Basically, the gist that I got from last time was the fact that our experiment as is is not good enough to be able to sent across as an abstract. That being said the ‘goal’ that we are pursuing is quite admirable, and it seems as though a lot of the work tha twe have already presented is good enough for the AVA, so it really is more like the basis of a PhD than an isolated project when you really think about it. Anyway, let’s go fetch the old abstract, and then we can rewrite a new one.   
  
Objective measurement of mental visual imagery through pareidolia-based reverse correlation

Saivydas Villani, Guido Maiello (Department of Psychology, University of Southampton, Southampton, SO17 1BJ, UK; email: sv5g24@soton.ac.uk)

Mental visual imagery lacks objective measurement tools, with current methods relying on self-report questionnaires like the Vividness of Visual Imagery Questionnaire (VVIQ). However, self-report measures are susceptible to demand characteristics and response biases (Pearson et al., 2013 Front Psychol 4:385). To address these limitations, we explored a pareidolia-based visual task as an objective measure of mental imagery, leveraging reverse correlation techniques (Brinkman et al., 2017 eLife 6:e21761). We investigated relationships between VVIQ, Cardiff Anomalous Perceptions Scale (CAPS), and a novel reverse correlation task. Five participants completed VVIQ, CAPS, and a visual task comprising practice trials and two main blocks. Participants identified target digits in white noise images. Results showed moderate negative correlations between VVIQ and CAPS, stronger for visual-specific items. Training accuracy positively correlated with VVIQ. While exact digit classification was unsuccessful, model confidence ratings were consistently close to targets. Perfect test-retest reliability of target digit confidence across blocks suggests methodology validity. These findings indicate potential for this paradigm in objectively measuring mental visual imagery, contributing to our understanding of individual differences in visual imagery ability and their relation to anomalous perceptions. This study demonstrates the utility of reverse correlation techniques in probing internal mental representations and their relationship to self-reported cognitive abilities.

--

EXPLANATION

Basically, I want to submit an asbtract so that I can present my work at the Applied Vision Association in cardiff. The work is based on the project we have been working on here in this space as you can see from our history. The only pickle is that we don’t have any resutls from our small pilot study, we need to go back to the drawing board and revise. Here is the rundown on what was supposed to happen:  
  
I create an online study where participants could take the VVI Q & CAPS questionnaires, then they would do this visual task. The task consists of looking at 10 whitenoise pixel stimuli that are quite small (16x16) pixels and are told to look for a target digit, either ‘6’ or ‘9’. The catch is that none of these images inherently have the taret digit, but pareidolia should lead participants with higher visual imagery to project their mental model of the target digit to pick up on the little signal within any given image such that their composite would resemble the target digit, there was also a training round with 10 trails where there are 9 random noise images and 1 image will have an embedded ‘3’ that the participants are asked to look for and this gets progressively harder each trial, this was used both as a sanity check and practice. Anyway the point of all of this is that I trained neural networks to classify these composite images, and these models can give confidence ratings on each digit, thus we can have a quantifialble measure of the quality of the compsoite and thus a score for the reconstruction, we could even create partial composites to see the rate of composition etc. Then we were going to validate this by correlating these scores to the VVIQ and CAPS to show that they are stemming from the same underlying thing and that pareidolia is indeed bringing these things together etc. Unfortunately, we did not get these resutls, as none of the participants were able to reconstruct compopsites that resemble the digit. Now, we can’t just throw away all the work that we did, so instead we need to present the abstract as a foundation for this as though it were a PhD project or something. Basically, reveserse correatlion without augmentations as we have done it would simply take too many trials for this to be used as a valid assessment tool in clinical appliactions, thus what we will have to do is revise the paradigm. So we can shift it to a more methodological study that looks at the underlying mechanism that works in pareidolia (what is the similarity function that operats within humans in this task?) this can be then used to create a model that performs in the task much like a human, so we can have a more ecologically valid validation tool and create a valid stimulus set that would allow for controlled and quantitative assessment of an individuals iamgery ability.   
  
for added context here is the draft of the old abstract:  
  
