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DEVELOPMENT AND INTERACTION OF SENSORY SYSTEMS IN BABIES

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ABSTRACT

Sense enables babies to perceive the physical and chemical changes that occur in the external environment. It occurs as a result of the dynamic interaction of sensory stimuli with sensory receptors in the eyes, ears, tongue, nose, and skin. The stimuli that newborns see, touch, and hear affect their brain development. The brain develops faster in the early years than in other years. Newborns have a vestibular system, proprioceptive sense, neonatal imitation, and special senses that help them understand the world. Some babies' senses are more sensitive than others. Each baby develops differently. The interaction that the baby will establish with his/her environment early on is invaluable for supporting its development. Their senses are stimulated from birth by the warm intimacy and contact established with the adult and the rich stimulating environment. Stimulation of the senses is critical to supporting the baby's holistic development. This study discusses the relationship between interaction and the development of the sensory system in babies and offers suggestions for families and educators.

Keywords: Baby, Newborn, Sense, Sensory development, Interaction

INTRODUCTION

Babies use their senses to learn about the outside world and they receive all kinds of stimuli through various sensory models. These sensory models are created by touch, sight, hearing, smell, and taste. A dynamic period occurs in which stimuli are received through sensory models and the right responses are given to these stimuli (Gallahue, Ozmun, and Goodway, 2014). Newborns can see, hear, smell, and taste. They can also sense pressure, pain, change in position, heat, and smell (Çetin-Sultanoğlu & Aral, 2015). Newborns give little meaning to these sensory stimuli they encounter at first, but soon begin to ascribe meaning to them. The senses are crucial for adapting to the environment and surviving during infancy (Çetin-Sultanoğlu & Aral, 2015). The process of organizing the information received by the central nervous system via the senses and making sense of it is called perception (Gallahue et al., 2014). Perception begins in the prenatal period and develops rapidly during infancy and childhood (Aral & Sağlam, 2016). Perception, or receiving information from the baby's surroundings via the senses, organizing it, and interpreting it meaningfully, is an important task in infancy (Snow & Mcgaha, 2003).

Brain cells are connected by bonds called synapses. They form clusters that perform various functions in the brain (Santrock, 2021). Visual, auditory, tactile, and other stimuli reaching the newborn's brain increase the number of synaptic connections. Depending on the baby's needs and environmental stimuli, the connections used are preserved and strengthened, while unused connections disappear. These connections occur in the first months of life and are strengthened and made permanent as the baby receives external stimuli. This is why development during infancy needs to be supported through the use of appropriate methods and environments. The baby's environment should be equipped with sufficient and appropriate stimuli for the developmental period (Ünal, 2020).

What babies see, touch, and hear in their early years affects their brain development, which is already faster at this time than in other years. The sights, sounds, smells, touch, language, and eye contact that babies experience when they are born affect the formation of neural pathways and the creation of synaptic bonds (Fox, Levitt, & Nelson, 2010).

METHODOLOGY

The study is a review type study and the results are discussed by including the relevant literature information and the findings of domestic and foreign studies on the subject.

First of all, the development of sensory systems was discussed; the vestibular system known as the sense of movement-balance, proprioceptive sense known as the sense of body awareness, neonatal imitation, which is called neonatal imitation in the literature, and special senses such as taste, smell, hearing, vision and touch were explained. Secondly, the interaction of the infant with the environment was discussed in relation to sensory stimuli.

1. Development of Sensory Systems

The senses work as a team with babies' cognitive skills to recognize and understand the outside world. Today, we can talk about having six or seven senses. In addition to our sensory organs such as eyes, ears, tongue, skin, and nose, these are the kinetic receptors in muscle joints that detect motion and the receptors in the inner ear semicircular canals that provide the sense of balance (Oğuz-Atıcı, 2020). This part of the paper will explain the special senses such as the vestibular system in babies, proprioception, neonatal imitation, and sight-hearing-taste-smell. The vestibular system, known as the sense of movement and balance, will be discussed first.

1.1. Vestibular System (Movement-Balance Sense)

The word vestibular is a combination of the words "movement" and "balance." The sense of movement and balance in the inner ear is called the vestibular system. It is responsible for babies' posture, movement, balance, body control, and attention. Movement means the displacement of the whole body or a part of the body. For the baby to move, the body parts have to be coordinated, balanced, and work together. The vestibular system sends signals received from the environment to the brain, which then organizes the body in accordance with these signals (Çetin-Sultanoğlu & Aral, 2015).

