Everything written in: Blue = written by me - Green = taken from doc

Describe the proposed subject population, including gender, race, ethnicity, language, and literacy.

All subjects must be 18 years of age or older and may be of any gender, race, and ethnicity. Subjects will mainly be composed of PBS undergraduate students. Subjects must be fluent in English in order to understand the research procedures. There will be no minors, prisoners, mentally disabled, or institutionalized persons recruited for this research. Online studies include adult participants from around the world.

Identify any criteria for subject inclusion or exclusion. If inclusion/exclusion criteria are based on gender, race, or ethnicity, explain rationale for restrictions.

Participants must have normal or corrected-to-normal vision and hearing in order to participate in the study.

Describe the process for how you will be recruiting potential participants. Include a description of how contact information will be obtained.

Subjects will primarily be recruited from the PBS SONA pool (credit and paid) but also include word of mouth methods (such as email, posting on social media outlets, etc.). Occasionally subjects will be recruited from campus advertisements approved by the Office of Research, such as through campus email listservs. Emails will be sent to people who have indicated they would like to be contacted for research studies. For studies involving multiple sessions, participants will provide their email address, phone number, and availability. We will contact those participants via email or phone. Online studies will be advertised through the websites Prolific: https://app.prolific.co/, Open Science Framework program Open Sesame: https://osdoc.cogsci.nl/, Qualtrics: https://www.qualtrics.com/, Cognition.Run: https://www.cognition.run/ , and Pavlovia: https://pavlovia.org/docs/home/about. Participants will be provided a web link to complete the task - no downloading applications are necessary.

Describe where at UCSB your research will occur.

Behavioral testing will be performed in the Psychology East basement room 0814C.

Some behavioral testing will be conducted online via the Open Science Framework program
OpenSesame: https://osdoc.cogsci.nl/ , Prolific: https://app.prolific.co/ , Qualtrics:
https://www.qualtrics.com/,
Cognition.Run: https://www.cognition.run/ , and Pavlovia: https://pavlovia.org/docs/home/about.

Provide a brief description of the project in lay terms, including the specific study objectives, rationale, and hypotheses.

This project will investigate rhythmic elements in music's effects on our ability to remember the order of a sequence of events, attempting to answer the question "Can an isochronous auditory rhythm act as a temporal scaffold to enhance the encoding of visual episodic memory for temporal order?". Through testing participants' temporal order memory, subjects will be asked to complete memory tasks on a computer. The research will be exploring episodic memory for us to study techno music's effects on our neural entrainment to an external clock. Pursuing this question will allow us to test the Dynamic Attending Theory with episodic memory encoding, building upon previous research conducted by Jones & Ward (2019) which found participants showing higher levels of recognition for items presented in a rhythmic manner compared to an arrhythmic manner. This research will be able to build upon Jones & Ward's findings with a temporal order memory task, observing techno music's effects on encoding. Using a lyricless, isochronous techno track as our rhythmic stimulus, we will replicate and expand upon established findings with powerful, ecologically valid stimuli.

Participants will be presented with a sequence of neutral scene images and will be instructed to pay attention to the order in which the images appear. During presentation of the sequence, they will be exposed to one of three different types of auditory stimuli playing in their headphones: (1) an instrumental techno track with the downbeats *in-sync* with presentation of the images; (2) an instrumental techno track with the downbeats *out-of-sync* with the images; (3) a fixed ambient drone without a rhythm; (4) an isochornous metronome. After the encoding sequence, participants will be asked to complete the retrieval phase in complete silence. To test memory retrieval, participants will be asked to conduct a temporal order judgment task to compare which of two randomly selected images was presented first in the encoding sequence. There will be 10 trials for each of the 4 types of audio stimuli (40 sequences and 40 temporal judgments in total), with audio type during encoding randomized throughout the study. We hypothesize that participants in the in-sync condition will have significantly higher accuracy rates and faster reaction times in their temporal order judgments compared to participants in the out-of-sync, ambient and metronome conditions.

We will control for individual differences such as state anxiety (the State-Trait Anxiety Inventory, STAI [Speilberger et al., 1983]), musicality (the Goldsmiths Musical Sophistication Index, [Müllensiefen et al., 2014] (Gold-MSI), and attentional control (the Attentional Control Survey, [Derryberry & Reed, 2002] (ACS).