Mental visual imagery lacks objective measurement tools, with current methods relying on self-report questionnaires like the Vividness of Visual Imagery Questionnaire (VVIQ). However, self-report measures are susceptible to demand characteristics and response biases (Pearson et al., 2013 Front Psychol 4:385). To address these limitations, we explored a pareidolia-based visual task as an objective measure of mental imagery, leveraging reverse correlation techniques (Brinkman et al., 2017 eLife 6:e21761). We investigated relationships between VVIQ, Cardiff Anomalous Perceptions Scale (CAPS), and a novel reverse correlation task. Five participants completed VVIQ, CAPS, and a visual task comprising practice trials and two main blocks. Participants identified target digits in white noise images. Results showed moderate negative correlations between VVIQ and CAPS, stronger for visual-specific items. Training accuracy positively correlated with VVIQ. While exact digit classification was unsuccessful, model confidence ratings were consistently close to targets. Perfect test-retest reliability of target digit confidence across blocks suggests methodology validity. These findings indicate potential for this paradigm in objectively measuring mental visual imagery, contributing to our understanding of individual differences in visual imagery ability and their relation to anomalous perceptions. This study demonstrates the utility of reverse correlation techniques in probing internal mental representations and their relationship to self-reported cognitive abilities.

DRAFT new abstract:

Mental Visual Imagery lacks obkjective measurement tools, with current methods relying on self-report questiionaires the like Vividness of visual imagery questionnaire (VVIQ). However, self-report measure are susceptible to demand characteristics and response biases (someone et al.). That being said, there are reports that individuals who self-report to have more vivid visual imagery also self-report to experience pareidolia more frequently and or intensely (REF). Thus, the present study explores a paredolia-based visual a pareidolia-based visual task as an objective measure of mental imagery, leveraging reverse correlation techniques. However, given the limitations of reverse correlation techniques, namely the vast number of data that is required from participants to create a composite, the present study starts with a datadriven approach to create a validation method and accompanying ‘artifical observers’ to establish a pipeline for an objective measure visual imagery that leverages pareidolia. The study explores how different similarity mechanisms might be at play when a participant is asked to look for signal in noise (pareidolia). Namely, the study explores how pixel difference, correlational differences, and spectral differences, might be at play to better understand pareidolia. The overarching goal here is to create a pipeline wherein partticipants will be able to complete a visual task wherein they will look for target symbols in precrafted stimuli which each have an accompanying rating of the underlying level of signal within in. These measures, along with the accompanying composite images that stem from it can be further evaluated by a neural network classifier. This is all with the aim of creating the visual imaery assessment tool.

--

Longer version:

Mental visual imagery assessment currently relies heavily on self-report measures like the Vividness of Visual Imagery Questionnaire (VVIQ), which are susceptible to demand characteristics and response biases (REF). Recent studies suggest a link between self-reported vivid visual imagery and increased experiences of pareidolia (REF). This study explores a novel, objective measure of mental imagery using a pareidolia-based visual task and reverse correlation techniques.Our initial pilot study (n=6) investigated relationships between VVIQ, Cardiff Anomalous Perceptions Scale (CAPS), and a reverse correlation task where participants identified target digits in white noise images. While correlations between VVIQ, CAPS, and task performance were not statistically significant, the VVIQ-CAPS relationship approached significance, warranting further investigation with a larger sample size.The pilot study revealed limitations in the reverse correlation paradigm, particularly the high number of trials required to generate recognizable composites. Even with 50-100 trials using correlational differences (Euclidean distance or least squares comparison between stimuli and an ideal observer), the resulting composites did not resemble the target digits.Given these challenges, we propose a revised methodological approach to create a more efficient and ecologically valid assessment tool. This data-driven approach aims to:

1. Explore different similarity mechanisms underlying pareidolia, including pixel differences, correlational differences, and spectral differences.
2. Develop "artificial observers" using machine learning techniques such as convolutional neural networks (CNNs) or generative adversarial networks (GANs) to model human perception in pareidolia tasks.
3. Create a validated stimulus set with quantifiable levels of embedded signal, allowing for controlled assessment of individual imagery abilities.
4. Implement a visual task where participants identify target symbols in pre-crafted stimuli, with performance evaluated by both human judgments and neural network classifiers.

