

Understanding fetal programming to promote prevention and wellness counseling

To best assist clients in healing psychological suffering, counselors have long sought to understand the fundamental origins of threats to mental health. One of the profession's hallmarks is its commitment to identifying how racial, economic, gender and other social injustices impose conditions that compromise well-being.

This professional allegiance to understanding the environmental factors that drive psychological wellness has developed parallel to the highly influential biomedical model of mental health that emerged in psychiatry over the past half century. The biomedical paradigm often underscores internal processes related to temperament, genetic susceptibility and other issues that drive one's ability to withstand stressful events, thus creating a general tension with the ecological, social justice position of counseling. This tension has often been translated into the age-old nature-nurture debate and raised an intriguing question: Is the human psychological condition predetermined by genetic code and biological constitution, or is it shaped and manipulated by experience and interaction with the environment?

Although the nature-nurture debate has persisted for centuries, recent trends in neuroscience and genetics reveal that rather than being opposing forces, nature and nurture are engaged in complex transactions. We increasingly understand that changes in the environment literally alter our biology — our biology in essence listens and responds to our environment. The burgeoning field of epigenetics and its relationship to fetal programming explains one of the primary

mechanisms of this transaction between biology and environment.

Epigenetic processes include a range of mechanisms working at the cellular level to alter how our genes vary their expression without altering the underlying genetic code embedded in the DNA itself. In this sense, epigenetic mechanisms act as the interface between environment and DNA. (Readers can refer to the September 2015 Neurocounseling column for an extended discussion of this topic.) What is particularly germane to the counseling profession regarding epigenetics is that much of what we have suspected about conditions of poverty and marginality and their relationship to psychological ill health has been affirmed. Epigenetics demonstrates that these adverse conditions alter our physiology in ways that increase our susceptibility to poor psychological health. With this comes the promising message that understanding epigenetic mechanisms can serve as the foundation for sound and empirically driven prevention strategies, particularly very early in life.

Knowing that early environment is one of the architects of lifelong mental health, we turn this discussion to the impact of our first environment, the womb, on psychological development. More specifically, we turn to the concept of fetal programming — the way that signals from the prenatal environment (i.e., the mother's physiology) can alter developmental trajectories, in some cases through epigenetic mechanisms. Such alterations can leave lasting imprints that result in susceptibility to psychological suffering later in life.

This concept emphasizes the impact of one of the bookends of life span development, highlighting the early determinants of our health and mental health. This discussion is particularly important given that the prenatal period is a component of mental health etiology that is often overlooked. For counselors, an understanding of fetal programming can clarify some of the origins of psychological health *and* directly inform our practice. Efforts to promote wellness and minimize mental health issues for pregnant women have the potential to impact the well-being of both the mother and the child. Such interventions could act as the ultimate mental health prevention strategy, shaping a healthy prenatal environment for the developing fetus and potentially imparting resiliency across the life span.

Fetal programming

The concept of fetal programming — also known as the fetal origins hypothesis or the developmental origins of health and disease — originated from the epidemiological studies of David Barker and colleagues. Barker studied 5,654 men born in Hertfordshire, England, between 1920-1930 and observed that those with low recorded birth weights were particularly prone in later life to cardiovascular disease, obesity and Type 2 diabetes. To make sense of this association, Barker hypothesized that poor nutritional conditions during fetal life programmed the structure and physiology of the developing offspring in a way that increased their risk for disease later in life (we now understand that much of this programming involves epigenetics).

Barker dubbed this the “thrifty phenotype hypothesis.” The idea is that the nutritional conditions coming from the mother signal something about the impending environment (e.g., famine). In turn, these environmental signals shape the biology of the fetus during development (a true nature-nurture transaction) to adaptively prepare the child to live in its future conditions. So, when faced with a food shortage (and hence receiving the signal of future famine), the fetus becomes “thrifty” and develops in a way that physiologically prepares the child to adjust to a postnatal life with an expected food shortage.

This predictive adaptive response becomes problematic, however, when there is a mismatch between the expected and actual environment. The offspring develops to be highly efficient at storing fat when calories are abundant, with the expectation that times of feast will be rare relative to times of famine. If that same individual is born into an environment with frequent access to foods overly rich in calories, then the developmental programming becomes highly maladaptive, manifesting in problems such as obesity, Type 2 diabetes and cardiovascular disease. In the example, the fetus is primed for deprivation it never encounters.

