Hippocampal role in the interaction of semantic memory with learning and decision

* We are Especially concerned with associative learning, how is it affected by already existing semantic associations
* Especially since associative learning seems to rely strongly on the hippocampus

So for our investigation we rely mostly on associative inference paradigms

* Simply put, it is the ability to make indirect associations:
  + If you learn A-B and B-C, you can deduce A-C
* This ability is particularly useful if the C state is not neutral or unconditioned but rewarded,
  + While A and B are neutral
  + In this case, we can see how it is adaptive to be able to make the link between a neutral stimulus indirectly associated with a reward
* It seems straightforward but it involves many processes

And studies have shown the regions and processes involved for different steps of associative inference

* First you need to represent the state a stimulus corresponds to
  + And the other states the stimulus is associated to
  + For instance a rewarded or unrewarded state
  + For this, the OFC seems to play a central role,
    - as its lesion or inactivation strongly impairs this abibilty
  + And functinal imaging as allowed to make a correlation between functionnal connectivity between OFC and hippocampus and performance in this task.
  + Overall, results seem to indicate that this hippo-OFC axis is central to represent and to retrieve the current and associated state
* So as I said before, we are interested in reward and value
  + And if value learning is involved, this recruits the striatum and the dopamine system for reinforcement learning
* If the indirectly associated value seems to be computed along the hippocampus-OFC axis,
  + The connectivity between the striatum and hippocampus seems to also corelates with performance in this tasks
    - Probably to transfer the correct expected value to the striatum
  + Finally there might be a role for the dopamine from the VTA to the hippocampus in facilitating value transfer, but it is not clear
* So we want to add a dimension to the picture by considering pre-existing semantic association
  + Meaning that A B and C are semantically linked, for instance, a picture of a garden and a picture of a lawn mower
  + A behavioral study showed that pre-existing association seems to improve performance
  + And that people with hippocampal lesion are only able to do the task above chance if there is a semantic link
    - So hippocampus necessary for a task that relies on arbitrary associations, but not for one that relies on existing ones

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So we want to better understand the processes behind this facilitation, that doesn’t seem to rely on hippocampal processes

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So in order to investigate that, we are doing an experiment similar to ones done before on associative learning

* 1) association or preconditioning phase, when people are exposed to AB associations and asked to learn them
* 2) reward or conditioning phase, where people learn the link between B and C, with C being a reward
* 3) a last phase where people are asked to make the inference by choosing rewarded A stimulus, indirectly associated with reward

A first analysis is then to use correlation of performance with activation of a region of interest

* And this shows that the hippocampal activity during learning seems indeed to be correlated with later performance
* However, if we use semantically linked AB pairs, because as the link is pre-existing, it shouldn’t be necessary
* And we expect to see less of this correlation, but maybe another region could be predictive

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Another possible analysis is to make use of the stimuli used to measure the association

* For instance by associating a scene and an object,
  + you can use a localizer trained to differentiate scenes and object
  + and you see if you decode a scene in an object, it is likely because the two stimulus are now associated
* now we expect this effect to appear faster for semantically linked pairs because of the semantic association

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And that s