023; Chen et al., 2017; Laborde et al., 2018; Yüksel et al., 2013). Further to that, exploratory analyses revealed no significant changes in HR, SDNN, or RMSSD. The findings can be integrated into the overall research that found no evidence for significant differences between baseline and neutral hypnosis conditions in the three metrics (Aubert et al., 2009; Boselli et al., 2018; Laborde et al., 2018), and no significant reduction in RMSSD during hypnotic induction (Callara et al., 2023).

We propose various explanation approaches for the absence of significant autonomic changes. First, due to the absence of a pre-induction baseline recording, the ability to detect dynamic autonomic changes is limited, and it remains unclear whether the initial induction phase (t1) already reflected an autonomic shift from wakefulness. Further, participants might have been in a state of high parasympathetic activity even before the hypnotic induction started, with ceiling effects accounting for the absence of a shift towards increased parasympathetic activity.

Second, methodological limitations of HRV metrics should be considered. RMSSD predominantly reflects vagally mediated parasympathetic activity (Berntson et al., 2005), whereas the LF/HF, commonly used as an index of sympathovagal balance, has been extensively critiqued for its limited sensitivity and interpretational ambiguity, particularly regarding sympathetic modulation (Billman et al., 2013; Reyes del Paso et al., 2013). Thus, it is possible that subtle shifts in sympathetic activity throughout hypnosis were not captured by the HRV parameters, since they cannot display absolute sympathetic activity. Supporting this notion, another study addressing autonomic modulation throughout hypnosis based its findings on electrodermal activity (EDA), a reliable marker for sympathetic activity, and found a significant reduction (Kasos et al., 2020). Similar findings on EDA were discussed by other authors with no absolute increase in parasympathetic activity indexed by HF (Kekecs et al., 2016). Following the interpretation approach by Kekecs et al. (2016), these findings suggest that the autonomic effects of hypnosis may primarily be reflected in sympathetic rather than parasympathetic modulation, which the current measurement approach may have been insufficiently sensitive to detect. Future research could apply multimodal measurements, especially to detect sympathetic modulation, to address this explanatory framework.

Third, the absence of autonomic shift might be due to the affective states elicited throughout the procedure. While we anticipated a shift towards parasympathetic dominance, individual emotional experiences can modulate ANS activity in complex ways. Research claims that positive deactivating emotions (e.g., calmness, quiescence) are associated with increased vagally mediated HRV, whereas activating positive affects (e.g., joy, excitement, interest) tend to facilitate no distinct ANS pattern (Behnke et al., 2022; Duarte & Pinto-Gouveia, 2017; Ketonen et al., 2023). If participants experienced the hypnotic induction as an activating or expectancy-driven state, characterized by strong approach tendencies towards the upcoming hypnotic state and suggestions, rather than a calm and relaxed one, the predicted parasympathetic shift might not have occurred. Further to that, participants might have experienced negative emotions, like fear or anxiety, since the instructions prepared them for expecting uncomfortable electric shocks during the experiment. The sympathetic activation and vagal deactivation associated with such negative emotions (Kreibig, 2010) might have inhibited a shift towards parasympathetic activity. The current analysis did not include data on affective valence or arousal, leaving this interpretation speculative. Future research should incorporate measures of emotional states to clarify their role in modulating the relationship between hypnosis and autonomic activity.

Fourth, the duration of the hypnotic induction may have been an influential factor. The current procedure lasted approximately 12.5 minutes (M = 743s). Since research showed greater hypnotic depth several minutes after hypnotic induction, without further suggestions, the absence of autonomic activity changes might have been due to the length of the procedure (Cardeña et al., 2013). Some studies reporting significant autonomic modulation used longer inductions (≥ 25 min), suggesting that measurable changes in ANS activity may develop gradually over time (Aubert et al., 2009; Emdin et al., 1996). It is therefore plausible that autonomic shifts could emerge during extended hypnotic engagement or following deeper stages of hypnosis that were not reached within the timeframe of the procedure.

Finally, the results provide no support for a distinct shift in physiological activity towards autonomic relaxation and parasympathetic dominance. This interpretation aligns with findings from active-alert hypnosis induction in comparison to formal hypnotic induction with relaxation instructions, which showed that hypnotic responsiveness seems independent of a physiological relaxation component (Banyai & Hilgard, 1976). This might indicate that hypnosis is not contingent upon a specific autonomic profile but can emerge across a range of physiological states. Therefore, it seems plausible that hypnosis primarily arises from cognitive and psychological processes (e.g., expectancy, context), in line with non-state socio-cognitive theories (for review, see Geagea et al., 2024).

