Cognitive and Neuropsychophysiological Dimensions of High Trait Anger: A Systematic Review Protocol

Protocol Registration

This systematic review is prospectively registered in PROSPERO (International Prospective Register of Systematic Reviews) under registration ID: 1013197

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Funding Statement

This review is conducted without external funding.

Competing Interests

The authors declare no conflicts of interest.

Amendments

Any modifications to this protocol will be updated in PROSPERO record, along with a rationale for each change.

Dissemination Plan

The results of this review will be submitted for publication in a peer-reviewed journal and presented at academic conferences.

Title

"Cognitive and Neuropsychophysiological Dimensions of High Trait Anger: A Systematic Review Protocol"

Background

Anger is a fundamental and evolutionarily significant emotion, present in all humans, that serves an adaptive function in responding to perceived threats, injustices, or frustrations (Spielberger, 1988). While anger can be beneficial in certain contexts, excessive or dysregulated anger is associated with negative psychological, social, and health consequences (Deffenbacher et al., 1996). The ability to regulate anger effectively is critical for emotional well-being and interpersonal functioning.

A key construct in anger research is trait anger, which refers to an individual´s stable tendency to experience anger frequently and intensely across various situations (Spielberger, 1988). Anger can also be conceptualized along two additional dimensions: state anger, a temporary emotional response to a specific provocation, and anger expression, which includes anger-in (suppressed anger) and anger-out (externally expressed anger; Spielberger, 1988).

Among these, high trait anger (HTA) is particularly concerning, as it has been linked to chronic stress, increased aggression, emotion regulation difficulties, and negative health outcomes. Given its wide-ranging implications, understanding the cognitive and neuropsychophysiological mechanisms underlying HTA is crucial for developing effective assessment tools and interventions.

In the cognitive domain, HTA is associated with specific thought patterns, such as heightened sensitivity to anger-inducing stimuli and a predisposition to interpret ambiguous situations as hostile or threatening. These cognitive biases not only contribute to the maintenance of anger-related emotional states but may also play a role in the development and perpetuation of anger-related disorders. Individuals with HTA often exhibit selective attention toward hostile social cues, memory biases favoring negative interpretations, and recurrent rumination over past anger-provoking experiences (Deffenbacher et al., 1996; Wilkowski & Robinson, 2008).

At the neuropsychophysiological level, HTA involves characteristic brain-body interactions during anger episodes, particularly within the autonomic nervous system, endocrine system, and neural circuitry. Individuals with HTA may exhibit elevated heart rate

(HR), increased skin conductance response (SCR), and heightened cortisol levels in response to anger-provoking stimuli. These physiological markers reflect a heightened stress response that, if sustained over time, may contribute to chronic stress, increased health risks, and impaired anger regulation.

Additionally, HTA may be associated with alterations in key brain regions involved in emotional reactivity and regulation**,** such as amygdala, prefrontal cortex (PFC), hypothalamus, anterior cingulate cortex (ACC), and insula.

These neuropsychophysiological markers and patterns reflect heightened emotional reactivity, impaired regulatory control, and dysregulated stress responses in individuals with HTA. The combination of autonomic hyperactivity (elevated HR, SCR, and cortisol), altered neural activation (amygdala hyperactivity, reduced prefrontal regulation, heightened hypothalamic and insular activity), and disrupted connectivity within emotion-regulation circuits contributes to increased vulnerability to reactive aggression, impulsivity, and sustained physiological arousal. Understanding these brain-body interactions is essential for developing targeted interventions aimed at enhancing emotion regulation and mitigating the negative consequences of HTA.

The significance of this systematic review lies in its potential to synthesize existing knowledge across cognitive and neuropsychophysiological dimensions, providing a comprehensive framework for understanding the intricate mechanisms that underlie HTA.

Purpose

The purpose of this systematic review is to investigate the multidimensional nature of anger, with a particular focus on cognitive biases and neuropsychophysiological markers associated with this emotion. This review aims to identify consistent findings, address methodological limitations, and highlight future directions for research.

By providing a comprehensive overview of HTA and its cognitive and neuropsychophysiological components, this review seeks to generate valuable insights that can be translated into practical applications, ultimately enhancing mental health outcomes and overall well-being. Additionally, by synthesizing existing research across these domains, this review will identify patterns, associations, and interrelationships that contribute to a more holistic understanding of anger.

