Computational Neuroscience: Neuronal Dynamics of Cognition

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Decision models:

Competitive dynamics

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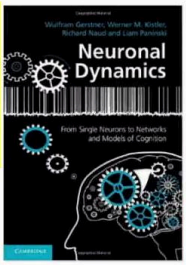
Reading for week 9:
NEURONAL DYNAMICS
Ch. 16 (except 16.4.2)

Cambridge Univ. Press



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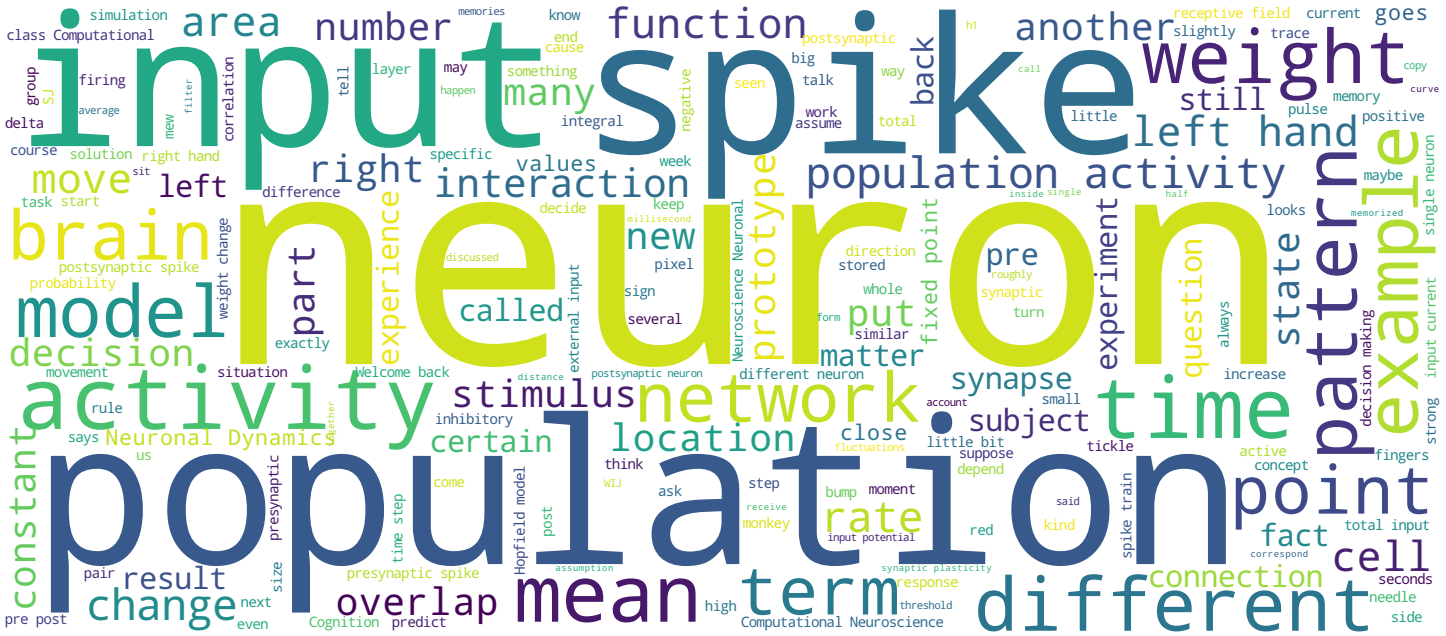
   - decision making
2. Perceptual decision making
   - V5/MT
   - Decision dynamics: Area LIP
3. Theory of decision dynamics
   - competition via shared inhibition
   - effective 2-dim model
4. Solutions
   - symmetric case
   -biased case
5. Simulations and Experiments
   - simulations and theory
   - simulations and experiments
6. Decisions, actions, volition
   - the problem of free will



