NeuLog

Scientific Research & Academic Studies Using NeuLog™ GSR Sensors

Contents

A- Anxiety / CBT

A-7. Metacognition, Stress & Recovery

- **Link:** Available via University of Manchester (Thesis) - Capobianco, Lora
- **Abstract:**

  A PhD thesis (2016) by Lora Capobianco examining the role of metacognition (thinking about thinking) in stress recovery processes.

  The thesis includes a series of studies (Study 2 and Study 3 are most relevant here) testing how Worry and Rumination affect physiological and emotional recovery following an induced stressor.

  Findings showed that these negative thinking strategies delay the return to a baseline state in physiological measures, and that beliefs about the "importance of thoughts" exacerbate the stress response.

A-13. Physiological Indices of Anxiety and Self-Regulation Under Task Demands and Talk Aloud

- **Link:** https://cornerstone.lib.mnsu.edu/etds/1448/
- **Abstract:**

  A 2024 thesis examining the impact of anxiety (verbal worry vs. somatic arousal) on cognitive performance and self-regulation.

  Subjects performed letter transformation tasks under quiet conditions and "talk aloud" conditions. The study sought to identify if physiological metrics distinguish between anxiety types and how speaking aloud affects regulation.

  Findings showed unique skin conductance patterns in subjects prone to worry, indicating increased effort for emotional regulation during tasks,,.

A-17. The effect of thought importance on stress responses: a test of the metacognitive model

- **Link:** https://doi.org/10.1080/10253890.2017.1417378
- **Abstract:**

  This 2018 study examines the metacognitive model, which posits that negative beliefs about the "importance of thoughts" (e.g., believing that negative thoughts are dangerous or can cause bad events) exacerbate psychological and physiological stress responses.

  The study involved 75 students divided into an experimental group and a control group. Participants were connected to a "fake" EEG machine and underwent a manipulation: the experimental group was told the machine would detect negative thoughts and punish them with a loud noise, while the control group was told the noise would be random. They then performed the Trier Social Stress Test (TSST).

  Findings showed that the manipulation significantly increased negative affect and decreased positive affect in the experimental group, supporting the idea that metacognitive beliefs impact the subjective experience of stress, although no significant differences in physiological measures were found between the groups.

A-49. Metacognition, Stress & Recovery

- **File Name:** Metacognition, Stress & Recovery.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  This doctorate explores the role of "metacognition" (thinking about thinking) during coping with and recovering from stressful situations.

  The research examined how obsessive thinking styles—worry and rumination—affect the body's recovery rate after subjects underwent a stress task (a simulated social "Stroop" test).

  The results revealed that a tendency to ruminate led to a slower and more prolonged physiological recovery (according to skin conductance measures), whereas worrying led to a delay in psychological recovery (negative emotions) relative to the control group.

A-58. The effect of thought importance on stress responses: a test of the metacognitive model

- **File Name:** The effect of thought importance on stress responses a test of the metacognitive model.pdf
- **Link:** https://doi.org/10.1080/10253890.2017.1417378
- **Abstract:**

  This article tests the "metacognitive model" of stress.

  According to this model, an individual's beliefs about their own thoughts (for example, how much they believe their negative thoughts have deep importance or harmful impact) are what determine their ability to recover from stress.

  To prove this, the experimental group underwent a manipulation using a fake EEG device, which led subjects to believe their negative thoughts were significant and physiologically recorded. The control group did not receive this message.

  Afterwards, both groups underwent a social stress task. It was found that subjects convinced of the importance of their negative thoughts experienced a dramatic increase in negative emotions, recovered more slowly, and exhibited a prolonged decrease in positive emotions compared to the control group, validating the importance of metacognitive beliefs in emotional regulation.

B- Clinical / Psychiatry

B-5. Cannabis users' experience of cannabis craving: a test of the cue-reactivity model

- **Link:** https://doi.org/10.54014/GXSW-HX1R
- **Abstract:**

  A PhD thesis (2016) by Mallory Loflin examining the "Cue-reactivity" model among heavy cannabis users.

  The study tested whether exposure to cues related to the drug (images, objects) triggers craving and a physiological response.

  Findings were mixed: a strong subjective craving response was found, but physiological responses (GSR and pulse) did not always show statistical significance compared to the control group or neutral cues, raising questions about the sensitivity of these measures in the context of cannabis.

B-12. Communicate Alternatively, Release Endorphins, and Self-Soothe (CARESS)

- **Link:** Available in ProQuest Dissertations & Theses Global.
- **Abstract:**

  A dissertation (2019/2020) examining the effectiveness of an intervention called CARESS for managing cravings among individuals in substance abuse recovery.

  The intervention is based on emotion regulation models and includes steps of alternative expression, endorphin release (e.g., "butterfly hug"), and self-soothing.

  The study compared an experimental group to a control group performing isometric exercises.

  Findings showed the intervention was effective in reducing physiological arousal immediately after performance, offering patients a practical tool for coping with crisis moments,

B-38. Detection of Universal Cross-Cultural Depression Indicators from the Physiological Signals of Observers

- **File Name:** Detection of universal cross-cultural depression indicators from the physiological signals of observers.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  This pilot study explores the use of neural networks to classify the depression levels of individuals appearing in videos, based solely on the physiological responses of observers watching them.

  The unique aspect of the study is that the observers did not speak or understand the language spoken by the subjects in the videos, aiming to identify whether universal, cross-cultural indicators of depression exist that elicit physical arousal in strangers.

  Since the dataset was imbalanced and noisy, the researchers developed a dynamic oversampling technique.

  The results showed that the system successfully predicted depression levels with a 57.9% accuracy rate, which is significantly higher than random guessing or the conscious diagnosis of the observers themselves.

B-39. Differences in Associations Between Autonomic Nervous System Activity and Psychopathic Traits Across Stress Paradigms and Measures

- **File Name:** Differences Autonomic.pdf
- **Link:** https://www.crimrxiv.com/pub/q7z2nfny
- **Abstract:**

  This article investigates whether the association between Autonomic Nervous System (ANS) reactivity and psychopathic traits varies depending on the type of stress-inducing task and the physiological measure itself.

