Current State of Research

Hi, so now we will begin to transition the current state of research in the field of split brains. There is a lot of exciting stuff, so we can't really cover it all unfortunately. So before we begin I wanted to give a quick outline of what we will be presenting to give a bit on context, so that way we don't get lost too easy.

First, we will explain some current experimental techniques used understand the asymmetries between hemispheres of the brain. Next, we will then dive deeper into some past and current paradigms in regard to some more specific research. And finally, we will attempt tackle some of the more open question and interesting implications that this research generates.

Overview / Relevance

Also, to tie in a bit of relevance, I do want to quickly point out a couple the main sources used for our discussion of current research. As I said, there were so many directions we could go in, but the most up to date review paper I found came out of a University in Italy. Of course, split brain patients were our focus, but in particular these papers focused on facial perception and the roles of emotional and social cognition in the hemispheric asymmetries.

Derrick is first going to use their 2016 paper, which discussed some techniques used by the department with regard to their own research; this will hopefully illuminate how such research is done and how findings are generated in some cases. Then I use their 2018 review paper to tie together most of the information discussed previously in an attempt to outline where the science currently is.

That being said, I will now pass it off to Derrick to discuss some the techniques used.

Current Paradigm

So hopefully we are now aware of what the corpus callosum is, the history behind the experiments, and how we go about investigating the hemispheric asymmetries in the brain. With this all in mind I'd then like to give an outline of where I'll try to take us next.

First I'll attempt to summarize and contrast the classic and current view of in regard to the role of the corpus callosal in various disconnection syndromes. Then I'll dive into a little more detail in a more specific realm of research that utilizes human faces to answer some more unanswered questions regarding some niche specifics around hemispheric asymmetries and how emotional processing may affect social cognition.

Classical View

The first general conclusion around hemispheric lateralization emerged from the

observations centered around white matter lesions that gave rise to cognitive, behavioral, and psychological dysfunctions as previously discussed. These dysfunctions are broadly defined as disconnection syndromes. The callosal syndrome relates to specific dysfunctions of split-brain patients.

The classical view is built on the study of various callosal syndromes in order to analyze these functional differences. Historical left vs. right hemisphere superiority gave rise to various pop culture interpretations that stemmed from the hypothesis that the regions were mostly separate. It was thought that copies of these left and right brain processes were just sent over to other side in cases that the other sided needed it.

Integrative View

Recently however, it has become clear that the corpus callosum may aid in **creating** these functional asymmetries in some cases, rather that just facilitating transfer. The first observation that suggests this involves selectively active cells within the corpus callosum.

This suggests that symptoms of callosal disconnection are not simply due to the loss of information transfer, but also due to loss of distributed balance mediated by the callosal fibers. Also, an important note, these balancing meditations worked together with the other cortical and subcortical nerve connections between hemispheres that I decided to cut out of the presentation. The key fact was that the corpus callosum doesn't work alone.

There's also a notion of an equilibrating role, due to evidence that the

(read second point)

This observation suggests that some callosal syndromes might be due to the result of the poor responses from an improperly informed hemisphere, as information still may be transferred by other subcortical pathways, but not processed correctly due to improper integration of bilateral transfer.

Also, transfer time was found to be different depending on the direction. This observation was attributed to other observations that show that the right hemisphere has a greater number of fast-conducting, myelinated fibers. This is significant because this asymmetry helps support the prevalent, more integrative interpretation, by demonstrating another factor responsible for dysfunctional asymmetries that arise in connection syndromes.

To sum it all up and put it a little more succinctly: the prevalent interpretation is one that views the interhemispheric communication taking place both by white matter and by bilateral subcortical projections that themselves influence informational processing. This makes the old view of the corpus callosum simply being used for information transfer much weaker.

Hemispheric Asymmetry For Faces

Now, to dive a little deeper into this, the authors focused on human faces as specific stimuli to narrow the focus, since the nature of stimuli present can often change outcomes.

It's well established that there is a strong asymmetry in facial processing, with a strong superiority of the right hemisphere, particularly in the fusiform face area (FFA). There is a significant amount of evidence backing this up in the paper, but I will not elaborate on it here. Instead, what I will focus on, and what the main point the paper makes, is that there is interhemispheric cooperation that also plays a role in facial processing. One study illuminates such cooperation in many areas, which the authors of also reported covariation in activity between corresponding areas in the two hemispheres, e.g., left and right fusiform gyrus. They state that in some cases interhemispheric connectivity was stronger (more active) between opposite facial processing areas, rather than typical one-sided hemispheric superiority. The more complex the processing however, the more specialized to the right activity tended to be.

These findings, as well as others that the paper goes over, support the integrative view previously discussed. More importantly however, it suggests a hypothesis that pushes back on the previously, mostly unquestioned, cerebral asymmetry and superiority of the right hemisphere; implicating the importance of understanding interhemispheric connections and their crucial role in facial processing.

Faces in the Disconnected Brain

Now his is where colostomy patients and the data behind callosal syndromes could shed more light on the issue, especially regarding the complexity of facial stimuli. This focus is a great demonstration of the current state of research regarding split brains.

Much of the current research around disconnected brains have produced much data supporting the superiority of right hemisphere in regard to facial processing. Again, mostly in regard to specific types of tasks, such as when the faces share same gander as the observers, in self recognition, or in faces that appear visually similar to one's self. More research on colostomy patients will help develop this area of research into more conclusive directions.

Overall (read slide). However, don't get me wrong, there is still plenty of evidence that supports the fact that each hemisphere is more specialized in and various tasks. Here the current research is mostly trying to figure out just how integrative the role of the corpus callosum is in regard to a certain type of task.

Social Perception and Cognition

Another specific debate in current research around disconnected brain has to do with emotional processing. They key observation consist of the fact that a major part of

facial perception is emotional decoding. Often expressions are detected automatically and our perception of others is changed, sometimes dramatically, by this decoding.

There are two main theories when it comes to the location of where this processing takes place: one, the valence hypothesis, which states that there is an asymmetry in emotional processing depending on emotional valence (positive and negative emotions), and two, the right hemisphere hypothesis, which states that all processing mostly occurs in the right hemisphere.

However, it appears that both theories are well-supported, even though they appear to be competing with each other. Some evidence suggest it depends on the amount of emotional stimuli present, where a greater degree of stimulation may increase degree of hemispheric specialization as a means to separate and process the emotions.

This idea was supported in a patient with a partial callosal resection, where the splenium (the thickest and most posterior portion) was kept intact. Under low stimuli tests, then observations followed the right hemispheric hypothesis, but under increased loads the observations followed valence hypothesis. However, only stimuli projected to the right hemisphere was seen in all cases, which may have an unknown effects. This finding supports the integrative view discussed earlier and the intact splenium (and thus the corpus callosum) is important for both sensory exchange and processing itself in some cases.