In summary, this systematic review aims to:

- Advance the scientific understanding of HTA,

- Inform evidence-based practices, and
- Establish a foundation for future research in anger assessment and management.

Objectives

This review aims to achieve a comprehensive understanding of HTA by investigating its cognitive and neuropsychophysiological, dimensions. The primary objectives are defined through the following research questions:

1. What are the predominant cognitive patterns associated with HTA?
2. What are the neuropsychophysiological markers within the central and peripheric central nervous system in HTA individuals?
3. How do cognitive (e.g., attentional biases), autonomic (e.g., heart rate and heart rate variability) and neural (e.g., brain activation) dimensions interact in the context of HTA?

These objectives and research questions will provide a structured and focused exploration of HTA, facilitating a systematic synthesis of existing literature.

Methods

We will conduct a systematic review to map the existing literature on HTA and its cognitive and neuropsychophysiological dimensions. This review will identify and analyze key aspects related to these dimensions, including:

- Patterns of cognitive processes associated to HTA.
- Neuropsychophysiological markers linked to anger regulation.
- Interactions between cognitive, autonomic, and neural mechanisms.
- Core theoretical frameworks underpinning HTA research.
- Assessment methods and measurement tools used in empirical studies.
- Sources and types of evidence contributing to current knowledge.
- Existing gaps in the literature and directions for future research.

By synthesizing findings across these domains, this review aims to provide a comprehensive overview of the mechanisms underlying HTA and support evidence-based advancements in anger assessment and management.

Eligibility Criteria

To ensure rigor and transparency, this systematic review will adhere to the following eligibility criteria**:**

Inclusion Criteria

- **Study Types:**
    - Peer-review articles and preprints (journal articles not yet peer-reviewed and/or published).
- **Study Designs Included:**
    - Randomized controlled trials (RCTs) examining cognitive and physiological mechanisms of HTA
    - Longitudinal studies assessing changes in HTA over time.
    - Cross-sectional studies examining HTA correlates.
    - Functional neuroimaging studies (fMRI, EEG) assessing neural markers of anger regulation
    - Psychophysiological studies measuring autonomic nervous system activity (e.g., heart rate variability, skin conductance response, cortisol levels).
    - Qualitative studies incorporating validated cognitive and physiological assessments.

- **Study Designs Excluded:**
    - Case studies, theoretical papers, and narrative reviews.
    - Studies focusing only on state anger without differentiation from HTA.
    - Studies examining pharmacological treatments**.**

- **Population Inclusion**
    - Adults (≥18 years old) with high trait anger (HTA)**,** identified through:
        - Validated psychological measures (e.g., State-Trait Anger Expression Inventory (STAXI-2))**.**
        - Experimental paradigms assessing anger-related cognitive and physiological responses.

- **Population Exclusion**
    - Studies conducted on children, adolescents (< 18 years old).
    - Clinical populations with psychiatric or neurological disorders, unless explicitly investigating HTA.
    - Participants undergoing pharmacological treatments (Pharmacological studies are excluded due to potential confounding effects on physiological and neural

markers of HTA, as medications may influence autonomic and neurobiological responses).

- Animal studies.
- Non-English language articles (unless an English translation is available).

Operationalization of Key Constructs

To systematically investigate the cognitive and neuropsychophysiological dimensions of HTA, this review will focus on the following key constructs and their respective measurement approaches.

1. **Cognitive Dimension**

   This review will examine cognitive patterns associated with HTA, emphasizing attentional biases, cognitive appraisal, and interpretation biases. Specifically, we will explore:

- **Attentional biases:**
  - Measured through reaction time tasks (e.g., the dot-probe task, emotional Stroop test), attentional cueing paradigms that assess heightened attention to anger-inducing stimuli, and eye-tracking technology**.**
- **Interpretation biases**:
  - Assessed using ambiguous scenario tasks, vignette-based paradigms, and attributional style questionnaires to determine whether individuals with HTA exhibit a heightened tendency to interpret neutral or ambiguous stimuli as hostile.
- **Cognitive appraisal**:
  - Investigated through self-report measures (e.g., the Anger Rumination Scale, Cognitive Emotion Regulation Questionnaire) to analyze how individuals perceive, evaluate, and regulate anger-provoking situations.