The present analysis also aimed to investigate the moderator effect of hypnotizability on the relationship between autonomic activity and hypnotic induction. Hypothesis 2 proposed that a greater hypnotizability level would elicit greater changes in autonomic activity indexed by LF/HF. The results provide no support for this hypothesis. Further to that, exploratory analyses showed no significant interaction effects as well. These findings might have been due to the homogeneous sample in terms of hypnotizability level, since Mediums and Highs seem to show similar hypnotic response patterns (Cardeña et al., 2013).

Furthermore, this analysis revealed a significant main effect of hypnotizability regarding heart rate (HR). As the correlation revealed, the findings imply that a higher level of hypnotizability is associated with greater HR over time. These findings are in contrast with previous research that reported no correlation (Ray et al., 2000; Sturgis & Coe, 1990) or opposite results (Harris et al., 1993) between high and low hypnotizable individuals. One plausible explanation may lie in the neurofunctional characteristics of highly hypnotizable individuals. According to Hoeft et al. (2012), these individuals exhibit increased trait-like functional connectivity between the salience network and executive-control networks, which is thought to support enhanced attentional focus, interoceptive sensitivity, and regulation of salient autonomic and emotional stimuli. In this context, elevated HR may reflect a physiological correlate of sustained attentional and emotional engagement, independent of the hypnotic induction. However, this interpretation remains speculative and warrants further investigation through controlled studies to assess its replicability.

Limitations and Future Directions

Several limitations of the present research warrant consideration. As this was a secondary data analysis, various limitations regarding study design, measures, sample, and statistical analysis were identified and are worth discussing.

In terms of study design, no baseline or control condition was included. This limits the extent to which the results can be interpreted as effects of hypnotic induction, and in light of the temporal progression of autonomic modulation. Future studies could address this limitation by adding a baseline recording in relaxed wakefulness and a control group receiving no hypnosis procedure. Furthermore, the same hypnotists and induction protocol were used for all participants. While this ensured uniformity across participants, the overall non-significant findings may not generalize to other protocols or hypnotists. Therefore, future research could use different hypnotist conditions (e.g., gender, audio recording) and various induction protocols (e.g., length, style) to investigate the stability of the findings across diverse contexts. Additionally, the hypnosis took place in the premises of the University of Vienna. The less inviting, more experimental environment may have inhibited deep relaxation, thereby limiting ecological validity. Moreover, since participants were not asked about their hypnotic state, depth, or emotional value during the hypnotic induction, it remains unclear how they subjectively perceived the hypnosis. Consequently, future investigations could incorporate post-induction interviews and take place in more naturalistic environments to address these limitations.

Beyond the study design, the collected measures and preprocessing technique might have influenced the interpretability of the results. As outlined in the introduction, HRV is strongly affected by respiration frequency and depth via respiratory sinus arrhythmia (RSA; Brown et al., 1993; Grossman & Taylor, 2007; Russo et al., 2017). Under normal conditions, spontaneous respiration occurs within 0.16-0.33 Hz (~10 – 20 breaths/min) and is considered to reflect vagal tone due to the rapid influence of the PNS on the heart. However, hypnosis in this study promoted slower breathing, which may have altered RSA and, consequently, time- and frequency-domain HRV indices. Although RMSSD is less sensitive to respiratory rate (Hill & Siebenbrock, 2009), the absence of direct respiratory measurement limits conclusions regarding vagal modulation. As recommended by Quigley et al. (2024), future HRV research should monitor respiration throughout the experiment. Additionally, the preprocessing toolbox (Vollmer, 2019) used in this study had certain limitations. HF and LF were only provided in normalized units (n.u.) rather than absolute values (in ms^2). LF/HF reflects only relative shifts but not the absolute magnitude of high- and low-frequency power. For example, while HF = 50 n.u. and LF = 50 n.u. yield LF/HF = 1, this could correspond to either 200 ms^2/ 200 ms^2 or 400 ms^2 / 400 ms^2, masking absolute changes in autonomic activity. This reduces the interpretability and increases error susceptibility. Depending on the research aim, future studies may benefit from toolboxes providing absolute as well as normalized HRV values (Quigley et al., 2024).

Another set of limitations concerns the sample. As this was a secondary data analysis, no a priori power analysis was conducted for the current purpose. A sensitivity power analysis to estimate the minimum effect size detectable for this analysis with 80% power using G*Power 3.1 (Faul et al., 2007) was carried out post experiment. The analysis revealed that a small-to-medium effect size (Cohen's d = 0.432) would have been detectable with the present sample size (appendix B). Therefore, the limited sample size may have reduced the ability to detect small HRV differences. Beyond sample size, the sample composition also represents restrictions. Gender was not included in the statistical analysis owing to the low number of male participants (n = 9). Since men and women differ in baseline autonomic profiles, with women typically showing higher vagal activity (Koenig & Thayer, 2016), the results may not be generalizable to the broader population. Prior findings on gender differences during hypnosis are mixed, with some studies reporting gender-specific effects (Boselli et al., 2018; Yüksel et al., 2013) and others not (Aubert et al., 2009). Future research should therefore consider gender as a potential confounding factor and strive for a balanced sample composition. In addition, the restricted variability in participants' hypnotizability levels may have obscured meaningful associations between hypnotizability and HRV measures. Although the sample likely reflected the 80 – 90 % of the population within the medium-to-high range of hypnotizability (De Pascalis et al., 2000), this limits generalizability. Moreover, Mediums and Highs may share stronger similarities in hypnotic phenomena and physiology, potentially underestimating hypnotizability's moderating role (Cardeña et al., 2013).