  Study participants were randomly divided into two groups: one faced the anticipation of a sudden, startling noise blast (countdown task), and the other performed a clinical social stress task requiring public speaking (SSST).

  It was found that skin conductance reactivity during the social stress task was negatively associated with Callous Affect. In the noise task, negative associations were found between skin conductance and heart rate responses and traits such as manipulative-deceitfulness and erratic lifestyle.

50. Physiological phenomena occurring in the psychodynamic psychotherapy process

- **File Name:** Physiological-phenomena-o.pdf
- **Link:** Published in Archives of Psychiatry and Psychotherapy, 2024; 4: 30–43.
- **Abstract:**

  A study examining the physiological phenomena that accompany the relationship between therapist and patient during psychodynamic psychotherapy.

  The researchers monitored the heart rate and skin conductance of patients in the initial therapy sessions, and compared the data by patient gender and therapist experience.

  One of the fascinating results showed that men exhibited significantly higher physiological reactivity (especially in skin conductance measures) compared to women at the beginning of treatment, a finding that sheds light on the deep somatic processes occurring in the therapeutic encounter.

52. Psychopathy and the Effect of Imitation on Empathetic Pain

- **File Name:** Psychopathy and the Effect of Imitation on Empathetic Pain.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  The research investigates the connection between psychopathic traits and the feeling of empathetic pain (empathizing with the pain of others).

  The researchers examined whether active "imitation" of a painful facial expression alters the physiological response to pain.

  The subjects viewed images of humans experiencing pain, fear, or a neutral expression, and were divided into a group that only observed and a group asked to imitate the facial expressions they saw.

  The researchers tracked skin conductance as objective, involuntary evidence to establish a correlation between levels of psychopathy and the ability to exhibit physiological arousal to the pain of another.

63. Physiological activity, severity of neurotic symptoms and personality traits of patients in a psychiatric day ward in the initial and final phases of the psychodynamic psychotherapy process. Quasi-longitudinal pilot study

- **File Name:** konop_et-al_physiological_activity_severity_of_neurotic_2024.pdf
- **Link:** DOI: 10.12740/APP/183673
- **Abstract:**

  The purpose of this pilot study is to examine the physiological activity of patients (heart rate and skin conductance) at the initial and final stages of a psychodynamic psychotherapy process lasting about 12 weeks in a psychiatric day ward.

  The researchers aimed to cross-reference these objective physiological data with subjective psychological data collected from patients' self-report questionnaires.

  The findings showed that in the final phase of treatment, there was a statistically significant decrease in patients' physiological arousal metrics, especially in the frequency of skin conductance spikes but also in heart rate, which aligns with an improvement in their mental state and a reduction in anxiety.

  Additionally, positive correlations were found between the severity of reported symptoms (e.g., on the OWK index) and autonomic nervous system reactivity.

C- VRET / Exposure Therapy

C-8. MR Pharmacy: Development and Evaluation of Therapeutic Mixed Reality Applications

- **Link:** https://ediss.sub.uni-hamburg.de/handle/ediss/9083
- **Abstract:**

  A PhD thesis (2021) by Fariba Mostajeran focusing on the development of "Mixed Reality" applications for treating physical and mental health issues (such as social anxiety, depression, and fall prevention in the elderly).

  The thesis consolidates several studies, including one comparing the effects of forest versus urban environments in VR.

  The work highlights the potential of these technologies to serve as "Digital Health Interventions."

C-11. Music Assisted Progressive Muscle Relaxation and Virtual Reality Exposure Therapy

- **Title:** Music Assisted Progressive Muscle Relaxation and Virtual Reality Exposure Therapy for Specific Phobia: Two Case Studies
- **Link:** https://scholarship.miami.edu/esploro/outputs/graduate/991031825004902976
- **Abstract:**

  A 2023 thesis presenting two case studies on treating specific phobias (fear of dogs and claustrophobia/elevators).

  The research examined a treatment protocol combining Progressive Muscle Relaxation with music (M+PMR) as preparation for Virtual Reality Exposure Therapy (VRET).

  The goal was to check if prior relaxation helps patients regulate anxiety and increase bodily awareness before entering the frightening simulation.

  Results showed the technique helped reduce anxiety and improve readiness for exposure, with participants reporting a high sense of presence and improved physiological awareness,,.

C-14. Measuring Prefrontal Cortex Response to Virtual Reality Exposure Therapy

- **Title:** Measuring Prefrontal Cortex Response to Virtual Reality Exposure Therapy in Freely Moving Participants
- **Link:** Available in University of Salford Institutional Repository.
- **Abstract:**

  A 2018 PhD thesis investigating brain activity (using fNIRS) during exposure to virtual heights.

  The research was conducted in a "CAVE" type VR system (Octave) allowing participants to move freely, aiming to improve ecological validity.

  The study tested healthy subjects and those with acrophobia, finding increased activity in prefrontal areas associated with fear regulation,,.

C-18. Novel Virtual Reality Intervention for Stress Reduction Among Patients With or at Risk for Cardiovascular Disease

- **Link:** https://cardio.jmir.org/2025/1/e66557
- **Abstract:**

  A 2025 pilot study examining the safety and efficacy of a VR intervention for stress reduction among 20 patients with cardiovascular disease or risk factors.

  Participants underwent a 30-minute VR experience featuring fractal and geometric visual effects accompanied by binaural music, aimed at quieting the brain's "default mode network" (DMN) and inducing relaxation.

  Results showed a statistically and clinically significant decrease in state anxiety scores (STAI-S) and a decrease in average heart rate by approximately 6 beats per minute. Qualitative interviews revealed that participants felt a "distance from stress" and enjoyed the experience.

  However, no significant changes were observed in blood pressure or skin conductance measures throughout the experiment.

C-22. Training with virtual reality simulations: Its effects on public speaking anxiety

- **Link:** Available in the Universitat Pompeu Fabra repository (Master's Thesis).
- **Abstract:**

  A thesis (2019) investigating whether a 3-session VR training reduces public speaking anxiety and improves performance among 56 high school students.

