Module:
Psychological Foundations of Mental Health

Week 2
Cognitive processes and representations

Topic 2
Attention – Part 2 of 2

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Lecture transcript

Slide 2
So what happens to items that we don't pay attention to? As I've discussed, attention enables us to focus on items of interest. An effect of this is to philtre out other elements which have not been selected and therefore might impede processing. So we're not aware of items that have not been selected by attention. Whatever we pay attention to we're aware of.

In this paper here, we provided a good demonstration of how attention enables us to philtre out information even if it's presented right in front of your eyes. In the task shown on the slide, red picture stimuli are presented with green letter strings superimposed over the top. And these two stimuli together were presented in a rapid serial visual presentation paradigm.

In some blocks, participant's task was to detect immediate repetitions in the letter strings. And in other blocks the task was to detect immediate repetition in the red picture string. So you can see here, the dress is repeating. And in the green stream you can see the word clock repeating.

Note that in the letter strings some of the strings are real words but some were actually a random arrangement of five letters. While the participants performed this task they were undergoing functional MR imaging in order that we can see what is happening in the brain during the different conditions.

Slide 3
On this slide here, you can see brain activity from the condition in which participants are paying attention to the green letter string. But what we've done is extract out activity related to real words in that stream compared to meaningless letter strings.

And so you can see activity across the left hemisphere in the top panel because, obviously, this is more related to language.

Slide 4
The graphs presented on this slide relate directly to the brain activity you saw on the previous slide, but they are of blood flow-- to BOLD signal, the Blood Oxygen Level Dependent signal, in the areas of interest shown in the previous slide. If you look on the left panel first you see the BOLD signal for left frontal and temporal cortices in the attend to letter strings condition.

You can see a clear difference here in the signal comparing real words to random letter strings. The

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important thing here is to note that when we look at the bold changes between words and random letters strings in the attend to pictures condition, on the right panel we see no differences between activity related to real words and related to meaning less letter strings. So even though these words are still presented right of fixation, just as they are in the attend to letter string condition, when the attention's not paid to them but instead to the pictures superimposed on top, they are entirely filtered out and we get no meaningful work related activity in the area shown on the previous slide at all.

Remember, this despite those words being at fixation. If they're not attended, we are not processing them in any meaningful way. This study links well to a fascinating phenomenon known as Inattentional Blindness which is the evidence that we, when we don't pay attention, can be effectively blind even to salient visual stimuli.

Slide 5
Have a look at these examples of Inattentional Blindness.

The term Inattentional Blindness was first coined by Mack and Rock and it's a classic demonstration of the power of attention. If your focus of attention is manipulated, it doesn't matter if your eyes are ever on the key event. You'll still remain effectively blind to it. It demonstrates the link between attention and awareness and that to be able to see something you need more than to look at it with your eyes you need to be paying attention to it too. If something salient happens, if attention is distracted, it still becomes invisible.

Something incredibly obvious can happen, but if the attentional parts of your brain haven't selected it, you simply miss it. And remember, your eyes could well have seen the events and will have landed on the relevant characteristics at some point. And studies that have looked at where people's eyes are have revealed that they often fixate the relevant parts of the image. As I talked about previously, anything that's fixated therefore arrives in V1. But still, if you're not paying attention to it you're unaware of it.

Slide 6
In order to introduce the attention networks in the brain, I'll outline an early and simple study using Positron Emission Tomography, PET, on sustained attention. Although it's the selection aspects of attention that prompt the most research, there are aspects of attention that are, perhaps, more like the man-on-the-street might describe paying attention. These are usually called Sustained Attention. And that simply means paying attention to the same item for a sustained period of time.

The study by Pardo and colleagues is a simple, but important, early example of the neural effects of sustaining attention over time. They used PET to examine blood glucose use across the brain in relation to particular tasks. In PET, participants are injected with a radioactive labelled glucose molecules. This label enables the scanner to detect where in the brain the tagged glucose is being used-- i.e. where energy is being required and therefore, where it is most active in a particular task.

Pardo used two types of task, a tactile one, and a visual one. And these tasks are performed in separate blocks. In the tactile task, over a sustained period, participants monitor the pauses in a constant light tapping of either their right or their left big toe. And the visual task, over similar time period, they maintain attention to a small dot and monitor whether the brightness at this dot changes.