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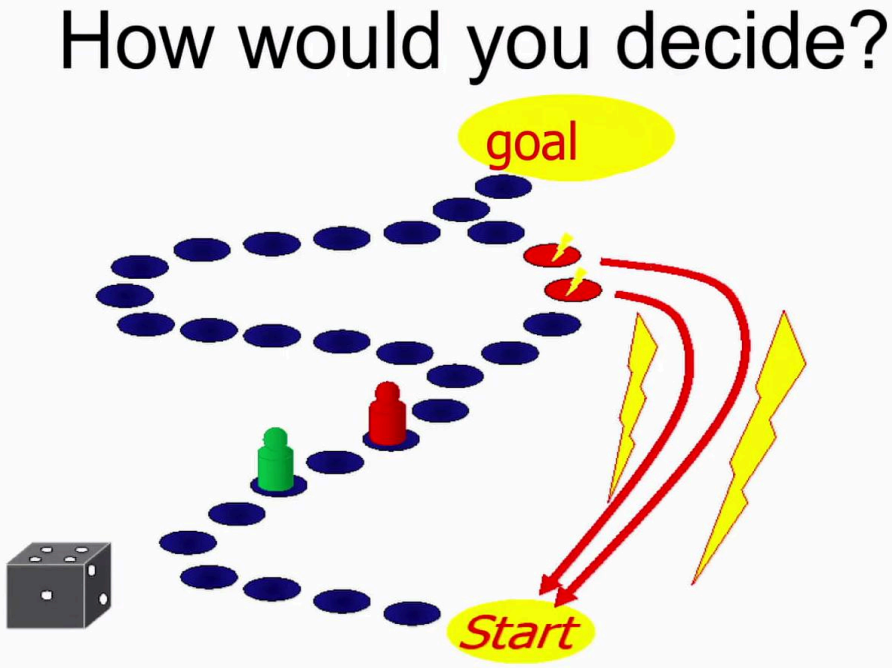
6. Decision: risky vs. safe



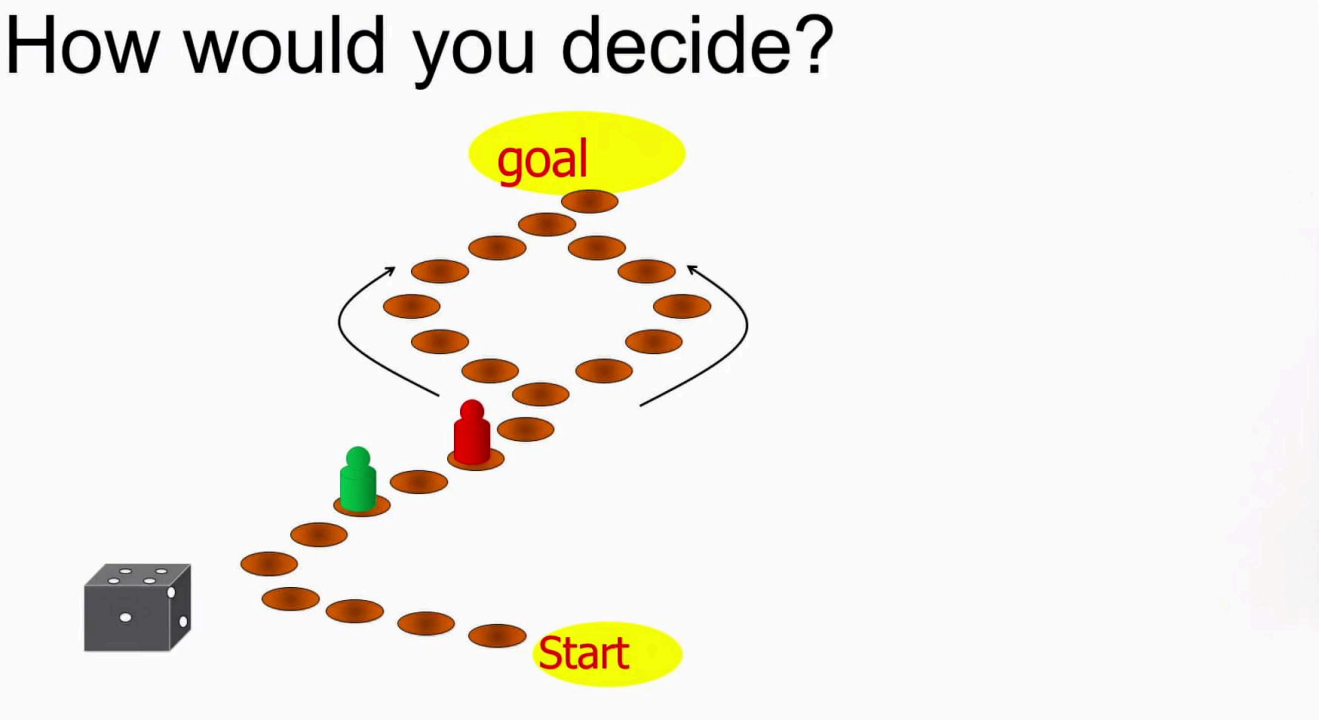
Welcome back to the class, Computational Neuroscience, Neuronal Dynamics of Cognition. This is the final part of our discussion of decision models using competitive dynamics. And then I would like to put the question of decision making into a larger context. To start with, let's do another of these psychophysical experiments. You are red, you have just a four, and now you have two choices. You can take the safe detour or you can take the risky shortcut, which could potentially put you back to the initial state. I want you to decide, I want you to make a commitment. So if you take the long shortcut, please put your left hand on your left knee. If you take the shortcut, that's risky, put your right hand on your right knee. Do this now, have you decided; are you a risky person or a safety person?