Finally, statistical limitations must be considered. Since repeated-measure ANCOVA assumes a linear relationship between covariate and dependent variable, the model does not account for non-linear associations, as Mixed Models would do. Furthermore, using hypnotizability as a continuous covariate rather than a between-subject factor (e.g., Mediums vs. Highs) might have reduced the ability to detect meaningful associations, as restricted variance diminishes the chance of identifying subtle individual differences. Still, we decided on ANCOVA due to statistical power reasons.

In conclusion, by employing a formal hypnotic induction, we found no evidence that hypnosis is associated with ANS activity modulation as indexed by HRV, independent of hypnotizability level among medium-to-high hypnotizable individuals.

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Appendix

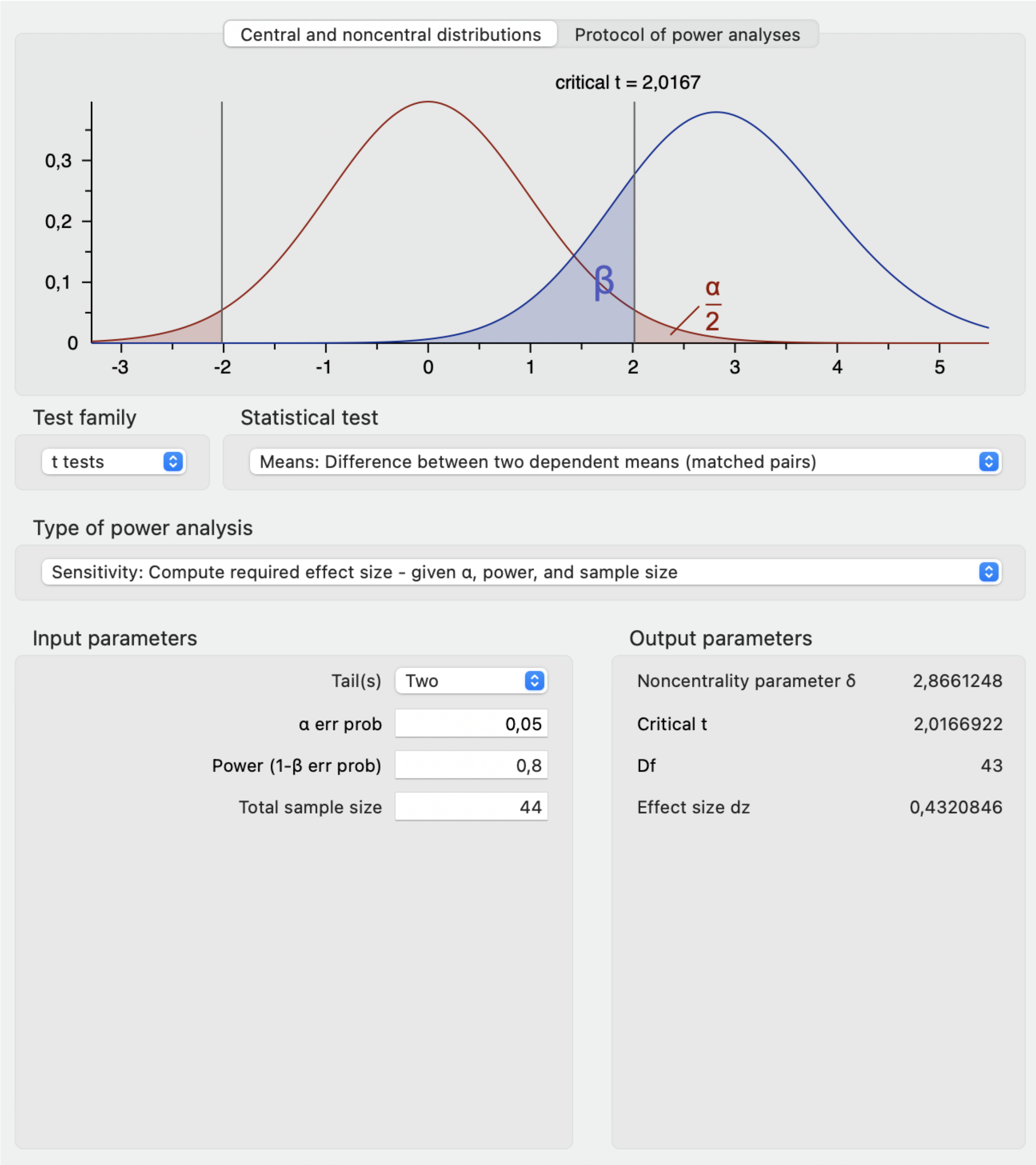
Appendix A

A1 - Summary of Hypnotic Induction Protocol

The session commenced by directing the participants' gaze to an external focal point and demanding auditory concentration ("…concentrate on the sign, fix your gaze firmly on the sign, and listen to me attentively…"). Initial awareness of the surroundings was quickly transitioned into an inner focus, followed by a progressive muscle relaxation sequence, moving systematically from the lower to the upper body. This physical release was explicitly coupled with cognitive disconnection ("…the more the tension in the musculature releases, the more your thoughts also release…"). The instruction then centered on the breath as an anchor for deepening the relaxed state ("…Breathing is like the calm waves on the beach... Inhale, the wave rolls in, exhale, the water recedes…"). Suggestions for excitement about the „hypnotic state" were given afterwards („…neither you nor I know how you will experience this altered state of consciousness today... this special combination of deepest relaxation and, at the same time, highest concentration…"). The cue for closing the eyes was delivered through the utilization of naturally occurring lid heaviness, with the instruction that closure would initiate a deeper trance state ("…when it is time, simply close your eyes... at the moment the eyes close, you will find yourself significantly deeper in trance…"). Post-closure, hypnotic dissociation was introduced by validating both critical and relaxed parts of the mind, ensuring passive compliance ("…while one part of you is trying to analyze my words and critically examine everything, another part of you can let go…"). The induction concluded with a numerical deepening procedure, counting from 1 to 20 to intensify the trance, with complete surrender being the goal at the final count.

