A Review on Dynamic Systems Theory and the Children's Motor Development

Article *in* Psychology and Education Journal · January 2020

CITATIONS
0

READS
3,469

3 authors, including:

Hazhari Ismail
Universiti Pendidikan Sultan Idris (UPSI)
23 PUBLICATIONS **47** CITATIONS
SEE PROFILE

Romarzila Omar
Universiti Pendidikan Sultan Idris (UPSI)
8 PUBLICATIONS **4** CITATIONS
SEE PROFILE

A Review on Dynamic Systems Theory and the Children's Motor Development

Hazhari Ismail[1], Sa'dan Abdul Aziz[2], Romarzila Omar[3]
[1]Department of Early Childhood Education, Faculty of Human Development, Sultan Idris Education University, Tanjung Malim, Perak, Malaysia
[2]School of Foundation Studies, Perdana University, Kuala Lumpur, Malaysia
[3]Department of Early Childhood Education, Faculty of Human Development Sultan Idris Education University, Tanjung Malim, Perak, Malaysia
hazhari@fpm.upsi.edu.my[1], saqdan910@gmail.com[2]

ABSTRACT

Adopting Dynamic Systems Theory (DST) as a way of comprehending the development of human being reconciles many controversies as it reorganizes the conventional approach to knowledge processing, which involves understanding cognitive science in collecting information from the local environment. This study reviews the major contribution of the theory in the holistic thought about development and how it has been developed with the children's motor skills development, also the strengths and limitations on the horizon from the theory basis. The beginning section explores on what way DST occurs in wider context within different fields, and next in the second section offers a detailed understanding of how DST involves the children's motor skills development. It also evaluates particular examples which focus on the main DST concepts. The end section focuses on advantages and disadvantages where the theory is restricted for taking the works of extension which brings to the inference of this perspective for a new understanding in children's development. Finally, it draws an explanation for behavioral changes that could be understood in which system motion is self-assembly and self-organizing with the framework to achieve needed actions. DST is believed to provide the greatest contribution where it knows system stability where all system elements are constantly interconnected and communicate with other triggers both internally and externally.

Keywords
Dynamic Systems Theory, motor development, children development

Article Received: 10 August 2020, Revised: 25 October 2020, Accepted: 18 November 2020

Introduction

Development theory has seen diverse fields shift in recent decades. There is a recent spotlight on the developmental cycle over time, besides relying the aspects that affecting the development (Jihua, 2016). The latest research has provided the view of the principle of cause and effect in which in-depth explanations of development are inadequate. Furthermore, according to Christiansen & Kirby (2003), some changes might occur and implies the development of new behaviour during the interaction of the components within a complex system over time. Dynamic systems theory (DST) has been incorporated into the field of psychology and promotes how the modern way of thinking can describe change. The establishment of the DST is not in isolation as where it is, because it also contributes as core aspects to a broad-ranging shift in developmental science for metatheory systems such as situated and sociocultural approaches, ecological systems theory, developmental systems theory, and connectionism (van Geert, 2020).

As a comprehensive theoretical structure in the area of physical sciences and is pursued as further alternative to take the place of the existing way to understanding human development which has been developing for many decades (Smith & Thelen, 2003). Application of this flexible structure and versatile basis to perceive the development and the way it develops, learns and changes in various field such as genetics, education and physical science. In terms of concepts from thermodynamics and nonlinear mechanics, DST is theoretically a theoretical method. Studying human behavior is profoundly essential, as the DST components are very easy to understand. But, in terms of the language and definition, it can seem a little different for researchers. In psychological perspective, DST is a more fitting theoretical structure to place psychological situation since it is succeeded in

taking into account the kinematics of the human body with certain phenomena (Fusella, 2013).

The symbol of people conduct is of various qualities. Several researchers have recently accentuated the potency of variation and tried to explain both consistency and variance in changes in behaviour across period and developmental complexity (Jihua, 2016). For example, the five years old boy can read the letter for his mother, but not for his teacher at kindergarten or sister at home, can discern different colours. Such kinds of performance instability situation may be vexing, but actually it is common for this development to be frustrating and this variance might happen to all human behaviour.

DST focused epigenetic mechanism which describes interactions within the development from genetic to environmental factor with many of the causality stages (Lunkeheimer, 2018), It then aims to enforce how new behaviors emerge and change over time which form the development process (Spencer et al., 2009). Nonetheless, DST has not emphasize on conventional dichotomies that are developed for centuries, like nurture versus nature, transition versus stability, as an essential feature in system, aside from retains awareness of one and the other facets that signified growth (Spencer et al., 2009). Moreover, numerous researchers conclude that DST cannot distinguish the state and production of the action behavior from both internal and external influences.

