Please find below answers to learning diary questions – thanks again for posing such inspirational ones. Since we covered the topics of the course for the most part in the first 5 lectures, I will dwell on the last lecture on learning diary questions, before the visiting lecture on neuroscience commercialization cases starting at 14.00

Q1 There was also an interesting description of subconscious impulses as the things that cannot fit into the limited capacity of attention and working memory. Is there a neuroscientific mechanism for increasing this capacity?

I am not sure if this answers the question, but at least in case of patients with blindsight (e.g., visual cortex destroyed and patient only has the ability to guess based on what the subcortical visual processing allows for) it is tempting to think whether the patients can become better in guessing over time. This involves naturally also building up of confidence, i.e., on that one can see some things without being aware of seeing them and guessing is well above chance level.

Q2 I recently learned that corvids can recognize human faces and classify them as friendly or hostile, and react to their gaze accordingly; following the gaze of friendly humans as they might be paying attention to something useful, and perceiving direct gaze from hostile humans as a sign of aggression. It seems they can even spread information about local humans to their peers. Clearly their social cognition is nothing to scoff at either. Perhaps corvids might display more development in brain regions corresponding to these topics compared to other birds.

This is true that animals have a lot of more intelligence than what was suspected still some time ago. I will share some videos on the lecture.

Q3 It was noted that visual cues are one of our main ways of gathering social information. Do blind people, who are missing these cues, learn to gather cues in other ways?

Yes, definitely, for example, in close relationships feeling the face of the other with fingers; also tone of voice. Losing eye contact and ability to see others' gaze and expressions definitely adversely impacts ability to "read" others.

Q4 FFA activates upon seeing a face. How well do paintings of faces activate FFA? For instance, Picasso's later paintings are quite abstract – do they still activate the same areas?

Less well than a real face, but if a face is recognizeable, there is FFA activation.

Q5 Finally, regarding free will, would it be possible to control another person by stimulating their brain? For example, by stimulating their motor cortex to force them to move (and possibly command them to for example rob a bank). Or would it be possible to inject thoughts into the brain and change the behaviour of the person and thus "make" him/her do something?

In a simple TMS experiment for example, stimulating the thumb area in motor cortex results in moving of the thumb without volition. It is a bit of an eerie feeling. In principle, inserting intracranial stimulators in multiple locations, it would be possible to make us do things we do not want, though controlling it smoothly would be an engineering masterpiece, and our ability to over time learn adaptive behaviors might thwart the hideous plan. Inserting thoughts is still easier via argumentation, but who knows perhaps some day even that might be possible. Induction of emotions via stimulation is possible even today, as brain stimulation is used as a treatment for depression.

Q6: The presented studies on brain networks were presumably performed using fMRI. Do you think it is possible to gain further insight using imaging methods with better temporal resolution yet worse spatial resolution, such as MEG?

Definitely, better yet combination of information from different methods as fMRI is spatially more accurate and MEG and EEG temporally more accurate.

Q7: My question is, have the mirror cells (mentioned in the lecture), been found also in humans or only in animal brain?

Yes, they have been found in humans too. In news article published in 2010 (https://doi.org/10.1016/j.cub.2010.03.013), it is stated "New single-cell recordings show that humans do have mirror neurons, and in more brain regions than previously suspected. Some action–execution neurons were seen to be inhibited during observation, possibly preventing imitation and helping self/other discrimination." A bit more on this on the last lecture.

Q8: It was also interesting to read about how important gazes are for processing social signals: Humans are of course the most social animals on the planet and we rely heavily on visual information - Do other animals have any kind of "facial" expressions to communicate (which of course we do not recognize as well)?

Certainly, for example, non-human primates certainly have frowns, threatening postures, etc. that are used akin the human facial expressions and non-verbal cues.

Q9: Could it then be that the people who seem to be naturally better at social situations might be better because they are more creative in making up possible scenarios? Or could allowing your brain down-time help with dealing with social situations better? What would be the amount that this helps over 1) consciously creating these scripts, or 2) getting some external help?

Drama play/therapy for example can help generate such scripts that help in various kinds of challenging social situations. Of course, practicing with another person via means of drama play might partly be effective due to stimulation of the script-creating process.

Q10: A note on the "hot debate" about free will. Does it actually matter? It's hard to prove one way or another to begin with, and if it was done; what would change? For example, the thought provoking question "can anyone be held accountable for their actions if there is no free will" should not be a question in my opinion, as without repercussions society would crumble to bits.

This comment/question I find to be right on the money ☺ Indeed so.