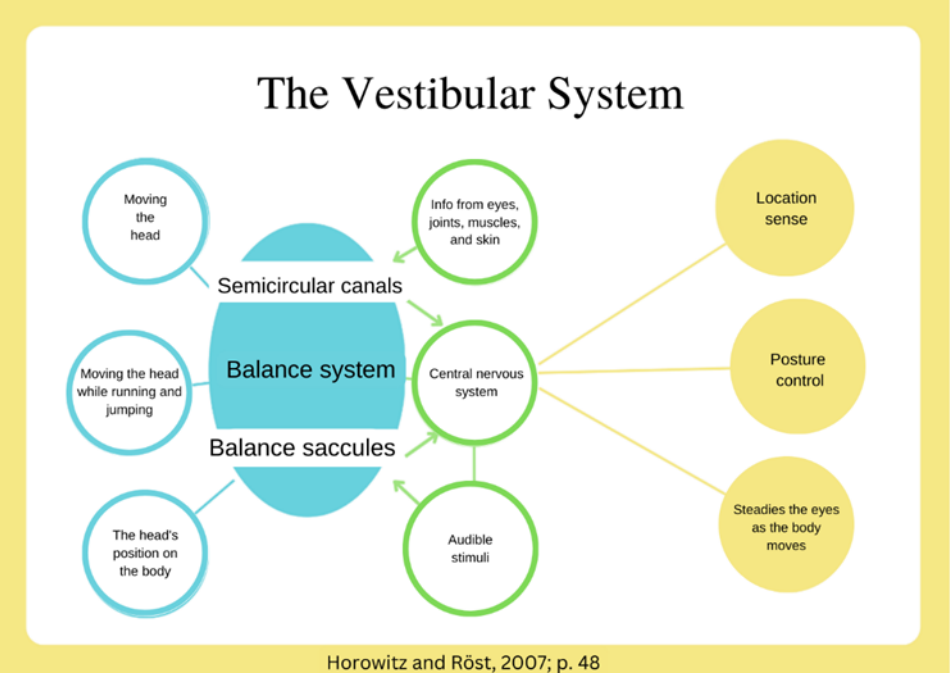

Figure 1. The Vestibular System

This sense begins to develop in the prenatal period. Increased attention and anything that affects spatial and non-spatial cognitive functions is important in the development of the vestibular system. It communicates with the brain, sending signals to the eyes and from the spinal cord to the arms and legs. It sends signals related to rotation and movements. It helps with balance and informs various types of movement. Each of these is associated with cognitive processes that can lead to different types of problems in the case of vestibular disorders.

As can be seen in Figure 1, these forms of movement can be listed as follows i) The baby's gaze can remain fixed while its head and body are moving, ii) Maintaining the baby's balance. Keeping the head stable in the neck and body posture when immobile and when moving, iii) Movements that require coordination between the baby's body, head, and parts, such as touching, iv) Making locomotor movements that require the baby to change position, v) The baby's ability to perform movements that do not involve locomotor skills such as pushing, reaching, catching, bending, etc. The vestibular system is thus very important for the development of the baby's movement (Wiener-Vacher, Hamilton, Wiener, 2013).

Movement skills are very important for development during infancy. Babies' movement skills allow them to get to know their surroundings and make discoveries. Each time they interact, they learn something new and increase what they know about the world. Movements and actions steer perception, and perception steers movements. Imagine that a baby sees an interesting toy at the other end of the room. The baby has to perceive the position of its body and plan what movements and actions to perform to reach the toy. Perception motivates babies to make movements. Although babies are initially incompetent in their movements, over time they master them and perform the most appropriate learning for themselves. (Santrock, 2021).

Moving causes significant improvements in perception. Babies need to perceive the possible outcomes of the action they will take to decide which movements to make and how to make them. Babies learn to adapt their bodies to the situation each time they fall when mastering locomotor movements (Kretch & Adolph, 2013).

Movement helps babies understand that objects are not flat but three-dimensional. Babies' depth perception improves as their motor skills develop. One study investigating whether the sensory-motor experiences of babies affect their perceptions and actions concluded that repeated seeing, reaching for, and touching behaviors affect the object-grasping reactions of babies aged 6 to 9 months and observed that tactile knowledge did affect object manipulation behavior and that babies usually exhibit grasping and manipulating behavior as soon as they reach for an object and feel it (Corbetta & Snapp-Childs, 2009). Another study on how babies' perceptions and actions affect object discovery investigated how babies behave in an environment with conditions in which the target object would move and make a sound in response to being touched by the baby and concluded that the longest interaction takes place upon contact with objects presented with a condition attached (Williams & Corbetta, 2016). A different study investigating how the characteristics of objects (auditory, visual, or tactile) will affect babies' perceptual motor behaviors found that babies look at unfilled to visually detailed objects more than filled objects, the same difference is not shown for reaching or manipulation and that more object infant interaction is seen in manipulation with the filled object (Wiener, 2018). The other topic to be addressed is the proprioceptive sense, known as body awareness sense.

