INTRODUCTION

NAILS: Neurally Augmented Image Labelling Strategies

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- <u>Topic:</u> P300 signals for image labelling

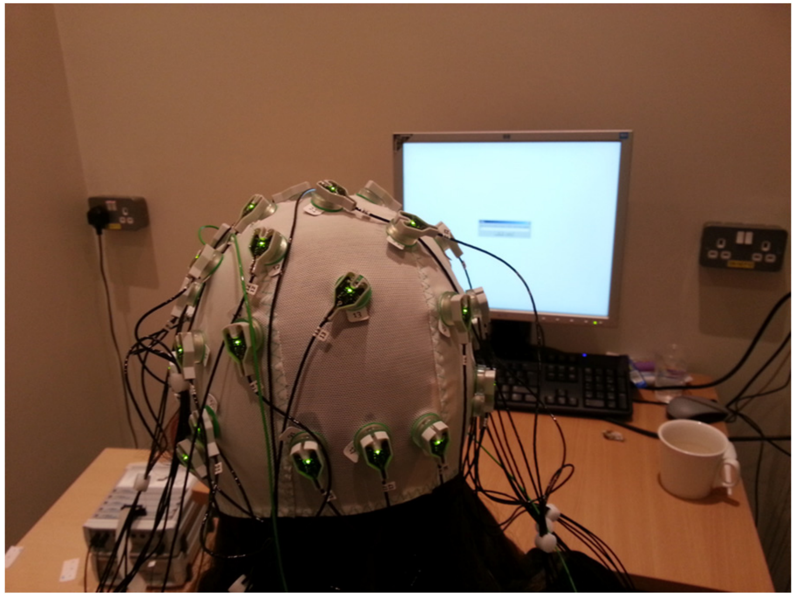
OVERVIEW

- Overview
- Examples on EEG, P300 & ERPs

- Our Task & Data Plan
- Schedule & Plan

