Decoding the time-course of object recognition in the human brain from visual features to categorical decisions

Neuroimaging field.  
Multivariate analysis techniques, e.g. Multivariate pattern analysis (MVPA).

Univariate EEG evaluate differences in activation, relative differences in average activity between experiences, while multivariate methods have the potential to examine differences in information.  
For example, comparing differences in distributed patterns of brain activation between experiences.

EEG offers the potential to examine the time-course of object representation in the human brain, revealing a dynamic evolution of object category structure over time.

Visual object recognition requires a number of hierarchically organised stages that progress through the occipito-temporal pathway.

MEG and fMRI data.

Multidimensional scaling (MDS), technique that can be used as a tool for visualising the representational space of objects in the brain.

Demonstrate the utility of examining the change in representational structure of object representation over time  
Brain’s response to visual objects is highly dynamic, evolving rapidly from sensitivity to low-level visual properties to more category-like representations.  
Also robust categorisation distinction between animate and inanimate objects that is sustained.

Face recognition:  
The time-course of face decoding follows a similar pattern: there is an initial sharp rise in performance of the classifier early in the time-course, shortly followed by a relatively brief plateau or drop in decoding, before a second, more gradual rise in decoding accuracy, with peak decoding occurring relatively late in the time-course.  
Two peaks in decoding reflect different levels of processing within the object recognition hierarchy.

Categories:  
Instead of decoding the category of “tools” comparted to “faces”, instead be erroneously decoding “long and thin” versus “round”.

Early visual processing included a shape-based model that compared the image silhouettes, a colour-base model (CIE) and a hierarchical visual processing model (HMAX).

Comparing performance with deep neural networks (DDNs).

Object invariance is the ability to successfully recognise objects despite high variability in their appearance.   
Position invariant category information is present early in the neural signal.

Size invariant information present in the signal from around 125ms post-stimulus.  
Position invariant information present around 150ms.