Motor Development Stages

This is impossible to deny the motor movement does not require any practical pattern in life. Those instructions are considered to accompany the development process or skill growth. There are different sequences of skills that describe the many steps from beginning with crawling which can strengthen the neck muscle, then is walking, and from holding things with fingers and hand to writing with any writing tool such pencil, crayon and pen. Those sequences are also analysed and represented the general developmental motor patterns.

The research will concentrate on DST's contribution as a new hypothesis to the children's motor development. The most suitable method for understanding on the role of DST aspects that can be implied in the physical motor skills particular for children development. In order to realize the DST can be linked to the motor development, the general developmental milestone of the typical development should first be clear. Therefore, two phases of motor development are; birth to two years old and two to seven years old children.

0 to 2 years old

In new-borns babies, multiple reflexes usually occur during this time. In short, the reflex is some sort of unconscious reaction or action that is indicative of a certain stimulation. It is a response in which fully spontaneous is completed without intention or thought. Reflexes generally happen during the initial year of infancy where it may fade after a half of year. The basic reflexes often contemplate as typical norms of function for the survival of the infant, as certain reflexes occur only during particular developmental times such as baby reflexes include rooting, biting, grabbing, Babinski, jumping and walking, and asymmetric tonic neck. This development stipulates nerve function of the normal brain, or else the baby's nervous system has some problem which disturbs normal development.

Knowing new-born reflexes is critical, since a lot of DST understanding knowledge and reflexes will be discussed later in this paper. There are other motor skills besides reflexes, for example locomotion, manual control, involuntary movements and postural control. These skills must be developed at the early years where there are used for optimum efficiency, as the skill will be used later to enhance a further ability. A systematic analysis on motor growth, specifically on sequences of skills, the researchers find the sequences to be limited on which previous skills were accepted as pre-requirement of conditions for subsequent skills (Spencer, Perone & Buss, 2011). Thus, a new ability of the infant will appear by adapting the previous skills for living.

2 to 7 years old

Children are developing both gross and fine motor skills at this stage to practice basic skills such as drawing, coloring and writing with hands-on

experiences in living skills. They typically enter early childhood education centre such as nursery and kindergarten or preschool where all activities that they play at school could be trained in order to enhance their eye hand coordination and develop their motor skills (Golenia, et. al. 2017). As early as four years old, children are learn on how to develop eye-hand coordination by exploring the surroundings and playing toys or other activities. This skill takes times to have a well-controlled development. In addition the task under motor control and together with the cognitive development is to improve children's temporal and spatial accuracy. As it is the ability to imagine a spatial pattern and it develop the understanding on how to fit it into a specific circumstance. Children can demonstrate the capability to reason spatially-temporally as early as possible. They enjoy exploring with blocks, puzzles, playing musical instruments or painting because they offer a different kind of spatial-temporal thought with a better motor development.

Children's Motor Development in DST

The DST offers the recent way of developing a thought that differed from the conventional perspective to understanding the motor development of children. This approach considers motor activity as does not rely solely on the central nervous system where it elevated from self-organized subsystems to generate movement patterns (Golenia, et. al. 2017). This study will concentrate on how DST's could benefit the motor development of children as the latest idea that relates with many possible insights.

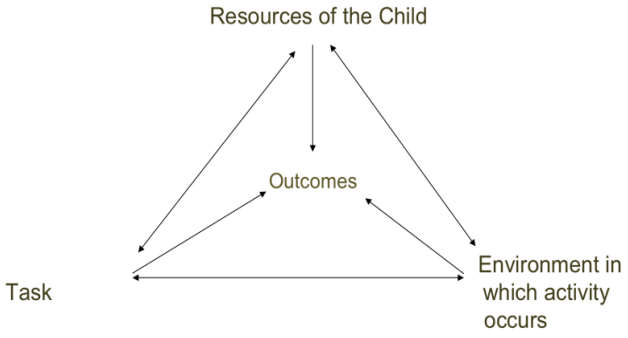

Figure 1. Link of resources of the child, task and environment. (adapted from Holt, Wagenaar & Saltzman, 2010)

The figure illustrates the variables that implied on how children can manage coordinated movement where the motor development result may vary in terms of the context, task applied and child's resources which the operation happens as attributes of a control system. According to van Geert (2020), a person who received distinct movement capacity that restrict the carrying actions that caused functional structure of the child's body, such as children's weight, body form, height, mental, and cognitive development. Next, the environment such as wind, temperature, light, gravity, adult figure that affecting in results and lastly for a task constraint involves task rules, aim and objective as well as task execution. Such kinds of restrictions offer different consequences on affecting outcomes of motor development of children, in particular overcoming the degree of freedom issues on how the human body, particularly muscles and joints, can move easily inside one in order to perform the chosen behavior. The entire systems of the body are configured individually to coordinate, as well as to be able to manage the body under any conditions to perform the action (Kam, Thelen & Jensen, 1990). The DST is resulted by the surrounding, environment, and body and nervous system interactions, this results in a change in behavioral motion.