2. **Neuropsychophysiological dimension.**

   The neuropsychophysiological profile of HTA will be examined across autonomic nervous system activity, endocrine responses, and neural activation patterns.

- **Autonomic Nervous System Activity:**
  - Heart rate (HR) and heart rate variability (HRV): Measured using electrocardiography (ECG) to assess sympathetic and parasympathetic nervous

system balance.

- Skin conductance response (SCR): Assessed via electrodermal activity sensors to evaluate physiological arousal during anger induction tasks.

- **Endocrine Markers:**
  - Cortisol levels: Measured via salivary or blood samples to explore hypothalamic-pituitary-adrenal (HPA) axis activation and its role in anger-related stress responses.
- **Neural Activation Patterns:**
  - Functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) will be considered to examine brain regions associated with anger regulation, including:
    - Amygdala hyperactivity (linked to heightened anger reactivity).
    - Prefrontal cortex activity (involved in anger control and emotional regulation).
    - Hypothalamic activation (regulating autonomic and hormonal responses to anger-inducing stimuli).
    - Connectivity between these brain regions, assessing functional networks implicated in anger regulation and aggression.

3. **Interaction Among Cognitive, Autonomic, and Neural Dimensions.**

This review will explore the interplay between cognitive, physiological, and neural processes in HTA, considering how these factors interact to influence anger expression and regulation.

- **Mediation Analysis:**
  - Investigating whether cognitive processes (e.g., attentional biases) mediate the relationship between autonomic responses (e.g., HR, HVR and SCR) and neural activity (e.g., amygdala activation).
- **Moderation Analysis:**
  - Examining how specific individual differences (e.g., emotion regulations strategies, trait aggression levels) moderate the relationship between cognitive biases, physiological reactivity, and anger expression.
- **Multimodal Approaches**:
  - Integrating data from behavioral tasks, psychophysiological measures, and

neuroimaging to assess how cognitive, autonomic, and neural mechanisms contribute to HTA expression and regulation.

By structuring this review around these operationalized constructs, we aim to provide a comprehensive, multidimensional analysis of HTA. The findings will help clarify the mechanisms underlying anger dysregulation, support the development of evidence-based interventions, and highlight methodological gaps for future research**.**

Search Strategy

A systematic search will be conducted across the following electronic databases: PubMed**,** PsycINFO**,** Scopus**,** Web of Science, and the Cochrane Database of Systematic Reviews**,** Google Scholar. Additional studies will be identified by screening the reference lists of included articles and relevant systematic reviews.

The search will be conducted in English, covering the publication period from the January 1990 to December 2024. The Boolean operator “OR” will be used to capture synonyms for key concepts, while “AND” will be applied to combine these concepts effectively. Where applicable, Medical Subject Headings (MeSH) and controlled vocabulary (APA Thesaurus in PsycINFO**)** will be used in addition to free-text searches to maximize retrieval of relevant studies.

Search Terms

1. **High Trait Anger Concept**

- ("high trait anger" OR “HTA” OR "trait anger" OR "anger proneness" OR "anger reactivity" OR "chronic anger")

2. **Cognitive Dimension**

- ("cognition" OR "cognitive bias" OR "attentional bias" OR "interpretation bias" OR "cognitive appraisal" OR "executive function" OR "threat perception" OR "hostile attribution bias")

3. **Autonomic measures**

- ("psychophysiology" OR “heart rate” OR “HR” OR "heart rate variability" OR “HRV” OR "skin conductance" OR “skin conductance responses” OR “SCR” OR "cortisol levels" OR "autonomic nervous system" OR "HPA axis" OR "sympathetic activation")

Neural measures

- ("EEG" OR “electroencephalography” OR "fMRI" OR “functional magnetic resonance imaging” OR “neuroimaging”)

Enhancing Search Sensitivity

To ensure comprehensive retrieval, we will:

- Consider alternative and expanded keywords to account for variations in terminology used across different studies.
- *Use truncation (e.g., cognit) and wildcards** where applicable to capture different word forms.
- Refine the search strategy based on database-specific indexing systems, adapting syntax accordingly.

This systematic approach will maximize coverage and flexibility, ensuring the inclusion of all relevant studies on HTA across cognitive, autonomic, and neural dimensions.