The results of these really simple trials show that the parietal cortex was involved for all tasks whether it was tactile or visual. And also, the involvement of the right and the left hemisphere was not equal. For the lateralised stimuli-- i.e. the toes-- when the left toe is monitored you get right parietal activity. But when the right toe is monitored you get a little left parietal activity, but also right parietal.

When they look at visual task-- which you remember was presented in the centre of the screen and so not lateralised-- they get only right parietal activity. This tells us, clearly, that the right parietal

cortex has a crucial role in sustaining attention across time. And, indeed, this is true of selective attention too.

Slide 7

Right parietal cortex is crucial for allocation of attention. And this, as I mentioned in the previous topic, is part of the dorsal stream of visual processing. Have a look at the figure on the slides here. This is from Kolbetter and Schulman and outlines the much larger network of attention based on analysis from many different studies, from different groups, and using different paradigms, but all studying visual attention.

They make a very useful distinction here between areas that appear to be more associated with bottom up, or exogenous attention, and top down, or endogenous attention. Looking on the figure here, the areas in orange indicate areas specifically involved in bottom up, or exogenous attention. And they're found in inferior parietal cortex and ventral frontal areas. If you look in blue, these are the endogenous areas, or top down attention areas, in more superior parietal areas and frontal eye fields. So the entire network encompasses both the dorsal and more ventral parietal regions, but also some areas in frontal cortex.

Slide 8

Critical pieces of information about the neural attention networks and about attention itself come from neuropsychological studies of patients with damage to right parietal regions. We call the syndrome that results from right parietal damage Visual Spatial Neglect. And it's called neglect as this describes how the patients behave.

They neglect one whole side of the world and they act as if it no longer exists. Now it's important to note that this is generally the left side of space in these patients. So suffering from right parietal damage will leave you with left visual neglect-- so neglect for the left side of space. But there is evidence that if people have a stroke, instead, on the left side of their brain and the left hemisphere, neglect resolves very quickly because these areas aren't as crucial for attention.

So these patients they-- males often fail to shave the left side of their faces and shave only the right side. Females makeup only the right side of their face. Patients ignore people approaching from their left side. And they often eat food only for the right side of their plate then say they've finished. And if you ask if they're still hungry, they'll say yes. And if you turn the plate around so what was on the left is now on the right they'll carry on eating.

So when you think about their behaviour, remember the strong link between attention and awareness. If you lose the ability to pay attention you lose the ability to be aware of those things too. Think about Inattentional Blindness. We're effectively blind to fixated items if we've not selected them by attention. These patients appear to be blind to items in the world around them as they can't select them by attention anymore.

Patients with neglect, if they do notice anything is wrong-- but sometimes they don't-- tell their family and doctors that they can't see properly. They feel that something's wrong with their vision. This may be how it is perceived, but this is not the case. There's usually nothing wrong with seeing or their visual cortex, but it's their attentional selection. And we know ourselves from Inattentional Blindness and change blindness how a lack of attention can render things invisible even to those of us who don't have a parietal lesion.

So as I mentioned briefly, remember the patients I'm talking about have damaged the right hemisphere, so the right parietal lobe, and so are impaired on the left side of space. We call the side that's impaired contralesional, so opposite the side of the lesion. And the side that's on the same side of their lesion that's not impaired, ipsilesional.

Slide 9
OK. So how do we assess a patient with neglect? I just want to show you a couple of tasks that we do, often, just at the bedside of the patient. First of all, the line bisection task. It's very simple and patients are presented with horizontal lines and asked to bisect the line-- that is mark the middle of the line. What they do is bisect the line much further to the right side. And this is because they don't perceive the left of it. So this, to them, appears to be the middle of the line.

Have a look at this video of a patient we saw just after he's had a stroke that's damaged right parietal cortex. And you can see how much of the left side can be lost to some of these patients.

Slide 10
Cancellation tasks are also given to patients after their stroke in hospital. They're asked to cancel out all of one type of stimuli. So here, patients are supposed to cancel out-- that's draw a line through-- all the small stars rather than the large stars. And the two that are crossed out in the centre are done by the experimenter. And you can see if you look to the far right side, the ipsilesional side, the patient has crossed out only the stars that are right, right, right towards that side. They're just not getting across at all or perceiving stars any further to the left.

Slide 11
You can see a patient in the next video completing cancellation task on a touch screen. What he's doing is supposedly touching every one of the C's in a field of C's, O's, and Q's. And if you watch him, and watch it to the end, you'll see that he finishes only having completed the right one side of the screen.