1.2. Proprioceptive Sense (Body Awareness Sense)

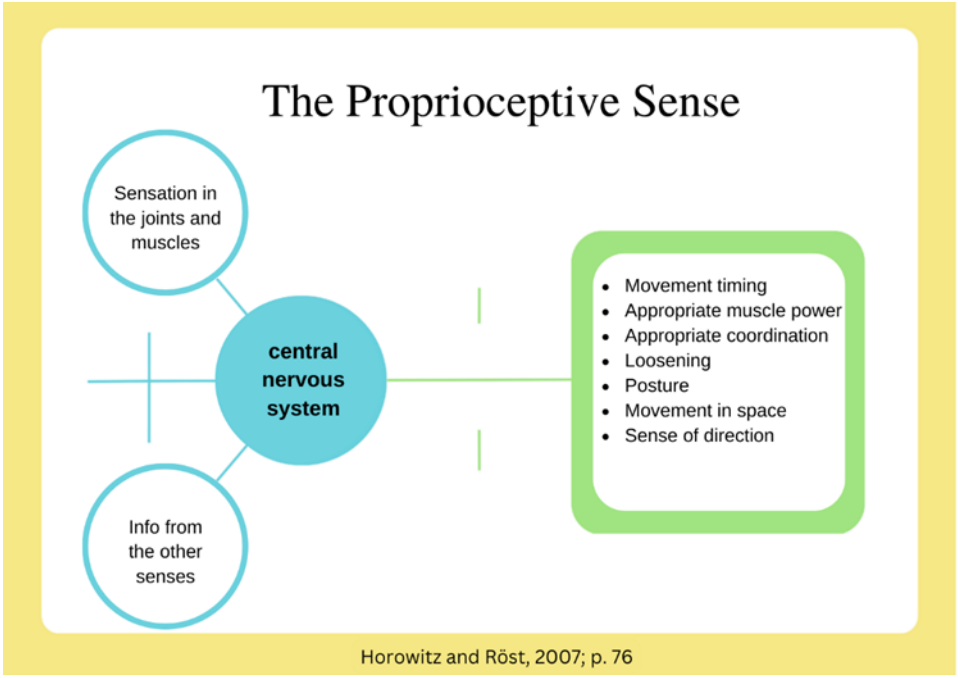

Figure 2. The Proprioceptive Sense

As seen in Figure 2, the body awareness sense in the joints and muscles provides information about body position. The proprioceptive sense is the sensory system that gives our brain the necessary information about our body's position and movements. It helps ensure the body parts work together and in harmony in space. The body awareness sense expresses the sensory messages that provide power, direction, and movement (Kadıoğlu-Altunbaş, 2020).

Looking at Figure 2, it can be seen that all the senses work as a team to present the brain with the clearest possible image. Information from the proprioceptive senses is combined with information from other systems. The information collected creates a map in the brain.

Comparing the incoming stimuli with this image, the brain sends the message to the muscles. This makes it possible to move appropriately.

Sensory receptors and gravitational receptors in the vestibular system send information to the baby telling it that its body posture has changed or how it should be changed if necessary. It provides the baby with a sense of posture and movement at this time (Horowitz and Röst, 2007). Body awareness in the joints and muscles perceives the situation when the position changes. When this happens, the proprioceptive system activates and helps the brain perceive the position of the body and its limbs (Isbell & Isbell, 2007).

The proprioceptive sense helps babies self-regulate. Self-regulation can be defined as the body's ability to process emotions and behaviors while simultaneously responding to the demands of a situation. Self-regulation allows us to respond spontaneously and flexibly depending on the situation or to delay this response. Self-regulation depends on the child's ability to sustain an emotion. Proprioceptive input can help control responses to sensory stimuli. Such inputs help soothe babies, calm them down, and protect them against other sensations that could overload the nervous system (O'Callaghan, 2020). The investigation of the sensory development of newborns will continue with neonatal imitation.

1.3. Neonatal Imitation

The sense of touch is taken up through receptors in the skin. It is transmitted to the baby's central nervous system, allowing various sensations such as pain, temperature, and pressure to be perceived. The sense of touch is also called the tactile sense. Perception of the environment can be defined as giving the appropriate responses to stimuli from the environment and adapting to the outside world. Touching is interacting with the surrounding objects and people (Çetin Sultanoğlu & Aral, 2015). Touch is a newborn sense and is debated by researchers. The sense of touch, which stems from interaction, starts with the caregiver's contact. Following contact, the process continues and includes mutual gaze and facial expressions. The newborn mimics the movements of the people it is interacting with. The baby's ability to respond to its partner in this way is called neonatal imitation (Meltzoff & Moore, 1977).