This paper will therefore provide an overview that linked to the main concepts of the DST principles which are non-linear development, multiply determined behavior and soft-assembled, and self-organization processes, along with the example of motor skills of children development.

Non-linear development

The main principle of DST lies where the systems change across time. There are particular of the body's elements in understanding human motor development, such as neurons, motor units, joints, and muscles that consider a limitation of the diverse degree of freedom (Adolph & Berger, 2006; Thelen & Smith, 1994). Systemizing motor movement structure instinctive in the fundamental units of the various joints and muscles of the body, along with perceptions from the environmental stimuli, it is essential to the neural portion in order to generate and engage in an activity that allow movement (Adolph & Berger

2006). Hence, to comprehend on how these components are well-integrated with the common variable that factorized the movement patterns. Otherwise, it allows the acknowledgement of single limb control and double limb control movements, such as walking and kicking. According to Heriza (1991), extension and flexion are the actions of single limb movement in which the transition period between two phases of extension and flexion movements is quantified from the beginning of movement from one joint to another. For instance, during walking, the spatial phasing and relative temporal are activated between limbs, the coordination between two extremities can be seen. Therefore, collective factors are used to determine how change can be assessed in coordinated movements. In DST, consistency and versatility are implemented, using temporal and spatial features in explaining the patterns of coordination (Schoner & Thelen, 2007; Schutte, Spencer & Schoner, 2003). Walking or kicking are coordinated movements which were known as the movement's spatial and temporal order as showing the consistency of the movement patterns. Flexibility then is used to validate the body movement change will negotiate the coordinative patterns with various environmental influences (van Geert & Steenbeek 2005).

The researches challenged the comparability and variations in age, environment or risk factors associated with the composite variables of infancy kicking activity. Heriza's experiment (1991), the coordinated single limb movement pattern is seen for the infant. The result has shown the kicking patterns is similar to verifying the joints' connected to other joints, the extension and flexion as well as the period of the movement for each phase. During the occurrence, three pairs of joints are stipulated the strong relationships between joints (such as ankle and hip, ankle and knee, and knee and hip). Furthermore, the phase lag of the knee and hip is very high in infant kicking behavior, where the flexion and extension are well synchronized to create a unit of movement. The joint coordination represents the slight lag in the process where the period of the flexion and extension is verified to contribute to the stability of the temporal period. The timing of flexion is shorter than the period of extension. Thus, the period between extension and flexion is defined as the cumulative factors of the kicking movement patter of single limb movement. However, inevitable factors like age setting or risk factors in describing kicking activity do not apply to the composite variables (Spencer and Perone, 2008). For the coordinated movement patterns, the variable that was known as cumulative factors such as joint relationship with the phase lags, and the period between extension and flexion is clearly signified. Therefore, an infant's stepping reflex is assumed to have parallels to the kicking action of the same collective variables.

Multiply determined behavior and soft-assembled

One of the concepts of the DST is the assembly behavior. This is the functions of DST, when the system is constantly modified in order to create movement patterns (van Geert, 2020). It occurs when other factors that interrupt the mechanism and resulting the dysfunctional structure. After that, the method must reorganize within background to the movement stability, thus the previous movement becomes unstable and less preferred. The movement patterns are built softly and flexibly when the system is only reacts and adapts to the both nature and nurture conditions. Hence, when the mechanism is disrupted, there is a probability to revert movement patterns provided that can be easily adjusted for a living. Certainly, there is softly assembled behavior that creates the pattern from several components; this defines as the brain is not regulating the behavior. By developing the new behavior later on (Schoner, 2009), it is important to identify on the brain mechanism and operations in complex body systems.

According to the conventional interpretations, this reflex of stepping activity happens in relation to the child's neural system, whereby certain parts of the brain areas developed and then the child activity was suppressed. For several decades this presumption was recognized and developed in the area of physical science. Studies have been particularly interested in the development of reflexes which would later vanish on infants. They have long recognized its resemblance to voluntary walking in the walking and jumping reflex (Thelen, 1994). Keeping a neonate upright and getting the baby down that evokes the reflex to a flat surface. Previous research gave many

hypotheses on the cause for reflex of stepping, which disappear later. Maturationist believes that the phenomenon occurred in lined with brain growth. The section within the cortex that inniate reflexes in order to regulate voluntary walking if the brain continues to develop (Lunkenheimer, 2018). The growth of the nervous system is thus capable of expressing the existence and absence of infancy reflexes. Thelen's experiment showed that locating infant into a tub of water where buoyancy decreased the effective weight of the legs to demonstrate the significance of meaning for the stepping reflex action (Thelen, 1994).As a consequence, the infant was kept upright and unexpectedly the movement of the walking reflex reappeared, close to the action of younger babies. The situation shows where the action trends are having provided as an attractor and the occupation of the various spaces is reappearing in stable condition.

