International Baccalaureate Sample B

Extended essay cover

Candidates must complete this page and then give this cover and their final version of the extended essay to their supervisor.

Candidate session number	0	0							

Candidate name	

School number	0	0				

School name	

Examination session (May or November)	MAY	Year	2009

Diploma Programme subject in which this extended essay is registered: PSYCHOLOGY

(For an extended essay in the area of languages, state the language and whether it is group 1 or group 2.)

Title of the extended essay: THE PSYCHOBIOLOGY OF AGGRESSION

Candidate's declaration

If this declaration is not signed by the candidate the extended essay will not be assessed.

The extended essay I am submitting is my own work (apart from guidance allowed by the International Baccalaureate).

I have acknowledged each use of the words, graphics or ideas of another person, whether written, oral or visual.

I am aware that the word limit for all extended essays is 4000 words and that examiners are not required to read beyond this limit.

This is the final version of my extended essay.

Candidate's signature: Date: 1-DEC.-2008

IB Cardiff use only: A: B:

Supervisor's report

The supervisor must complete the report below and then give the final version of the extended essay, with this cover attached, to the Diploma Programme coordinator. The supervisor must sign this report; otherwise the extended essay will not be assessed and may be returned to the school.

Name of supervisor (CAPITAL letters) _

Comments

Please comment, as appropriate, on the candidate's performance, the context in which the candidate undertook the research for the extended essay, any difficulties encountered and how these were overcome (see page 13 of the extended essay guide). The concluding interview (viva voce) may provide useful information. These comments can help the examiner award a level for criterion K (holistic judgment). Do not comment on any adverse personal circumstances that may have affected the candidate. If the amount of time spent with the candidate was zero, you must explain this, in particular how it was then possible to authenticate the essay as the candidate's own work. You may attach an additional sheet if there is insufficient space here.

Please see attached comments

I have read the final version of the extended essay that will be submitted to the examiner.

To the best of my knowledge, the extended essay is the authentic work of the candidate.

I spent [3.5] hours with the candidate discussing the progress of the extended essay.

Supervisor's signature: _ Date: 1/7/08

Viva Voce

Student Name:

Subject: Psychology

Candidate Number:

Supervisor:

Exam Session: May 2009

Comments:

has investigated a highly important psychological question, investigating what contributes individuals to be aggressive. Overall, Extended Essay is well structured, properly researched and cited, and analytically sound. Through the Extended Essay process, he is grateful to have discovered effective ways to research primary and secondary resources, established a strong foundation in the developmental process of writing a scientific paper, and will be able to utilize these newly acquired skills at the collegiate level. Correlating animal research on aggression to human explanations of aggression posed the biggest challenge, while his discovery and profound understanding of the neurological complexities involved with aggression was his most cherished acquirement. In conclusion, has a sufficient product and is confident he will not receive a mark lower than *Good.*

IB Psychology

The Psychobiology of Aggression

Psychology
Supervisor: .....
2 December 2008
Word Count: 3653

Abstract

Nature versus nurture is one of the most fundamental arguments in the field of psychology. Are our behaviors governed by nature, our heredity and our biology, or are they governed by nurture, our surroundings and our environment? In this paper, I will examine these opposing views as they relate to aggression. From the early stages of my paper I believed that aggression was more rooted in biology than in environment. But exactly how is aggression linked to biological factors and to what extent is aggression a heritable trait?

I have concluded that biology controls 75% of aggression, while environment controls the other 25%. My research has supported my initial hypothesis that biology is indeed the prominent factor influencing aggression. This research consists primarily of articles retrieved from SIRS Knowledge Source database and Academic OneFile database, including esteemed scientific and academic journals such as the *Harvard Mental Health Letter* and *Johns Hopkins Magazine*. Specifically, said research has shown that low serotonin levels and abnormalities in the frontal lobe of the brain correlate with high instances of aggression. In addition, at the molecular level, certain genes have provided surprising and possibly groundbreaking results regarding aggression in rats.