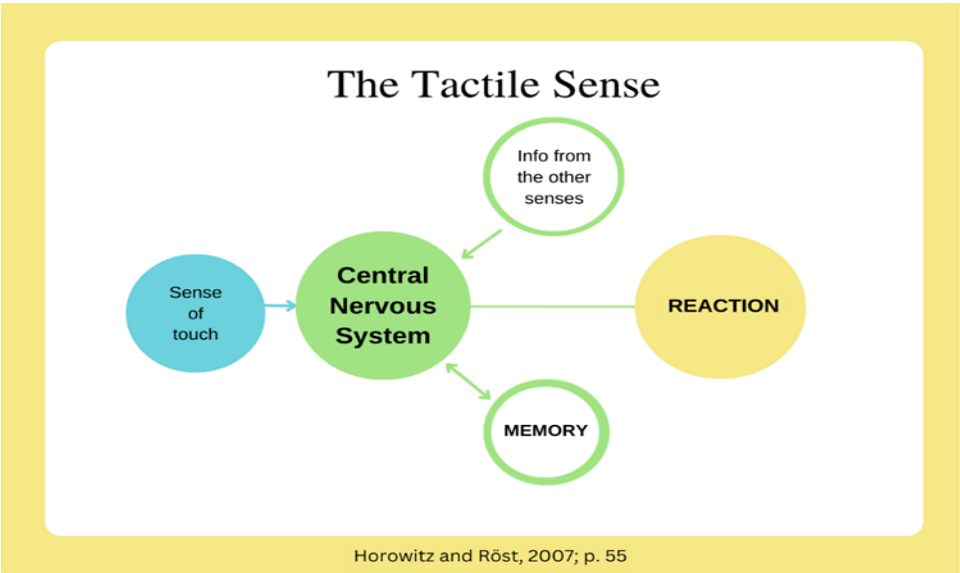

Figure 3. The Tactile Sense

Looking at Figure 3, it can be seen that the baby reacts in response to the sensory information gathered. The following section discusses the developmental process of this skill within the framework of neonatal imitation.

Meltzoff and Moore (1977, 1983, 1989, 2005) conducted the first studies ever on babies imitating the behavior of adults with babies aged two and three weeks. Studies have investigated whether neonatal imitations are genuine imitation behavior (Hayes & Watson 1981; McKenzie & Over, 1983; Abravanel & Sigafoos 1984; Anisfeld, Turkewitz, Rose, Rosenberg, Sheiber, Couturier-Fagan, Ger, & Sommer, 2001). In studies of imitation in newborns, the babies were expected to selectively match two different behaviors in a single measurement. The study used eye-tracking devices to determine the babies' heart rates and whether they were looking at the stimulus; in other words, to see if they were responding quickly. Most of the studies looked at the babies' daily behavior of sticking their tongues out and opening their mouths independently of the study. Infants were found to selectively increase the production of each behavior compared to its normal basic rate after seeing the specific behavior modeled (Meltzoff & Moore 1977, 1983; Nagy, Kompagne, Orvos, & Pal, 2007; Jones, 2009). Some researchers have criticized studies that say babies imitate the behavior of adults. They suggest that babies have no early imitating behavior as purported and that these types of behavior could be responses to certain stimulants encountered in daily life or even reflexes (Hess & Blairy, 2001). But as the modeled behavior is observed again after the movement stops and the matching of adult behavior is seen, we can say that these views are not supported (Jones, 2006; Meltzoff, Murray, Simpson, Heimann, Nagy, Nadel et al., 2017). Proceeding from these findings, the researchers found that in the first days after birth, babies repeated interactive behaviors such as "moving the lips, making sounds, opening-closing the mouth, sticking out the tongue, making lip sounds, and smacking the mouth" performed by adults in front of the newborns. But they determined that these repetitions were not so much imitation as behaviors matching the adults' behaviors. To sum up, for a behavior to be called (imitation) that behavior must be learned first. This means that the matching behaviors in newborns are not a learned response because their actions are not matched or reinforced by others (Jones, 2009).

According to the dynamic system theory, the imitation of the newborn is not a hereditary, specialized module. Each imitation is seen as the product of a system consisting of social, cognitive, and motor components with their developmental history (Jones, 2009). Babies' ability to imitate the actions of others is an important mechanism for social learning, that is, for acquiring new knowledge. The ability to imitate is also important in terms of the clues the child gives to adults about the information it has. Much in-depth discussion has been made as to when and how babies begin to imitate or voluntarily match the behavior of others. Opinions as to whether the imitation behaviors performed in the first two years of a baby's life are true imitation have changed over time. Although it is accepted that newborn babies can and do imitate, babies are said not to imitate others until the age of two. Instead of imitation behavior, different types of behavior are imitated at different ages.