Self-organization systems

To get a clearer comprehension on the way of DST leads to development, some crucial perspectives on the developmental area should be addressed in terms of the key concepts that have a robust influence. The first concept of DST is to have self-organization of the systems (Smith &Thelen, 2003).

Physical processes such as child development contain specific elements that communicate with each other, from the central nervous systems then it emerges to the movements and then it appears within the social context (Spencer & Perone 2008). Seems DST is the structures that develop from multilevel or causality over time is as free to organize and reorganize. System creating the patterns ahead is unnecessary as the structures can combine to generate new patterns where resulting in the expected behavior. It implies the fundamental development within DST is about the exploration of the later established qualitatively new behavior.

Behavior about an individual is not really consistent. This learns by interacting between individual and setting, how a person will respond to the immediate environment, which relies on many psychological, contextual factors emerging in real time and development as a component of the many subsystems operating together in such a task-specific context (Fusella, 2013). A movement pattern's self-organization is considered an actual, at which it remains at present for any moment (Plumert & Spencer, 2007). Growth phase is development over such periods as years, months, or days. The effect of the movement pattern in the subsystem is studied in DST with a view to understanding the impact of the dynamic behavior based on a specific task and the environmental context as well as in order to perform a task, the degree of freedom is accessible in a single functional unit configuration (Schutte, Spencer & Schoner 2003). For instance, to validate the relationship between these subsystems to generate the action, synchronized sequence, postural control and joint coordination, step lags, perceptual, and cognition process are remarked. That subsystem item has its own development rate of contribution. Therefore, there is no subsystem regulating other subsystems in which the assembly relies on the particular task's design and setting.

Study showed a distinction between infants of different ages with different kick period times and flexion stages, where younger baby had less kicks in minutes compared to older baby, while both had consistent kicking movement patterns (Thelen & Smith, 1994; Perone & Spencer, 2009). The study questioned the inconsistencies and according to DST, the conditions of the movement are not determined by a muscle pattern merely placed in correlation with the pattern of neuromuscular movement and consider the complex activities of the body, such as passive muscle condition, body building measures and muscle strength (Heriza, 1994). The kicking movement pattern is the outcome of self-organization which involves subsystem involvement. Spontaneously this activity arose from the interaction of these subsystem components (Smith & Thelen, 2003). Otherwise the presence of subsystems in both current and developmental period is known as movement impacts and provides reciprocal engagement with the setting. The study revealed that the higher kicking level and the low joint angles at peak flexion were noticed in kicking infants' behavior to analyze the quick gaps arising from the short periods.

Fischer & Bidell (2006) and Thelen (1994) demonstrate that the rise in mass and weight for the baby's legs made it impossible from an upright position will allow the baby to touch the legs as it was done frequently in the early stages. It enlightens that the kicking movement action influences body fat and muscle strength and has specific short gaps of the kicking process and period between the joint at the beginning of the flexion and not affected by changes in the development of brain system. This experiment demonstrated the capability to monitor the assembly and suppression of infant's reflex, by manipulating non-obvious causes, lenient for neurological process (Schoner & Thelen, 2007; Schutte, Spencer & Schoner, 2003). The dynamic of the subsystems in real and developmental time within the context led to the variations in kicking actions as the outcomes of the movement. Such subsystems have dynamically coordinated in real time to create the kicking. Over time, the same subsystems have evolved and learned or developed enough for the kicking action to self-organize. In conclusion, the kicking activity pattern differs by age, as well as the contextual variability such as setting and the range of system components like body mass, muscles, and joint strength. All components of movements are self-organized during both real and developmental time to establish the patterns of the volunteered movement. By the immediate environment, these preferred movement patterns are connected and will fill the room, then become a stable attractor. However, the muscle and joints are not coordinated to become stable in subsequent baby kicking's unstable motion. It may occur when there is an external disruption of the variable with a period of movement.

Discussion

Within the DST perspective, there are many works that obtain theoretical accomplishment to give a better consideration of change of developmental process and to define the theoretical perspective of between empirical researches and main concepts (Harbourne & Stergiou, 2009). Nonetheless, the researcher faces some remaining obstacles. For example, it is difficult to identify the component of the systems in generating new behaviors as soft-assembly process. Due to this, it is often difficult for ascertaining the reason as every factor affects various result and outcomes differing on the particular child's environment and other resources because the processes are not multiplying naturally.

