## Evaluation summary:

Having a personal interest in both sport and neurology and the interaction between them, led me to study the effects of exercise on the brain. However, as the brain is such a vast topic, I refined my research to focus on memory alone, so I could apply my findings to school students. This resulted in the specific question: “How does aerobic exercise improve memory?”

Throughout my research, there were several key findings including: An increase in brain neurogenesis; increase in brain derived neurotrophic factors and growth factors; the production of more neurons in the hippocampus and subsequent growth in volume. These were collected from a variety of primary and secondary sources and collated into a scientific report. The purpose of my report was to enlighten others about the significance of exercise and how it can assist in improving academic achievement.

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## E1: Evaluation of the research processes

To commence my research, I used two different processes. The first was refining my research question, which involved conducting some preliminary research to grasp the context of the topic and to see the variety of sources that I could potentially use. The second process was reading and analysing sources in depth to expand my knowledge on the topic. Online articles assisted me in this as they provided a solid foundation to my initial research, but they were not a crucial element for the whole process. There was a plethora of valid and reliable information, written by authors that had good credentials. The process of reading and analysing journal articles was undeniably the most valuable procedure because they contained primary data and information which otherwise was very hard to obtain. The biggest problem I found was the limited number of weeks I had to research and draw conclusions from key findings. This is because there was so much time consumed by determining whether a source was valid and reliable before being able to go on to analyse it.

Journal articles provided information that was highly reliable and valid to my research, meaning that I could then use them as a basis for my arguments in my evaluation. One of the most complex journal articles that I read was *Hyper-hippocampal glycogen induced by glycogen loading with exhaustive exercise.* This was a complex, scientific article that used a lot of acronyms for complicated scientific terms meaning that to start with it was very difficult to understand. However, by doing the process of researching and defining terms, eventually I started to understand to concepts the article was trying to express. Because journal articles are academic publications this made them generally well above my level of understanding, therefore, they were used later in my research when I was trying to consolidate findings and answer specific questions from previous more generalised sources. Nevertheless, they used references to show agreement between it and other sources and they used a lot of figures and graphs to validate and authenticate ideas, increasing their overall reliability and credibility. In the end, the was an effective process as it meant my knowledge vastly expanded right down to the finer details which helped immensely when writing my outcome and trying to express why developments occurred.

Books helped to expand my research as it gave me a greater level of detail on the topic and were easily accessible meaning that my research into the specific factors that exercise influences had a lot more substance because of analysing book sources. They were also easier to read which meant that I could glean key information a lot easier and quicker than, for example, journal articles. These sources were an extremely useful tool for gathering more foundation knowledge with higher reliability. Specific areas where this was the case includes the hippocampus and the effects of brain derived neurotrophic factors (BDNF) on the brain. For example, the book *Healthy brain, happy life* by Wendy Suzuki gave great summaries on all the details of the science behind exercise and the brain which meant that I could gain a better understanding on the whole picture. As well as the book *How the brain learns* by David Sousa which gave supporting cartoon diagrams on the significance of the role the hippocampus plays in converting information from working memory to long-term storage. I also cross-referenced the ideas and concepts from this book to increase the reliability and authenticity of information in other sources.

Furthermore, another process not directly related to sources themselves yet was crucial in the overall research process was the highlighting system that I used throughout all analysed sources. This was helpful as it meant that I could see the major ideas and concepts from each source, as well as quotes, qualitative and quantitative data from studies and experiments and other useful information. Subsequently, it was clearer when I went back to re-read sources or glean key findings I was able to keep everything organised, including my thoughts and how I was going to go about writing the outcome. On the other hand, this process was long-winded and hard to keep consistent particularly when quotes were also key findings or data was included in a quote. This meant that some familiarisation had to be done each time I went back so I kept all the information clear and classified.

## E2: Responses to challenges and opportunities:

Throughout the research process there were many challenges faced that had to be overcome and numerous opportunities where decisions had to be made in order for me to achieve the best outcome possible. The reaction and process worked through in response to these challenges helped develop my decision-making ability and my ability to think critically on how to resolve a problem because I only had a limited amount of time to make decisions and implement the solution.

One of the most difficult challenges that I faced was the problem of finding credible experts in the field of neuroscience or exercise science and how they relate to one another. This is because it is quite a niche field and therefore the people who are knowledgeable in the field will not want to talk to a student in year 12. Also, because the high-end scientists are based mainly in the United States the only way to communicate appropriately was via email, which meant that I got very few replies and the reply I did get said that they were too busy to have time to answer questions. Initially I planned to write to lots of different scientists who have a relation to the topic and hoped that I would receive one or two replies. However, I received no positive replies, consequently, I had to refer to other reliable primary sources to assist me in developing my research. This mainly included journal articles where professionals had written down and analysed their personal experiments. This meant that I got answers to my questions, just indirectly, minimising the effect of this challenge on my overall research process. On the other hand, I probably could have tried harder to find people that weren’t at the top end of the profession but still had some sort idea about the topic that could have answered my questions, just in not as much detail. By using different types of primary sources, I dealt with this challenge smoothly and learned to think critically about how I would find the information I needed, just in a different way to what I was expecting.

Initially, I thought that the size of the outcome would be sufficient to talk about the effect of exercise on both memory and concentration, however, a challenge I faced was dealing with the abundance of information I found on both topic, particularly memory. The sheer amount of information on memory due to the expanse and complexity of the topic meant that I had to change my research question in order to write an effective outcome and explain the effect of exercise on memory sufficiently. By changing the question after conducting so much research on concentration meant that I lost a lot of time, effort and sources making my research scope smaller. Nevertheless, by refining my question to just memory it meant that I was able to go into much greater detail on the specific factors involved with exercise improving memory rather than just skimming the surface on elements involved in both memory and concentration. In overcoming this challenge and making a decision, I was able to write a more effective outcome because the level of detail and understanding I could express through my writing was much better and meant that I could simplify the concepts for everyone to understand.

## E3: Evaluation of research outcome:

My outcome was constructed of a variety of primary and secondary sources of different types and lead to answering of the overarching research question. The outcome was valid in that it gave a range of factors for how exercise changes the brain anatomy, physiology and function to help improve memory, as well as communicating its significance. However, the outcome was also not valid in the sense that it only touched only a few of the key factors and not all the different ones. Therefore, the significance of the factors given may not make up all of the change that occurs in the brain in relation to exercising.

Furthermore, the research isn’t significant in that it doesn’t provide any new, scientific findings because it is more of a compilation of previous findings. As a year 12 student I have no credentials in this area with limited knowledge and prior experience, it limits the outcome’s reliability. Therefore, my outcome won’t be useful for any further scientific research conducted, neither will it be useful to anyone other than myself and others interested in the impact of exercise on the human body, particularly on memory function. But for these people, it will be an academic explanation behind improved memory after exercise and implement this into their life for greater achievement.

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