Citations:
Derryberry, D., & Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by

attentional control. *Journal of Abnormal Psychology*, *111*(2), 225-236.
https://doi.org/10.1037//0021-843x.111.2.225

Jones, A., & Ward, E. V . (2019). Rhythmic temporal structure at encoding enhances recognition memory. *Journal of Cognitive Neuroscience*, *31*(10), 1549-1562.
https://doi.org/10.1162/jocn_a_01431

Müllensiefen, D., Gingras, B., Musil, J., & Stewart, L. (2014). The Musicality of Non-Musicians: An Index for Assessing Musical Sophistication. *Psychology of Music*, *42*(2), 195–229.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Describe your study procedures in detail of how the research will be conducted. Include information about all study procedures (e.g., all interventions/interactions with subjects, data collection procedures) and follow-up procedures. Include the number, duration, and frequency of sessions to be completed with the participants. (Upload copies of all study materials to the Attachments tab.

The participants will be taken to the designated room and will first be presented with the IRB-approved consent form alongside an explanation of the task. Participants will be reminded that participation in the study is voluntary and that they can withdraw from the study at any time.

Temporal order judgment task
Participants will be given instructions for the encoding phase and test phase. For the encoding phase of each trial, they will see a list of 10 images appearing on the screen, one at a time. Their goal is to remember the images and the order in which they appear. For the testing phase, they will see two random images from the sequence and decide which was presented first. We will run 2-3 practice trials to make sure that the participants understand the task.
During the temporal order judgment task, participants will be wearing high-fidelity closed-back headphones provided in the lab. The headphone will play 1 of 4 types of audio during the encoding phase: (1) a rhythmic, instrumental, lyricless techno track, where the downbeats are in-sync with the presentation of the stimuli 2) a rhythmic, instrumental, lyricless techno track, where the downbeats are out-of-sync with the presentation of the stimuli (3) a non-rhythmic, instrumental ambient drone, and (4) a simple isochronous metronome. The presentation of the stimuli will still appear at the same rate of the in-sync techno condition across all trials.

After following the encoding task, participants will make the temporal order judgments in complete silence. Participants will be shown two images randomly selected from the sequence, and asked to decide which of the two images appeared first. Participants will answer by clicking on one of the two images, and the computer will record their accuracy and reaction time. Participants will take a self-paced break, then proceed to the next trial (10 trials for each of the 4 audio types randomized throughout the task).

After all temporal judgment trials are finished, participants will complete questionnaires measuring individual difference factors, including the
State-Trait Anxiety Inventory (STAI), the Goldsmiths Musical Sophistication Index (Gold-MSI), and the Attentional Control Survey (ACS).

Finally, participants will be debriefed. The full procedure will take approximately 30-45 minutes.

Describe the plan for compensating participants (if applicable) and prorating if an individual withdraws from the study.

Subjects who sign up for studies via the UCSB SONA credit subject pool will receive course credit (1 credit/hour). Non-credit participants will be paid in cash or Amazon gift cards at the rate of $10/hour. If a participant withdraws from a study before completion, they will receive full compensation (credit or payment). Participants will be informed of the compensation structure before conducting the task.

Describe psychological risk (psychological damage, embarrassment, discomfort, forced awareness).

Participants may become bored or fatigued while performing the task, but these experiences are usually mild and generally subside quickly after the study. Participants may be nervous about participating in a study that measures their memory performance.

Safeguard

To mitigate fatigue, the study procedures will be broken into smaller segments, in which participants may take a self-paced break after each trial. To mitigate nervousness about the study, the researcher will make sure to thoroughly explain all of the procedures of the study and answer any questions participants may have throughout the session. A researcher will always be present during a session to ensure participants are comfortable. Participants are allowed to withdraw from the study at any time for any reason.

Describe physical risk (injury, exposure to violence, medical equipment).

Participants may experience mild visual and auditory fatigue associated with presentation of visual and audio stimuli.

Safeguard

To minimize visual fatigue, images will be presented at the center of the computer screen against a dark gray background and presented at a moderate speed during the encoding sequence. To mitigate auditory fatigue, we will set a threshold on our computers to not play audio over 75dB, a safe level recommended by the Occupational Safety and Health Association. During the practice trials, participants will be given the opportunity to adjust the audio to a level that is comfortable to them. Additionally, we will make sure that participants are aware before starting the study that they are able to take self-paced breaks throughout the study, and that they are able to withdraw from the study without penalty.