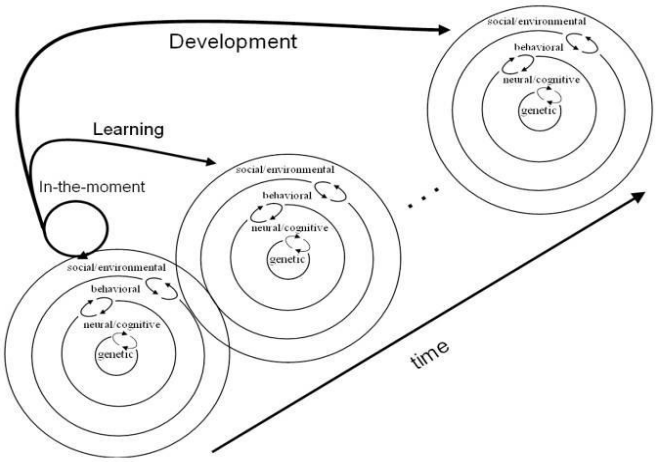

Figure 2. The relationship between the levels and centrals across time
(Spencer, Perone & Buss, 2012)

Figure 2 illustrates how interacting mechanisms lead to the development of behavior from hereditary to societal level (Spencer, Perone & Buss, 2012). That also suggests that each level is a highly complicated process throughout time between the person (Johnston & Lickliter, 2009). Several strategies have attempted to consider on the patterns arise in development at all different stages, but it has not yet been fully established how factor integration happens across stages. Therefore, it is not only to look at level integration, but also to look at the way of each level interrelates across the period scales in order to create evolutionary changes where the systems work over time. Some research has shown the effects of this multiple system which generates new patterns and produces behavior within developmental time scales (Schoner & Thelen, 2006). Through the use of DST for both actual and developmental period, and behavioral developments, such work has successfully incorporated.

Strengths of the DST

DST accepts quantitative and qualitative shift. Behavioral changes have been seen to assess the development of a new pattern as the slight quantitative variation may result in a marginal

shift in the systems and consequences (Lunkenheimer, 2018). DST supports development and growth where has changed both qualitatively and quantitatively. Scholars argue that the distinctions between quantitative and qualitative change will be explained across time. When there is a difference in the structure of attractor states, qualitative shift occurs within the DST perspective (Spencer & Perone, 2008), once a new attractor emerges, the entire mechanism is modified qualitatively, thereby establishing and emerging the new pattern. It is not intended to highlight qualitative versus quantitative changes, but quantitative changes within one particular aspect of the system may increase new qualitative behaviors. Nevertheless, the interpretation of both quantitative and qualitative changes which happen over period is difficult.

For instance, in a matter of seconds, the change to a walking posture from a crawling for infants occurs as this transformation takes place in a more gradual move. In fact, when the baby starts walking or a walking ability is appear, it is difficult to determine what is the explanation whether the walking movement as a new action in various contexts where walking can be observed as it goes and comes, and what is driving this transition across time. Thus, according to Thelen & Smith (1994), at first DST highlights how at the present systems will define behavior in that sense, but rather because DST acquires systems through time, this can be explained how well the attractor's behavioral condition can appear in the form of real and developmental period. It gives an exceptional view that DST would not emphasize system suitability, instead of incorporating elements into systems to create new behaviours. A further instance is a horse locomotion mechanism, the system quickly goes into the instant self-organization as the horse locomotion rises with regard to the pace of a walk to a trop and finally to a gallop. The motor patterns of the horse change, if only at the particular situation, without variable sequence. The systems are built to create a coherent and desirable behavior and movements by themselves.

The DST upholds the principle of manipulating the brain to perform the expected action or behaviour. A new-born’s capacity grows through the body and processes' complex self-organization. Numerous triggers can critically influence the production emergence of small and unexpected factors to explain the complex cycle. Equally, DST recognizes the importance of knowing the whole system. For instance, in considering the development of a child, even though this theory was more adequately explained for motor development, that it could not simply be inferred that another area, including cognitive growth, emotional maturity and character development, seems to be at the identical level. Presently, there is an increase in analysis and study into how it can be linked to DST (Raymond, 2006).

Furthermore, the temporal and spatial dimensions are studied mainly through actions and behavior, as they could be integrated into brain function development. With this dimension it is possible to escape the simple argument for assuming unit operations and the program. For example, in motor development temporal and spatial information and structure including locomotion, reflex actions, behavioral control, walking, and dance can now be related if the situation can predict in time and space.

The key point for defining equilibrium is related to uncertainty and stability, and how it has been balanced over time along with the flexibility dimension. DST concerns emerging from a single person on new skills. Nonetheless, it reveals where the new skills come from and the cycle of self development. A new infant, for example, that is expert in crawling and still improving walking ability by walking slowly. Indeed, if the baby desires for anything next to it, he or she can return to the crawling phase to have the item they want. If crawling is perceived a stable and preferable practice, walking appears to become less stable and less preferred behaviour. Nevertheless, as the baby grows and becomes a capable walker, with space and time he or she might fail to walk if he or she is more confident walking to have something now (Golenia, 2017).