Terms to know

Although fetal programming was developed in relation to prenatal nutrition and the risk for physical diseases, the concepts aptly apply to prenatal mental health and the risk for mental health challenges in the child. To fully grasp this important relationship, it is helpful to become familiar with some terms that capture key concepts related to fetal programming.

Phenotypic plasticity: *Phenotype* refers to observable characteristics produced as a result of gene expression. Genetics students are often introduced to the notion of phenotype using eye color as an example. The term *phenotypic plasticity* is applied when the observable gene product (the phenotype) is flexible and has an appearance based on a combination of the composition of genes and the environment. More specifically, the expression of certain genes is altered through epigenetic changes, resulting in a wide range of phenotypes.

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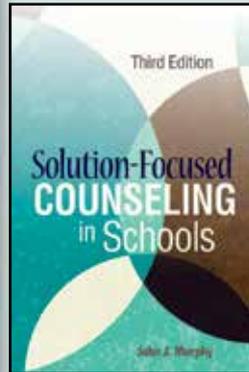
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A metaphor that may be helpful is the classic *Choose Your Own Adventure* children's books. The books are written in the second person and allow the reader to assume the role of protagonist. They are designed so that the story has many possible endings, each depending on the decisions the reader makes when faced with choices throughout the book. The reader can't change the words in the book or the number of pages — they are fixed like our DNA. However, depending on the environmental signal (in this case the reader's choices), the fixed pages may produce multiple endings (like a phenotype). Phenotypic plasticity — and the possibility for multiple endings — is essential to understanding how the developing fetus responds to programming signals to change its ending.

Weather forecasting, predictive adaptive responses and match/mismatch:

These terms are useful in understanding the potential for maladaptive development of the fetus. The term *weather forecasting* describes the process through which the fetus receives information about future environmental conditions through signals from the mother (e.g., nutrients or hormones).

Patrick Bateson, Peter Gluckman and Mark Hanson called the developmental adaptations the fetus makes based on the predictions about the future environment (per the weather forecast) *predictive adaptive responses* (PARs). Under the right conditions, PARs confer an evolutionary advantage. If the child's future environment matches the weather forecast, then the PAR will be adaptive; however, if the weather changes (i.e., the environment differs from the forecast received by the fetus), the PAR will be maladaptive.

In cases in which the weather forecast is an accurate measure of what the postnatal child encounters in the environment, this is considered to be a *match*. If, on the other hand, the environment encountered after birth is different from what was forecast prenatally, this is called a *mismatch*.

Prenatal stress

Although the fetal programming of long-term metabolic diseases may not seem particularly important to counselors, the fetal programming of mental health outcomes is profoundly relevant. Prenatal care justifiably emphasizes the physical health of the pregnant mother. We are well-

aware of the deleterious effects of prenatal exposure to drugs, alcohol, lead and various other potentially damaging substances. However, less attention has been given to prenatal psychological wellness.

In January 2016, the U.S. Preventive Services Task Force added pregnant women to the list of individuals recommended to receive depression screenings. This is significant because maternal mental health appears to deliver a weather forecast to the fetus, potentially resulting in fetal programming that could place the developing fetus at increased risk for a host of mental health challenges. We now know that maternal emotional distress affects the dyad (mother and developing child) during pregnancy. When exposed to stress prenatally (in the form of the mother's stress hormones), children are at increased risk of developing anxiety disorders, attention-deficit/hyperactivity disorder (ADHD) and conduct disorder. Stress in the pregnant mother is also linked to impulsivity, increased stress reactivity and a fussy, active infant temperament. Fetal programming may trigger some of these connections.

Vivette Glover applied an evolutionary perspective to demonstrate how fetal programming concepts may explain the relationship between prenatal stress and anxiety, ADHD and temperament. A stressed pregnant mother sends a weather forecast to her fetus foretelling a stressful environment. In an evolutionary sense, "stressful" might imply harsh, dangerous and unpredictable surroundings. The developing child may develop PARs related to anxiety — such as increased vigilance — that are ideal for spotting frequent dangers. Another PAR may be to develop readily distracted attention (a symptom of ADHD), which would be perfect for responding to unpredictable and frequently changing conditions. An active or fussy temperament might be the best way to ensure resource allocation when resources are scarce — the squeaky wheel gets the grease.

