Transferability of recall improvements in LLMs, using the property of historic formation or causality of key terms, to learning and recall in the human brain.

Experimentation with a Large Language Model (LLM) reveals that enriching a prompt with the history of the formation (etymology) of key terms improves recall and answer quality. My testable hypothesis is that such improvements are transferable to human brains and that the mechanism involved in improved prediction is based on the pattern generated by selection pressures (histories) that led to key words' eventual meaning. I would argue that the causation, and the underlying components of a word's meaning offer additional intrinsic correlation power.

Improvement in recall and answer quality in an artificial neural network:

I have conducted the following experiment on an LLM model:

Initial experimentation with GPT model Davinci 003 yielded initial promise with the aforementioned expansion of a prompt via keyword etymology integration. Coded below in python using Jupyter Notebook, blue text highlights original user input, red the added etymology, and green the AI response.

```
pip install openai
```

In [70]:

```
!pip install --upgrade openai
```

In [71]:

```
import openai
import json
```

In [72]:

```
with open ("apikey.json") as f:
    data = json.load(f)
value = data['api_key']
openai.api_key = value
prompt = input()
completions = openai.Completion.create(
    engine="text-davinci-003",
    #engine="gpt-3.5-turbo-instruct",
    prompt=prompt,
    max_tokens=300,
    n=1,
    stop=None,
    temperature=0.7
)
message = completions.choices[0].text
print(message)
```

```
is there a seahorse in the brain?


No, there is not a seahorse in the brain.
```

In [ ]:

```
#  Etymologies are not definitions; they're explanations of what our words meant and
how they sounded 600 or 2,000 years ago.
```

In [73]:

```
etymology=input()
```

```
the word seahorse from latin hippocampus due to its shape
```

In [74]:

```
prompt = prompt + etymology
print (prompt)
```

```
is there a seahorse in the brain?the word seahorse from latin hippocampus due to its s
hape
```

In [75]:

```
with open ("apikey.json") as f:
    data = json.load(f)
value = data['api_key']
openai.api_key = value

completions = openai.Completion.create(
   engine="text-davinci-003",
    #engine="gpt-3.5-turbo-instruct",
    prompt=prompt,
    max_tokens=300,
    n=1,
    stop=None,
    temperature=0.7
)
message = completions.choices[0].text
print(message)
```

```
, so it is often used to describe the part of the brain called the hippocampus. Howeve
r, there is no physical seahorse in the brain.
```

Proposed underlying mechanism in LLM:

Words are composed of assemblage of other words going through selection pressures to establish their meaning (Sharma et. al 2023). The enrichment of a key word in a prompt with its etymology improves prediction. Although the exact mechanism is not well understood, the potential underlying mechanism could be that additional correlation opportunity is introduced by the key words' components and the causation or historical selection that gave it meaning. Tokenizing the prompt with key words' underlying histories and core semantics creates richer context (multidimensional vectors) for accurate prediction.

Proposed mechanism in human brain:

GPT uses multi-dimensional vectors to represent and process language. These vectors capture semantic and contextual information about the words, enabling the model to understand the relationships between them and is similar to the reactivation and strengthening of neural pathways. When an event is being recalled, the neurons that originally fired synchronously fire again in the same fashion. This strengthens the synaptic connections or "importance" of this sequence, and enhances not only the ease in firing again, but the opportunity for new branching. As it is commonly described, "neurons that fire together, wire together". The bigger the stimulus structure, the better able a neuron is to match to other neurons, and increase the impact of the learning taking place. By increasing the number of salient possible pathways, etymology has the potential to impact how a word is encoded over time and recalled in the brain, subsequently altering predictive engagement with stimuli.