  The experimental group trained in front of a virtual audience (using the Beyond VR app), while the control group trained alone in a classroom.

  Results showed a significant decrease in self-perceived anxiety (SUDS) in the VR group. However, no significant improvement in actual speaking performance was found, and physiological measures did not always match subjective reports, with heart rate actually increasing in the VR group.

C-23. VR Scenarios to Treat Mental Health

- **Link:** doi: 10.31577/cai 2022 2 627
- **Abstract:**

  This article (2022) outlines the design and development of VR scenarios for rehabilitating schizophrenia patients, focusing on improving cognitive and social functions.

  Scenarios include a subway ride, a morning kitchen routine, and spending time in a public park, allowing patients to practice daily skills in a safe, controlled environment.

  The system is designed to provide therapists with a real-time monitoring tool for the patient's state (biofeedback) to personalize treatment, aiming to improve patient autonomy and quality of life.

C-41. Electrodermal Activity in Response to Stress Reduction: A Virtual Reality Experience in Hydrotherapy and Non-Hydrotherapy Environments

- **File Name:** Electrodermal Activity in Response to Stress Reduction_ Virtual R.pdf
- **Link:** https://ida.gallaudet.edu/honors_capstones/94
- **Abstract:**

  This work examines the use of Virtual Reality (VR) simulating water therapy (hydrotherapy) as a means of stress reduction.

  Instead of direct contact with water, participants in the virtual environment were immersed in a relaxing underwater world.

  This group was compared to a control group that experienced an urban environment (a virtual tour of New York City).

  The goal was to determine if a hydrotherapeutic environment holds an advantage in reducing stress.

  The findings showed that participants in the water group subjectively reported a decrease in stress levels. However, Skin Conductance Level (SCL) metrics did not show a statistically significant difference between the groups, suggesting that both virtual environments may offer stress-reduction benefits.

C-59. VR SCENARIOS TO TREAT MENTAL HEALTH

- **File Name:** VR SCENARIOS TO TREAT MENTAL HEALTH.pdf
- **Link:** doi: 10.31577/cai.2022.2.627
- **Abstract:**

  The article describes the development of a Virtual Reality (VR) based rehabilitation system designed to assist in the treatment of schizophrenia.

  Instead of relying solely on medication that primarily affects only the positive symptoms, the system offers virtual environments from daily life—such as riding a subway, performing tasks in a kitchen, or walking in a crowded park.

  These scenarios allow patients to practice social skills and cope with delusions (hallucinations) in a completely safe, risk-free environment.

  The system's uniqueness lies in the integration of real-time biofeedback, which monitors the patient's physiological state during practice. If an extreme stress level is detected or a psychotic episode develops, the accompanying medical staff is alerted, can intervene immediately, stop the simulation, or personalize it.

D- Neuro / Cognitive

D-2. Manipulation of Cognitive Load in Simulation-Based Medical Education

- **Link:** Available in the Queen's University (Canada) repository - Bruder, Eric A. Thesis
- **Abstract:**

  A Master's thesis (2018) by Eric Bruder examining the effectiveness of measuring "Cognitive Load" among medical residents during simulated medical resuscitation scenarios.

  The study compares self-reported subjective reporting (VAS scale) with an objective physiological measure (GSR) across four different scenarios designed to increase or decrease cognitive load (e.g., using familiar algorithms vs. complex memory tasks).

  The findings showed that while self-reporting was sensitive to most changes, the GSR measure responded significantly mainly in controlled memory tasks and stages where the "Worked Examples" method was applied to reduce load, but was less sensitive to changes in certain complex clinical scenarios.

D-6. Musical Anhedonia and Individual Differences in Sensitivity to Music Reward

- **Link:** Available in the Wesleyan University repository (Thesis).
- **Abstract:**

  A thesis examining a phenomenon called "Musical Anhedonia"—a condition where individuals with normal hearing do not experience pleasure from music.

  The study used behavioral and physiological measures to compare a control group with a subject having anhedonia.

  Participants listened to moving musical pieces and were asked to report peak moments ("chills").

  Findings showed a correlation between reported excitement and increased skin conductance in the control group, a response not observed in the anhedonic subject.

D-10. Multi-Modal, Multi-State, Real-Time Crew State Monitoring System

- **Title:** Multi-Modal, Multi-State, Real-Time Crew State Monitoring System
- **Link:** NASA Technical Reports Server (Based on text context)
- **Abstract:**

  This paper describes a project to develop a real-time monitoring system for air and space crews, aiming to detect dangerous cognitive states such as inattention or extreme stress.

  Researchers built a system combining data from three physiological sources: brain activity (EEG), heart rate variability (HRV), and skin conductance (GSR). The system was tested using psychological tasks simulating relaxation and concentration.

  Findings showed that combining EEG and GSR metrics using Machine Learning algorithms significantly improved the operator state classification accuracy (up to ~80% accuracy) compared to using each sensor individually,,.

D-16. Temporal Dynamics of Human Emotional Response to Aversive Stimuli

- **Link:** https://huskiecommons.lib.niu.edu/allgraduate-thesesdissertations/7248
- **Abstract:**

  A 2019 thesis focusing on mathematical modeling (System Identification) of the human emotional response over time.

  The research focused on building Control Theory models to describe how humans generate and regulate emotion in response to aversive visual stimuli, and the effect of external distraction on this response,

D-20. Machine Learning, Virtual Reality, and Biomechanical Simulation to Aid Physical Rehabilitation

- **Link:** https://escholarship.org/uc/item/3mj32501
- **Abstract:**

  A 2021 doctoral dissertation presenting the development of the "Open Butterfly" system—a VR rehabilitation game designed for patients with shoulder injuries. The system combines biomechanical simulation (Open Sim) to calculate joint forces and torques with gamification to increase motivation.

  The study included two experiments over 8 weeks where patients performed personalized exercises.

  The innovative aspect of the work is the development of machine learning models (XGBoost) capable of predicting complex biomechanical metrics in real-time based solely on VR controller movement data, without the need for expensive systems, enabling accurate and accessible remote rehabilitation (Telehealth).