Notes

Summary

0m 17s

6. Decision: risky vs. safe



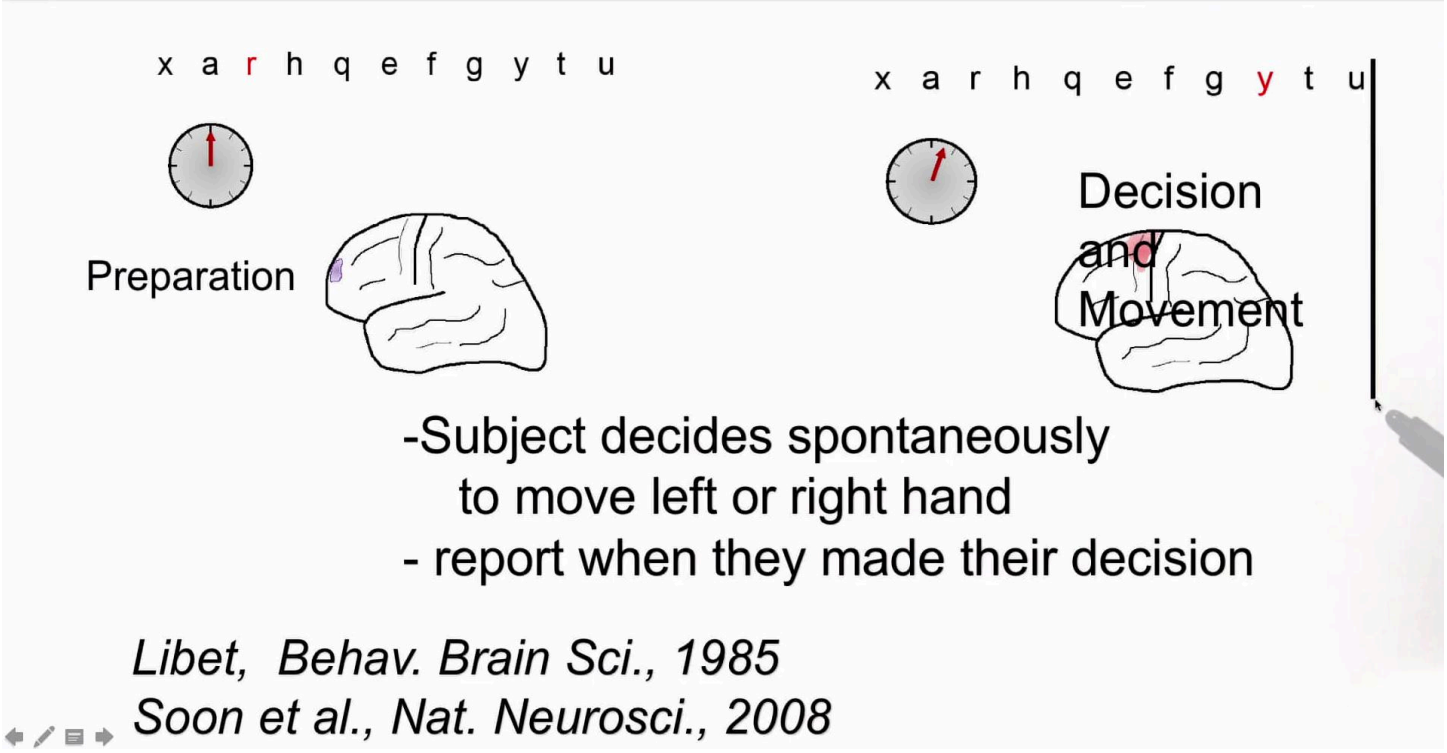
Now let's do this again. In this task, here again, you're red. You have a four. You can decide to go left or go right. Take your decision, now. So, when I do this with the students, they usually smile at me in this situation, say, well, but here, what's the point?

