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SYSTEMATIC LITERATURE REVIEW: EFFECT OF CORRELATED COLOR TEMPERATURE (CCT) ON PIANISTS' RESPONSES

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Abstract: *The quality of piano performance, both in music education and recitals, is often disrupted by psychological pressure and cognitive load that affect concentration. External factors, particularly interior design elements such as stage or studio lighting, are known to affect pianist physiological and cognitive conditions non-visually. This study aims to integrate empirical findings regarding the impact of Correlated Color Temperature (CCT)—specifically comparing warm (3000K) and cool (6000K) color temperatures—on pianists' responses using the Systematic Literature Review (SLR) method. Literature evaluation was conducted using the PRISMA guidelines, with a synthesis of findings categorized into three main aspects: lighting, musical performance, and the validity of physiological indicators. Relational density analysis of these aspects indicates a significant research gap in previous studies: heart rate measurement proved to be less sensitive in assessing the effects of CCT on cognition. Conversely, Electroencephalography (EEG) is highly valid for measuring emotional responses and brain connectivity during piano playing, but this instrument has not been specifically applied to test lighting variables. These findings highlight the need for neurodesign integration using EEG instruments to validate the impact of 3000K and 6000K CCTs on pianists' responses. This can also serve as a foundation for evidence-based design practices in performance spaces and music schools.*
Keyword: *Correlated Color Temperature, Concentration, Physiological Responses, EEG, Piano Performance, Systematic Literature Review.*

Abstrak: Abstrak ditulis dalam Bahasa Indonesia yang berisikan Pendahuluan, tujuan penelitian, metode/pendekatan penelitian dan hasil penelitian. Abstrak ditulis dalam satu alenia, tidak lebih dari 200 kata. (ARIAL 10, spasi tunggal). Kualitas permainan piano, baik dalam pendidikan musik maupun resital, sering kali terganggu oleh tekanan psikologis dan beban kognitif yang memengaruhi konsentrasi. Faktor eksternal, khususnya elemen desain interior seperti pencahayaan panggung atau studio, diketahui memengaruhi kondisi fisiologis dan kognitif musisi secara nonvisual. Penelitian ini bertujuan untuk mengintergrasikan temuan empiris mengenai dampak *Correlated Color Temperature* (CCT)—khususnya perbandingan antara suhu warna hangat (3000K) dan dingin (6000K)—terhadap respons pemain piano menggunakan metode *Systematic Literature Review* (SLR). Evaluasi literatur dilakukan menggunakan panduan PRISMA, dengan sintesis temuan yang dikelompokkan ke dalam tiga aspek utama: pencahayaan, performa musikal, dan validitas indikator fisiologis. Analisis hubungan antar aspek (*relational density analysis*) menunjukkan adanya kesenjangan penelitian yang signifikan dari penelitian terdahulu: pengukuran detak jantung (*heart rate*) terbukti kurang sensitif dalam menilai efek CCT terhadap kognisi. Sebaliknya, *Electroencephalography* (EEG) sangat valid untuk mengukur respons emosi dan konektivitas otak saat bermain piano, tetapi instrumen ini belum diaplikasikan secara spesifik untuk menguji variabel pencahayaan. Temuan ini menunjukkan perlunya integrasi neurodesain menggunakan instrumen EEG untuk memvalidasi dampak CCT 3000K dan 6000K terhadap respons pemain piano. Hal ini sekaligus dapat menjadi landasan bagi praktik desain ruang pertunjukan dan sekolah musik berbasis bukti (*evidence-based design*).
Kata Kunci: *Correlated Color Temperature*, Konsentrasi, Respons Fisiologis, EEG, Performa Piano, *Systematic Literature Review*.

