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Defining the Biological Identity of the Unborn: A Scientific Approach to The Human Zygote

Abstract

The humanity (or lack thereof) of the zygote is one of the most prevalent and fundamental questions in science now. Past the philosophical, moral, ethical and legal objections and implications behind this issue, the question of the humanity of the unborn is at its most fundamental level a scientific one. After all, human beings are simply rational animals, whose reproductive processes we understand now better than ever. This paper will serve as an insight into dealing with the often controversial and politically-charged topic of the unborn from a purely scientific perspective.

Cover Page Footnote

The Faculty Mentor for this Honors project was Laura Jeanne Mozingo, Biology.

Pedro Slon Rodriguez

Professor Mozingo

Honors Contract

Spring 2019

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The humanity (or lack thereof) of the zygote is one of the most prevalent and fundamental questions in science now. Past the philosophical, moral, ethical and legal objections and implications behind this issue, the question of the humanity of the unborn is at its most fundamental level a scientific one. After all, human beings are simply rational animals, whose reproductive processes we understand now better than ever. This paper will serve as an insight into dealing with the often controversial and politically-charged topic of the unborn from a purely scientific perspective.

This research project will be limited to the fertilization and early development processes that take place, mostly in analyzing what they mean for the zygote in terms of its possible humanity. It is not meant to be a thorough explanation of early embryonic development rather; its purpose is to use what we know from areas of science like genetics and cellular biology to try and get to a meaningful conclusion about the biological identity and status of the unborn.

An important concept to explain before moving into the particular case of the zygote, is that science points at the fact that life is a continuum. That is to say that life is a continuous process whose ends (beginning and end) can be clearly distinguished, but that is constituted by an uninterrupted process throughout. This goes back to a main point in modern cell theory that

states that new cells must be generated by pre-existing cells (Sir W. M Turner, 1890). It essentially means that no cell can generate itself because to generate itself it would have to exist already, and if it already exists it does not need to be generated. This has led some scientists to say that because life is a continuum then questions about the beginning of life are unanswerable. This research will therefore focus on the beginning of life for a concrete being (the zygote), that is to say, when that being starts existing. Examples of when modern science draws the line between new and older generations include genetics, where we can analyze the parental generation, as well as observe clearly when the next generation (offspring) is present. This will avoid tracing the origins of life to millions of years ago, and keeping it to a concrete, practical case.

A first important distinction to make is between the gametes (sperm and eggs), and the resulting product after fertilization has taken place (the zygote). Gametes are specialized cells that have only one complete copy of that species' genetic information (called "haploid" cells), and whose sole purpose is to "meet" a gamete from the opposite sex of that species in order to allow for fertilization to occur. The ova (or eggs) can live for about 24 hours, and sperm can last up to 5 days in the proper environment, but the zygote that forms after these two gametes fuse in fertilization can grow and live up to 100 years in ideal conditions.

Fertilization can be thought of as the encounter between said gametes that combines both copies of the genetic material of the parents to generate a (diploid) cell that will grow under the proper conditions into a mature member of its species. In this way, both gametes complement each other in order to complete the full human genome of a human being after fertilization. The resulting zygote has a unique genetic composition that is entirely different from that of its constituent gametes (Condic, M. 2008). In mature members of the human species, all the body

(somatic) cells are diploid, except for the gametes, further differentiating them from the rest of the body. We can therefore put the zygote in a different category than the gametes that brought it about. This is evident by its molecular composition (including its now diploid genetic material), as well as the zygote's behavior.

Other than differentiating cells by their composition, scientists have found it appropriate to tell when there is a new cell by looking at the way that cell behaves (Condic, M. 2014). In this sense the zygote is also very distinct from the gametes. This is evident in the fact that merely 30 minutes after fertilization has taken place, the zygote prevents any more sperm from coming in and fertilizing the egg. This is referred to as "polyspermy," and the newly-formed zygote undergoes a lot of intricate processes, changes and produces very specific proteins to prevent this from happening (Dr Mark Hill 2019, *UNSW Embryology*). This anti-fertilization behavior can be contrasted directly with the behavior of the gametes; whose sole purpose is to allow for fertilization to occur. Both by its genetic information, produced proteins, overall molecular composition, and by its behavior, even at its earliest stages of development, the zygote that is produced after fertilization is both alive and with human genetic material.