The extensive definition of DST is the individuality-based method for solving the problem in a particular manner. There is a final argument to remember as a consequence, by referring to the epigenetic environment. Nevertheless, the direction can appear different

only under such circumstances through the existence of constraints and internal as well as external factors. As well as the path will be based on how well the child manages to overcome and gets through various body and systems muscle configuration (Spencer, Perone & Buss, 2011). The degree of freedom eliminates the chance that each one is organized separately at each point in time. It illustrates the explanation for people's differences, as they experience another journey.

Weaknesses of the DST

With a developing theoretical context, several different terminological and analytical methods employed by various studies that make it difficult to review and use together, even though they adopt the similar methodology. Most scholars consider the term similar, however, with different meanings and structures are applied. For instance, the highlight for the DST is the self-organization system in developing a new activity, yet no standardization of self-organization meaning that can be pertained to study about human development (van Geert, 2020). We see the behavior as results arising from contact with the process and the environment. Additionally, the guides on which variables can be considered to define boundaries of influence in some behavior. This indicates to the use of various approaches and techniques by some researchers in researching the development and growth such as simulation and mathematical approaches, using observation method and experimental approach with data integration. Additionally, the perspective is hard to grasp, it requires to quantify quantitative and numerical proof, so it can be difficult to get it wrong and falsify. Therefore, in this field, different methodologies can need to be developed in order to perceive better understanding of dynamic process in human development.

DST concedes the consistency of the attractor's with space across period to conduct the task but discusses little regarding neurophysiology only. As said by Spencer (2006), the central nervous system plays a significant function in the human body and not just brain maturation. However, there was very few clarifications about the appearance of new actions, particular for motor movement patterns related to behavioral versatility, and it is not enough to prove this. Furthermore, Thelen's developmental research which studies for DST also does not focus much on nutrition and genetics. The creation and emergence of new abilities, according to Thelen (2005), is not the product of environmental or genetic causes, but how human developed by self-organizing has been operated over period. It can overwhelm, due to each person has different abilities and cannot be tackled with comparable growth.

Though the special concept of DST where the development is observed as non-linear process, the development must be seen as waxing and waning trends through time and space (Harbourne & Stergiou, 2009). Yet quantifying the emergence of new habits and growth is very complicated and abstract in human research. As studies require the longitunal analysis to gather all changes happen as naturally as it also needs to be done as a result of particular growth in order to explore it works to usefulness in other areas of life growth. Furthermore, DST receives the challenge of answering the concerns of diversity, since as a new theory again. The DST research tends to have faith in different areas such as physical and motor development, language and speech, cognitive, socio-emotional developments. However, how cultural background can directly impact behavioral changes is not yet effective in proving the correlation in this field.

Additional drawback in designing DST implementation is that the improvements are empirically difficult to detect (Adolph et al., 2008). For example, the study requires to question how logically to endorse coordination actions over the long-term period due to some developmental changes consume different observations and are actually produced by revision sampling (Spencer & Perone, 2008). The Spencer & Perone (2008) work analyzes how transition could take place continuously over time. In particular, the dynamic structures are generated and modified in the state during the operation of the structures by continuous accumulation of the central nervous systems and brain. The systems accumulate continuously, new attractor states are thus formed. Nevertheless, through generalization, it is hard to verify this principle, and require more studies.

Implications

The crucial lessons taken from DST is illustrating how it can be the deliberate action. For instance, if a person says greeting to other people by waiving and raising a single hand, or if the individual intentionally yawns, does the outcomes of an individual's self-organizing is applied? This method of self-organization appears to take decided yawn until they feel completely conscious of carrying out the wanted behavior or action. Thelen and Smith (2003) drew up the tangible example in the experimental developmental research. They believed that any hard-wired genetic code for a maturation phase of motor growth in infants is not being determined. In its position, the stage of the continuous interaction between infants with evolving environment had emerged within dynamic self-organization for motor development. Often, the concept of international behavior is best defined by contact between minds, bodies and environments as a complex operation (Raymond, 2006).

The appearance of actions within period is hardly being observed as a natural development. DST helps one to consider that the entire body views as a complex although with basic actions such as walking and kicking movements and baby involuntary actions in order to bring together where the situational can be understood and the function of contextual variables that affecting change (Spencer, Perone & Buss, 2011). Moreover, it brings away from behavioral expectations due to situation happens with the clarification and each progression can be experienced over time, where it is not a linear process.