D-24. Towards Automatic Cybersickness Detection, Early-Prediction, and Reductions for Virtual Reality Applications

- **Link:** Dissertation (2022) from the University of Texas at San Antonio (UTSA).
- **Abstract:**

  A doctoral dissertation proposing a framework for automatic detection, early prediction, and reduction of "cybersickness" in VR.

  The research utilizes deep learning algorithms (such as CNN-LSTM and DeepTCN) that analyze physiological data (heart rate, respiration, GSR) and behavioral data (head movements, eye tracking).

  The study demonstrates that the onset of sickness can be predicted approximately 90 seconds before the user feels it, allowing for the triggering of mitigation mechanisms (like reducing the field of view) in real-time.

D-26. Predicting Performance Under Stressful Conditions Using Galvanic Skin Response

- **Link / File Name:** 1606.01836v1.pdf and the full thesis in 960806938-MIT.pdf
- **Abstract:**

  This paper explores the potential of using physiological signals, specifically **Galvanic Skin Response (GSR)**, to predict human performance levels under extreme stress conditions. Often, workers in sensitive roles (such as pilots or military personnel) are trained and evaluated in stress-free simulated environments, which do not necessarily predict their actual functioning in stressful real-world situations.

  In an experiment, subjects were asked to solve math problems under low and high-stress conditions.

  By analyzing the GSR data collected exclusively during the low-stress condition, **the researchers successfully predicted with a median accuracy of 75% which subjects would perform well under high stress**, compared to only 50% accuracy without biometric data.

  The conclusion is that biometric signals obtained in a calm environment can be used to predict future stress resilience.

D-28. Effects of the Automatic Self-Transcending Meditation on cognition and mental states in the EEG, skin conductance and behavioral performance: a pilot study

- **Link / File Name:** 2022.10.11.511756v1.full.pdf
- **Abstract:**

  The purpose of this pilot study is to examine the immediate effects of Automatic Self-Transcending (AST) meditation on cognitive functions and mental states.

  The experiment was conducted on three subjects who practiced meditation for 20 minutes, comparing their performance on a cognitive task (Stroop test) before and after the meditation, combined with EEG and skin conductance (SC) measurements.

  The findings demonstrate that **meditation has an immediate positive effect, reflected in better reaction times and improved executive control**. Furthermore, the researchers identified that **during meditation, there is a significant increase in frontal interhemispheric synchronization of brainwaves in the alpha-1 and beta frequencies**, along with specific and unique changes for each participant in skin conductance responses and brain potentials.

D-29. Mazed and Confused: A Dataset of Cybersickness, Working Memory, Mental Load, Physical Load, and Attention During a Real Walking Task in VR

- **Link / File Name:** 2409.06898v1.pdf
- **Abstract:**

  The article presents "VRWalking," a new dataset designed to investigate the effects of cybersickness on working memory, attention, and physical and mental load during active walking scenarios.

  In the experiment, 36 participants navigated a virtual maze while physically walking for 15 minutes, concurrently performing timed cognitive tasks.

  The analysis reveals that **cybersickness symptoms worsened as the duration of the experience increased, and the affected group demonstrated poorer working memory performance while reporting higher physical load**.

  To validate the data quality, the researchers fed the dataset into deep learning models and **successfully predicted the severity of cybersickness with 95% accuracy**.

D-32. On Shooting Stars: Comparing CAVE and HMD Immersive Virtual Reality Exergaming for Adults with Mixed Ability

- **Link / File Name:** https://doi.org/10.1145/3396249 (File: 3396249.pdf)
- **Abstract:**

  This study compares two prominent virtual reality setups: a full-room environment (CAVE) versus wearable headsets (HTC Vive HMD) in the context of physical exercise (exergaming).

  The comparison included 40 participants—comprising adults with cognitive-developmental disabilities and those without—who played a virtual star-catching game.

  The results clearly indicated that **the HMD system was significantly superior: it encouraged wider ranges of motion, higher game scores, a stronger sense of presence, and more robust physiological (biofeedback) responses indicating alertness and engagement**.

  The research concludes that today's HMD headsets are highly effective and preferred for physical rehabilitation and health purposes.

D-47. The senses of agency and ownership (מתוך Joey Stephens Thesis)

- **File Name:** Joey Stephens Thesis Dec 2024.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  This thesis explores the feelings of "ownership" and "agency" that humans experience in virtual reality (VR) environments, particularly when operating virtual tools.

  The researcher examined whether artificial delays in controlling tools in VR increase users' frustration levels, and whether this increase alters baseline physiological measures (such as sweating).

  The goal was to determine if frustration from a difficult task might bias the results of past empathy and body illusion studies in VR. The results indicated a trend of increased skin conductance during trials with control delays.

D-57. The effect of positive extrinsic emotion regulation on the Late Positive Potential (LPP) to aversive stimuli

- **File Name:** The effect of positive extrinsic.pdf
- **Abstract:**

  The study examines humans' ability to regulate negative emotions through a mechanism of "positive extrinsic distraction".

  In contrast to intrinsic emotion regulation (like cognitive reappraisal), which requires conscious cognitive effort, this study tested whether presenting a positive visual stimulus immediately after exposure to a disgusting or fearful image would lead to an automatic reduction in the emotional response.

  The researchers monitored brain activity (EEG), focusing on the Late Positive Potential (LPP) component, which indicates arousal.

  The results showed that extrinsic distraction indeed managed to attenuate and curb the subjects' emotional response just half a second after the harsh image appeared. However, the positive effect faded quickly and was not sustained over time.

  These findings have applied potential for developing emergency systems that can externally and effortlessly regulate stress levels.

D-61. Dogs Barking and Babies Crying: The Effect of Environmental Noise on Physiological State and Cognitive Performance

- **File Name:** dogs barking.pdf (and duplicate dogs_barking_and_babies_crying__the_effect_of.6.pdf)
- **Link:** DOI: 10.4103/nah.nah_16_23
- **Abstract:**

  The study investigates the effects of everyday, disturbing environmental noises—a baby crying and dogs barking—on humans' physiological state and cognitive performance, comparing them to exposure to white noise (static background noise).