Potential techniques to investigate include:

* Transfer learning with pre-trained CNNs for feature extraction
* Variational autoencoders for generating and manipulating stimuli
* Bayesian optimization for efficient stimulus selection
* Multi-task learning to jointly model VVIQ scores and task performance

This methodological study aims to establish a robust pipeline for objectively measuring visual imagery ability, leveraging pareidolia and advanced computational techniques. The resulting assessment tool could have significant implications for both research and clinical applications in understanding individual differences in visual imagery and their relationship to anomalous perceptions.

250-word version for submission:

Mental visual imagery assessment relies heavily on self-report measures like the Vividness of Visual Imagery Questionnaire (VVIQ), which are susceptible to biases (REF). This study explores a novel, objective measure of mental imagery using a pareidolia-based visual task and reverse correlation techniques. Our pilot study (n=6) investigated relationships between VVIQ, Cardiff Anomalous Perceptions Scale (CAPS), and a reverse correlation task where participants identified target digits in white noise images. While correlations were not statistically significant, the VVIQ-CAPS relationship approached significance. The study revealed limitations in the reverse correlation paradigm, particularly the high number of trials required to generate recognizable composites. We propose a revised methodological approach to create a more efficient and ecologically valid assessment tool. This data-driven approach aims to:

1. Explore different similarity mechanisms underlying pareidolia (pixel, correlational, and spectral differences).
2. Develop "artificial observers" using machine learning techniques to model human perception in pareidolia tasks.
3. Create a validated stimulus set with quantifiable levels of embedded signal.
4. Implement a visual task where participants identify target symbols in pre-crafted stimuli, evaluated by both human judgments and neural network classifiers.

This methodological study aims to establish a robust pipeline for objectively measuring visual imagery ability, leveraging pareidolia and advanced computational techniques. The resulting assessment tool could have significant implications for both research and clinical applications in understanding individual differences in visual imagery and their relationship to anomalous perceptions.

--

Title: Methods to Create and Evaluate Pareidolic Stimuli in Pixel Space

Mental visual imagery, while intriguing, presents significant measurement challenges. Traditional assessments rely on self-report measures, such as the Vividness of Visual Imagery Questionnaire (VVIQ), which are inherently subjective. This study explores an innovative approach to objectively measure visual imagery through a pareidolia-based visual task, leveraging the hypothesised connection between mental imagery and pareidolic experiences. Our previous work involved a genetic reverse correlation task where participants identified symbols (letters, digits, X's and O's) in noise images, generating composites that resembled the target digits over multiple trials. To quantify the clarity of these reconstructions, we developed neural network classifiers trained on artificially created datasets mimicking experimental data. These classifiers, utilising architectures such as LeNet-5 and custom designs, along with augmented MNIST data, demonstrated classification accuracy comparable to human judgements. This alignment suggests that the models may be capturing processes similar to human perception. Beyond classification, these models serve a dual purpose in creating pareidolia stimulus sets with quantifiable signal metrics. These stimuli can be employed in forced-choice experiments to measure individual differences in pareidolia activation, potentially serving as an objective measure of mental visual imagery. Our approach incorporates various similarity mechanisms underlying pareidolia, including pixel difference, correlation measures, and convolutional approaches, to simulate observers. This methodology offers several advantages: it enables the quantification of pareidolia sensitivity, facilitates the measurement of individual differences, and enhances our understanding of how mental representations of digits are recognised and projected onto noisy, ambiguous stimuli. This data-driven approach establishes a robust pipeline for objectively assessing visual imagery ability, with potential implications for both research and clinical applications in understanding the spectrum of visual imagery experiences. (Word count: 250)