According to Raymond (2006), there are picture schemes that regard human self-organization structures as attracting men. The attractor states discussed earlier tend to be stable if the person, mission, or environment that affects the systems are taken into account since the systems are directly engaged with the actual situation. The structures must proceed the process of self-organization, soft-assembly and reorganization before they reach a consistency to implement the new habits or actions that are more preferred and stable. The consequence of this idea occurs whilst the attractor would have a diverse profile in an image schema centered on every unit engaged in particular actions.

DST provides the details on the real activity and intervention occurs within the process rather than the consequences or effect of the actions. Throughout children's motor skills development, the thresholds that provide typical children with the standard knowledge about the way to assess the baby and children either in the correct movement process or not are significant. However, it says us about the creation process itself. In motor growth milestone, for example, usually child starts to be crawling, seating, standing, walking and running. Yet the cycle of moving to walking from crawling has been neglected and this has constantly been the case with conventional community schemes struggling to discuss on the individual differences and in what way it is affected by environment. Therefore, the exploration of different study strategies to recognize the changes in movement such as experimental and longitudinal studies that adopt these matters.

Young children should not be treated as passive participants of stimulations from the surrounding when applying DST in children's development rather than as active recipients in development because every child has designated experiences and contexts that influence further actions. For example, while reflexes are assumed to be automatic behavioral responses, involuntary movement happened through the development of motor movement patterns where different stimuli encourage rather than trigger the response. This does not mean that the idea of reflexes has been ignored, but the definition has been extended taking into account certain variables that influence the developmental changes. Therefore, it is such a daunting situation to combine the complex structures with time frame. Back to the constraints, it's important to consider the amount of child capital in context. Nevertheless, it leads to the analysis of an atypical development of children by overcoming this restriction.

Conclusion

DST plays the main influence in the area of technology is where it focuses on the growth process and prevents duality definition. It is more

important to understand growth, and how it changes over time. This provides a new viewpoint that the brain is not the main shift in function, because certain variables such as the individual's environment, activities, and resources can be seen as a limitation that could lead to various developmental contributions, and the changes may vary. In the development of infants, DST claims that infants are no longer as passive as active environmental recipients. The explanation for behavioral change can be understood in which system motion is self-organizing and soft assembly within the framework to achieve preferred behaviors. All system elements are constantly connected and communicate with other triggers both internally and externally. DST provides the greatest contribution where it knows system stability. It refers to many assumptions of developmental stability that shift, and to all queries about why, how and what affects the structures.

References

[1] Adolph, K.E., Robinson, S.R., Young, J.W., Gill-Alvarez F. (2008) *What is the shape of developmental change*? Psychological Review, 115:527–543.

[2] Christiansen, M.H., Kirby, S. (2003) *Language evolution*. Oxford, UK: Oxford University Press

[3] Fischer, K. W. &Bidell, T. R. (2006*). Dynamic development of action and thought*. In W. Damon & R. M. Lerner (Eds.), *Theoretical models of human development*. Handbook of child psychology (6th ed., Vol. 1, pp. 313-399). New York: Wiley.

[4] Fusella, P. (2013) *Dynamic Systems Theory in Cognitive Science: Major Elements, Applications, and Debates surrounding a revolutionary metatheory*, Available from http://dynapsyc.org/2013/Fusella.pdf (access on 19 December 2014)

[5] Golenia L, Schoemaker MM, Otten E, Mouton LJ and Bongers RM (2017) What the Dynamic Systems Approach Can Offer for Understanding Development: An Example of Mid-childhood Reaching. *Front. Psychol*. 8:1774.

[6] Harbourne, R. T., & Stergiou, N. (2009). *Movement Variability and the Use of Nonlinear Tools: Principles to Guide Physical Therapist Practice*. *Physical Therapy*, *89*(3), 267–282.

[7] Heriza, C.B. (1991*)Implications of a Dynamical Systems Approach to Understanding Infant Kicking Behavior*, *PHYS THER*, Journal of the American Physical Therapy Association. 1991; 71:222-235.

[8] Holt, K.G., Wagenaar, R.O and Saltzman, E. (2010) *A Dynamic Systems constraints approach to rehabilitation,* Boston, Available from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-35552010000600002, (Accessed on 24 December 2019)

[9] Jihua, D. (2016) *A dynamic systems theory approach to development of listening strategy use and listening performance*, Systems, 63: 149-165.

[10] Johnston, T.D., Edwards, L. (2002) *Genes, interactions, and the development of behavior*. Psychological Review, 109:26–34.

[11] Johnston, T.D. and Lickliter, R. (2009) *A developmental systems theory perspective on psychological change.* In: Spencer, J.P., Thomas, M.S.C. and McClelland, J.L. editors. *Toward a new grand theory of development: Connectionism and dynamic systems theory re-considered*. New York: Oxford University Press, pp. 285–298.

[12] Kamm, K., Thelen, E. and Jensen, L. (1990) *A Dynamical Systems Approach to Motor Development, PHYS THER.* 1990; 70:763-775.