Whereas understanding aggression must be our ultimate goal, we must be wary of the possible consequences that this can have. With this knowledge, we could theoretically "cure" aggression, but at the same time, those with bad intentions could take advantage of the biological mechanisms of aggression for darker purposes. This is why ethics must always be taken into consideration when dealing with these sensitive topics. As I examine aggression and its implications, I will periodically look back to the APA Ethics Code in this manner throughout the paper.

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The Psychobiology of Aggression

"Virginia Tech Shooting Leaves 33 Dead…in what appears to be the deadliest shooting rampage in American history" (Hauser & O'Conner, 2007). One cannot watch the news or read a newspaper without seeing a report of violence. It seems that we have grown far too accustomed to carnage in our everyday lives. If it's not a crazed gunman in Virginia, it's a deranged football player in Tennessee or some John Doe somewhere on the 5 o'clock news.

Are aggressive individuals a product of the world we live in, or are they are victim of their own biological makeup? This argument falls under the domain of one of the most prominent psychological issues since the introduction of the discipline, nature versus nurture. As is the case with virtually every argument of this type, the answer is not simply one or the other, but it is an amalgamation of both. The real mystery of aggression has to do with varying degrees. To what degree is aggression nature, or biological? Equally, to what degree is aggression nurture, or environmental?

This paper asserts that while aggression is widely regarded as the product of a competitive environment, overt aggressive behavior is dictated by heredity and biological factors more so than by environmental factors. The relationship can best be expressed as a 3:1 ratio, or 75% nature and 25% nurture. But before examining the primary biological and environmental roots of aggression, one must define aggression. Aggression is any behavior intended to intimidate or harm. It can be verbal or physical. It can be aimed at another or aimed at oneself. The Harvard Mental Health Letter says that, "Aggression includes several kinds of behavior with different motives--protection of oneself, defense of a child, revenge, impulsive anger, and intimidation to gain social status or material goods" (Violence I, 2000). Now that we have a

functional definition of aggression, we can examine the neurological, biochemical, and environmental aspects that influence aggression.

Biological Aspects of Aggression

Aggression is one of the most fundamental behaviors of any organism, and it is truly multifaceted. The complex nature of aggression is reflected in the fact that its origins are complex as well. The biological factors of aggression include the breakdown of neurotransmitters as well as the highly specialized brain structures and their functions, which together underline the abnormalities of the atypically aggressive person. The neurotransmitter serotonin regulates many behaviors in humans and animals alike and research has shown that there is a strong correlation between serotonin levels and aggression. "Low serotonin levels [are associated] with the irritability that leads to impulsive, uncontrolled, reckless, aggressive, violent, or suicidal behavior" (Sylwester, 1997, p. 75). Serotonin is a versatile compound that manages several functions of the body, but its role in aggression is still vague. "People who commit impulsive arson, suicide, and homicide have lower than average levels of the serotonin metabolite (breakdown product) 5-HIAA in their spinal fluid" (Violence I, 2000). Examining the brain directly is invasive and highly dangerous, and ethical considerations dictate that patients should not be subject to physical or emotional harm. (American Psychological Association [APA], 2003) However, by examining the spinal fluid of these subjects, we can get a good idea of the brain chemistry of perpetrators without jeopardizing their safety.

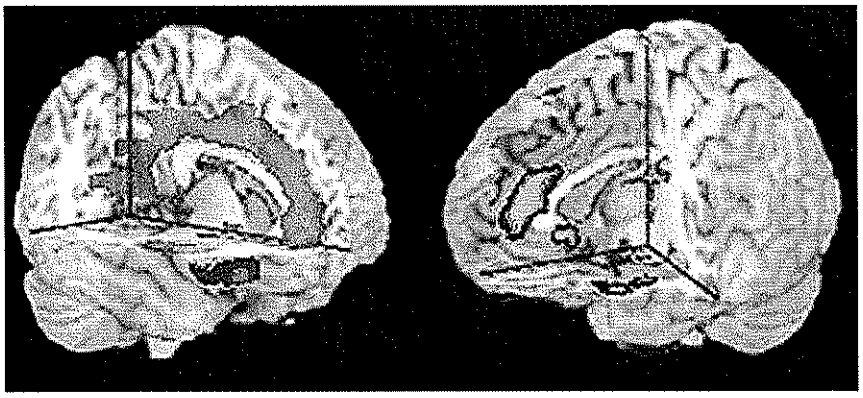
Our growing knowledge and understanding of the role of serotonin in aggression can possibly be put to good use in the future to treat patients with impulsive aggression. Low serotonin levels might be treated with the use of SSRIs, selective serotonin reuptake inhibitors. SSRIs work by blocking the reuptake of serotonin therefore increasing the stimulation of