Evolutionary theorists working with chimpanzees and macaque monkeys say that baby imitations are an innate behavior. They reported that behaviors in newborn monkeys such as sticking out the tongue, slapping the mouth, and opening the mouth similar to human facial movements disappeared in the first month or so. They found that baby chimpanzees less than one week old could distinguish human facial movements and imitate them, but that when they are two months old, chimps no longer imitate gestures. Chimps were seen to start opening their mouths frequently in response to any of three facial movements presented to them. These findings suggest that facial imitation in newborns is most likely an innate ability developed

through natural selection in humans and chimpanzees. Some studies say that social communicative behavior begins to develop with the disappearance of newborn imitation (Myowa-Yamakoshi, Tomonaga, Tanaka, and Matsuzawa, 2004; Ferrari, Visalberghi, Paukner, Fogassi, Ruggiero, & Suomi, 2006; Paukner, Simpson, Ferrari, Mrozek and Suomi, 2014).

Neurological studies have proven that neonatal imitation exists. (Mirror neurons) is the term used for brain cells that are activated when a living thing makes any movement it sees and observes someone making the same movement. Some studies say that given the existence of mirror neurons, imitation is hereditary (Iacoboni, Woods, Brass, Bekkering, Mazziotta, Rizzolatti, 1999; Decety, Chaminade, Grezes, Meltzoff, 2002; Grezes, Armony, Rowe, Passingham, 2003; Iacoboni 2005; Iacoboni & Depreto, 2006).

Dynamic systems theory argues that imitation is the ability to match the behavior of others and that this ability is not present at birth. Instead, it appears in the second year and continues to develop throughout infancy and afterward. Studies say that imitative behavior occurs when the baby acquires different types of knowledge and motor, cognitive, and social skills. This theory states that imitation cannot be observed directly. Instead, it assumes that the observed behaviors are the behaviors of an individual that match the behavior of the other person (Thelen & Smith, 1994; Gottlieb, 2007; Want & Harris, 2002).

Imitation is thus a dynamic action that affects and supports the parent-infant relationship. Reciprocal imitation between babies and caregivers promotes interpersonal intimacy and bonding. New cognitive neuroscience studies have presented findings about babies' cortical body maps. Brain images of babies show that the sensorimotor cortex is involved in imitation. These brain maps help explain how babies match the behaviors they see to their bodily actions. Imitation is a key skill for development and learning starting in the early years (Meltzoff and Marshall, 2018).

One study on a newborn's imitation of tongue and mouth-opening movements found that imitation behaviors increased during face-to-face interaction (Ullstadius, 1998).

Although opinions on imitation behaviors in the early years differ, it can be said that newborn imitation is related to later social and communicative skills. Newborn imitation and face-looking behaviors can be important indicators of social attention skills in the early period (Paukner, Simpson, Ferrari, Mrozek, and Suomi, 2014).

Newborn babies fight to survive from an early age by participating in social cues appropriately and responding appropriately to the messages they receive. Mothers are experts in nonverbal communication with their babies, such as close body contact, mutual gazing, and facial expressions. Newborns can respond to these cues by mirroring the mouth-opening and tongue-protruding movements of adults who are trying to communicate with them. This suggests that early social interactions develop the social bond between mother and baby, support interpersonal interactions, and provide opportunities for infants to learn social communication norms (Nagy, 2006; Gaskins, 2006; Paukner et al., 2014).

Different studies have shown that about 50% of infants show poor performance, and infants who do not mimic at 2-3 days of age exhibit increased gaze avoidance during play interactions. If individual differences in neonatal mimicry predict later social-communicative abilities, it may be particularly useful for identifying developmental disorders such as autism spectrum disorders and at-risk infants who exhibit impairments in various basic social skills, including shared attention and both verbal and non-verbal skills. (Heimann, Nelson & Schaller, 1989; Elsabbagh & Johnson, 2010). The final section in sensory development will discuss babies' sense of taste, smell, hearing, sight, and touch.

1.4. Personal senses (Taste, Smell, Hearing, Sight, Touch)

The basic structure of the eyes, ears, and olfactory receptors (smell) develops in early pregnancy. Some of the primary receptors for touch, position, and motion perception also develop in early pregnancy. The construction of the basic or initial neural architecture of each sensory system occurs during the last 15 to 18 weeks (22 to 40 weeks of pregnancy) of fetal life and the first three to five months of a newborn's life.

The sequence of neuro-sensory development does not change significantly with premature birth. The processes continue to progress, whether in the womb or the neonatal intensive care unit. The timing proceeds according to the developmental maturity or developmental age of the fetus or infant. Premature birth does not accelerate any of the processes of early sensory development. But genetic defects or exposure to intense or unusual stimuli can delay or inhibit sensory development. The physical, sensory, and social environment of the fetus, infant, and young child is critical in supporting the healthy and appropriate development of the brain and nervous-sensory systems (Graven and Browne, 2008).