This naturally poses the question: Is it just a human cell, or is it an organism? There is a clear distinction between a person and a cell. For example, the cells in my arm are diploid and have human genes, proteins, and so on, and they are part of my living body, but if I were to cut or scrape my arm and that cell were to die, that doesn't mean that the organism or being (me) would also die. In order to answer this question, we must first have a definition of what an organism *is*. The Merriam-Webster Dictionary states two definitions for organism: "1: a complex structure of interdependent and subordinate elements whose relations and properties are largely determined by their function in the whole

2: an individual constituted to carry on the activities of life by means of parts or organs more or less separate in function but mutually dependent : a living being” (<https://www.merriam-webster.com/dictionary/organism>).”

Applying this definition to the zygote we can see that it works on the first point, as the ever-growing number of cells work together towards the zygote’s growth and development, which through the process of pregnancy will result in a fully mature member of the human species. The second definition of an organism also seems to apply to the human zygote as well, as major organs and tissues like the heart, spinal cord, and brain start forming at around only the third week of pregnancy, the 5th week of gestation (US National Library of Medicine). Given the definitions and evidence proposed, the natural conclusion seems to be that the zygote is a living organism that belongs to the human species. Further evidence for this comes from the fact that the cell divisions that go on within that newly-formed zygote are not random, unlike regular somatic cell division. This includes early differentiation of cells for future body parts, and the physical location of the cells within the growing zygote.

The next question that arises is whether an organism of the human species and a person are the same. Now that borders more on the philosophy aspect than on the scientific facts, and so this paper will avoid that distinction. George Robert and Patrick Lee propose a good, simple, non-philosophical definition of what it means to be human in their 2005 paper “Acorns and Embryos,” and they state that “One is a human person by being a living member of the human community, a member of the human species.” (R. George, Lee, P. 2005). They argue that the zygote checks all these necessary boxes, and that it must therefore be considered a person. Their argument seems to be based on the scientific observations and conclusions that the zygote is a) alive, b) belongs to the human species, and c) is an organism, and then states that because these

premises are true then the zygote is a human being, and therefore a person. One could argue that they take the risk of equating a person and a human being. Once again, any objections to that are merely philosophical and will not be discussed in this paper. Others may argue that the zygote does not “look” human (given that its composed at its very beginning of only a few cells), but there are some serious reasoning flaws behind this argument. The most important one is that this statement operates under the assumption that to be human one must look a certain way. This is demonstrably false, as humankind is as diverse as any animal species, and that does not make any of us any less human.

On the negative side however, Carlos Bedate and Robert Cefalo argue that calling a zygote a person is incorrect, because “In summary, the zygote makes possible the existence of a human being but does not in and of itself possess sufficient information to form it. The formation of the embryo depends on a series of events that will have to occur during the course of the ontogenesis (development*), some of which are outside the control of the genetic program” (Bedate, C. A., and R. C. Cefalo. 1989). They essentially argue that since for its proper development the zygote needs interaction and processes not directly commanded by its genetic information then it must mean that it is not a human being.

This, however, seems to either miss or misunderstand that life is a continuum. It can be argued that even a fully grown, born individual of the human species is dependent on factors and processes outside of what is in their genetic material for its survival and development. This principle can be proven with a simple thought experiment and an imaginary friend named Lucas. Lucas is about to be one years old and is dependent on his family for his survival. Despite having all the genetic material that he needs, there are still a lot of factors that are external to him that could result in his death. A few of these are his parents not feeding him, getting into a car

accident, and drowning in the bathtub. With this perhaps bizarre thought experiment it is clear that because life is a continuum, there are many factors external to an individual/being that could end that life, but this does not mean that said life was not there to begin with. Going back to Bedate and Cefalo's argument, the fact that the zygote needs external support to become an embryo is as relevant to its humanity as saying that a toddler requires external support to become a preschooler.

Furthermore, they fail to explain or provide any evidence to justify the implication that even though a zygote should not be considered a human being, an embryo must be. They seem to be implying that a zygote is not human yet, but once that zygote grows into its embryonic stage of development (around the 11th week of gestation) it somehow acquires its humanity. In their paper however, they fail to provide any substantial reasons behind this otherwise arbitrary requirement for humanity.

After looking and weighing arguments for and against the unborn being human beings, we can extrapolate that using widely accepted definitions of organisms, and areas like genetics and cellular and molecular biology, the scientific evidence indicates that the zygote, from its earliest stages of development, is an alive human organism.

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