serotonin receptors in neurons. (National Library of Medicine, 2007) This form of drug therapy would, in effect, bring a chemical balance to patients with low serotonin levels. It has been documented that, "The selective serotonin reuptake inhibitors (SSRIs) seem to reduce the risk of violence associated with post-traumatic stress" (Violence II, 2000). Whether or not this would translate into a reduction of all forms of aggressive behavior is debatable, however.

In addition to the breakdown of serotonin, several brain structures contribute to the behavior of aggression. The amygdala is part of the limbic system which is found in the frontal lobe of the human brain. (Merriam-Webster's Medical Dictionary, 2008) "The amygdala . . . governs or mediates the expression of rage and fear. The surgical removal of this region makes aggressive wild rhesus monkeys docile and lethargic, unable to respond to threats or even to recognize them" (Violence I, 2000). Obviously, without the amygdala these monkeys would not be able to defend themselves and would die out. Therefore, from an evolutionary standpoint, the amygdalae's role in regulating aggression is vital to many organisms' survival.

Another area of the frontal lobe that regulates aggression is the prefrontal cortex. A recent study by Monte Buchsbaum examined the brains of 41 convicted murders who pleaded insanity. Many of the murderers did in fact have legitimate psychological disorders, and their brain scans were compared to the brain scans of a control group. In some particular areas of the brain, the murderers were found to have less nerve cell activity than the control group. "The key difference…was in the prefrontal cortex, the bundle of white matter behind the forehead" (Monmaney, 1998). The frontal lobe has a strong correlation with aggression. The amygdala and prefrontal cortex are both found in the frontal lobe, and together they influence a wide range of behaviors, including aggression. The anterior cingulate cortex, the ACC, regulates aggression as well. It is also found in this brain region, connected to the prefrontal cortex.

Reduced activity of the anterior cingulate cortex has been found to be correlated to aggressive behavior. A study conducted by researchers Andreas Meyer-Lindenberg and Daniel Weinberger of the National Institutes of Health (NIH) looked at the MRIs, magnetic resonance imaging, and fMRIs, functional magnetic resonance imaging of 97 subjects. The subjects were divided into two groups, one for each variant of a common enzyme monoamine oxidase-A (MAO-A). This enzyme breaks down neurotransmitters, primarily serotonin. The fMRIs looked at brain activity as the subjects performed a task: matching emotionally suggestive pictures of angry and scared faces. The NIH (2006) researchers drew some interesting conclusions:



Source: NIMH Clinical Brain Disorders Branch

> Structural (left) and functional (right) MRI scan data shows that subjects with the violence-related version of the MAO-A gene (MAOA-L) had reduced volume and activity of the anterior cingulate cortex, which is thought to be the hub of a circuit responsible for regulating impulsive aggression.

The three major brain areas mentioned: the amygdala, the prefrontal cortex, and the anterior cingulate cortex are all located in the frontal lobe and are all interconnected. Together they regulate the complex behavior of aggression in humans. By knowing the functions of these three

brain areas, we could possibly use technology to identify and treat people who have a predisposition to excessive aggression. In the future, perhaps MRIs and fMRIs can point of atypically aggressive people, who would then be medicated with SSRIs. We are still far from achieving this, however it seems as though in the future, aggression may be treatable.