  Twenty participants were exposed to these stimuli while their heart rate and skin conductance were measured, and simultaneously performed cognitive tasks (reaction time, visuospatial memory, and mathematical processing).

  The results indicate that listening to biological distress sounds (especially baby crying and barking) produced significant physiological arousal, manifested by increased heart rate and sweating, compared to white noise. Cognitively, while the arousal shortened reaction times due to a state of alertness, it significantly impaired processing ability and accuracy in solving mathematical problems.

  The conclusion is that these noises create a burden that impairs tasks requiring sustained attention.

E- Behavioral / Decision making

E-1. Emotional State of Consumer in the Urban Purchase: Processing Data

- **Link:** https://doi.org/10.2478/fman-2018-0009
- **Abstract:** This 2018 article by Andrii Halkin presents a unique field experiment in the field of Neuromarketing. The objective was to assess the emotional state and fatigue of consumers in real-time during shopping in an urban environment (kiosks and discount stores). The study aimed to move beyond laboratory confines and measure responses in a natural setting. Researchers tracked the shopper's journey from leaving home, arriving at the store, browsing, standing in line, and returning. The results showed distinct physiological changes at different stages of shopping, with high emotional load recorded during crowding or time pressure. The conclusions are intended to help marketers design more pleasant shopping environments that reduce "emotional fatigue" in consumers.

E-36. How is variability in physiological responses to social stress related to punishment and reward sensitivities? Preliminary findings from the revised reinforcement sensitivity theory of personality perspective

- **File Name:** Anxiety to social stress.pdf
- **Link:** https://doi.org/10.1080/10615806.2023.2290667
- **Abstract:**

  This study examines the relationship between personality dimensions, according to the revised Reinforcement Sensitivity Theory (RST), and physiological responses to social stress.

  Sixty-one students participated in the Trier Social Stress Test (TSST), during which their heart rate and skin conductance level (SCL) were measured.

  The researchers found that individuals with higher Behavioral Inhibition System (BIS) sensitivity—meaning they are more sensitive to punishment—exhibited heightened physiological reactivity to stress. Conversely, participants with high reward sensitivity showed lower heart rate reactivity.

  Furthermore, high reward interest was associated with a better and faster recovery of skin conductance after the stress task. The findings highlight the importance of reward sensitivity as a mechanism that may provide resilience against social stress.

E-37. Blind area target aiming system and preference selection training system design

- **File Name:** Blind area target aiming system and preference selection training.pdf
- **Link:** https://doi.org/10.37099/mtu.dc.etdr/38
- **Abstract:**

  This academic report describes the development of two Cyber-Physical Systems (CPS).

  The first project deals with a security system for identifying and aiming at targets in blind areas, using passive infrared sensors and a webcam for face detection.

  The second project, where physiological data was collected, focuses on coping with mental stress. The system is designed to learn user preferences regarding lighting (colors and brightness) and music, assuming that a proper combination of these can assist in relaxation and stress reduction.

  The system identifies when the user is stressed and, based on prior learning, activates the optimal relaxing environment.

E-40. Hormones, Autonomic Nervous System Activity, and Criminal Behavior

- **File Name:** Hormones and criminal behaviour.pdf
- **Link:** https://www.crimrxiv.com/pub/evwtnuz4
- **Abstract:**

  A large-scale study conducted on 495 university students examines the combined influence of hormones (testosterone and cortisol) and Autonomic Nervous System activity (heart rate and skin conductance) on the propensity for impulsive and violent criminal behavior.

  The findings revealed a direct, positive association between impulsive and violent crime and both testosterone and cortisol.

  The main finding highlighted a significant interaction between testosterone levels and heart rate reactivity: the positive association between testosterone and crime becomes significantly stronger as resting heart rate decreases.

  The researchers conclude that different biological indicators act together and serve as critical indicators for understanding the etiology of crime.

E-42. CONSTRUCTION SAFETY PERCEPTION ANALYSIS USING AFFECTING SENSING TECHNOLOGY AND VIRTUAL REALITY

- **File Name:** FinalPaper_56.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  The article investigates the potential of combining Virtual Reality (VR) with "affective sensing" technology to analyze and evaluate safety at construction sites.

  Safety at construction sites depends not only on regulations but also on the workers' hazard perception and subjective feeling of security.

  The researchers created a virtual construction environment based on laser scan and GPS data from a real site, incorporating various hazard scenarios. The experiment's goal was to examine physiological responses to these hazards as a means of training and evaluation.

  The preliminary experiment indicated the potential of using biometric sensing as an indicator for understanding workers' fear and caution, while also pointing out the challenges of implementing these technologies in a virtual environment.

E-43. Neuroergonomic Assessment of Hot Beverage Preparation and Consumption: An EEG and EDA Study

- **File Name:** Hot beverage.pdf
- **Link:** doi: 10.3389/fnhum.2020.00175
- **Abstract:**

  This neuroergonomic study examines brain and physical activity during one of the most common daily tasks: preparing and consuming hot beverages like coffee.

  The objective was to compare the user experience between two coffee machines (one from a market-leading company and the other from a competitor) in a naturalistic office setting.

  Twenty-six participants were connected to wireless sensors for EEG and skin conductance monitoring.

  The results revealed that the market-leading machine required less cognitive effort, which was reflected both in self-reports and in physiological responses of arousal and emotional valence during use. This is the first study to combine biometric measures to comprehensively investigate user experience in routine beverage machines.

E-44. How is variability in physiological responses to social stress related to punishment and reward sensitivities? Preliminary findings from the revised reinforcement sensitivity theory of personality perspective

- **File Name:** How is variability in physiological responses to social stress related to punishment and reward sensitivities Preliminary findings from the revised r (1).pdf
- **Link:** https://doi.org/10.1080/10615806.2023.2290667 *(Note: This article also appeared in the previous round under a different file name, but was reviewed again here as per your request).*
- **Abstract:**

  This study examines the relationship between personality dimensions according to the revised Reinforcement Sensitivity Theory (RST) and physiological responses to social stress.