Slide 12
Drawing tasks are also a very striking way to see the impairments that patients with neglect suffer from. If you look on the left you'll see a copying condition. So the patients have been given a clock, a house, and a flower to copy. And you'll see in the patient's version, the right side-- the ipsilesional side is completed very well but the left side has not been completed at all. And these patients say that they've finished the images and they're not aware of there being any missing on the left hand side.

In spontaneous drawing they're asked to draw something from their mind. So here you can begin to see that this is not to do with what they're looking at in front of them. This is drawing a face from their memory, and drawing a clock from memory. And again, you see the same impairment. So the right side of the image is much better and contains much more detail than the left side.

In that last panel you can see some paintings from the patient who was completing the line bisection earlier. When he was in rehabilitation he was doing lots of paintings. And although his neglect has got a lot better, still, in the picture of the flowers on the right side in the vase there's lots of flowers and on the left side there's none at all.

Slide 13
Linked to the failures in spontaneous drawing, a famous study by Bisiach and Luzzatti on what they call representational neglect, showed that these patients fail also to attend to internal mental images. Think back now to my comments relating to William James's description of attention also being directed to internal streams of thought. The patients that were local to Milan were asked to imagine standing at the north end of the square near the Duomo doors and then describe everything that they could see.

They were accurate, in this condition, at describing the west side of the square but not the east because the west side of the square, in this representation, was to their right, and the east to their left. However then they asked the patients to mentally shift to the south side of the square. And they now described very accurately what was on the east side because this is now represented in the right side space for them. Mentally moving so different sides were on the ipsilesional side revealed

that the patients had not forgotten what was in the square, but they were unable to be aware of it when those parts of the mental image fall into the impaired contralesional side of space.

Slide 14
OK. There is evidence that although we're not aware of items that we don't pay attention to, under some conditions we can implicitly process this information. And so researchers have been interested in whether neglect patients are also able to implicitly, or unconsciously, process items on the unattended side. In this famous study by Marshall and Halligan, they gave patients pictures of two houses. And in one of these houses there were images of flames coming out of the left windows.

They checked and confirmed that the patients were unaware of the flames coming out of the left sided windows. However, when they were asked which of these two houses would you live in, and they were asked to make a forced choice because they couldn't see, consciously, any difference between them, they always chose the house without the flames coming out of. So Marshall and Halligan suggested that there's some residual, unconscious processing going on in these patients.

Slide 15
The implicit detection of threat-- that's the fire in Marshall and Halligan's paper-- links well with a growing body of data suggesting that when an emotionally threatening stimuli are presented on the neglected side there is some residual processing. Here, in Patrick Bulimiar and Sophie Schwartz's study, their patients were presented with pictures of spiders or flowers. And these were designed to be very similar, apart from clearly being of different types of stimuli. Pictures of the spiders and flowers were presented to the right side, the left side, or both visual fields.

And the patients that took part had a milder form of neglect called Extinction. Within Extinction patients can detect left sided stimuli when they're presented alone. But when they're presented to stimuli on the left and right side simultaneously, they only detect the one presented on the right hand side. So therefore, bilateral trials, when there's a stimulus on the left and right, are the most difficult for these patients.

In their study, when patients are presented with bilateral stimuli, if spiders were on the left side they were detected much more frequently than if flowers were present on the left side. This suggests that something about the emotional intensity or the threat of the stimulus, if you like, enabled preserved processing. So they were actually consciously detected. The same authors have demonstrated this similar processing on the left side for faces with emotional expressions. Next week you'll learn much more about preferential processing for emotional stimuli, but this time in the context of mental health rather than neurological patients.

Slide 16
In this topic, I've outlined to you the cognitive processes of attention and you've seen that its principal function is selection. This is often selection from the sensory input, but attention also selects from our mental images and trains of thought, bringing parts of these into conscious awareness. We also learn that attentional selection could be exogenous-- that's from the bottom up stimulus properties-- or endogenous-- from our own control. And I outlined to you that attention is linked to awareness such that we are aware of item selected by attention and unaware of those that we've not selected.

Inattentional blindness is an impressive demonstration of this phenomenon as is the neurological syndrome of neglect. These patients are no longer are aware of this side of space that they can't attend to. In the final section, I outlined that residual processing is possible in these patients and that this residual processing appears to be of emotional, often with a negative valence, stimuli. This evidence links with research you will learn about next week.