--

Mental visual imagery assessment traditionally relies on subjective self-report measures, necessitating more objective evaluation methods. Building upon established genetic reverse correlation techniques for generating pareidolic stimuli, this study introduces novel computational approaches to create and evaluate these stimuli in pixel space. We developed a methodology that combines artificial data generation, simulated observers, and neural network classifiers to quantify and analyse pareidolia-based visual tasks. Our approach involves creating synthetic datasets that closely mimic experimental data from reverse correlation tasks. These datasets serve as training grounds for neural network classifiers, utilizing architectures such as LeNet-5 and custom designs, augmented with MNIST data. To simulate human observers, we implemented various similarity mechanisms, including pixel difference, correlation measures, and convolutional approaches. This multi-faceted method allows for the creation of pareidolia stimulus sets with quantifiable signal metrics. The classifiers not only aim to model human-like classification of ambiguous stimuli but also generate new stimuli with controlled levels of embedded signal. These stimuli can be employed in forced-choice experiments to measure individual differences in pareidolia activation. Our data-driven approach establishes a robust pipeline for creating, evaluating, and analysing pareidolic stimuli, potentially offering insights into visual processing and imagery. By focusing on the computational aspects of stimulus generation and evaluation, this methodology provides a novel framework for exploring the intersection of visual perception, pareidolia, and individual differences in visual experiences, with implications for both research and potential clinical applications.

--

We are now also apparently going to recreate the genetic version of the reverse correlation which I initialliy obkected to because it literaly goes against the whole definition of imagery in the sendse that that’s the ability to cojurre an image in one’s mind with the absence of outside stimuli but here the stimuli go beyond that, but its actually an empirircal question because in the fist few trials there is definitely not enough signal for us to say that they are just visually discriminating and its just something that get clearer and clerare as the participant go through the experiment so its all Gucci mane.

--

New Draft:  
  
Mental imagery is the cognitive process of creating or recreating sensory experiences in the mind without direct external stimuli.

Traditional assessments rely on self-report measures, such as the Vividness of Visual Imagery Questionnaire (VVIQ), which are inherently subjective. But how do we objectively measure mental images? One potential solution is pareidolia. Reverse correlation is a task that relies on pareidolia. We thus conducted a mind-reading trick/experiment. We asked 18 participants to choose any digit from 1-9. Participants were then shown noise images and selected those that resembled the mental image they had formed of their chosen digit. We employed a genetic search algorithm to guide the participants’ selections, so that their selected digit progressively formed from the noise, creating a “classification image”, which is just the sum of the stimuli in which the participants report seeing their chosen digit. We input the generated classification images to deep neural network image classifiers trained at recognizing digits from images and were able to “mind-read” the participant’s imagined digit 40% of the time (p<.001; well above chance=11%). We also showed the classification images to a new set of participants, who were able to correctly identify the digits 60% of the time. Thus, both humans and DNNS can interpret the reconstructed mental images. We’ve thus demonstrated a method that can reconstruct and mind-read participants’ mental images. In future, the DNNS can act as simulated observers to design stimulus sets that can induce pareidolia, allowing for creation of further experiments that can measure things like individual differences in pareidolia activation/frequency. This data-driven approach establishes a pipeline for objectively assessing visual imagery ability, with potential implications for both research and clinical applications in understanding the spectrum of visual imagery experiences.

--

Mental imagery is the cognitive process of creating or recreating sensory experiences in the mind without direct external stimuli. Traditional assessments rely on subjective self-report measures, such as the Vividness of Visual Imagery Questionnaire (VVIQ). To objectively measure mental images, we explored pareidolia through a reverse correlation task.

We conducted a mind-reading experiment with 18 participants, asking them to choose a digit from 1-9. Participants selected noise images resembling their mental image of the chosen digit. A genetic search algorithm guided selection, progressively forming the digit from noise. The sum of these selections allows for the creation of a 'classification image'.

We input the generated classification images to deep neural network (DNN) image classifiers trained to recognise digits. The DNNs correctly identified the participant's imagined digit 40% of the time (p<.001; well above chance=11%). A new set of participants correctly identified the digits from classification images 60% of the time.

This method demonstrates the ability to reconstruct and mind-read participants' mental images, interpretable by both humans and DNNs. Future applications include using DNNs as simulated observers to design stimulus sets inducing pareidolia, enabling experiments measuring individual differences in pareidolia activation/frequency.