Abnormalities in the brain may occur when infants are not provided with adequate and rich sensory stimuli during critical periods of development. Severe permanent mental, social, and emotional dysfunctions are seen in babies who lack the rich environment that have the necessary sensory experience and the means to provide sensory-motor exploration (Balıkçı, 2013).

Looking at the facial expressions of babies shows that they can distinguish many basic tastes. When they try sweet foods, they react like adults by relaxing their facial muscles. They react to sour tastes by pursing their lips. Babies open their mouths differently when there is something bitter (Steiner, Glaser, Hawilo, & Berridge, 2001).

As with taste, some smell preferences are known to be present from birth. For example, the smell of bananas and chocolate produces a relaxed and happy facial expression in babies. By contrast, the smell of rotten eggs produces a sulking expression in babies (Ganchrow, Steiner, & Daher, 1983).

The transmission of sound to the ear and the transfer of auditory information to the brain are poor in newborns. However, these skills improve in the first few months and babies can hear various sounds (Saffran, Werker, & Werner, 2006). It is no surprise that babies just three days old turn their eyes and heads in the direction of a sound. The precise positioning of the sound improves greatly during the first six months (Litovsky & Ashmead, 1997).

Babies prefer noise to simple sounds in the periods after birth. Newborns understand the difference between various sound patterns. They can distinguish the difference between the gradually rising decibel and the gradually falling decibel; rhythmic beat tone sequences and non-rhythmic sounds like in music; conversations that reflect happiness, those that contain negative or neutral emotional characteristics, and the languages spoken by people who speak two languages, provided that the rhythmic elements are different (Ramus, 2002). Reacting to sound allows the baby to explore its surroundings.

Babies cannot focus their eyes well. Visual acuity is limited. Newborns cannot see objects clearly. They see their parents' faces blurred even at a close distance. Even though newborns still cannot see well, they discover their surroundings by scanning interesting images and watching moving objects. But their eye movements are slow (Slater, Riddell, Quinn, Pascalis, Lee, and Kelly, 2010).

Newborns prefer to look at faces. One study investigating whether being physically prominent can affect the choice to look at the face found that babies mostly prefer to look at photos with faces, although prominence, meaning clear and vivid images that are not blurred, does distract smaller babies, this effect decreases with age, and babies prefer to look at photos with a human face, even if the images are unclear (Kwon, Setoodehnia, Baek, Luck, & Oakes, 2016).

One study on the growth and development of touch divided 80 newborns into two groups, namely, control and experimental groups. Twenty-four hours after birth, the babies were touched twice a day for 15 minutes at a time. Differences in head circumference, height, and weight 42 days after birth were observed between the two groups in favor of the experimental group (Lihong, Weihong, & Fentao, 2002).

The first sensory system to develop is the sense of touch. At around seven to fourteen weeks of pregnancy, the entire surface of the embryo becomes sensitive to touch. Tactile perception develops in three different ways. Active touch (i.e., active tactile perception of the external environment), self or body perception (i.e., the role of touch in determining the shape of the body and its arrangement in space), and emotional touch (i.e., the role that tactile input plays in social/interpersonal relationships) (Bremner & Spence, 2017).

Touch is often used in combination with other senses to make sense of environmental stimuli. Our sense of touch is greatly influenced by sub-visual, auditory, and olfactory information, and multi-sensory interactions are crucial for our understanding of the world and the development of tactile perception (Bremner & Spence, 2017). For example, gaze (sight) and touch can be used to recognize a toy (Trawick-Smith, 2014). The shape, texture, temperature, strength, and weight of an object can be discovered through sight, smell, touch, and hearing (Ceylan et al., 2021).

Furthermore, adult touches have a positive effect on the child's emotions and mental health. These touches have been found to cause smiles, gazes, and increased attention in infants (Santrock, 2021). Routine, affectionate caresses can lead to positive gains in the development of children at risk (Berk, 2015). It is a social function that mediates the bond between children and adults. The first sensations experienced in the first years of life are tactile (Bremner & Spence, 2017). Touch is one of the main ways that adults want to communicate and play with their babies. Calming and holding a crying baby has implications for the mother-infant relationship, cognitive development, socialization, ability to cope with stress, and the development of the baby's immune system (Snow & Mcgaha, 2003). Touch is one of the easiest ways to shape emotional and mental health. Touch is an integral part of early life and is also

the mediator of sensory information received during the daily care of the baby and young children (Ceylan et al., 2021).