INTRODUCTION

In music education and performance, playing the piano demands a high level of focus, pitch accuracy, and tempo precision (Morijiri & Welch, 2022). However, the performance quality of pianists is often disrupted by psychological pressures, such as stage fright, and concentration fluctuations that burden cognitive capacity. This pressure is not only triggered by internal competency factors but is also significantly influenced by the physical environment. An environment perceived as "threatening" or full of distractions will trigger self-defense mechanisms that divert cognitive resources away from musical focus (Papageorgi et al., 2013), one of which is the lighting element. This lighting consists of several variables that influence each other, namely light intensity (Gómez-Sirvent et al., 2024a), distribution patterns, and color temperature (Gao et al., 2025). Lighting is not merely an illumination utility, but rather a crucial element that directly impacts the visual comfort and mental load of pianists. Insights from environmental psychology, such as Attention Restoration Theory (ART) and Stress Recovery Theory, confirm that the spatial environment plays an important role in restoring concentration and measurably reducing stress (Kaplan, 1995; Ulrich, 1991). The interaction between environmental elements and the behavior of pianists can be understood through the Stimulus-Organism-Response (S-O-R) framework by Mehrabian and Russell (1974), where the physical variables of the space (Stimulus) affect the internal and neurophysiological conditions of the pianists (Organism), which then produces a specific performance output (Response). The stage or music studio environment acts as an independent variable in the form of manipulating the color temperature of light within the warm 3000K and cool 6000K spectrums. The manipulated stimulus will be received by the condition of the pianists, and the result will then be a response that affects their performance.

In practice, Correlated Color Temperature (CCT)—especially in the warm (3000K) and cool (6000K) color temperature ranges—is the design variable most frequently manipulated to engineer spatial atmosphere (Gao et al., 2025). This modification has been proven to affect mental states; for example, lighting adjustments can make an auditorium feel more calming and reduce music performance anxiety levels (Gómez-Sirvent et al., 2024b). Conversely, stage lighting with excessively cool color temperatures has been proven to trigger glare, which significantly disrupts the visual comfort of pianists (Oliveira et al., 2024).

Although theoretical insights regarding lighting effects continue to develop, there is an urgent research gap, namely that existing literature rarely examines specifically how CCT affects the cognitive load of pianists using objective measurement instruments. Evaluations often rely solely on subjective assessments (questionnaires) or less sensitive indicators. As an empirical example, CCT levels have been shown to affect user cognitive accuracy, but heart rate indicators failed to detect these changes precisely (Afifi et al., 2024). In contrast, Electroencephalography (EEG) instruments have proven to possess a very high level of validity. Brain connectivity in the beta (12-30 Hz) and gamma (30-45 Hz) wave ranges recorded through EEG can reflect the emotional state of pianists in real-time during active playing (Ghodousi et al., 2022). Unfortunately, EEG physiological tools have not been applied to test spatial design variables such as CCT.

It is a fact that heart rate measurements are less sensitive to CCT effects, while highly valid EEG instruments have not been optimally utilized in spatial design. Therefore, this research using the Systematic Literature Review (SLR) method aims to identify empirical literature regarding the relationship between lighting variables (CCT 3000K vs 6000K), pianists' responses, and the validity of physiological instruments. This review is expected to identify a measurable methodological structure of design physiology, while simultaneously serving as a solid foundation for future evidence-based design of music performance spaces.

METHODS

This research uses the Systematic Literature Review (SLR) method based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). These guidelines were chosen because they ensure transparent, reliable, and replicable research results. The PRISMA approach is crucial for integrating interdisciplinary data—specifically interior design, environmental psychology, and neuroscience—which serves as the foundation for understanding design physiology in music performance spaces. Through systematic search procedures and selection criteria, this method is able to minimize selection bias and strengthen the methodological standards of the research.

A comprehensive literature search was conducted through three main scientific databases: Scopus, ScienceDirect, and Google Scholar. The publication timeframe was limited to the last ten years (2015–2025) to capture the most recent literature, especially that related to the development of physiological response recording technology. The search strategy utilized Boolean operators (AND, OR) in the title, abstract, and keyword sections to formulate a sharp search string. The search keywords were grouped into three conceptual domains.