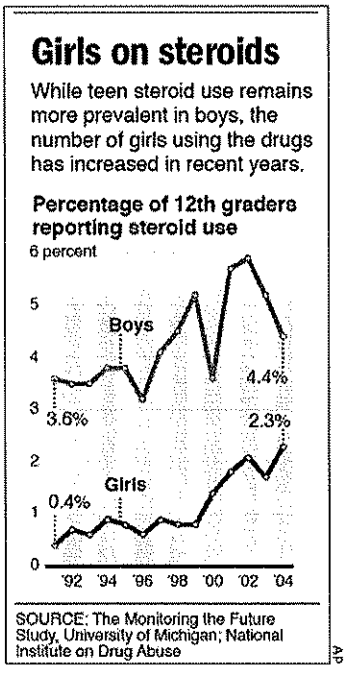
Environmental Aspects of Aggression

The biological aspects of aggression comprise only 75% of aggression, so what about the other 25%? Environment plays a lesser but still significant role in aggression. Living in a poor neighborhood or growing up as a gang member may influence one's aggressive behavior, but these phenomena are not observable. The only overt environmental factors that influence aggression come in the form of steroid abuse.

Steroids today are very much a part of our culture. Steroids have forever tainted the game of baseball. The 2006 Tour de France winner Floyd Landis was stripped of his title when it was discovered that he was using steroids. Olympic medalists Justin Gatlin and Marion Jones were given lengthy suspension after the steroid incidents; Jones was also stripped of every medal won since the year 2000. (Associated Press, 2007) Steroids not only mar an athlete's reputation, but they also pose serious health risks. "Anabolic steroids can lead to early heart attacks, strokes, liver tumors, kidney failure, and serious psychiatric problems. In addition, because steroids are often injected, users…are at risk for contracting dangerous infections, such as HIV/AIDS and hepatitis B and C," says the National Institute on Drug Abuse [NIDA] (2006). The rewards are few and the risks are many, but some athletes feel that taking steroids is the only way they can keep up in our competitive environment. "Scientific evidence indicates that anabolic steroid abuse among athletes may range between one and six percent" (NIDA). This number may seem surprisingly low, however many cases of steroid abuse go unreported and unrecognized.

The largest steroid scandal ever was in the sport of baseball. An intriguing fact about steroid use in baseball is that Latin American players were guilty in largely disproportional numbers. "Seven of the 12 American and National League players who were caught taking steroids during major league baseball's first season of mandatory testing were Latin American." To make sense of this data, consider that, "They made up just 24.6 percent of the 829 players on active rosters and disabled lists on opening day of the 2005 season" (Contreras, 2006, pp. 44-46). This means that the 25% Latin American population was accountable for over 58% of the steroid cases. Twelve people may not be enough to draw conclusive data, but a subsequent report indicates that, "Of the 30 major- and minor-league ballplayers who had tested positive for steroids as of mid-August, fully 22 hail from Venezuela, the Dominican Republic and Colombia" (Contreras, 2006, pp. 44-46). Assuming that the Latin American population is roughly the same, these numbers show that Latin Americans account for over 70% of all steroid cases.

Baseball players are not the only ones using steroids however. "There's been a substantial increase [in steroid use] for girls during the 1990s…Overall, up to about 5 percent of high school girls and 7% of middle-school girls admit trying anabolic steroids at least once, with use steadily rising since 1991." The majority of these girls use steroids to enhance their image, rather than their performance. Steroids can be an alternative to dieting or more dangerous practices such as drug abuse and anorexia. At the same time, the rising trend in steroid use can be attributed to recent increases in girls' participation in sports (Johnson, 2005).



With the data on Latin American and high school girls' steroid use, we have seen the

cross-cultural and cross-gender impacts of steroids. Steroids are not limited to American athletes. They are not limited to male athletes. In fact, they are not limited to athletes at all. Because this potentially dangerous substance is becoming more and more widespread, steps must be taken to deter steroid abuse. Issuing suspensions and stripping athletes of their medals is a start, but what about the thousands of others who illegally use steroids everyday? The government needs to crack down on these steroid users and treat them for what they are, drug abusers.

