

The Effect of the Maternal Environment on Intelligence

Intelligence has become an important feature of our American culture with the ever increasing amount of research in measuring the “true” Intelligence Quotient (IQ). However what truly influences intelligence interested me more than correctly measuring IQ. The document I found that was the most interesting was an article that was published in the New York Times Magazine “Can You Make Yourself Smarter?” by Dan Hurley. In this document, researchers were finding different ways that an individual can improve their working memory, and there were some disagreements about whether or not working memory was a part of the biological aspect of intelligence. This comes back to the age old disagreement in psychology known as nature vs. nurture. If intelligence is based on nature, or genetics, there is nothing you can do to influence it since it is all in your genes. However, there are certain “nature” aspects in life in which one has no control over either. The first thing that comes to mind is before birth, when the fetus is developing in the mother’s womb, which brought me to the topic that I wanted to pursue. How greatly does the mother’s caution of her health, before the fetus is born, or maybe before one knows that they are pregnant, affect the rest of the child’s life in relation to their future intelligence? If the maternal environment had a great affect on intelligence, the fetus is putting their intelligence, and the rest of their lives, theoretically in the hands, or rather the wombs, of their mothers. This topic is worth pursuing because prenatal care is super important for the life of a child, and if it could affect the intelligence of the fetus, their lives could be messed up before day one.

The fetus is connected to the mother through the placenta, which is where all of the nutrients the baby needs comes from. Anything the mother ingests is transferred to the fetus; and anything toxic to the fetus could ultimately disrupt the normal development of the unborn child.

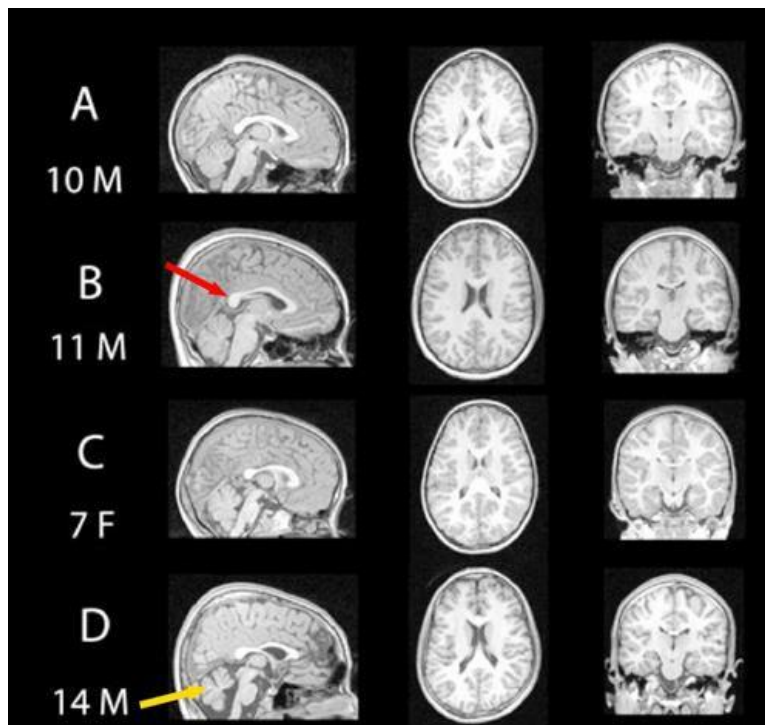
Although some would say that intelligence has everything to do with your genes, and not about the environment, the maternal environment is extremely important in the development of the fetus, and greatly affects intelligence. The use of alcohol, drugs, and malnutrition on the mother's part has a definite consequence on the life of their child in the future, leading to lower intelligence quotients and learning disabilities which put the child at a disadvantage before they ever take that first breath.

Prenatal Alcohol Exposure

A negative example of the importance of the maternal environment on the child's future scores on intelligence tests is the mother's use of alcohol. One of the worst toxins that a mother could expose her baby to is alcohol. Alcohol is a depressant which the Encyclopedia Britannica defines as "a drug or other agent that slows the activity of vital organs of the body" ("Depressant | Drug."). Alcohol is fed through the placenta to the fetus, which hinders normal development. When the baby is born with heavy prenatal alcohol exposure, the baby is essentially born an alcohol addict, and experience withdrawal symptoms. **The infant's brain is not correctly developed, which could affect the different nerves all throughout the body which is controlled by the brain, and could "disrupt every step in central nervous system development, from proliferation, migration, and differentiation, to synaptogenesis and myelination; in fact, alcohol can directly lead to apoptotic and necrotic cell death" (Thomas).**