QUICKLY: EEG

- EEG (Electroencephalography) recording systems come in many forms

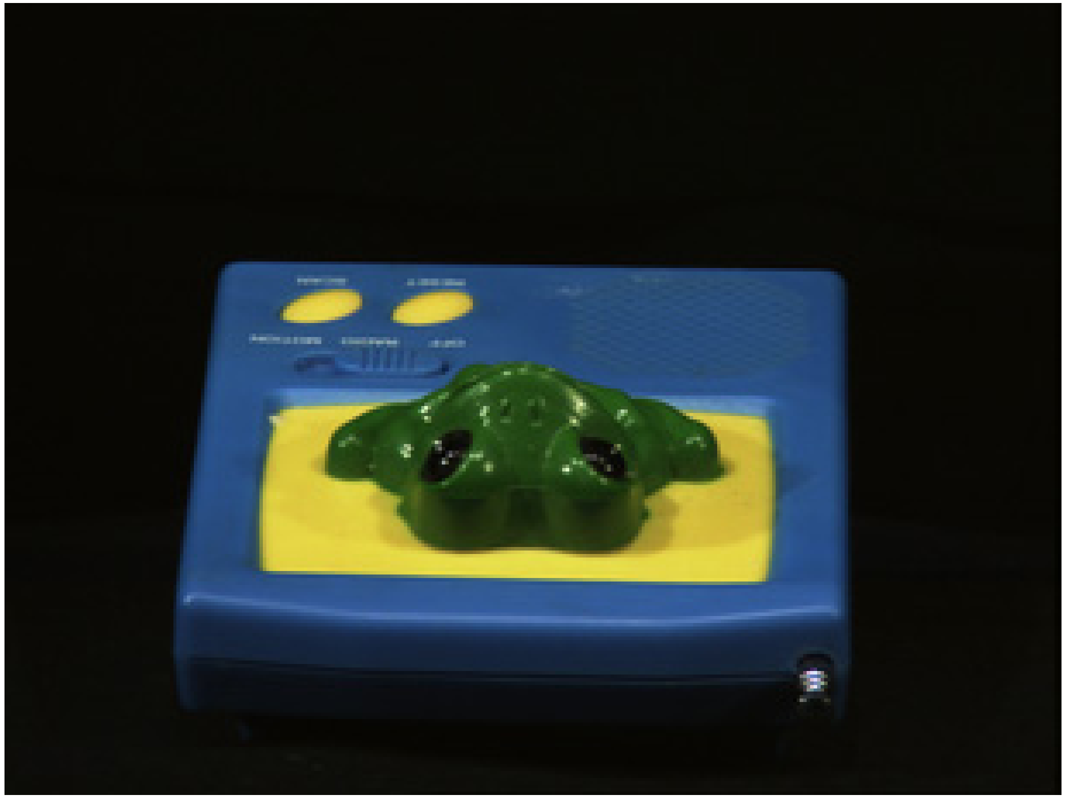


P300 EXAMPLE

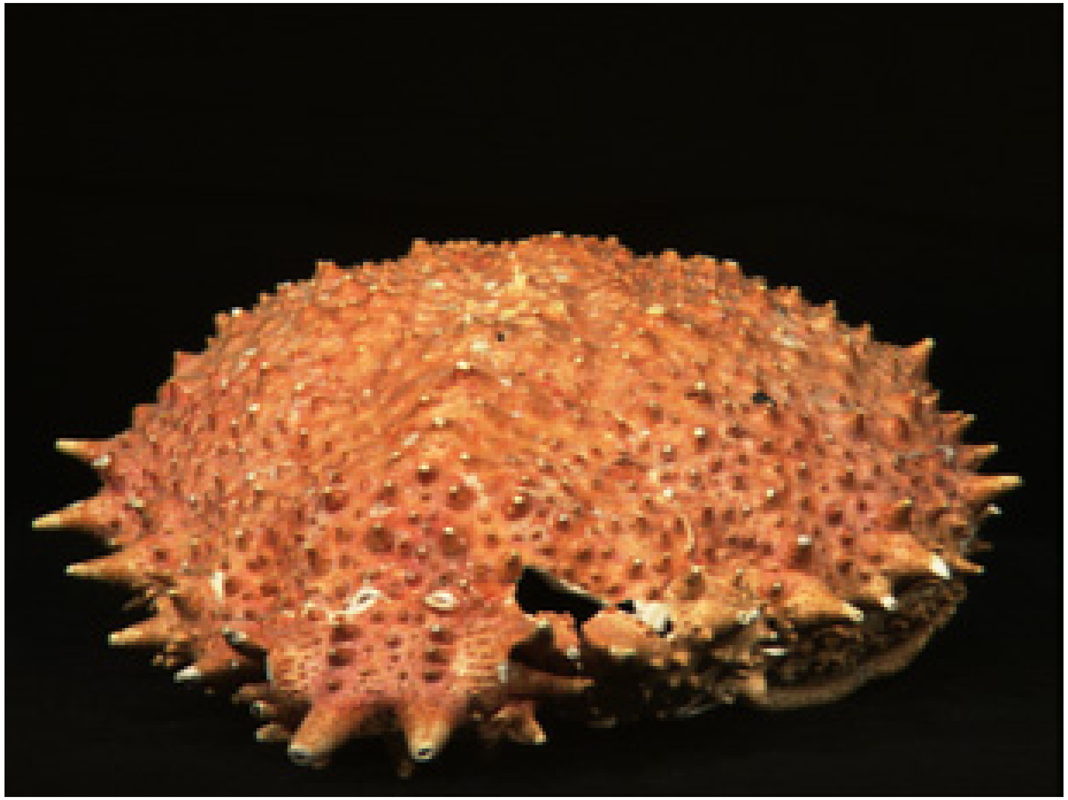
- This concept is best introduced with an example
- Find the image of a can of coke in the following stream of images:

P300 EXAMPLE

P300 EXAMPLE



P300 EXAMPLE



P300 EXAMPLE

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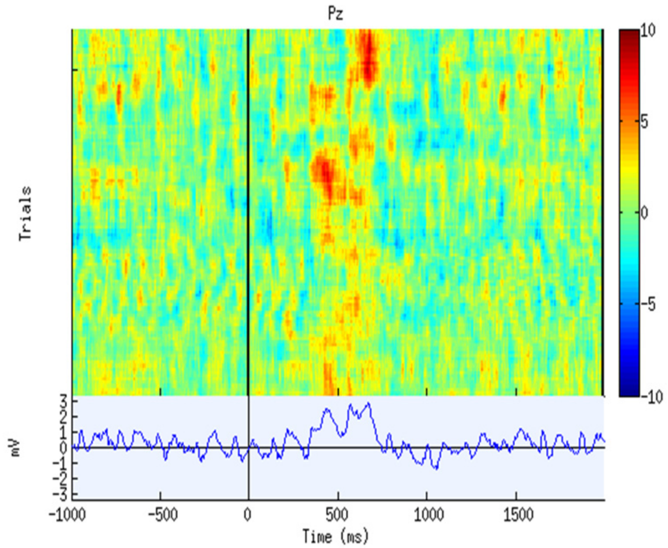
P300 EXAMPLE

- Everybody noticed it?