One study analyzing maternal touch monitored the total duration of maternal touch and the types of touch used by mothers. The study reported a decrease in behaviors such as caressing with age and an increase in touches such as tickling and shaking as the infant grew older. Mothers make more static touches when they hold their babies in their arms. There are more touches such as swaying and tickling in the interaction on the ground and this may be because mothers look for different ways to interact with them as their babies grow with the effect of social laughter with age and the increase in mutual gazing (Jean, Stack, & Fogel, 2009). Another study examining infant touching behavior during mother-infant interactions found that when the mothers put on a dull expression, their babies were more active to touch them, exhibited touching behavior for longer, and showed tactile behaviors having a soothing effect (such as finger strokes, caresses, and tugging) but used static touches in normal interaction, mostly touching their mothers (Moszkowski & Stack, 2007). These studies indicate that touch is an integral part of the mother-infant relationship and that the need for touch is a condition that needs to be met during infancy. At this point, we can say it is wrong to define touch only in terms of skin and that it also includes an emotional and social dimension. Studies investigating babies' touch behaviors based on body perception and self-awareness found that the speed of tactile stimulation (rapid or slow touch) and the source of tactile stimulation (such as a human hand or a brush) were influencing factors. They found that infants prefer slow touches and are more interested in stimuli involving people (Della Longa, Filippetti, Dragovic, & Farroni, 2020; Filippetti, Johnson, Lloyd-Fox, Dragovic, & Farroni, 2013). These findings confirm the view that infants notice relaxing touches, confident touches, and hugs. The secure bond that parents establish with their baby in the first years is strengthened by tactile actions such as the mother's close contact with her baby during breastfeeding, stroking its hair, and hugging (Santrock, 2021; Taştepe & Başbay, 2015).

As can be seen, sensory systems are instrumental to development, and information entering a sensory system affects and supports other systems. In the same way, one stimulus can stimulate all the sensory systems at the same time. For example, we touch, taste, smell, hear, and see at the same time. Information transmitted by our multiple senses improves our perception of ourselves and the outside world (Bremner & Spence, 2017). As the senses develop and interaction between them increases, the child begins to use more of his or her senses together to obtain information (Gallahue et al., 2014).

Babies perceive and interpret information from different sensory systems as a whole. During the first six months, babies show significant improvement in intersensory perception. They visually notice an object, touch it, and distinguish how it differs in shape from other objects, or they figure out the connection between sound and image in a toy. Again in the first six months, babies can match the speaker's lip-sound synchronicity, emotional expressions, age, and gender with the speaker's face. They can perceive and remember unfamiliar voices and faces (Berk, 2015). Interaction is a key factor in the sensory development of babies.

2. Baby's Interaction with the Environment

Interaction with the environment is crucial for daily life. Perception and action play key roles in this daily communication. Although they are born with the ability to taste, smell, touch, hear, and see, newborns initially have limited knowledge about themselves and the world. The first sensory experiences contribute greatly to their understanding of the world and connection with it. This is why adults should enrich the baby's environment, but parental participation here is also very important (Meilanie et al., 2023). Because even though there are children's books, coloring crayons, and toys at home, if activities are not carried out with the parent, the rich stimuli in the environment will have no function. It should not be forgotten that the baby needs an environment equipped with rich stimuli as well as an adult who can make the rich stimuli in the environment meaningful for the baby.

The senses need to be stimulated by the warm intimacy, touch, and rich stimulating environment established with the adult early on. Supporting sensory development is important for the baby's overall development (Thompson and Raisor, 2020; Meilanie et al., 2023).

One study played two different videos to babies to measure the attention paid to faces. An interesting cartoon film for children was shown and clips, again for children, including a chat between an adult actor and two puppets were also shown. The faces of animals and the puppets were added and the researchers calculated the rates at which the babies looked at the faces of the characters in the videos. The study found that the babies' behavior of looking at faces increased with age and that they looked more at larger static faces that were talking to each other (Frank, Amso, & Johnson, 2014). Babies can match the sound and image they hear with the appropriate face from 2 months of age (Bristow et al., 2009). Another study found that babies noticed consistent mispronunciations when they saw a face pronouncing unfamiliar words when objects recognized by the babies were presented to them and pronounced correctly and incorrectly (Weatherhead & White, 2017).

In addition to all this, babies' interaction with their environment and the information they obtain by using their senses affect the acquisition of cognitive skills. Learning is associated with new objects so instead of simply looking at an object interactions with the object need to be strengthened through sensorimotor actions (Corbetta et al., 2018).

Environmental information received through the senses significantly affects the development of the central nervous system. The brain needs sensory stimuli to maintain its development and function healthily. The stimuli presented to the baby greatly affect sensory development (Viswanathan, 2023). Sensory materials related to touch, sight, smell, hearing, and taste support the development of the baby's brain, forming the basis for other developmental areas and facilitating learning. Sensory games help develop infants' and children's academic skills along with attention, their ability to distinguish sounds-images-textures, their body awareness, hand-eye and eye-foot coordination, fine-gross motor skills, not to mention establishing healthy and safe relationships, socialization, language and speech, self-confidence, and self-esteem. In short, supporting sensory development is vital in supporting all areas of development, including brain development (Norman, 2023). Babies develop fine and gross motor skills as well as hand-eye coordination when touching, stirring, and carrying sensory materials. Using descriptive words such as hard/soft, rough/smooth, liquid/solid, and

hot/cold to describe sensory materials helps with infants' vocabulary development and concept learning (Ceylan, Beşir, & Korkut, 2021; Ünal, 2020).