Table 1. Database Search Strategies and Query Strings

Database	Search String
Scopus	TITLE-ABS-KEY ("lighting" OR "color temperature" OR “CCT” OR “3000K” OR “6000K” OR “interior design” OR “built environment”) AND "physiological response" OR "EEG" OR "electroencephalography" OR "eye-tracking" OR "heart rate") AND ("concentration" OR "music performance" OR "performance anxiety" OR "cognitive load" OR "pianist")
Science Direct	("lighting" OR "color temperature" OR “CCT” OR “3000K” OR “6000K” OR “interior design” OR “built environment”) AND "physiological response" OR "EEG" OR "electroencephalography" OR "eye-tracking" OR "heart rate") AND ("concentration" OR "music performance" OR "performance anxiety" OR "cognitive load" OR "pianist")
Google Scholar	("lighting" OR "color temperature" OR “CCT” OR “3000K” OR “6000K” OR

	“interior design” OR “built environment”) AND "physiological response" OR "EEG" OR "electroencephalography" OR "eye-tracking" OR "heart rate") AND ("concentration" OR "music performance" OR "performance anxiety" OR "cognitive load" OR "pianist")

In the initial identification stage, a total of 121 articles were obtained from all search databases. Furthermore, a screening process was conducted based on titles and abstracts to eliminate studies irrelevant to the research focus, leaving 53 articles to be fully evaluated. In the full-text review stage for eligibility, articles that did not meet the inclusion criteria—such as not measuring physiological responses, not using color temperature as an independent variable, or not being in the context of interior space design—were excluded from the analysis. After going through the final selection process based on the PRISMA flowchart, a total of 10 main articles that met all criteria were determined to be included in the synthesis stage.

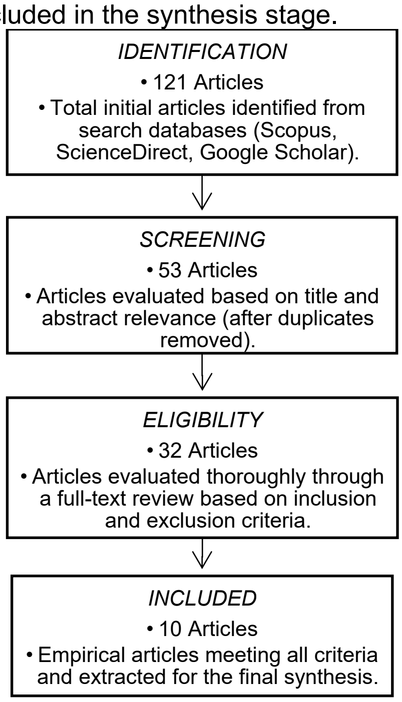

Figure 1. Article Selection Process Based on PRISMA Guidelines

The literature selection process applied strict boundaries. A study met the inclusion criteria and was included in the review if it focused on the impact of physical environmental variables (specifically spatial lighting manipulation), explored musical performance responses (especially the concentration level of pianists), used objective physiological measurement instruments (such as EEG, eye-tracking, or heart rate), and was an original empirical article that had gone through a peer-review stage. Conversely, studies were excluded if they relied solely on subjective perceptual assessments without validation from physiological instruments, focused exclusively on the technical aspects of light without evaluating human cognition, or were not empirical studies, such as literature reviews and book chapters.

The execution of the literature selection adopted a multi-layered screening workflow in four main stages based on the PRISMA guidelines, and the data extracted from the selected articles were categorized using the S-O-R framework to systematically map the cause-and-effect flow between independent and dependent variables. In the first stage, namely identification, a total of 121 initial articles were obtained from all search databases. Entering the second stage (screening), screening was conducted based on the relevance of titles and abstracts as well as the removal of duplicate articles, leaving 53 articles. Furthermore, in the third stage, namely eligibility evaluation, a total of 32 articles were thoroughly evaluated through a full-text review to ensure the suitability of the methodology and instruments used. Through a strict elimination process in the final stage (included), a total of 10 empirical articles that met all eligibility criteria were determined to be extracted in the final synthesis.

Each article that passed the selection was then examined using content analysis and categorized into three thematic aspects to map the existing research framework. The first aspect is cognitive and musical performance, which includes the level of instrument mastery, concentration, pitch accuracy, and stage anxiety. The second aspect focuses on the lighting of the musical environment, which examines the specifications of light color temperature or Correlated Color Temperature (CCT). The third aspect is the validity of objective physiological instruments, which evaluates the sensitivity level of measuring tools in identifying pianists' cognition.