Notes

Summary

1m 02s

6. fMRI variant of Libet experiment: volition and free will



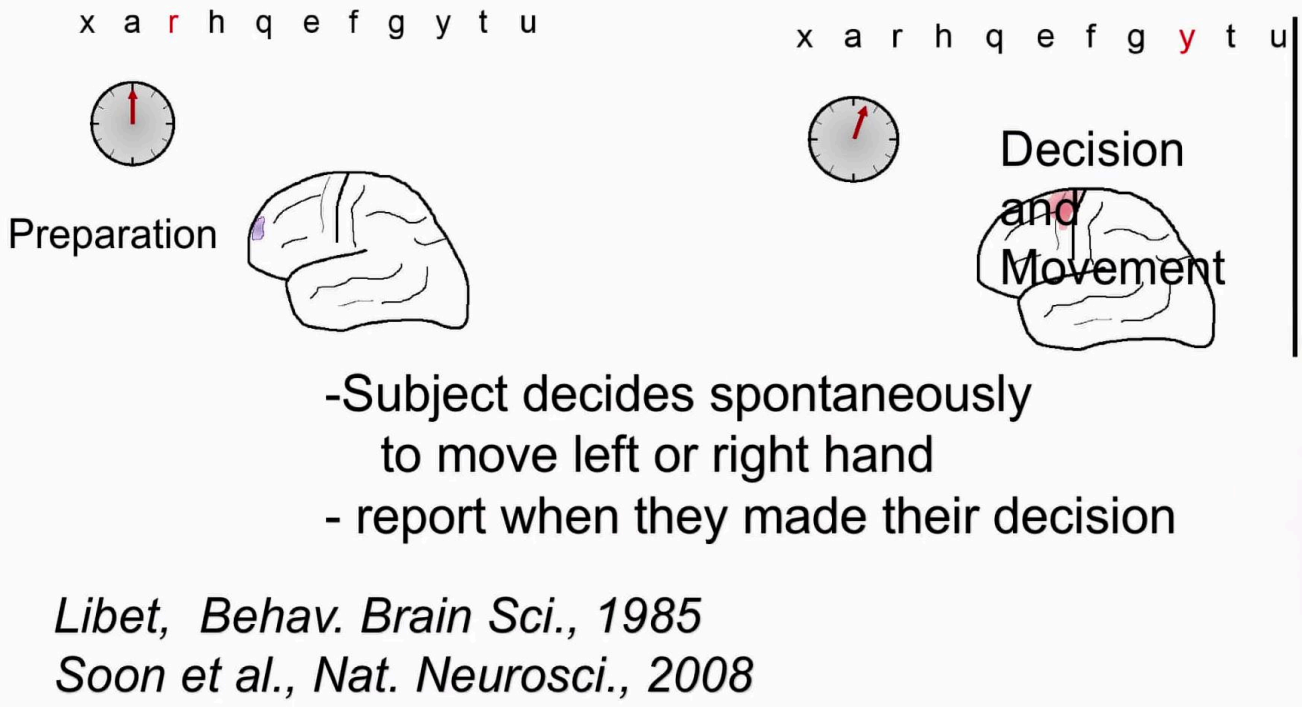
The point is that it's difficult to study decision making. One day to study decision making is that you put the subject into a completely irrelevant task. The subject is Lionel scanner and he can move either left hand or the right hand, just tickle a little bit with the fingers and the subject is told to report when he wants to tickle with the fingers when he feel the urge to tickle with the fingers. And he should report the timing by looking at the sequence of characters that appear at a rate of two per seconds. And for example, our subject here reported that he wanted to move his left hand at the moment when he says the Y. Now I can ask, when did he actually move the left hand? And this is the point here, and you can see that at the moment when he felt the urge to move the left hand. Some area in motor cortex is actually activated. Now, this is an area that's really very close to the control of the muscles in the hand. So this is motor control and hence roughly a second or so before the actual movement. But now we have the point when the object moved and we can ask, where there other pioneers that very involved?

Notes

Summary

1m 21s

6. fMRI variant of Libet experiment: volition and free will



-Subject decides spontaneously
to move left or right hand
- report when they made their decision

Libet, Behav. Brain Sci., 1985
Soon et al., Nat. Neurosci., 2008

Even before the subject reported his move, and in fact, there are areas in frontal cortex that would have a tendency to show activity even two or three seconds before the actual, the subject actually moves. Now, this is not a one to one correlation, but in slightly more than 50% of the cases looking at activity in frontal cortex was able to predict the actual movement with left hand or right hand. So this is a modern FMI variant of the Libet experiment and it has been puzzling because it looks like your brain knows before yourself knew what you want to do.