Q11: The Youtube video on blindsight was especially interesting, and made me wonder if other versions of consciousness can be studied the same way visual consciousness was?

Yes, there are cases of deaf-hearing, that resemble blindsight. For example: https://www.sciencedirect.com/science/article/abs/pii/S0010945208708372

Q12: When discussing social cognition and how it functions in for example autism compared to neurotypical viewers, it made me wonder how social cognition functions in people that have social anxiety. Are people with social anxiety for example hyper aware/conscious of the social situation or misreading social ques? Or are they reacting to "too many" social ques?

Anxiety disorders are linked to hyper-reactivity of amygdala; the brain's alarm systems are going off and elevating stress levels – often due to harmless events/stimuli.

Q13: I am quite confused with the balance theory.

Yes, the balance theory is an old social psychology theory, basically, it is an attempt to present in formal way phenomena such that enemies of friends tend to be(come) enemies, friends of friends tend to be(come) friends. According to this theory, if there is imbalance, effort is required to work around it.

Q14: What do you think about The Chinese room argument that essentially computers cannot have a real consciousness but at the best only simulate it?

This is a very good question. My counter to this is in fact that as artificial brains created by growing neural tissue from stem cells develop further, it may well be that someday we will see consciousness in man-made "computers" ☺ https://www.nature.com/articles/d41586-020-02986-y

Q15: I did not understand what it means that adults are capable of four to five levels of intentionality inference. What could be an example of this?

For example: While I am not saying it out aloud, I suspect that you silently suspect that I suspect that you are guilty of damaging my car in the parking lot. This would be 3 levels of intentionality. It indeed gets increasingly complicated as one adds levels of intentionality, and most adults would have a limit in 4 or 5.

Q16: It makes sense that social cognition is studied with experimental setups based on scripts. However, these scripts are very much culturally bound. Would be interesting to know if we could see differences in brain activity if we look at people from different cultures. Some social cognition issues are anyway very differently perceived in different cultures!

We have some empirical evidence for this in our recent study. Indeed it is the case. I will tell about this more in the last lecture.

Q17: What is the point of lesion symptom mapping?

There were in the learning diary multiple very good points on questioning the validity of the approach, not the least of the arguments being the plastic changes following the lesion. However, in cognitive neuroscience, different types of approaches, methods and sets of findings each offer leads and clues into the mystery of mind-body problem. This way, the lesion studies, while suffering from many shortcomings, add to the bigger pool of evidence.

Q18: What's wrong with the brain of patients with ASD?

This is a million dollar question. There are some factors that are murking the waters, most notably that autism is a heterogeneous disorder. I found a review article pointing to abnormalities in anterior cingulate cortex and its connectivity with prefrontal areas; yet there are many different candidate structures and brain connectivity factors. More on autism on the lecture.

Q19: When the split hemisphere patients were mentioned, I was wondering if this practice of treating these very complicated cases epilepsy is still used or if there are less invasive methods?

Split brain operations – cutting the corpus callosum of patients, are no longer performed as epilepsy treatment, but brain surgery sometimes is performed to remove epileptic foci. Decisions nowadays are better informed than in the past.

Q20: schizophrenic patients show in different cognitive domains that they falsely perceive other people's gaze directed at them. I was wondering if there are findings on patients with autism spectrum disorder too? As I have encountered patients who reported that they had problems understanding the gesture of people pointing at something and they would just stare at the pointing finger without figuring out that would have to follow the direction of that finger to actually see what they are pointing at. So, I thought there could be similar difficulties with recognizing gaze direction and draw conclusions from that?

Schizophrenia and ASD share some commonalities, for example, it is not uncommon that a person diagnosed as autistic as a minor later obtains the diagnosis of schizophrenia as an adult. Of course, this is a diagnostic issue, as diagnoses are based on symptoms and there are multiple

different etiologies, mostly unknown. But yes, SCH and ADS patients both have difficulties in reading others, issues with their social cognition that are often debilitating for them.

Q21: The amygdala makes a quick decision in the prejudice you have about another person: do I think this person is trustworthy or not. Could the parameters/factors that decide what prejudice you have (who you find trustworthy) change throughout your life? In a way that based on a persons experiences, they might link an emotional expression as untrustworthy, when it was linked to someone being trustworthy before?

Yes definitely these change throughout life. In fact, it is easy to instill biases, via associating a group with something negative – our brain is naturally wired to learn about and alert about possible dangers. On the other hand, it is possible to regulate such biases, their effects on our choices and behaviors.