  Sixty-one students participated in a social stress task (TSST) where their heart rate and skin conductance were measured. It was found that **individuals with high sensitivity to punishment (behavioral inhibition) showed heightened physiological reactivity to stress, whereas those with high sensitivity to reward were characterized by more moderate heart rate reactivity and a faster recovery of skin conductance**.

  The results highlight the importance of the reward system in building mental and physiological resilience in social stress situations.

E-45. Involuntary Responses to Laboratory and Lottery

- **File Name:** Involuntary_Responses_to_Laboratory_and (1).pdf
- **Link:** Not specified in the source.
- **Abstract:**

  This experiment analyzes involuntary physiological responses (heart rate and skin conductance) in subjects when they are informed of an upcoming lottery and when the outcome of the lottery is revealed to them.

  The study compares the physiological responses between participants assigned to a "low stakes" condition and those assigned to a "high stakes" condition, in order to understand how information and risk magnitude affect physical arousal.

  Although natural variance was observed in the responses of different subjects to winning or losing, the research confirms a clear connection between the provision of information and spikes in biometric measures.

E-51. A Contactless Health Monitoring System for Vital Signs Monitoring, Human Activity Recognition and Tracking

- **File Name:** Poslad Contactless Health Monitoring 2023 Accepted.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  A technological article presenting the development of "HealthDAR," a low-cost, contactless system for medical monitoring and recognizing daily activities using radar.

  The system is capable of monitoring vital signs, detecting coughs, tracking social distancing, and identifying hygiene activities (such as washing hands or touching the face).

  The goal is to eliminate the need for wearable sensors that sometimes bother patients, by using deep learning algorithms to analyze radar reflections.

  The system demonstrated accurate and stable performance in diverse field experiments.

E-54. Neural Assessment of Consumer Preferences for Food Products

- **File Name:** Sargent_Thesis_final.pdf
- **Link:** https://doi.org/10.17918/00000042
- **Abstract:**

  This comprehensive doctoral thesis examines consumer preferences for food and beverage products using a neuroergonomic approach, which combines traditional subjective self-reports with objective physiological and brain measures (EEG, fNIRS, EDA).

  In one of the thesis studies, the researcher evaluated the user experience and usability of two coffee machines (from a market leader versus a competitor) in a naturalistic office setting.

  Another study examined the effect of consuming hot beverages, including coffee and tea, on cognitive work task performance.

  The integration of objective measures enabled the researcher to identify situations where users experienced frustration or positive arousal, and to examine how the interface's ease of use affected the enjoyment of the beverage itself.

  The main findings emphasize that an intuitive and efficient user interface is associated with positive arousal and a higher preference for the finished product.

E-56. The Monty Hall problem revisited: Autonomic arousal in an inverted version of the game

- **File Name:** The Monty Hall problem revisited.pdf
- **Link:** https://doi.org/10.1371/journal.pone.0192542
- **Abstract:**

  This article analyzes the physiological arousal levels of people playing the classic version versus an "inverted" version of the "Monty Hall problem" (a famous probability puzzle). In both versions, the prize for winning was identical (a luxury pen).

  However, in the inverted version, participants physically received the prize before the game began and were told they would have to return it to the host if they lost, creating a threat of potential loss.

  The researchers measured the players' Galvanic Skin Response (GSR). The findings unequivocally proved that participants in the inverted version, facing the danger of losing an item already in their possession, exhibited much higher levels of autonomic arousal than players in the classic version.

  This study validates the psychological claim that the potential for loss provokes a stronger and more intense emotional and attentional response than the prospect of an equivalent gain.

E-60. Acute stress induces habit formation as evidenced by a contingency degradation task

- **File Name:** accute stress.pdf
- **Link:** DOI: 10.17605/OSF.IO/GFECX
- **Abstract:**

  The research examines whether acute stress situations cause humans to abandon calculated, goal-directed behavior, and shift to behavior based on automatic actions (habits).

  For this purpose, participants underwent a stress-inducing test involving placing a hand in ice water under strict video surveillance (SECPT). Following this, they performed a learning task, where the effectiveness of their keystrokes gradually decreased.

  The findings proved that the control group participants (who were not exposed to stress) identified the decrease in effectiveness and voluntarily reduced their number of keystrokes.

  In contrast, the stress group participants blindly and habitually continued to press the keys at a high frequency, even though the action yielded no positive results. The results confirm that acute stress impairs cognitive flexibility and leads to automatic, habit-based behavior.

F- General psychology

F-3. Investigation of the physiological processes of the human body with the help of digital sensors within biology lessons

- **Link:** 10.31392/NPU-nc.series15.2022.3K(147).02
- **Abstract:**

  An educational article (2022) by Placinta and Coropceanu demonstrating how to integrate digital technologies into biology teaching in schools (11th grade).

  The article describes inquiry-based lesson plans where students measure physiological processes such as respiration, pulse, and physical exertion.

  The goal is to improve students' digital skills and their understanding of the human body through hands-on experience ("Learning by doing").

  Results showed that using sensors increased student motivation and allowed for deeper analysis of biological data through graphs and tables.

F-4. Resilience, Health and Stress: Using an Ecological System Model

- **Link:** Available in the University of Leicester repository (Thesis).
- **Abstract:**

  A PhD thesis (2019) by Zainab Alanazi examining an ecological model of resilience (EEA Model).

  The work includes a series of experiments testing how different resilience components predict physiological and psychological responses to stressors (such as the Cold Pressor Test and viewing emotional videos).

  Findings showed that different types of resilience are associated with different recovery patterns, and there is a relationship between physiological measures (like skin conductance) and reported anxiety levels.

F-9. Scenario-Based Immersive Virtual Reality Platform for Testing Empathy Types: A Development Study

- **Link:** 10.1109/ACCESS.2025.3624300
- **Abstract:**

  A recent development study (2025) presenting **VRET**, an immersive virtual reality platform designed to diagnose empathy types (cognitive, affective) in adolescents.

  The system places users in realistic social scenarios within a school environment (such as a classroom or cafeteria) and requires them to react to situations involving virtual characters.