To comprehensively synthesize the findings and prove the location of the research gap, this study developed a conceptual integration framework using a comparative relational density analysis approach. This analysis examines the gap between how often a theme or instrument appears in the literature (frequency) and how precisely it is able to map user responses (relational density/validity).

RESULTS AND DISCUSSION

Literature Synthesis

Based on the empirical data extraction process, this review identified 12 main studies directly related to the topic of design physiology and musical cognitive performance. The literature is grouped into three main scientific discipline clusters: (1) environmental psychology and interior design (focusing on lighting color manipulation (Afifi et al., 2024; Daly Miqdad Daly Ahmad & Putri Andini, 2024; Gao et al., 2025; Oliveira et al., 2024); (2) neuroscience and physiology (focusing on the use of objective instruments (Afifi et al., 2024; Ghodousi et al., 2022); and (3) music performance evaluation (focusing on anxiety and assessment (Gómez-Sirvent et al., 2024a; Massie-Laberge et al., 2019; Morijiri & Welch, 2022). The synthesis of this literature confirms a shift in measurement methodology in spatial design research, namely from subjective perceptual assessments to objectively quantifiable cognitive response recordings.

Table 2. Findings from Included Articles

Author & Year	Independent Variable	Methods	Main Findings	Relevance
(Choi & Suk, 2016)	CCT: 3500K, 5000K, 6500K.	ECG, math tests, Likert scale.	6500K increases arousal and focus; 3500K promotes relaxation.	High CCT aids intense focus; low CCT is ideal for neural recovery.
(Daly Miqdad Daly Ahmad & Putri Andini, 2024)	Auditorium interior (Audiovisual).	Subjective questionnaire.	Interior audiovisuals directly affect seating comfort.	Validates interior design as a key factor in user comfort perception.
(Gao et al., 2025)	CCT: 3000K, 4000K, 6000K.	d2-R cognitive test, EEG, EDA.	6000K yields highest concentration/accuracy; 3000K yields the lowest.	Validates multidimensional physiological tools (EEG, EDA) for CCT evaluation.
(Gómez Sirvent et al., 2023)	Room color & Lighting type (Daylight vs. Artificial).	Eye-tracking (saccades, pupil), SDS questionnaire.	Artificial lighting (no daylight) significantly increases saccadic eye movements.	Absence of natural lighting triggers physiological anxiety responses.
(Oliveira et al., 2024)	Stage lighting (Cooler temperatures).	Subjective survey.	Cooler stage lighting is strongly associated with higher glare incidence.	High CCT negatively impacts pianists' visual comfort.
(Afifi et al., 2024)	Background color & CCT (3000K vs. 6000K).	Heart Rate (HR) monitor, cognitive tests.	CCT affects cognitive accuracy, but heart rate remains unchanged.	HR is insensitive to CCT. Highlights the urgent need for EEG in lighting studies.
(Ghodousi et al., 2022)	Targeted emotional states.	EEG (Beta 12-30Hz & Gamma 30-45Hz bands).	Brain connectivity effectively reflects musicians' emotional states during play.	EEG is highly valid and sensitive for real-time emotional transfer in piano performance.
(Gómez-Sirvent et al., 2024a)	Ambient light intensity & audience distance.	Eye-tracking, SDS questionnaire.	Lower lighting intensity creates a calming effect on users.	Eye-tracking is a valid objective indicator for lighting-induced anxiety.
(Massie-Laberge et al., 2019)	Performance expression conditions.	Motion capture (Kinematics).	Head movements correlate strictly with musical structure and expression.	Confirms body gestures can be quantified as objective physiological data.
(Morijiri & Welch, 2022)	Performance quality (Self vs. External).	Subjective expert evaluation.	Primary evaluation criteria are tone quality, phrasing, and pedaling.	Defines the exact subjective metrics for "performance quality" (the thesis dependent variable).