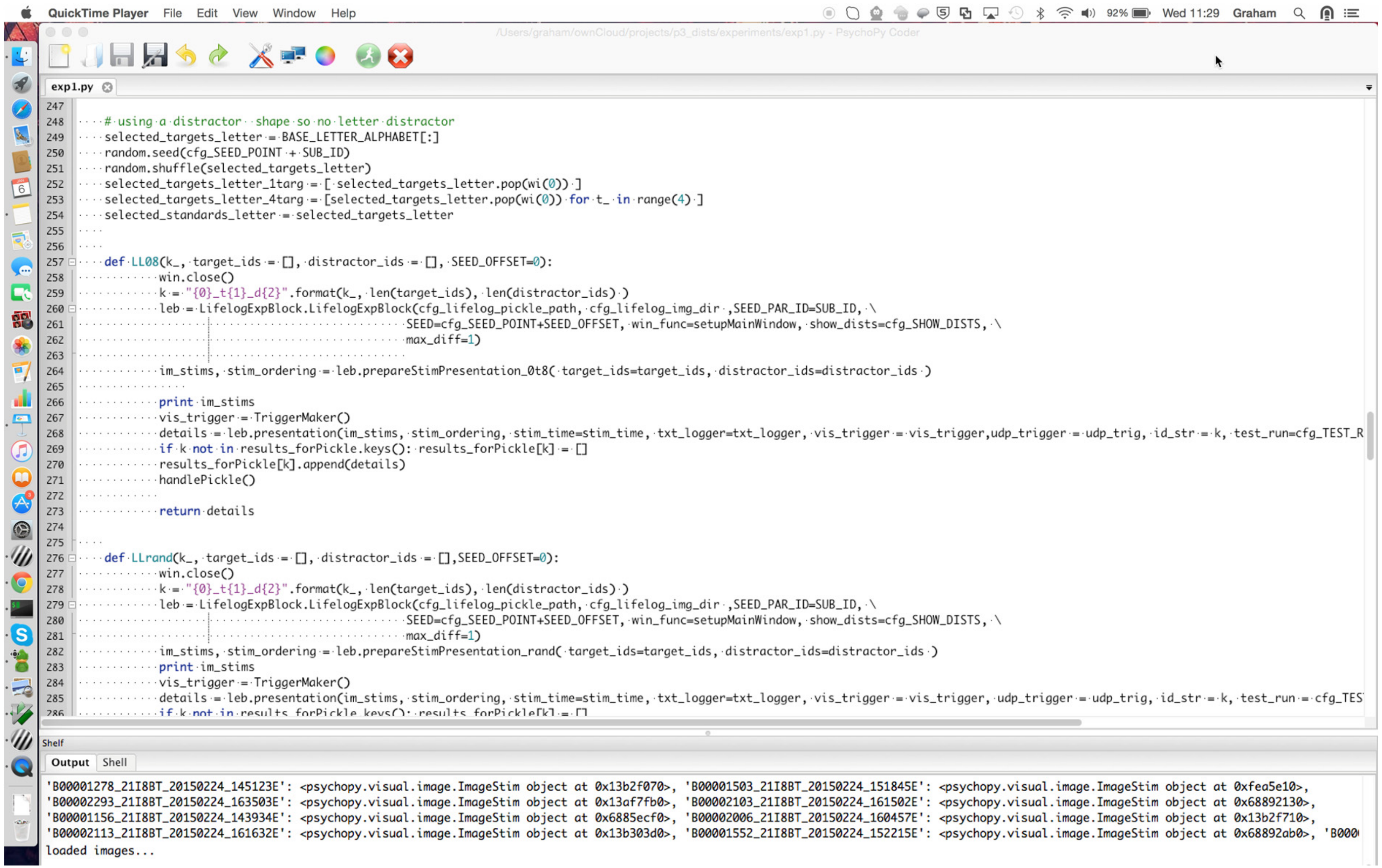
P300 RESPONSE

- There is nothing special about the can of coke, I could have told you to look out for the cup instead or used entirely different images

- This works because you do not know when the can of coke will appear and as a result when it does, your attention orientates to it (sort of like going through television stations)

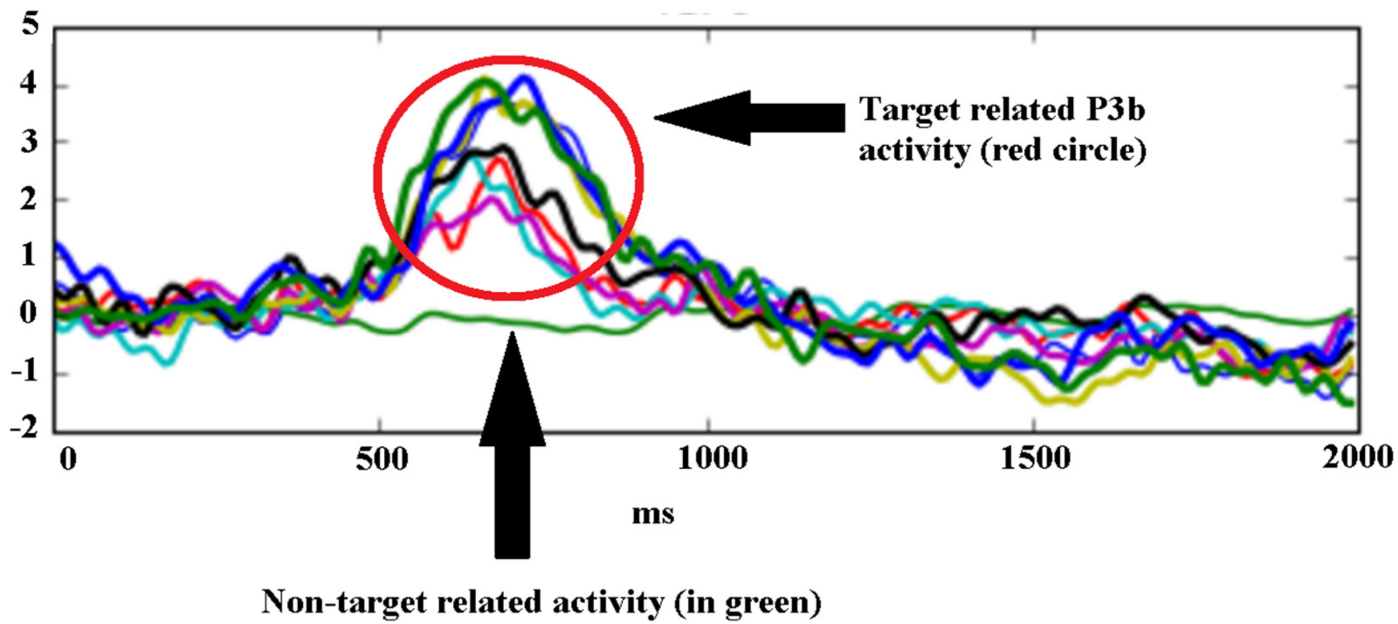


ANOTHER EXAMPLE (RSVP)