Notes

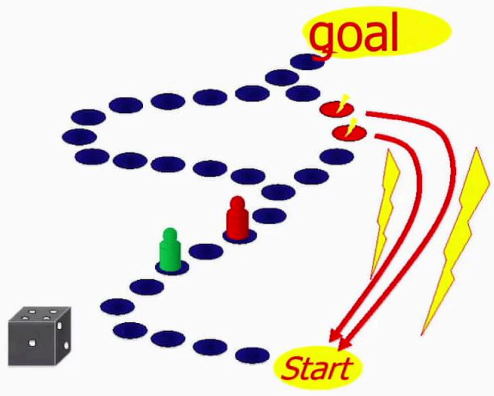
Summary

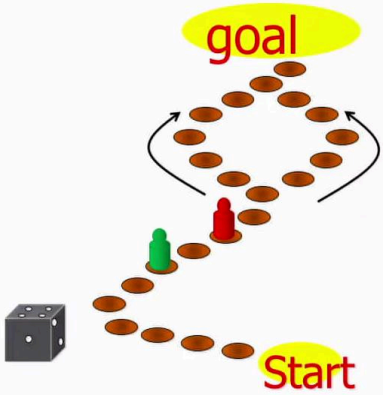
2m 50s

What decides? Who decides?

'Your brain decides what you want or what you prefer … '

' … but your brain – this is you!!!'





The question then is, who decides? It seems your brain decides what you want or what you prefer. Is that a philosophical problem? I don't think it's a problem because in the end your brain, this is you, where else if not in your brain would be stored, your experiences, your memories, your values.

Notes

Summary

3m 36s

What decides? Who decides?

'Your brain decides what you want or what you prefer … '

' … but your brain – this is you!!!'

-Your experiences are memorized in your brain

-Your values are memorized in your brain

-Your decisions are reflected in brain activities

'We don't do what we want, but we want what we do' (W. Prinz)

The problem of Free Will (see e.g. Wikipedia article)

Now your experiences are memorized in the brain. Your values are memorized in the brain. Therefore, of course, your decisions should be reflected somehow in the brain activities. Now, normally you're in a situation where the decision is relevant. It's your values that tell you and your experiences that tell you it's better to go left or go right, but these experiments have been done in a completely irrelevant situation, left or right. This really doesn't matter. But then it could, in fact, be just noisily tickling on some areas of the brain that biased your decision. But in a way, this doesn't matter because the whole decision did not matter in this case. So statements like we don't do what we want but we want what you do. Which means our brain decides for you have been made based on these kinds of experiments. But as I've just indicated, you can also give a slightly different interpretation of these results. So this relates to the problem of volition, the problem of taking actions, the problem of free will, which is indeed a philosophical problem. Modern brain science tries to contribute to this.

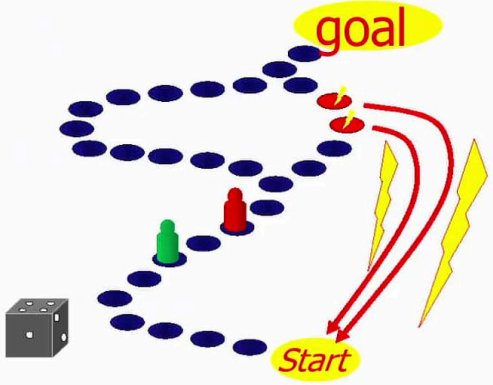
Notes

Summary

4m 02s

6. Decision: risky vs. safe

- decisions are taken in the brain
- competing populations is a transparent model
- relevant decisions involve personal values and experiences



Let, me summarize, decisions are taken into brain. Modeling indicates that we can understand these decisions as interaction between populations, and these populations compete with each other, but this is just a model. Now, relevant decisions involve personal values and experiences, and these values and experiences I expect are also stored in the brain.

Notes

Summary

5m 26s

6. Selected References: Decision Making

Suggested Reading:
- *Salzman et al. Nature 1990*
- *Roitman and Shadlen, J. Neurosci. 2002*
- *Abbott, Fusi, Miller: Theoretical Approaches to Neurosci.*
- *X.-J. Wang, Neuron 2002*
- *Libet, Behav. Brain Sci., 1985*
- *Soon et al., Nat. Neurosci., 2008*
- *free will, Wikipedia*

Chapter 16, *Neuronal Dynamics*, Gerstner et al. Cambridge 2014

So, if you want to know more, you can look at that such as the reading, and of course as always the chapter, of the Neuronal Dynamics book.

Notes

Summary

5m 56s