Fetal Alcohol Spectrum Disorders (FASD) is a group of four different disorders that prenatal exposure to moderate to heavy alcohol use is responsible for; the most extreme being Fetal Alcohol Syndrome (FAS) that tends to not only cause significant cognitive issues, but also include physical birth defects. **According to the Center for Disease Control (CDC), "binge drinking is defined as a pattern of alcohol consumption that brings the blood alcohol**

concentration (BAC) level to 0.08% or more. This pattern of drinking usually corresponds to 5 or more drinks on a single occasion for men or 4 or more drinks on a single occasion for women” (“Alcohol & Public Health: Frequently Asked Questions.”). IQ is negatively correlated with the amount of prenatal alcohol exposure the fetus has. “The mean IQ in FAS is in the low 70’s for those with facial anomalies and in the low 80’s for those without facial anomalies,” with the severity of the facial disfiguration usually increasing with the amount of alcohol exposure in utero. Any exposure to alcohol in the maternal environment can lead to the formation of a Fetal Alcohol Symptom Disorder where, “[a]pproximately 25% of individuals with a FASD have an intellectual disability” (Eme). The development of the brain is severely affected in FASD patients as you can see by the figure below.



Each row signifies a different Fetal Alcohol Symptom Disorder, increasing in severity as you go down the column. The first row being no prenatal alcohol exposure, followed by partial fetal alcohol syndrome (pFAS), and the last two rows are children with Fetal Alcohol Syndrome

(FAS), the most severe (Thomas). The red arrow points to the visible decrease in the size of the corpus callosum which, according to the Myers' Psychology for AP textbook, is the "large band of neural fibers connecting the two brain hemispheres and carrying messages between them." The yellow arrow shows you in the case of the Fetal Alcohol Syndrome, the most severe case of FASD most commonly identified by the physical facial birth defects, an undersized hippocampus. If the hippocampus is not as fully developed as it should be because of the alcohol exposure in utero, the communication between the two hemispheres of the brain would be slowed, and may have problems relaying messages between the two. If the two halves of your brain cannot talk to one another effectively in an efficient way, the scoring on intelligence tests will be lower than an individual who has a fully functioning corpus callosum. The hippocampus "helps process explicit memories for storage" (Myers). With a smaller hippocampus, the practical intelligence generally measured on the many intelligence tests will be substantially lower than anyone with a fully functioning, properly sized hippocampus.

Prenatal Drug Exposure

When the infants of drug-using mothers are born, the infant is essentially born addicted to the drug. The baby has been receiving the drug through the placenta just like any other source of energy the mother consumes. They are born a drug addict and then experience withdrawal symptoms, such as shaking and crying, physiologically dependent on the drugs that their mother had been providing for them for the past 9 months. "Using sophisticated technologies, scientists are now finding that exposure to cocaine during fetal development may lead to subtle, yet significant, later deficits in some children, including deficits in some aspects of cognitive performance, information processing, and attention to tasks" ("What are the effects of maternal cocaine abuse?").

Methamphetamine is a stimulant, which is defined as a drug which “excite neural activity and speed up bodily functions” (Myers). This drug is sold in both solid and powdered form which is ingested by being snorted, smoked, swallowed, or is directly injected into the bloodstream. Unfortunately, according to a Survey done by the National Surveys on Drug Abuse, “Of the more than 16 million Americans over the age of 12 who have used meth, about 19,000 are pregnant women” (Society for Neuroscience). Elizabeth Sowell PhD, from the University of California conducted a study in 2010 on 61 different children, each with varying amounts of prenatal methamphetamine exposure, taking structural MRIs of their brains to see differences in brain development. Not only did the researchers find that children who were prenatally exposed to methamphetamine generally had the same brain abnormalities as Fetal Alcohol Symptom Disorder cases, but there have been a few cases where even greater brain abnormalities were observed. The prenatal drug exposure had a great effect on the children’s IQs that the researchers were able to “predict a child's past exposure to drugs based on brain images and IQ information” (Society for Neuroscience).

Prenatal Malnutrition

During the nine months of pregnancy, a single cell egg and a single sperm develop into an 8 pound bundle of joy. Entire organs are formed during this time, including the most important one of all, the brain. The fetus needs the correct nutrients in order to develop into a healthy baby. Therefore, if the mother is malnourished, as they might be in third world countries, the babies do not develop fully. When the fetus does not receive the correct amount of nutrients, it has to decide which organ it will use all of its power on, also known as the Barker Hypothesis (Dover). In most cases, the brain wins when it is matched up with other developing organs, which explains the issues found in other parts of the body, such as heart complications, but the

brain still does not develop normally and fully without the proper nutrition. “As examples, protein-energy malnutrition causes both global deficits, which are testable by general developmental testing, and area-specific effects on the hippocampus and the cortex;” which was explained before as influencing the storage of explicit memory and is a key part of intelligence.