It's easy to see the adaptive benefits of these behaviors should the child encounter the stressful, dangerous environments some of our evolutionary ancestors inhabited. Some children do reside in environments that simulate these dangers. Two examples include high-crime neighborhoods and households in which considerable chaos

or maltreatment exists. Those who are not raised under such conditions — or even those who are — would likely benefit from more-tempered programming than our ancestors required, given the other demands in our current environment.

In many cases, the adaptively designed traits of anxiety, ADHD or fussy temperament become a mismatch in our current settings. Increased vigilance or readily distracted attention tend to be poor fits with current educational settings. Fussy temperaments become challenging for many parents and put the child at increased risk for maltreatment. The fetal programming of prenatal maternal stress thus results in a mismatch between what was intended to be adaptive fetal development and the current environment.

Appreciating fetal programming and its subsequent developmental outcomes can be informative for counselors. For one, it offers a paradigm shift in how we might think about mental health struggles. For example, maybe ADHD isn't pathological, but rather the result of adaptive development that just happens to be a mismatch for the environment. By looking through this lens, perhaps counselors can help to modify environments. Understanding fetal programming also highlights maternal mental health not only as a treatment target for the mother's well-being, but as a prevention target to promote positive life span development in the child.

Fetal programming of a dysregulated stress response

Many of the psychological and behavioral challenges described in connection with prenatal maternal stress are likely related to the now well-documented programming of a child's hypothalamic-pituitary-adrenal (HPA) system, one of the major systems involved in our fight-or-flight response (for an extended discussion on this system, see the October 2014 Neurocounseling column). Dysregulation of the HPA system may manifest as enhanced stress responsivity in a child and the inability to "turn off" the stress response.

Consider a pregnant mother suffering from chronic stress related to economic hardship, an abusive partner, physical safety concerns and a general lack of family or community support. The mother's HPA axis (we will refer to this stress response

system as the “alarm system”) responds with elevated levels of stress hormone (called cortisol). Typically, the fetus is protected from maternal cortisol by the placenta, but there is evidence that maternal stress may epigenetically alter the levels of protection in a way that exposes the fetus to cortisol (a complex process we are simplifying for the purposes of this article).

As high levels of maternal cortisol reach the fetus, fetal programming mechanisms may take effect. Maternal stress hormones forecast a stressful future environment for the fetus. Through fetal programming and epigenetic mechanisms, the fetus adjusts and calibrates its alarm system to be hypersensitive (a PAR). This would be ideal in a highly stressful world in which one would want the alarm system going off all the time to better respond to frequent dangers (constituting an environmental match). However, an alarm system that is chronically triggered and difficult to turn off results in wear and tear on the body. This is akin to leaving your car battery on perpetually; eventually, the battery will completely drain. In the current world, a hypersensitive alarm system is not required, so the child will suffer the behavioral and

emotional difficulties without incurring any benefits (a mismatch).

The role of counselors

Prenatal care has traditionally been entrusted to other fields such as nursing or obstetrics, but some aspects of the prenatal period are closely aligned with the core tenets of the counseling profession. Promoting maternal mental wellness acts as the ultimate form of prevention by supporting the optimal physiological (mental and physical) life span development of the child. Counselors can promote mindfulness and other mind-body techniques to reduce maternal stress and promote positive infant self-regulation. In addition, counselors can help pregnant women cope with depression through therapeutic interventions such as interpersonal therapy. The role of counseling interventions in treating prenatal mental health is particularly important because there is still much speculation concerning the impact of various pharmaceuticals (i.e., antidepressants) on the developing fetus.

The dyadic interconnection at the center of fetal programming is also a powerful

therapeutic port of entry for counselors. Evidence suggests that fetal programming is more dynamic than deterministic. The kind of sensitive, attuned and responsive parenting that occurs in positive attachment relationships may reverse or buffer against prenatal programming effects by overriding previous signals of stress with developmental inputs of safety and security. Counselors can facilitate positive attachment interactions through infant mental health interventions, attachment-focused relational therapies, parenting psychoeducation and behavioral strategies related to challenging child temperaments and behaviors.

As such, epigenetic changes are in many cases a dynamic process and may be mutable throughout life. Although there may be critical periods during which epigenetic changes are more responsive to manipulation, this does not imply that there is a time after which change is impossible. There is promise in the notion that across the life span, some epigenetic pathways can be reopened in response to future experiences, meaning counselors can facilitate positive environmental signals that may rewire or reverse previous

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