Table 3. Mapping of S-O-R Framework Variables and Assessment Methodologies

Categories	Element	Measurement Instruments
Stimulus (S)	Physical Environment: Correlated Color Temperature (CCT) [Warm 3000K vs Cool 6000K] , Light intensity, Light distribution patterns.	Visual comfort, spatial atmosphere engineering, glare reduction.
Organism (O)	Internal & Neurophysiological Conditions: Cognitive load, Mental state, Emotion, Stress recovery.	Objective measurements: Electroencephalography (EEG) [Beta 12-30 Hz & Gamma 30-45 Hz waves], Heart rate, Eye-tracking.
Response (R)	Performance Output of Pianists: Concentration level, Pitch accuracy, Tempo precision, Stage fright / Performance anxiety.	Subjective perceptual assessments (questionnaires) shifting to objective cognitive response recordings.

Based on Table 3, the operationalization of the S-O-R framework empirically maps the causal relationship between physical environment modifications and the performance quality of pianists. In the Stimulus (S) aspect, the manipulation of Correlated Color Temperature (CCT), particularly in the 3000K and 6000K spectrums, acts as the primary environmental variable that triggers non-visual responses. This external stimulus is then received and processed by the pianists' internal conditions (Organism/O), which include fluctuations in cognitive load, mental state, and stress levels during piano playing. The interaction between light and these neurophysiological conditions ultimately produces a specific Response (R), whether in the form of concentration levels, pitch accuracy, or the emergence of performance anxiety in pianists.

Furthermore, the literature mapping through this S-O-R framework emphasizes a methodological gap in measuring the Organism (O) and Response (R) variables. The majority of the literature shows that the evaluation of pianists' performance responses has thus far been dominated by subjective instruments or less sensitive physiological measurements, such as heart rate. Although Electroencephalography (EEG) has been recognized as an objective instrument with a high level of validity for reading brain waves and emotions in real-time, its integration to specifically test the impact of lighting modifications (CCT) has not been optimally explored. Therefore, the synthesis of variables in Table 2 confirms the urgency of a neurodesign approach, where EEG instruments are critically needed to validate the specific impact of the physical environment on the cognitive responses of pianists.

Lighting Characteristics

The CCT range empirically determines the level of physiological arousal and human concentration. Complementing previous findings, the experiment by Choi and Suk (2016) proved that cool-temperature light (6500 K) produces the highest problem-solving performance and academic concentration because it triggers maximal sympathetic nerve arousal. Conversely, warm-temperature lighting (3500 K) has been proven to facilitate optimal vagal relaxation, thereby reducing tension but being less supportive of task-completion concentration (more ideal for resting/relaxing activities). These findings strongly confirm cognitive performance fluctuations due to CCT manipulation, which aligns with the Yerkes-Dodson Law (1908) curve regarding the relationship between physical arousal and performance.

Technically, manipulating distribution patterns (such as dimming the audience area) is useful for creating a "comfort zone" for pianists on stage, although exposure to high-intensity cool-temperature light risks causing glare that disrupts comfort. For activities with medium visual demands (such as reading sheet music), the lighting intensity should ideally be maintained in the range of 500 lux to avoid burdening visual performance. From the perspective of D.K. Ching's spatial organization, a performer's private zone can be defined through an "imaginary partition" resulting from extreme lighting contrast, rather than using physical boundaries. This centralized lighting pattern is highly relevant to the theory of visual privacy, as it is able to block the pianists' visual distractions from the surrounding area. Consequently, a psychological shield is created that effectively isolates and minimizes the pianists' anxiety regarding the audience's presence. The success of this light distribution manipulation is in line with neuroarchitectural experimental findings through virtual auditorium (VR) testing; this study highlights that a decrease in lighting levels in the audience zone contributes significantly to an increased sensation of calmness in pianists. This perceptual finding is also validated by physiological measurements; the use of eye-tracking instruments proves that a dark audience area is highly effective in suppressing irregular eye movements (saccadic eye movements) that are typically triggered by anxiety (Gómez Sirvent et al., 2023).

In addition to Correlated Color Temperature (CCT) and distribution patterns, illuminance levels or light intensity are fundamental elements that determine the success of stage lighting. Technically, illuminance refers to the amount of luminous flux illuminating a work surface area, measured in lux (lx). From an interior architecture perspective, this lighting intensity has a direct impact on the vitality of a space and the users' eye ability to adapt visually (Ching, 2012). Therefore, an ideal illuminance design must be able to provide optimal task visibility while maintaining visual comfort, especially in spaces with sharp dark-light contrast characteristics such as auditoriums (Karlen & Benya, 2004).

