**ERQ marking: Neurotransmission**

Below you will find three sample ERQs for the question:

*Evaluate research on the role of neurotransmission in human behaviour*.

For each of the samples, refer to the rubric to award marks. After each sample, there is a predicted grade as well as feedback on the strengths and limitations of the sample.

## **Sample 1**

Neurotransmission is the process by which neurons transmit information and signals in order for certain bodily functions, either psychical or psychological to occur. Communication between this neurons begins when an action potential travels to the axon terminal of a presynaptic neuron. This electrical impulse causes vesicles to fuse with the membrane of the presynaptic neuron and release certain molecules; neurotransmitters, which bind to the receptors on the postsynaptic neuron to carry on this action potential to the next neuron. These neurotransmitters are then released from the receptors, and either return to the presynaptic neuron, or are dissolved by enzymes. Often the role of neurotransmitters is studied indirectly. This is sometimes done by using an antagonist - that is, a drug that blocks the receptor site on a neuron and does not allow a neurotransmitter to do its job.

A study by Troster showed that acetylcholine plays a role in the encoding of memories, but not the retrieval of LTM. To carry out the study there were three conditions.  Each subject was injected with either a saline solution, a .5 or a .8 mg solution of scopolamine, an acetylcholine antagonist. They then carried out three tests.  In the first test, they were asked to recall a list of 14 words.  Recall was tested immediately after reading the list and then after 45 minutes. The high scopolamine group recalled the least in both conditions.  In the second test, participants were given a map of a fake state and asked to memorize the location of the cities.  After one minute they were given a blank map and a list of cities and asked to place them on the map. Once again, the high scopolamine group did poorly. Finally, participants were given a test of memories of famous people and events.  They found no significant difference in the scores of the three conditions.  It appears that acetylcholine may play a role in the encoding of memory, but not its retrieval.

This study is highly standardized which allows other researchers to replicate the findings. The study is problematic in that scopolamine has strong side effects, so the researcher and the participant would know whether it was the placebo or not. The task is also very artificial and may not reflect how memories are usually created.

Antonova wanted to see if scopolamine affected activity in the hippocampus, particularly in the creation of spatial memories. The sample was made up of 20 healthy adult males. The study used a double-blind procedure, with participants randomly allocated to one of two conditions, one in which participants would receive a scopolamine injection, and the other group would receive a placebo.  At the beginning of the experiment, participants were put into an fMRI while playing a virtual reality game that was designed to test the participants’ abilities to create spatial memories. The objective of the game was to navigate through an arena to reach a pole. Once they reached the pole, the screen would go blank for 30 seconds and the participants were told to rehearse how they got to the pole, then they would appear in a different location in the arena to find the pole again. The fMRI measured the participant's brain activity. The researchers found that those who were injected with scopolamine demonstrated a significant reduction in the activation of the hippocampus when compared with the placebo group. This suggests that acetylcholine plays an important role in the encoding of spatial memories in humans. Although there was a higher rate of error in the scopolamine group, it wasn’t a significant difference between the two. However, there was a significant difference in the activity of the hippocampus between the two groups. This implies that the design of the task itself was not ideal to show performance difference, and without the use of technology, there would be no way of knowing of the biological effects between the two groups.

The study was a repeated measures design, which allowed the researchers to eliminate participant variability. The study was also counterbalanced, with some doing the scopolamine condition first and some doing the placebo condition first to control for practice effect. In addition to that, the study was also a Double-Blind Experiment, preventing researcher bias in the results. In order for the results to be considered reliable, the study would need to be replicated, due to the small sample size.

Although these studies provide good insight into aspects of how neurotransmission affects behaviour, they cannot provide a full scope on the impacts it has. Neurotransmission cannot be directly observed in the brain, so researchers use indirect measures such as animal research, fMRIs showing brain activity or the use of antagonists. This means that the research is based on assumptions that may prove in the future not to be accurate.