The association between steroids and aggression in humans is tenuous at best. Very few studies have been conducted to test this relationship, and even those results were contradicting and controversial. Athletes make up the majority of steroid users and there is some evidence of an association between athletes and aggression:

> In 1998, a University of Massachusetts study looked at statistics for sexual assaults at 20 Division I college campuses between 1991 and 1993 and found male student athletes made up 3.3 percent of the male population at the schools surveyed yet were accused of 19 percent of the sexual assaults on campus (Kiefer, 2007).

This phenomenon cannot be attributed to steroids however, because there are countless extraneous variables that must be taken into consideration.

In animals however, we can see a clear trend between steroid administration and aggression. "Male Syrian hamsters (Mesocricetus auratus) treated with moderately high doses (5.0mg/kg/day) of anabolic/androgenic steroids during adolescence display highly escalated offensive aggression" (Fischer, S. G., Ricci, L. A., & Melloni, R. H., 2007, pp. 77-79). There is a positive relationship between steroid administration and aggression in this case. Steroids increase the amount of testosterone in its user and while steroid administration increase aggression, the reverse is also true. "In mice, castration reduces the probability that a male will attack a rival"

(Huntingford, F., & Turner, A., 1988, pp. 44-47). While steroids and aggression have no evidential connection in humans, in animals there is some degree of correlation between the two variables. Nonetheless, it is apparent that the biological side of the argument makes a stronger case for the origins of impulsive aggression than the environmental side.

The Genetics of Aggression

Groundbreaking animal research is continually paving the way to a greater understanding of aggression in both animals and humans, and it is obvious that this research has powerful implications for the field of psychology. Because of ethical and practical considerations, researchers must use animals to test the associations between aggression and different variables. Complex variables such as aggression must be tested under controlled conditions, namely in a laboratory. These controlled conditions require that only one variable be tested at a time; aggression and steroids, aggression and serotonin, etc. Because humans cannot be harmed or exploited under the American Psychological Association ethical code, it is impossible to manipulate them in laboratory settings. (APA, 2003) In addition, the fact that the environment and heredity vary so widely in humans makes animal studies a valuable alternative.

Impulsive aggression has been linked to specific neurotransmitters, predominantly serotonin. A famous case study exhibited a Dutch family whose men exhibited, "Impulsive aggression, arson, attempted rape, and exhibitionism. The investigators pinned the syndrome on a mutation in the gene for monoamine oxidase A (MAOA), an enzyme that helps metabolize serotonin and norepinephrine" (Hendricks, 1996). This gene, which codes for MAOA, is also found in mice. Scientists took advantage of this genetic parallel to truly assess the role of this gene in aggression through animal studies.

"A French team reported it had created a mouse model of MAOA deficiency. Like the Dutch men, the mice were overly aggressive" (Hendricks, 1996). By now, the connection between MAOA has been well established by this and subsequent studies. One such study was conducted by Jean C. Shih, a neuroscientist for the University of Southern California. Shih has created a Tg8 strain mouse which displays high levels of aggression. "Shih has found that [Tg8] male mice lack a gene for the enzyme called monoamine oxidase A, which breaks down serotonin and other neurotransmitters. When this gene is missing, animals act in an aggressive and hyperactive manner" (Krieger, 2001).

But how do scientists create mice with genetic anomalies like the ones we have just examined? The process of gene mutation is a long and complex process that involves a relatively new technique called gene knock-out. "The lengthy technique, which can take a year or more, involves deleting, or knocking out, a single gene in mouse embryos, plus subsequent stages of interbreeding to get baby mice that lack the gene" (Hendricks, 1996). In the case of the Tg8 mice, gene knock-out was employed to delete to gene coding for MAOA, resulting in a fierce and aggressive subject. Other genes have had similar effects on aggression, suggesting that aggression may be more biologically based than initially thought.

One such gene was recently tested, again using mice. The researchers used gene knock-out to produce mice missing a specific gene. Using control mice, those who did have the nNOS gene, and knock-out mice, those who did not have the nNOS gene, Randy Nelson and Solomon Snyder of Johns Hopkins University observed the behavior patterns of both and compared the two groups in their displays of aggression. The scientists concluded, "Genetically, these mice are like other laboratory mice except for the missing gene. In appearance and behavior, they are the same as other mice too, except that they are extremely violent and sexually aggressive." In fact,

"In a 15-minute period, knock-out mice also bit, wrestled, and chased each other twice as often as control mice did" (Hendricks, 1996). These finding clearly demonstrate that the nNOS gene has a strong influence over aggression in mice.