The Relationship Between Lighting and Piano Performance Responses

Activities with high motor demands, such as playing the piano, are highly susceptible to environmental stressors. Based on the literature review, cognitive responses and musical performance are categorized as follows:

Table 4. Pianists' Cognitive and Performance Responses

Response Category	Selected Literature	Main Findings
Cognitive Performance (Concentration & Accuracy)	Gao et al. (2025), Afifi et al. (2024)	Cognitive performance, attention, and task accuracy are significantly affected by light color temperature spectrum exposure.
Performance Anxiety	Gómez-Sirvent et al. (2023, 2024a)	High stage lighting intensity and the absence of natural light trigger a feeling of being "exposed," drastically increasing pianists' stress and anxiety.
Performance Quality (Tone & Kinematics)	Morijiri & Welch (2022), Massie-Laberge et al. (2019)	Performance evaluation relies on tempo stability, pitch accuracy, emotional expression, and expressive body movements (kinematics).
Emotional Expression	Ghodousi et al. (2022)	Emotional states are actively and measurably processed through cortical brain activity while pianists play the instrument.

The literature review shows that environmental factors have a significant impact on the cognition and psychology of pianists. In terms of cognitive performance, parameters such as attention and task completion accuracy are highly vulnerable to changes in the spatial light color temperature spectrum (Afifi et al., 2024; Gao et al., 2025). This vulnerability is further exacerbated by stage lighting intensity settings; the absence of natural light often creates a sensation of being "exposed," which drastically triggers a spike in stress and performance anxiety in pianists (Gómez Sirvent et al., 2023).

Besides cognitive and psychological responses, the evaluation of musical performance quality itself relies on technical and emotional indicators. Tempo stability, pitch accuracy, and expressive body language (kinematics) are the main benchmarks in assessing the quality of piano playing (Massie-Laberge et al., 2019; Morijiri & Welch, 2022). Furthermore, the depth of expression or the emotional state of pianists when interacting with their instruments is not something abstract, but rather an active process that can now be recorded and measured precisely through cortical brain activity (Ghodousi et al., 2022).

Physiological Measurement Tools

The use of objective instruments is an essential standard for validating the effectiveness of built environment interventions. However, an analysis of commonly used instruments reveals highly variable levels of precision. For example, heart rate measurement has been shown to have limitations, as it is not sensitive enough to capture cognitive changes triggered by manipulations of light color temperature (Afifi et al., 2024). Similarly, cognitive assessment methods such as the d2-R psychometric test are indeed capable of measuring concentration comprehensively. Unfortunately, the paper- or computer-based nature of this test makes it incapable of recording the dynamics of cognition in real-time when pianists interact with their instruments, which demand high motor loads (Gao et al., 2025).

Visual and neural mapping technologies provide more accurate results than standalone measuring tools or mere perception. The use of eye-tracking, for instance, has proven highly valid in evaluating spatial stress levels through the detection of spikes in the frequency of saccadic eye movements caused by a stressful environment (Gómez Sirvent et al., 2023). However, in the context of lighting experiments, this instrument is prone to bias (confounding variables); pupillary response is highly reactive to changes in light itself, and this tool cannot map emotional depth directly. Ultimately, the Electroencephalography (EEG) instrument occupies the highest hierarchy in neurophysiological precision. Connectivity of Beta (12-30 Hz) and Gamma (30-45 Hz) waves in EEG recordings is recognized as the most responsive and effective indicator for mapping intense focus and active emotional states in real-time when a pianist performs on stage (Ghodousi et al., 2022).

Despite occupying the highest hierarchy in neurophysiological precision, the use of Electroencephalography (EEG) in the context of musical performance is not without limitations. Referring to the characteristics of piano performance, which demands high motor loads and expressive body movements (kinematics) (Massie-Laberge et al., 2019; Morijiri & Welch, 2022), brain wave recording using EEG is highly susceptible to motion artifacts and muscle activity interference. Additionally, from a psychological perspective, the attachment of electrode devices to the head has the potential to create a physically "exposed" sensation. This exposed sensation is a primary trigger for performance anxiety (Gómez Sirvent et al., 2023), which can become a confounding variable affecting the pure emotional state (Ghodousi et al., 2022) if musicians are not given adequate adaptation time. These operational challenges further highlight the current research gap, where the reliability of EEG still needs to be specifically calibrated to evaluate physical environmental variables such as color temperature (CCT).