**786 words**

**Focus on the question:** The essay is focused on the question.  **2 marks.**

**Knowledge and understanding**: There is clear knowledge of neurotransmission; the role of acetylcholine could be explained in more detail.  The ways in which neurotransmission is studied are also addressed. Psychological terminology is used effectively.  **5 marks**

**Use of research**: Two studies are well described and explained with regard to the question.  **6 marks.**

**Critical thinking**: There is evidence of critical thinking relevant to the question, but could be more developed. **5 marks.**

**Clarity and organization**: The essay is well organized. Ideas are clearly communicated. **2 marks**

**Total**: 20 marks

**Predicted**: 7

## **Sample 2**

Neurotransmission is a process of communication within the brain. Neurons release chemicals known as neurotransmitters in response to stimuli or internal changes, which are then transferred to electrical signals. Different neurotransmitters are known for different effects in the brain. For example, Acetylcholine plays a role in the consolidation of memory. Roger & Kesner, and Antonova et al both studied the role of acetylcholine in the consolidation of memory, and together provide solid evidence that acetylcholine plays a role in the consolidation of memory.

Roger & Kesner’s study aimed to determine the role of acetylcholine in the formation of spatial memory. There is a high concentration of acetylcholine receptors found in the hippocampus, an area of the brain responsible for the formation of memories. The study looked at the formation of spatial memory in 30 rats. The rats were randomly allocated into 2 groups. The treatment group was injected with scopolamine, which blocks acetylcholine receptor sites. The control group was injected with a placebo saline solution, as there was a possibility that the injection itself changed the rat's behaviour through adrenaline or stress. They were then put into a maze. The results showed that the treatment group made more mistakes, which suggested they took longer to learn the maze.

The study manipulated an independent variable and tried to control extraneous variables, thus it can determine a cause and effect relationship. It is highly standardised and has high reliability. However, due to the simplicity of the study, there is no triangulation, lowering credibility. The lack of theory triangulation also highlights a potential weakness of the study, reductionism and ecological validity. Because the study’s goal was to ultimately relate to the role of acetylcholine in human behaviour, the choice of rats provides a problem with ecological validity.  Whether this study can be able to be generalised to human behaviour is unclear, as cognitive processes such as memory may be more complex in humans.

Antonova et al supported Roger & Kesner’s study on the role of acetylcholine. They wanted to research the effect of acetylcholine on encoding spatial memories in humans. The study used a sample of male adults. The participants were randomly allocated into 2 groups. The treatment group was injected with scopolamine and the control group injected with a placebo. The participants then play a “virtual arena game”, and brain activity was scanned with a fMRI during the activity. The activity consisted of participants finding their way to a pole, and then with a wait of 30 seconds the participants would be set in a different location and find the pole again. There is a question of whether this activity is ecologically valid, as this activity is quite artificial and may not represent spatial encoding in real life.  The participants returned 3 - 4 weeks later and repeated the procedure, but received the opposite treatment. By using repeated measures, Antonova eliminates participant variability. The results showed that participants had lower brain activity in the hippocampus when injected with the scopolamine solution. There was no significant difference in the rate of error between the two groups (although scopolamine did have more errors). This suggests that although the fMRI provides strong biological evidence, the actual arena task itself may not properly reflect spatial memories.  The study was counterbalanced, meaning that participants did the two treatments in different orders, eliminating the potential of the practise effect. The study was also carried out blindly, eliminating researcher bias.

Research provides empirical support that acetylcholine plays a role in the consolidation of memory. The research has high internal validity. However, cognitive processes such as consolidation of memory are abstract concepts, and models can often be reductionist in terms of explaining how memory works.  Thus, due to the complex nature of memory, research lacks ecological validity as experiments have to attempt to limit as many potential confounding variables as possible. Research on memory also may have difficulties with construct validity. For example, in Antonova’s study, although there was a significant difference in levels of brain activity in the hippocampus between treatments, there was no significant difference in the actual amount of errors, which is what would actually be significant in the real world.

In conclusion, research on the role of neurotransmission in behaviour, specifically acetylcholine on consolidation of memory, is quite strong and has high internal validity and reliable results. Whether these results can directly be generalised to humans was a concern in Rogers & Kesner’s study, but Antonova’s study minimized those concerns, as he found biological support for the theory. Research on the role of neurotransmission does have potential concerns of ecological validity due to the difficulty of isolating and operationalising variables in the complex abstract process of memory.