Describe confidentiality/privacy risk (invasion of privacy, potential breach of confidentiality, exposed to criminal or civil liability, loss of job/employability, mandatory reporting to outside entities).

There is a very minimal risk that subject data might be identifiable. In most cases, no information is collected that would link an individual's identity (e.g. name) with their data. We do not collect any sensitive personal information such as birth dates, addresses, or social security numbers.
Safeguard

For the purpose of data collection, arbitrary codes are assigned to subjects so that no identifying information can be linked to subject data.

Describe how and where data will be stored. Include the survey host information (e.g., survey host name, if IP addresses are collected, etc.), and types of devices (e.g., computer, tablet, Cloud service storage, etc.) used to store the information and if the devices are encrypted and/or password protected.

All behavioral data will be codified without subject identifiers. Data are securely stored either in locked testing rooms on password-protected computers (in the case of in-person participation) or in encrypted online servers (in the case of online participation) that only the researchers can access.

Safeguard

The lab is locked at all times in order to protect against possibilities of theft. The computer is password protected, so that only experimenters can access any information on the computer, or access the computer remotely via the internet. Only the investigator or their laboratory assistant/grad student fellow will have access to any data. There are no transcripts or videos of the study sessions.

Describe risk to autonomy (incentives, coercion, economic, use of own students/staff/friends). Address risks of privacy and confidentiality if the participant is in a lower position of power or has a personal relationship with the research team.

Subjects will receive course credit (1 credit/hour) or monetary payment ($10/hour).

Safeguard

Subjects are free to discontinue the experiment at any time and will still be compensated for the time they have participated in the experiment.

Describe any risks not listed above

Safeguard

Describe the procedures for obtaining informed consent. Include who will be responsible for seeking consent, how, when, and where consent will be obtained. If research will involve a non-native speaking population or an international component, describe the investigator(s) linguistic proficiency and/or how the consent documents will be translated in the subject's native language. Describe the measures taken to ensure subjects are informed about the research and how the appropriateness of the consent process will adhere to cultural standards.

For in-person research studies, the researcher will explain the study to the subject in detail highlighting the purpose, procedures, risks, safeguards, and benefits associated with the study. The subject must provide written informed consent before participating. A researcher will always be present to answer questions and make sure the subject is comfortable. At any time the subject can withdraw from the study for any reason.

For online studies, participants will read through the "Online Studies Consent" and make a "yes" or "no" button response via the Prolific (https://app.prolific.co/), OpenSesame (https://osdoc.cogsci.nl/), Qualtrics (https://www.qualtrics.com/), Cognition.Run (https://www.cognition.run/), or Pavlovia (https://pavlovia.org/docs/home/about) website as to whether they agree to participate in the study or not.

The participant may withdraw from the study at any time for any reason. The researcher may terminate the study or withdraw the participant from the study if the participant fails to make the study visit or if the participant is unable to perform the task. De-identified data might be shared with research collaborators at UC Santa Barbara and possibly researchers at other universities for basic research purposes only. If data is shared, it will be shared using a secure server that is password-protected. Subjects will not be identifiable.

CONSENT FORM

Describe the benefits, if any, to the subjects, to the class of subjects, to society, and to the advancement of knowledge. If there are no direct benefits anticipated for the subjects, please state as such. Do not include compensation as a benefit.

There are no direct benefits to the participant for participating in the study.

The benefits of this study will be contributing to advancing societal and scientific knowledge. This study will allow us to fill gaps in our understanding on multisensory memory and dynamic attending theory. It allows us to build upon previous research to see how this temporal scaffold can enhance episodic memory. Additionally, the use of techno music allows us to use an ecologically valid and culturally rich stimulus for our study. A large portion of the student population listen to music while studying, and the recent boom in the popularity of the electronic music industry calls for research to see whether the effects of music while studying is something that should be advocated for or not. Techno music's lyricless, groovy, and isochronous nature allows us to take a step up from simple metronomes while making sure we reduce confounds such as the effects of lyrics on the phonological loop and the general subjective nature of music.

Explain why any risks to the study are reasonable in relation to the potential benefits to subjects and/or society.

The benefits from insights gained by understanding music's effects on visual episodic memory are far greater than the minimal risk of the procedures. Similar research in the past has been quite beneficial and has been published in numerous peer-reviewed articles, and presented at many conferences. We expect that the continuation of this project will only lead to greater advancement of knowledge.