Another example would be iron deficiency which “alters myelination, monoamine neurotransmitter synthesis, and hippocampal energy metabolism in the neonatal period.” The myelination affects the speed of neural impulses traveling in the brain, which can lead to slower reaction time and slower cognitive analysis of tasks that would be typically found in an intelligence testing situation, which could potentially lead to lower test scores. Another deficiency being zinc deficiency “alters autonomic nervous system regulation and hippocampal and cerebellar development,” which negatively affects the prefrontal cortex and its functions (“The American Journal of Clinical Nutrition.”)

Conclusion

Some argue that the maternal environment doesn't have a great influence on intelligence, and it is mainly the DNA that contributes the most to your intelligence, not what your mother did while she was pregnant. Some mothers would even feel that way today; they feel they can smoke, and do drugs, and drink, and disregard the effects the toxins can have on the baby that could last all of their lives. One major argument that some have to support the claim that intelligence is all about your genes is the argument that monozygotic twins have very similar IQs, and have the same DNA. However, they also share the same maternal environment, receive the same nutrients through the placenta, and the womb itself could be the explanation between the intelligence quotients and not the DNA itself.

What is needed to be learned from all of this is that intelligence is based on a number of factors, some can be controlled, such as the amount of effort put into one's own education, participating in activities that aim to strengthen the brain to work better; and there are some that we cannot change. DNA is one of them, and the maternal environment dealt to an individual to be born from. However, the amount of future Fetal Alcohol Symptom Disease cases can be lowered and prevented. We can instill proper prenatal care by informing the risks and consequences that one has on the lives of their children when they make poor decisions while pregnant. Legislature should step in, and do more, such as making it illegal to drink when you are aware that you are pregnant. While some mothers have been facing criminal charges for exposing their baby to alcohol in utero, it is not illegal in every case. If there were stricter laws on the use of teratogens while pregnant, there would be a decrease in the amount of FASD children, and fewer children with subpar brain development due to drugs or malnutrition. The use of illegal substances such as methamphetamines are illegal, however, more severe consequences should be enforced if the woman is found to be under the influence of drugs while she is pregnant. These babies need to be protected for their own future in any way that we can, they cannot fight for their own IQ.

Works Cited

- "Alcohol & Public Health: Frequently Asked Questions." *Centers for Disease Control and Prevention*. Centers for Disease Control and Prevention, 7 Nov. 2014. Web. 15 Mar. 2015.
- Hurley, Dan. "Can You Make Yourself Smarter?" *NY Times Magazine* 18 Apr. 2012. Print.
- "Depressant | Drug." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 8 Sept. 2014. Web. 12 Mar. 2015.
- Dover, George. "The Barker Hypothesis: How Pediatricians Will Diagnose and Prevent Common Adult-Onset Diseases." *Transactions of the American Clinical and Climatological Association*. American Clinical and Climatological Association, 2009. Web. 18 Mar. 2015.
- Eme, Robert, and Erin Millard. "Fetal Alcohol Spectrum Disorders: A Literature Review with Screening Recommendations." *Http://www.apadivisions.org*. APA Division 16: School Psychology, 1 Jan. 2015. Web. 12 Mar. 2015.
- "Fetal Alcohol Exposure and the Brain - Alcohol Alert No. 50." *Fetal Alcohol Exposure and the Brain - Alcohol Alert No. 50*. U.S. Department of Health and Human Services, Dec. 2000. Web. 12 Mar. 2015.
- Hurley, Dan. "Can You Make Yourself Smarter?" *NY Times Magazine* 18 Apr. 2012. Print.
- Myers, David G. *Myers' Psychology for AP*. New York: Worth, 2011. 84, 201, 272. Print.
- Society for Neuroscience. "Brain abnormalities identified that result from prenatal methamphetamine exposure." *ScienceDaily*. Science Daily, 17 March 2010. Web. 17 Mar. 2015.

"The American Journal of Clinical Nutrition." *Nutrition and the Developing Brain: Nutrient Priorities and Measurement*. American Society for Clinical Nutrition, Jan. 2007. Web. 8 Mar. 2015.

Thomas, Jennifer, Kenneth Warren, and Brenda Hewitt. "Fetal Alcohol Spectrum Disorders." *NIAAA Publications*. NIAAA. Web. 15 Mar. 2015.

"What are the effects of maternal cocaine use?" *Drug Abuse*. The National Institute on Drug Abuse, Sept. 2010. Web. 16 Mar. 2015.