Conceptual Integration of the Environment and Pianists' Responses

To integrate the findings comprehensively and map the structure of relationships among variables, this study developed a conceptual integration framework through a relational density analysis approach. Adapting modern science mapping methodologies, the analysis results will show whether the instruments frequently used in the literature have been proven accurate in objectively measuring user responses.

Based on data extraction from the 10 selected articles, causal relationships are integrated into the Stimulus-Organism-Response (S-O-R) framework, which is visualized through a Sankey Diagram in Figure 2. This visualization divides the research flow into three main aspects: the environment as the Stimulus, measurement instruments as the Organism, and cognitive-physiological outcomes as the Response.

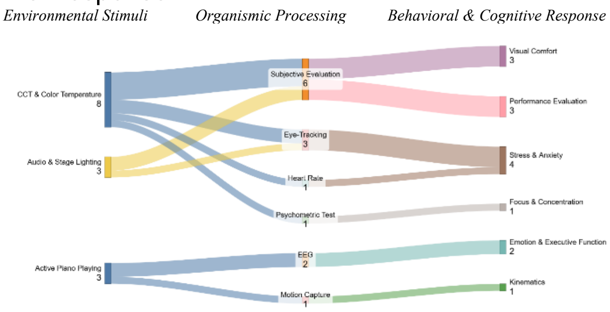

Figure 2. Conceptual Integration through the Stimulus-Organism-Response (S-O-R) Framework: Relationship Flow Among the Environment, Measurement Instruments, and Pianists' Responses.

Referring to the relational flow visualization in Figure 2, there is a very strong dominance of the conventional pathway, where Correlated Color Temperature (CCT) and stage lighting variables are mostly evaluated using subjective instruments (questionnaires) or eye-tracking to measure visual comfort and spatial anxiety. Conversely, there is a very clear missing link between interior design variables (CCT) and Electroencephalography (EEG) instruments.

Although in the scope of neuroscience, EEG has been validated as the instrument with the highest relational density and precision for recording the focus and emotions of pianists in real-time, this technology has never been applied to test CCT variables in piano playing spaces. The absence of a line connecting CCT directly to EEG in this diagram mathematically confirms the urgency of this research to bridge that methodological gap, in order to establish evidence-based design standards for piano playing spaces.

CONCLUTION

This systematic literature review (SLR) has synthesized ten empirical articles to map the interaction among lighting variables, the cognitive-physiological responses of pianists, and the validity level of measurement instruments. Based on the relational density analysis integrated within the Stimulus-Organism-Response (S-O-R) framework, this research concludes that Correlated Color Temperature (CCT) is proven to significantly affect the arousal level, concentration, and anxiety of pianists. Cool color temperatures (6000K–6500K) have been proven capable of triggering high concentration, but are prone to causing glare, which directly disrupts visual comfort. Conversely, warm color temperatures (3500K) combined with audience area dimming have been proven to act as a barrier that facilitates relaxation and creates visual privacy to reduce performance anxiety.

Furthermore, this review highlights the limitations of conventional measurement instruments (Organism). Heart rate measurement has been proven insensitive in detecting cognitive changes due to CCT manipulation, written psychometric tests fail to record real-time cognitive dynamics, while eye-tracking instruments are prone to light intensity bias. Based on the Sankey Diagram visualization (Figure 2), the Electroencephalography (EEG) instrument is validated as a crucial missing link or methodological gap. Although neuroscience places EEG at the highest hierarchy of precision—particularly through Beta and Gamma wave connectivity—for recording real-time focus and emotions while playing the piano, this technology has never been integratively applied to test the impact of CCT in performance spaces. This confirms a contextual disconnect in the current literature mapping, while simultaneously ensuring that CCT testing using EEG is an urgent novelty to establish evidence-based design standards for music spaces.

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