  The platform aims to overcome self-reporting biases found in traditional questionnaires by collecting multi-modal data in real-time.

  A usability test conducted with 99 participants showed that the system is perceived as innovative and engaging, although issues regarding wearability were noted.

  The collected data is used to develop AI algorithms for empathy classification,

F-15. The Effect of Loving-Kindness Meditation on Physiological and Psychological Reactions

- **Link:** https://digitalcommons.georgiasouthern.edu/etd/1513
- **Abstract:**

  A 2016 dissertation testing whether a 12-week course in "Loving-Kindness Meditation" (LKM) reduces physiological and psychological reactions to watching violent videos.

  The study compared a meditation group to a control group.

  Psychological findings showed increased awareness and observation skills, but surprisingly, no statistically significant difference was found in physiological responses between the groups after the course,

F-21. Effects of exposure to immersive videos and photo slideshows of forest and urban environments

- **Link:** https://doi.org/10.1038/s41598-021-83277-y
- **Abstract:**

  This article (2021) compares the psychological and physiological effects of exposure to forest versus urban environments in VR.

  Researchers tested two display modes: 360-degree videos (immersive) and standard photo slideshows. Participants performed a stress-inducing math task before exposure to the environments.

  Results showed that forest exposure improved cognitive performance and reduced mood disturbances compared to the city.

  A surprising finding was that photo slideshows (less immersive) were more effective at reducing physiological arousal (GSR) than videos, possibly due to the higher emotional arousal generated by realistic video.

F-30. Evaluating Aesthetics During Interaction Episodes

- **File Name:** 2643572.2643583.pdf
- **Link:** http://dx.doi.org/10.1145/2643572.2643583
- **Abstract:**

  This article serves as a pilot for a large-scale study examining how the visual aesthetics of software interfaces influence user experience and product usability.

  The researchers argue that evaluating aesthetics from a static, initial glance is incorrect, as dynamic interaction consists of continuous episodes; therefore, real-time responses must be evaluated.

  During the experiment, 20 participants evaluated different music players using tools such as eye tracking, questionnaires, and biometric sensors.

  The preliminary findings showed that **aesthetic interfaces provide greater user satisfaction and lead to more efficient and faster task completion, while reducing physical and mental effort**.

F-33. Comparing Psychophysiological Responses to Vicarious Pain Experience Elicited by Videos Featuring either Humans or Avatars

- **File Name:** 3616961.3617801.pdf
- **Link:** https://doi.org/10.1145/3616961.3617801
- **Abstract:**

  The purpose of this study is to determine whether humans feel the same level of empathy for "vicarious pain" when it is inflicted on a digital avatar compared to a real person.

  Twenty-three participants watched videos showing either a human or an avatar placing their hand in ice water. Simultaneously, their Heart Rate Variability (HRV) and Electrodermal Activity (EDA) were monitored to gauge their emotional stress response.

  The study found no statistically significant difference in the psychophysiological metrics between the two viewing conditions.

  This suggests that **avatars can elicit human-like emotional responses, serving as a viable and effective alternative to real people in VR environments for education, work, and simulations**.

F-34. ACUTE STRESS DETECTION IN HUMANS THROUGH RESONANT FIELD IMAGING SYSTEM AND A VIDEO-BASED FILTERING TECHNIQUE TO MEASURE STRESS FROM A DISTANT POINT

- **Link / File Name:** 65_2018-05-22_Raveendra_Thesis_FINAL.pdf
- **Abstract:**

  This thesis focuses on developing accurate methods for measuring acute stress levels.

  The researcher simultaneously evaluated two technological tools: a Resonant Field Imaging (RFI) system, which analyzes electromagnetic frequencies around the human body, and a remote video-processing technique to detect microscopic physiological movements indicative of stress.

  Stress was induced using a challenging real-time puzzle game.

  The experiment validated the systems, revealing a **direct and clear correlation between high RFI frequency readings (above 599 MHz) and spikes in GSR and heart rate stress metrics**.

  The remote video algorithm helped overcome RFI range limitations and successfully distinguished between physical and mental stress.

F-35. Analyzing Affective Responses to Virtual Spaces Using Physiological Sensors and Verbal Descriptions

- **File Name:** Analyzing Affective Responses to Virtual Spaces.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  This research investigates how the architectural design of spaces emotionally affects users by employing physiological sensors and verbal descriptions. The study included 86 participants who experienced diverse virtual reality (VR) environments while metrics such as brainwaves (EEG), heart rate, and electrodermal activity (EDA) were measured.

  The goal is to provide architects with data-driven tools to evaluate user experience during the design phase rather than relying solely on intuition.

  Results indicate a clear relationship between physiological metrics and spatial parameters, such as height and shape. For instance, taller spaces were associated with calmer emotions.

  The paper demonstrates how combining VR, biometric sensors, and machine learning can create an effective tool for measuring emotional responses to architecture.

F-46. Irrational Happiness Beliefs

- **File Name:** Irrational Happiness Beliefs.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  A doctoral thesis that deeply examines "irrational happiness beliefs" and their impact on coping with stress. In the main part of the work, subjects underwent an acute pain task (inserting their hand into an ice water bath at a temperature of 3 degrees Celsius) in order to assess pain tolerance levels.

  The research cross-referenced psychological variables such as state anxiety and beliefs about happiness with physiological measures of pain, and showed that the experimental group exhibited significant changes in heart rate and skin conductance during the pain experience compared to a control group.

F-48. Empathy as a Predicting Factor of Stress Contagion Susceptibility

- **File Name:** MEEKS-PRIMARY-2025.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  This thesis examines whether the trait of empathy predicts a person's susceptibility to "stress contagion."

  Participants in the experiment listened to audio recordings of a speaker in a natural and relaxed state, or alternatively, a speaker in a state of noticeable stress, while their stress metrics were monitored.

  The findings proved that subjects with a high level of empathy showed a significantly stronger physiological stress response (a sharp increase in skin conductance) in response to the stressed speaker compared to people with low empathy. The study confirms that stress can be "caught" through vocal cues alone.