Appendix B

B1 – Sensitivity Analysis



Faul et al., 2007

Appendix C

C1 – List of Materials

AI – Tool	Function	Field of Application	Remarks
Copilot (GPT-4)	Language Polishing	Final-Stage Revision	AI tools were used solely for language refinement and spelling/grammar correction to ensure linguistic accuracy.
Grammarly	Grammar & Spelling Correction	Final-Stage Revision	AI tools were used solely for language refinement and spelling/grammar correction to ensure linguistic accuracy.

German Abstract

Hypnotische Induktion wird häufig eingesetzt, um fokussierte Aufmerksamkeit, tiefe Entspannung und Dissoziation von der Umwelt zu fördern. Die zugrundeliegenden physiologischen Mechanismen sind jedoch weiterhin Gegenstand der Forschung. Diese Sekundäranalyse untersuchte Veränderungen der Herzfrequenzvariabilität (HRV) als Indikator für Veränderungen der Aktivität des autonomen Nervensystems (ANS) während einer formalen hypnotischen Induktion. Dazu unterzogen sich 44 Teilnehmer*innen (35 weiblich, 9 männlich; Durchschnittsalter = 19,93 Jahre) mit mittlerer bis hoher Hypnotisierbarkeit (M = 8,273, Bereich 5 – 11 auf einer Skala von 0 – 12) einer hypnotischen Induktion (M = 743 s) im Rahmen eines größeren Experiments zur kausalen Rolle des Affektaustauschs beim stellvertretenden Furchtlernen. Während der Hypnoseeinleitung erhielten die Proband*innen von einer weiblichen Hypnotiseurin Suggestionen zur Fokussierung der Aufmerksamkeit, Entspannung, zum Schließen der Augen und zur Vertiefung des Zustands. Die Elektrokardiogramm-Aufzeichnungen wurden vorverarbeitet und mit einer HRVToolbox in MATLAB analysiert. Die Ergebnisse zeigten keine signifikanten Veränderungen der HRV-Indizes (LF/HF, Herzfrequenz, SDNN, RMSSD) zwischen den ersten und letzten fünf Minuten der Hypnoseeinleitung, und die Hypnotisierbarkeit hatte keinen signifikanten Einfluss auf diesen Zusammenhang. Diese Befunde legen nahe, dass die Aktivität des ANS unter dem hier angewandten neutralen Hypnoseeinleitungsverfahren stabil bleibt. Dies stützt die Annahme, dass formale Hypnose nicht zwangsläufig ein spezifisches autonomes Muster hervorruft, und unterstreicht die Notwendigkeit, zu klären, unter welchen spezifischen Bedingungen eine physiologische Modulation auftreten kann.

Schlüsselwörter: Hypnose, hypnotische Induktion, autonomes Nervensystem, ANS, Elektrokardiographie, EKG, Herzratenvariabilität, HRV