After recording their data, Nelson and Snyder came up with the following conclusions for the experiment:

> Their theory is that NO somehow inhibits aggressive behaviors. Because their brains cannot produce NO, the knock-out mice are uninhibited in terms of aggression. Further testing demonstrated that the mice are normal in other respects that might have accounted for their aggressive behavior. For example, they have only normal levels of testosterone, the male hormone that plays a well-established role in aggression (Hendricks, 1996).

This is an important point to note. By assuring that the other variables are normal, we can say with reasonable certainty that the change in behavior was brought about by the missing nNOS gene. Also, "The gene in question, which codes for an enzyme called neural nitric oxide synthase (nNOS), is 'virtually identical in humans and in mice.' And neurons, where the enzyme is produced, are also 'virtually identical in mice and humans'" (Hendricks, 1996). Because of the parallel between mice and humans for this gene, this experiment can give us a more thorough understanding of the impact of this gene on human behavior. If mice can be "cured" using gene therapy, perhaps humans can also be "cured" in the same manner.

With the documented evidence of both the MAOA gene and the nNOS gene, it is obvious that genetics plays a large role in the regulation of aggression in animals. It is not yet apparent, however, whether these relationships exist in humans. Either way, because of the genetic similarities between mice and men for the two genes, we can conclude that genetics plays some

sort of role in the regulation of aggression in humans, though we do not specifically know the extent of that role as of yet.

Conclusions

Are aggressive individuals a product of the world we live in, or are they are victim of their own biology? Biology and environment work collaboratively to regulate aggression and that aggression is inextricably linked to both. Aggression is hard-wired into every individual's being. Certain people have a predisposition to behave aggressively, just like certain people have a predisposition for heart disease or diabetes. The extent of their aggressive behavior depends somewhat on their environment. Someone with a predisposition to aggression, whether it is low serotonin levels, an abnormal brain structure, or a missing gene, might not be aggressive if he were raised in a favorable environment. On the other hand, had that same person grown up in a harsh and unfavorable environment, he would almost certainly become aggressive.

To learn more about aggression and its etiology, additional research must be done. Specifically, the association between steroids and aggressive must be further evaluated. Our knowledge on that subject is far too scarce. Twin studies would most benefit the study of aggression in regards to environment. As stated earlier, two children with the same biological makeup that grew up in different environments would display different levels of aggression. Because ethics protect against the invasion of privacy, a functional way to measure aggression must be agreed upon to compare the twins. (APA, 2003) If twin studies were able to be conducted under this scenario, we could truly assess the role of environment in aggression.

So what does this mean for the future? As we learn more about aggression and its origins, will our newfound knowledge be used for the betterment of humankind or for its destruction? First, imagine if aggression could be treated. People who could not control their violent behavior

could take a pill and they would no longer feel the need to act aggressively. Aggression could be treated like any other disease is treated and meaningless massacres and crime might come to an end. Now imagine if aggression could be exploited. Governments could genetically engineer super soldiers for war or super athletes for sports. We are still far from knowing everything we need to know about aggression, but it is apparent that understanding aggression has serious implications for the future. Whether this knowledge is used for good or for evil, however, is up to us.

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Assessment form (for examiner use only)

Candidate session number	0	0							

Assessment criteria		Achievement level: First examiner	maximum	Second examiner
	A research question	2	2	
	B introduction	2	2	
	C investigation	3	4	
	D knowledge and understanding	3	4	
	E reasoned argument	3	4	
	F analysis and evaluation	2	4	
	G use of subject language	3	4	
	H conclusion	1	2	
	I formal presentation	3	4	
	J abstract	2	2	
	K holistic judgment	2	4	
	Total out of 36	26		

ame of first examiner: Examiner number: _
CAPITAL letters)

ame of second examiner: _____ Examiner number: _____
CAPITAL letters)