F-55. SCARED TO DEATH: AN EXAMINATION OF UNDERLYING TERROR FOLLOWING DEATH AWARENESS

- **File Name:** Scared to death_ an examination of underlying terror following de.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  The thesis examines the "Terror Management Theory" (TMT), which posits that human awareness of death arouses deep existential anxiety, which is immediately repressed through psychological defense mechanisms (such as strengthening worldview and self-esteem).

  The research addresses recent criticisms of the theory, which argue that no actual physiological evidence has ever been presented to show that people actually experience "terror".

  Using a combination of self-report questionnaires and Galvanic Skin Response (GSR) measurements, the researcher tested the stress and arousal levels of participants who were asked to write about their own death.

  The results were mixed: exposure to thoughts of death did not cause an increase in autonomic nervous system physiological arousal or reported stress.

  However, it did evoke significant subjective feelings of sadness and distress.

  The conclusion is that "terror" does not necessarily manifest as a simple physiological fight-or-flight response, but constitutes a complex experience of multiple negative emotions.

G- Others

G-19. Affective Computing for Game User Research

- **Link:** Available in the proceedings of the eCAADe 2023 conference (Proceedings of the 41st Conference on Education and Research in Computer Aided Architectural Design in Europe).
- **Abstract:**

  This study explores the use of affective computing technologies to analyze user experience in immersive game environments.

  Researchers developed a "Serious Game" simulating historical trade routes and urban networks on a topographic map.

  The goal was to understand how gamification elements influence player decision-making and emotions. Multi-modal data was collected, including video for gesture analysis, EEG for brain activity, and GSR for emotional arousal.

  Findings showed a correlation between game events (such as receiving a positive or negative "chance card") and sharp changes in physiological measures, indicating emotional and cognitive engagement during decision-making.

G-25. Validity Testing the NeuLog Galvanic Skin Response Device

- **Link:** The file does not contain a direct link, but it is a paper presented at an IEEE conference in October 2020.
- **Abstract:**

  This paper describes the validation of the NeuLog NUL-217 GSR sensor by comparing it to the recognized and accurate laboratory system, Biopac. The study involved eight participants who were connected to both systems simultaneously.

  Participants viewed a blank screen, watched a virtual reality (VR) roller coaster video, and performed a series of hand gestures.

  The purpose of the study was to verify whether the NeuLog system, which is cheaper, portable, and more convenient, provides sufficiently reliable data for psychophysiological research, despite its use of dry electrodes.

  The results showed a significant positive correlation between the NeuLog readings and the Biopac system. Although the absolute skin conductance levels differed (the NeuLog tended to show fluctuations with a higher amplitude), the dynamics, timing, and relative changes in responses tracked well across the two systems.

  The conclusion is that the sensor is reliable and suitable for studies requiring the detection of phasic changes in arousal.

G-27. A temporal parcellation of the sensory-evoked responses during the rubber hand illusion reveals manipulation- and illusion-specific correlates

- **Link / File Name:** 2021.01.15.426770v2.full.pdf
- **Abstract:**

  This study analyzes the neurophysiological responses that occur during the "rubber hand illusion" (RHI) to determine exactly when the brain responds to the feeling of ownership over a foreign body.

  Using multivariate classification models on EEG readings, the researchers found that **brain responses differentiate between the illusion state and control conditions at a very early stage (130-150 milliseconds after the stimulus)**.

  Surprisingly, however, they found that **there is no significant correlation between the neural signature in the brain and the skin conductance changes** that accompanied the illusion in the subjects.

  Therefore, the paper concludes that the brain processing of the illusion and the physical autonomic nervous system responses are separate processes that each independently contribute to the sensation.

G-31. Fusion-Vital: Video-RF Fusion Transformer for Advanced Remote Physiological Measurement

- **Link / File Name:** 27898-Article Text-31952-1-2-20240324.pdf
- **Abstract:**

  The article introduces "Fusion-Vital," a deep learning model based on a Transformer architecture designed for wireless, remote measurement of physiological signs (heart rate and respiration).

  Instead of relying solely on RGB video cameras or modern Radio Frequency (RF) sensors, **the model fuses both modalities to create an adaptive and stable solution**. This integration is achieved by converting data into a time-difference format, aligning both information channels on a shared temporal axis.

  Extensive evaluations demonstrated that **the fused model significantly outperforms existing single-sensor models, proving impressive robustness in difficult situations**, such as partial body occlusion or extremely poor lighting (darkness).

G-53. ¿IMPORTA EL TIEMPO? INDAGANDO SOBRE LA CODIFICACIÓN TEMPORAL Y SU CONDICIONAMIENTO EN HUMANOS

- **File Name:** Rodríguez, Nicolás y Correa Freisz (...) (2017). Importa el tiempo indagando sobre la codificación temporal y su condicionamiento en (...).pdf
- **Link:** https://n2t.net/ark:/13683/eRer/hSv
- **Abstract:**

  An article (written in Spanish) investigating how humans encode the dimension of time and respond to it in "classical conditioning" learning processes.

  The researchers combined neutral visual stimuli (like differently colored squares) with anxiety-inducing aversive stimuli (like a grating sound of scratching a chalkboard for three seconds).

Electrodermal activity (sweating) was used as a metric to measure the subjects' anticipation and fear upon hearing the grating sound in relation to the timing of the visual stimuli appearing on the screen.

G-62. Affective Computing for Game User Research

- **File Name:** ecaade2023_249.pdf
- **Link:** Not specified in the source.
- **Abstract:**

  This article explores how "Affective Computing" tools and machine learning can be used to understand the emotional user experience within dynamic gaming environments.

  The researchers developed a board game, simulating historical trade route networks, and continuously monitored the players' mental and physical state.

  Data collection combined tracking skin conductance (GSR), brainwave activity (EEG), and using cameras (and computer vision algorithms) to analyze movements and expressions in real-time.

  Analysis of the results demonstrated how significant events in the game (like fear of bankruptcy) lead to dramatic spikes in the players' skin conductance levels and characteristic changes in brainwaves. The long-term goal of the research is to apply these technological methods to objectively evaluate how humans react to and experience architectural spatial design.