P300: A LIFELOG EXAMPLE

- We've done this where participants are required to search a stream of visual data for certain targets images/concepts



** Example ICA component activity*

P300-RSVP STRATEGY

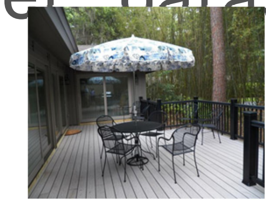
- What this type of approach takes advantage of:
  - The speed of human visual recognition/processing i.e. we can often present these images at a very fast rate (example given) *via RSVP (Rapid Serial Visual Presentation)*
  - The on-the-fly capability of defining search tasks for users (within some constraints)

TASK & DATA PLAN

- For NTCIR-13 we will release a dataset from 10 experiment participants preforming a number of search tasks

- The images used will be derived from the Places 2[1] dataset and the ImageNet[2] dataset

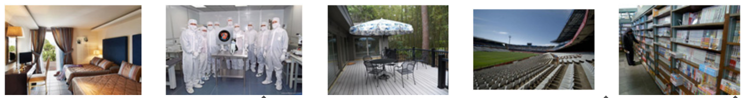




Places 2 dataset made available from MIT , [2]ImageNet Stanford vision lab

TASK & DATA PLAN

- The experiment for each participant will involve 8 search tasks
- i.e. *"Find photos of cats amongst the following stream of images"*
- Each search task is broken into 3 blocks (24 blocks total)
- Each block contains 450 images presented at 5 Hz



- 45 (10%) of these are targets (relevant) and 405 (90%) are non-targets(non-relevant)

TASK & DATA PLAN

- The aim for participating organisations will be to successfully predict from neural and behavioural (key press) which images are relevant (target) or non-relevant (non-target) for the relevant search query

- Participating organisations will be provided with training/validation data: 2 of 3 blocks for each search task

TASK & DATA PLAN

- During the evaluation period participating organisations will benchmark their prediction models using an online REST API (with some time-based limitations)
- We will provide raw/pre-processed feature vector for both neural / behavioural data for each image (-X task X subject) and must submit a prediction (0, 1)
- Accuracy will be assessed across all predictions for subjects X search - tasks on a withheld test set

TYPES OF SEARCH TASKS

- *Search-tasks will be modelled around those in ILSVRC
  - Four scene-centric search-tasks from Places2 i.e. find images of ‘art_gallery’, ‘nursing_home’, ‘oilrig’, ‘television_room’
  - Four object-centric search tasks from ImageNet i.e. find images of ‘cat’, ‘car’, ‘mushroom’, ‘desert’

. Exact search tasks will be identified during a piloting phase identifying those which a human is capable of sufficiently doin

TYPES OF DATA

- Data will be available in raw and numerous pre-processed formats to participants to lower the barrier to entry for those unfamiliar with processing EEG signals

- Neural-data feature vectors will include raw, bandpassed, wavelet, ICA, and other common feature transformations on which ML methods can be applied

TYPES OF DATA

- Example pipelines will be provided in python enabling participating organisation to leverage an already working (naive) solution to get started right away

- Before the evaluation period begins code examples will be provided showing participants how to interact with the online evaluation system

SCHEDULE & PLAN

- Next Steps:
  – Internal DCU ethics application to begin conducting experimentation (*July 2016*) – Approved (August)
  – Pilot experiments validating RT & neural responses (Sep *2016 – Oct 2016*)
  – Collection of final experimental dataset (*Oct 2016 – Nov 2016*)
  – Dataset release (*Jan 2017*)

CONCLUSION

- We can better understand the types of search-tasks where detection of neural events are useful
- Amplify insights and perspectives on labelling-behaviour of users (i.e. nuance and state-of-mind)
- Will help to develop state-of-the-art methods for such tasks
- Will help to understand the connection between behavioural and neural responses when performing an image search-task in this way

THANK YOU

- Further information will be available as the task structure develops at:
  - ntcir-nails.computing.dcu.ie
- If any further queries please feel free to: ghealy@computing.dcu.ie