This data-driven approach establishes a pipeline for objectively assessing visual imagery ability, with potential implications for research and clinical applications in understanding the spectrum of visual imagery experiences.

--

Mental imagery is the cognitive process of creating or recreating sensory experiences in the mind without direct external stimuli. Traditional assessments rely on subjective self-report measures, such as the Vividness of Visual Imagery Questionnaire (VVIQ). To objectively measure mental images, we explored a novel approach using pareidolia and reverse correlation.Classification images are visual representations created by summing noise patterns in which an observer reports seeing a target stimulus. This technique allows us to reconstruct and visualize participants' mental representations. We aimed to leverage this method to objectively assess visual imagery ability, addressing the challenge of measuring a cognitive process that is not directly observable.We conducted a mind-reading experiment with 18 participants, asking them to choose a digit from 1-9. Participants selected noise images resembling their mental image of the chosen digit. A genetic search algorithm guided selection, progressively forming the digit from noise. The sum of these selections created a 'classification image', representing the participant's mental image of their chosen digit.We input the generated classification images to deep neural network (DNN) image classifiers trained to recognise digits. The DNNs correctly identified the participant's imagined digit 40% of the time (p<.001; well above chance=11%). A new set of participants correctly identified the digits from classification images 60% of the time.This method demonstrates the ability to reconstruct and interpret participants' mental images using both computational and human observers. It establishes a data-driven approach for objectively assessing visual imagery ability, with potential implications for research and clinical applications in understanding the spectrum of visual imagery experiences.  
--

Mental imagery is the cognitive process of creating or recreating sensory experiences in the mind without direct external stimuli. Traditional assessments rely on subjective self-report measures, such as the Vividness of Visual Imagery Questionnaire (VVIQ). To objectively measure mental images, we explored a novel approach using pareidolia and reverse correlation.

We conducted a mind-reading experiment with 18 participants, asking them to choose a digit from 1-9. Participants selected noise images resembling their mental image of the chosen digit. A genetic search algorithm guided selection, progressively forming the digit from noise. The sum of these selections created a 'classification image', representing the participant's mental image of their chosen digit.

We input the generated classification images to deep neural network (DNN) image classifiers trained to recognise digits. The DNNs correctly identified the participant's imagined digit 40% of the time (p<.001; well above chance=11%). A new set of participants correctly identified the digits from classification images 60% of the time.

This method demonstrates the ability to reconstruct and interpret participants' mental images using both computational and human observers. Future applications include using DNNs as simulated observers to design stimulus sets inducing pareidolia, enabling experiments measuring individual differences in pareidolia activation/frequency.

This data-driven approach establishes a pipeline for objectively assessing visual imagery ability, with potential implications for research and clinical applications in understanding the spectrum of visual imagery experiences.

--

Mental imagery is the cognitive process of creating or recreating sensory experiences in the mind without direct external stimuli. Traditional assessments rely on subjective self-report measures, such as the Vividness of Visual Imagery Questionnaire (VVIQ). To objectively measure mental images, we explored a novel approach using pareidolia and reverse correlation. We conducted a mind-reading experiment with 18 participants, asking them to choose a digit from 1-9. Participants selected noise images resembling their mental image of the chosen digit. A genetic search algorithm guided selection, progressively forming the digit from noise. The sum of these selections created a 'classification image', representing the participant's mental image of their chosen digit. We passed the generated classification images to deep neural network (DNN) image classifiers trained to recognise digits. The DNNs correctly identified the participant's imagined digit 40% of the time (p<.001; well above chance=11%). A new set of participants correctly identified the digits from classification images 60% of the time. This proof-of-concept demonstration bridges the gap between subjective self-reports and objective measurements of mental imagery. By combining reverse correlation with machine learning, we offer a novel, data-driven method to visualize and quantify individual differences in mental imagery ability. This approach not only provides a more objective assessment but also opens new avenues for exploring visual imagination. Future applications include using DNNs as simulated observers to design stimulus sets inducing pareidolia, enabling experiments measuring individual differences in pareidolia activation/frequency.