**796 words**

**Focus on the question:** The response is focused on the question.  **2 marks.**

**Knowledge and understanding**: The response demonstrates some clear understanding relating to neurotransmission and its role in behaviour. The process could be better explained.  Psychological terminology is used but not always appropriately explained or developed to demonstrate understanding.**4 marks.**

**Use of research**: There are two studies that are clearly described and explained in some detail, but not always clearly.  The question is about human behaviour.  The animal study is acceptable and its limitations in understanding human behaviour are  addressed. **4 marks**

**Critical thinking**: There is some evidence of critical thinking.  Some of the ideas are not well explained and there are some errors in understanding. The critical thinking is rather redundant.  **3 marks**

**Clarity and organization**: The response is well-organized; and language generally communicates effectively, but some ideas lack clarity. **1 mark.**

**Total**: 14 marks

**Predicted**: 6

## **Sample 3**

Nerve cells are called neurons are one of the building blocks of behaviour. These neurons send electrochemical messages in the brain, in order for the person to have the ability to respond to the stimuli. The stimuli are either from the environment or from the internal changes in the body. The process by which the messages are sent is neurotransmission. Neurotransmitters have the role of the body’s natural chemical messengers, which move the sent information from one neuron to another. The neurotransmitters are released into the gap between the neurons, the synapse. They also fit into receptor sites. Once the message is fully passed onwards, the neurotransmitters can either be broken down by an enzyme or go through the process of reuptake.

Neurotransmitters have been proven to influence a range of different effects on human behaviour. They affect a person's mood, sleeping patterns, the ability to learn, memory, mental illnesses, and even sexual arousal.

Fisher did a study to see the role that neurotransmitters play in human attraction. In her study she had people who had just fallen in love come into her lab to have their brain activity measured. She had them lie in an fMRI and then see photos of their loved one, family and friends and total strangers.  Fisher observed what is now called the "love cocktail."  She saw that there was more neurotransmission for dopamine and adrenaline and less for serotonin.  Fisher argues that this is why we are so happy when we are in love (dopamine), why we are excited about love (adrenaline) and why we are obsessed with love (serotonin).

The limitation of this study is that she only looked at Americans. Americans are from an individualistic culture, so their brains may act differently from collectivistic brains.  In addition, fMRIs are expensive and they may be seen as unethical.  Many people suffer from claustrophobia.  Fisher would have to remind the people that they may withdraw at any time from the experiment.  In addition, it is important that the information about the level of love that the participants feel should be kept confidential so that they do not suffer any consequences for taking part in the study.

Another study that looked at the role of neurotransmitters is a study on the role of cortisol on memory by Newcomer. Newcomer wanted to find out if higher levels of stress affect memory. Cortisol is secreted by the adrenal glands and may affect the hippocampus. In the study the researchers had participants read and try to recall a passage of prose text over a period of four days. One group was given a placebo pill, one was given a pill with a high level of cortisol and the last group was given a small dose of cortisol. The researchers found that the higher the level of cortisol, the less they were able to remember.

This study is able to show a cause and effect relationship.  It also, however, has ethical problems as the use of cortisol may have increased their level of stress.  The study also only studies Americans, so it is not clear if this would affect other cultures. Finally, it only looks at prose.  There are other types of memory that could be affected, like learning a list of words or a set of numbers.

In conclusion, both of the studies show that neurotransmission plays a role in human behaviour. Both studies lack ecological, internal and construct validity, but because they are experiments, cause and effect can be determined. The research should be replicated in other cultures to see if we can see the same results.

**600 words**

**Focus on the question:** There is an attempt at focus, but it is not well sustained.  **1 mark.**

**Knowledge and understanding**: There is some understanding of neurotransmission demonstrated.  The actual function of various neurotransmitters identified is not correctly or adequately explained.  Cortisol is not a neurotransmitter; it is a hormone. **2 marks.**

**Use of research**: There are two studies used.  The first one is not explained in good or accurate detail.  The second study is not relevant to the demands of the question. **2 marks**.

**Critical thinking**: There is an attempt at critical thinking, but it is superficial, often inaccurate and at times of marginal relevance to the question. **1 mark.**

**Clarity and organization**: Language and organization are not always clear. **1 mark.**

**Total**: 7 marks

**Predicted**: 3