

Brain Wiring Game: Demystifying Synapse Formation and Brain Development During the Early Years

A Participatory Learning Tool for Promotion of Nurturing Care

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Abstract

The early years in a child's life are 'critical' as synaptic connections in the brain form and mature in this period. A child's potential for development becomes irreversibly reduced if these early years are not enriched in a stimulating physical and psychosocial environment. Elucidating the underlying technical scientific concepts related to brain development to lay persons is a challenge specially in low-and-middle-income countries like India with limited literacy and/or ignorance. If these technical concepts are to be taken to the last person, across the last mile then simple, effective, acceptable solutions need to be metamorphosed for the local context considering the cultural, social and economic constraints.

Brain wiring game is a participatory activity that helps to sensitize the audience about the 'sculpting' role of experiences on synapse formation and brain development during the early years. It evolved in 2018, during the preparatory phase of a field implementation research for empowering caregivers on Nurturing care being implemented in 4 districts of Maharashtra, India. Since then, it has been played with more than 200,000 individuals representing an entire spectrum from rural, urban and tribal areas, irrespective of their literacy status or socio-economic background. It has been played in a variety of settings ranging from classroom training sessions, field training sessions, mothers' meetings at village level, Palak melawa (Community fair for Parents), sensitization meetings and community-based events. The participants who have been sensitized through this include parents, other caregivers, frontline health workers, para-medical staff, village council representatives and health professionals.

Introduction

The early years in a child's life are 'critical' as synaptic connections in the brain form and mature in this period.[1] A child's potential for development becomes irreversibly reduced if these early years are not enriched in a stimulating physical and psychosocial environment.[2,3] The underlying concepts of brain development including synapses formation, pruning of synapses, brain plasticity, the experience-expectant or serve and return function, effects of toxic stress, are difficult to understand and comprehend.[3–5] Unless a person understands the importance of his/her actions – the *why* part, merely asking them to do or not do something will not serve the purpose. If an individual understands the potential impact of his/her actions the probability that he/she will comply to the given task or indulge in or practice a behavior increases manifold. Making an individual realize the positive impact of his/her actions is a potential way of making someone internally motivated.[6,7] Challenge is how to translate the scientific technical concepts to a form which will enable the commonest of the common to understand and imbibe those. The challenge becomes even more when such things are to be elucidated to the illiterate, ignorant, poor or marginalized individuals who may not have the required education or resources or technology to afford or access the tools that may already be available. This warrants that, simple, cost-effective, acceptable solutions need to be metamorphosed for the local context considering the cultural, social and economic constraints if such technical concepts are to be taken to the last person, across the last mile.

The Brain Wiring game is a participatory activity that helps to sensitize the audience about the "sculpting" role of experiences on synapse formation and the brain development during

the early years. The objective of sharing this brief report is to explain its genesis, evolution and application so that it may be used or adapted in other low-and-middle-income countries like India with resource constraints.

Genesis and evolution

The game was conceived by the Team at Mahatma Gandhi Institute of Medical Sciences in Sevagram in an attempt to come up with something that is simpler yet cogent to drive home the concepts related to early brain development. The intent was to have a participatory activity that does not require much preparation or special material or specific requirements and can be undertaken with different spectrum of participants irrespective of their literacy status and/or socio-economic background and in a variety of settings particularly the field/community settings.

The brain wiring game is inspired by the *The Brain Architecture Game* developed by the National Scientific Council on the Developing Child and the FrameWorks Institute.[8] We would like to give the credit to the developers of *The Brain Architecture Game* who made us think about how we can take some of the underlying concepts on which that game is based to the last person, across the last mile. The cost, specific materials and specifications needed for *The Brain Architecture Game* were truly a constraint. We could not foresee the illiterate or the poorest of the poor in our area play *The Brain Architecture Game* and learn from it. Therefore, there was a perceived need to come up with something that was simpler yet compelling enough to sensitize such parents/caregivers to the concepts of early childhood and brain development as these concepts are too important to let go. This intent and thought process facilitated evolving of the brain wiring game.

It evolved during the preparatory phase of the UNICEF Early Childhood Development (ECD) project (2018-2020) being implemented in four districts of Maharashtra, India and has been extensively used in the UNICEF ECD project since then. The game has been played with around more than 200,000 individuals in different settings irrespective of their literacy status or socio-economic background. The game has been played in a variety of settings ranging from classroom training sessions, field training sessions, mothers' meetings in Anganwadi centre, Palak melawa (Community fair for Parents), sensitization meetings and community-based events. The participants who have played this game involve an entire spectrum from rural, urban and tribal areas involving but not limited to parents, other caregivers, frontline health workers, para-medical staff, Panchayat Raj/Gram Panchayat members and professionals.