Selection of Studies

A charting form will be used to systematically identify studies for inclusion in the review based on predefined inclusion and exclusion criteria.

Screening Process

1. **Title and Abstract Screening**:
    - Two independent reviewers will screen the titles and abstracts retrieved from the search strategy to determine relevance.
    - Studies that do not meet the eligibility criteria will be excluded at this stage.

2. **Full-Text Review**:
    - Articles deemed potentially eligible will undergo a full-text review by two independent reviewers to confirm inclusion.
    - The decision will be based on the study's relevance, methodology, and alignment with the review objectives.

Resolution of Discrepancies

- Any disagreements between reviewers will be resolved by a third reviewer, who will act as an arbitrator.
- Reasons for exclusion at the full-text review stage will be documented and reported in a PRISMA flow diagram to ensure transparency in the selection process.

Retrieval of Studies

The full-text articles of all eligible studies will be **retrieved** using institutional library services and database access. If an article is not available through these primary sources, additional retrieval methods will be employed, including:

1. Searching open-access repositories, such as ResearchGate and Google Scholar.
2. Contacting the corresponding author via email to request access to the full text.

If the full text remains unavailable after these efforts, the study will be excluded, and the reason for exclusion will be documented to ensure transparency.

Data Extraction

A data extraction form will be developed and refined iteratively by two independent reviewers to systematically collect relevant information from the included studies. The data extraction process will be performed independently by both reviewers, followed by discussions to ensure accuracy and consistency. Any discrepancies will be resolved through consensus, with a third review consulted if necessary.

The extracted data will include, but is not limited to:

- Study characteristics (e.g., author, year, study design)
- Participant demographics (e.g., age, sample size, inclusion criteria)
- Cognitive and neuropsychophysiological dimensions assessed (e.g., attentional biases, heart rate variability, neural activation)
- Methods used (e.g., experimental paradigms, mediation/moderation analysis)
- Key findings (e.g., significant results, effect sizes, correlations)
- Risk of bias Assessment (e.g., assessment tools used, study limitations)

Risk of Bias Assessment

Each study will be independently evaluated by two reviewers, with disagreements resolved through discussion or by consulting a third reviewer.

Data Presentation & Synthesis

The results of this review will be reported following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency and methodological rigor.

Data Visualization & Organization

Where appropriate, the extracted data will be structured using the PICO (Population, Intervention, Comparison, Outcome) framework and summarized in tables and figures.

Example Table 1: Characteristics of Included Studies.

Date	Study ID	Study Design	Participants	N	Objectives	Outcome measures	Setting	Key findings	Limitations	Risk of bias

Or

Example Table 2: Article Mapping According PICO's Strategy.

Search No.	Data base	Date	Authors	Article Title	Participants	Objectives	Methods	Outcomes	Summary	Limitations

This structured approach will allow for systematic synthesis and comparative analysis across studies, facilitating the identification of patterns, methodological gaps, and key findings

Data Synthesis

A narrative synthesis will be conducted to summarize findings across studies**.** This approach will allow for a qualitative comparison of results, identifying patterns, methodological trends, and inconsistencies across included studies. If appropriate, effect sizes from quantitative studies will be reported.

Timeline

Start Date: March 31, 2025. **End Date:** October 31, 2025.

Budget

No external funding is required for this systematic review, as it will rely exclusively on existing literature and publicly available data.

Ethical Considerations

As this review involves the analysis of publicly available**,** published data, ethical approval is not required. No human participants or confidential information will be included.

Dissemination

Findings from this systematic review will be disseminated through:

- Publication in a peer-reviewed journal to ensure accessibility to researchers and practitioners.
- Presentations at academic conferences to share insights with the broader scientific community.

Protocol Registration

This systematic review protocol will be prospectively registered with PROSPERO, ensuring transparency and adherence to best practices in systematic review methodology.

References

Deffenbacher, J. L., Oetting, E. R., Thwaites, G. A., Lynch, R. S., Baker, D. A., Stark, R. S., Thacker, S., & Eiswerth-Cox, L. (1996). State–Trait Anger Theory and the utility of the Trait Anger Scale. *Journal of Counseling Psychology*, *43*(2), 131–148. https://doi.org/10.1037/0022-0167.43.2.131

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