The point to be considered here is that not every baby will be born with the same sensory sensitivity. No two children learn and develop at the same speed. Individual differences exist. Stimulating the child's senses at different levels affects how they think and understand (Taştepe & Başbay, 2015). Furthermore, expecting children to do things beyond their capacity also hinders their development. Expensive early childhood education centers have emerged in recent years where children are exposed to a lot of content and curricula that they are not ready for. There is no scientific evidence that "super babies" are being raised in these places. Conversely, stimulating babies with stimuli that are much more difficult than they can process causes their development to regress and their curiosity for learning to decrease. The result is similar to when stimuli are absent. The development expected as a result of experience occurs naturally at an early age when age-appropriate materials and fun daily activities are provided by caregivers for babies and young children (Berk, 2015).

The child's living environment is structured by adults from birth. The needs of the child may conflict with the structured environment from time to time. An environment will affect children and adults differently and carry different meanings and feelings. Therefore, a key role for parents and educators alike is to monitor and assess the child in an environment where the baby will interact using his/her senses and to support the child's sensory development.

DISCUSSION AND IMPLICATIONS

Conclusion

A baby who is born healthy can perform its functions even if all sensory organs are not yet mature. Every healthy parent is eager to support their baby. The task of adults here is to create a developmentally appropriate environment for the baby, ensuring that learning about the outside external world occurs and is permanent. The way to do this is largely through the relationship of the caregivers with the baby and their interactive behavior.

One study examining brain images during mother-infant interaction found that regions of the brain associated with motivation, attention, decision-making, thinking, emotion, and empathy were activated (Swain, Lorberbaum, Kose, & Strathearn, 2007). Adult behaviors closely affect brain development and will undoubtedly affect the relationships that the baby will establish in later life. Adult-infant interaction, therefore, requires that parents and other caregivers respond to the needs of the baby through play in accordance with that particular baby's developmental characteristics so that healthy development continues (Ulutaş, Aksoy and Çalışkan, 2016).

When the people around the baby respond to its needs, this tells the baby that the signals it is sending to the outside world are being received and understood, so the baby makes an effort to continue its interaction with the adult. This also marks the beginning of social communication and socialization. Positive continuation of interactive behaviors enables the

baby to develop a sense of trust toward his environment, and a baby with a sense of trust becomes open to discovering and learning new things.

Being in a continuous and close relationship with caregivers is also associated with positive social-emotional development and emotion regulation skills. By observing caregivers, the baby creates its own communication and interaction models as a model of adult behaviors (Rattaz, Puglisi, Tissot, & Favez, 2022).

As we have seen, an infant's relationship and interaction with adults are crucial if the baby is to develop healthily in all respects. Children will reach their developmental potential under the right conditions. For this to happen, the family should support the child's development by creating appropriate opportunities.

Recommendations

Each baby is born with different levels of sensory development. Sensory skills can be improved by supporting them through interaction. Good quality experiences support the baby positively. Just as every baby has the potential to develop, every parent has the potential to support the baby's development. Parents can massage the baby's arms, legs, and body. They can give the baby a teether when it is teething. They can play soft music to the baby after storytime to help it fall asleep. Baby blankets with different textures -- hard, soft, lumpy, felt --can be made. Different sounds -- loud-quiet, fast-slow -- can be played to babies. Various scents can be accumulated in tiny bottles. Games that support hearing, taste, touch, and sight can be played together early on. Parents could prefer wheeled toys that can be pushed and pulled or toys that can be carried during the walking period. Any material that stimulates the senses can be considered sensory material. It does not have to be a designed toy, it can be household items such as bath loofahs, ear cotton buds, shaving foam, toothbrushes, aluminum foil, toilet paper, wet towels, mirrors, lights, pillows, as well as natural materials such as seashells, stones of different colors and sizes, sand, water, grass, fresh air. The more the baby can interact with his or her environment in the early period, the more his or her development is supported positively.

Increasing education programs for parental support in sensory development supports the holistic development of infants. the information provided for raising parental awareness has an important place in the sensory development of infants. it also affects other areas of children's development such as cognitive, language and emotional development. Investigating and revealing these effects can be used in future research. Supporting the sensory system is also important for babies with special needs. Whether it is a typical or atypical development process, the sensitivity of parents on this issue both supports the development process and prepares the ground for early diagnosis and early intervention. Considering the importance of sensory development in the development process, the formation and development of sensory systems and sensory integration studies should be addressed in research.

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