Scientific background for the Game [5,9,10]

The Facilitators for the game need to be well versed with the background scientific background for the Brain wiring game as they will need to explain and emphasize the same to the participants during the debriefing session after the game has been played.

The brain develops from the bottom up

Brain development (synapses formation for various areas of development like motor vision, speech, emotions, language, math's, logic and social attachment) begins before birth and continues into adulthood. However, most brain development occurs in the early years, brain grows to 80% of its weight within three years. A synaptic connection is a

connection between nerves, and it serves to send messages from one part of the brain to another. The human brain has billions of synaptic connections. These connections are necessary for all of our thought processing. If these connections are not made correctly, it can affect how the child thinks. The number of synaptic connections is very less at birth, brain makes 700 synaptic connections per second after birth. Human infants are unique in the amount of influence that the environment has on their developing brains. This is the reason that we stress how many connections are made in the first few years after birth, and the rapid increase in brain size.

Environment and Experiences ‘Sculpt’ the brain

The connections in the brain are built starting in the earliest years of life, and that the experiences to which a child is subjected to literally *sculpts* the brain architecture i.e., experiences shape the brain structure for better or worse. Toxic stress has negative effects on the developing brain. All children experience some level of stress and can cope with it if they are supported by a loving caregiver. Absence of any supportive caregiver leads to children experiencing toxic stress. Toxic stress weakens the architecture of the developing brain, which can lead to lifelong problems in learning, behavior, and physical and mental health. In the absence of responsive caregiving that falls short of providing a nurturing environment or if responses are inconsistent or unreliable or inappropriate, the brain’s connections are not formed as expected, that can lead to disparities in learning and behavior.

Brain develops on a “Experience-Expectant” function –

The brain requires a response in order for these synapses to grow and for the capacity to develop. So, we say that the brain is “experience-expectant” because it is expecting input in order to develop. Stimulation from only one direction i.e., only from the developing child is not enough. A Sensitive and Responsive caregiver will be able to identify and respond to the child’s needs and provide the necessary experiences which the developing brain is expecting for development. In short if you expect the brain of a child to develop in a particular way then the caregivers got to provide/ensure the analogous experiences for it. Children who do not have opportunities to have a response, will have less well-developed brain structures.

Brain plasticity decreases with age

'Plasticity' refers to the ability of the brain to change and modify itself based on experiences. This ability helps children adapt to many changing circumstances. Normal brain plasticity is influenced by experiences i.e., exposure to adverse experiences (biological or social risk factors) damage the neuronal connections. The brain has a lot of plasticity early in life. The physiological effort required to modify neural connections in a child is much less in first three years than after the school going age. If we can Prevent the possible damage by avoiding exposure to adverse experiences it is much more desirable and less resource intensive rather than trying to treat the damage caused at a later stage of life. It is much easier to bring the child back to a normal trajectory if we start early in his/her life. Prevention of brain damage is less expensive than treatment (and more effective).

Context

In low and middle-income countries, 43% of under-fives are at risk of suboptimal development and stunted growth, fail to reach their full potential leading to poor academic success and low employability due to poor health, inadequate nutrition, exposure to stress, and limited age-appropriate stimulation.[11–13] Nurturing care framework by WHO, UNICEF, and the World Bank outlines the importance of the earliest years, from pregnancy to age 3 as a window of opportunity when the brain grows faster than at any other time. This period is also critical for well-being and productivity with the capacity to modify the way genes are expressed which last throughout life.[14,15]

Why Use This Game?

To help the audience understand the factors affecting brain development: what promotes it and what may derail it?

- To emphasize the importance of responsive caregiving;
- To sensitize regarding the powerful role of loving relationships and enabling conducive environment on early brain development;
- To emphasize the effect of adverse childhood experiences, toxic stress on brain development of children.

Reflection

We never imagined that this game would be used this extensively or become so popular and valued by the different stakeholders. The participatory nature, being experiential, less resource intensive, non-dependence on sophisticated materials, simplicity and being able to connect to the brain development concepts have made this game popular and effective. All the front-line health workers from project area especially the ASHA and Anganwadi workers and their Facilitator and Supervisors have helped to take this game to the last person and across the last mile. We truly owe it to them to facilitate effective utilization of this game. It simply would not have been possible without their enthusiasm and commitment for advancing the cause of Early Childhood Development.

Truly, sometimes the simplest things are the most powerful!

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