[13] Lunkenheimer, E. (2018). Dynamic System Theory, In The SAGE Encyclopaedia of Lifespan Human Development, Thousand Oaks, SAGE Publications, Inc.

[14] Michael, S. (2007) *The Continuity of Mind*, Oxford University Press. Pp. 17-8.).

[15] Munakata, Y. and McClelland, J.L. (2003) *Connectionist models of development.* Developmental Science, 6:413–429.

[16] Perone, S. and Spencer, J.P. (2009) *A dynamic systems approach to the development of stable individual and*

populations differences during infancy. Poster presented at the 6th Biennial Meeting for the Society for the Study of Human Development; Ann Arbor, MI.

[17] Plumert, J.M. and Spencer, J.P. (2007) *The emerging spatial mind*. Oxford, UK: Oxford University Press

[18] Raymond, G. (2006) *Embodiment and Cognitive Science*, Cambridge University Press. Pp. 226-7.

[19] Schoner, G. and Thelen, E. (2006) *Using dynamic field theory to rethink infant habituation*. Psychological Review, 113:273–299

[20] Schutte, A.R., Spencer, J.P. and Schoner, G. (2003) *Testing the dynamic field theory: Working memory for locations becomes more spatially precise over development*. Child Development, 74:1393–1417

[21] Smith, L.B. and Thelen, E. (2003) *Development as a dynamic system*. Trends in Cognitive Sciences. 7:343–348

[22] Smith, L.B., Thelen, E., Titzer, R. and McLin, D. (1999) *Knowing in the context of acting: The task dynamics of the A-not-B error*. Psychological Review, 106:235–260

[23] Spencer, J. P., Clearfield, M., Corbetta, D., Ulrich, B., Buchanan, P., &Schöner, G. (2006). *Moving toward a grand theory of development: In memory of Esther Thelen*. *Child Development, 77*, 1521-1538.

[24] Spencer, J. P., Perone, S., & Buss, A. T. (2011). *Twenty years and going strong: A dynamic systems revolution in motor and cognitive development*. *Child Development Perspectives, 5*(4), 260–266

[25] Spencer, J.P., Perone, S. and Johnson, J.S. (2009) *The dynamic field theory and embodied cognitive dynamics*. In: Spencer, J.P., Thomas, M. and McClelland, J.L. editors. *Toward a unified theory of development: Connectionism and dynamic systems theory reconsidered*. New York: Oxford University Press

[26] Spencer, J.P. and Perone, S. (2008) *Defending qualitative change: The view from dynamical systems theory*. Child Development, 79:1639–1647.

[27] Spencer, J.P., Smith, L.B. and Thelen, E. (2001) *Tests of a dynamic systems account of the A-not-B error: The influence of prior experience on the spatial memory abilities of 2-year-olds*. Child Development, 73:377–404.

[28] Thelen, E. (1992) *Development as a dynamic system*. Current Directions in Psychological Science, 1:189–193.

[29] Thelen, E. (2005). *Dynamic systems theory and the complexity of change*. *Psychoanalytic Dialogues, 15*, 255-283.

[30] Thelen, E., & Bates, E. (2003). *Connectionism and dynamic systems: Are they really different?Developmental Science, 6*, 378-391.

[31] Thelen E, Corbetta, D. Spencer, J.P. (1996) *The development of reaching during the first year: The role of movement speed*. Journal of Experimental Psychology: Human Perception and Performance. 22:1059–1076

[32] Thelen, E., Fisher, D.M. and Ridley-Johnson, R. (1984) *The relationship between physical growth and a newborn reflex*. Infant Behavior and Development, 7:479–493.

[33] Thelen, E., Schoner, G., Scheier, C. and Smith, L.B. (2001) *The dynamics of embodiment: A field theory of infant perseverative reaching*. Behavioral and Brain Sciences, 24:1–86.

[34] Thelen, E. and Smith, L.B. (1994) *A dynamical systems approach to the development of perception and action.* Cambridge, MA: MIT Press

[35] Thomas, R. M. (2001). *Connectionism and dynamic systems*. In Recent Theories of Human Development. Thousand Oaks, CA: Sage.

[36] Van der Maas, H.L.J. and Dolan, C.V. (2006) *A dynamical model of general intelligence: The positive manifold of intelligence by mutualism*. Psychological Review. 113(4):842–861.

[37] Van Geert, P. (2020). *Dynamic Systems, Process and Development*. Human development, *63*(3-4), 153–179.

[38] Van Geert, P. &Steenbeek, H. (2005*). Explaining after by before: Basic aspects of a dynamic systems approach to the*

study of development. Developmental Review, 25, 408-442.

[39] Warren, W.H. (2006) *The dynamics of perception and action.* Psychological Review, 113(2):358–389