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Psychology

Child Development

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Content

1 Introduction

Psychology is a large field that has to be divided in divisions. One of them is called Developmental Psychology. This branch considers all changes a human being experience through the way of life. It is not an own independent branch that can be studied without concerning the others. Because the emphasis is on the changes not on the subject, all other branches are touched such as Cognitive Psychology, Social Psychology and so on. It is rather a branch that accompany through the whole life than a branch that covers a certain topic independent of age. It is rather longitudinal than transverse regarding the lifespan, and shows the experienced changes in that branches.

But Developmental Psychology is still a too large area. The first part of life has so much and dramatic changes that it is necessary to create an own part: Child Development. Child Development covers everything (psychological) from conception to adolescence. In other words the first two decades.

Because the changes are so critical and deciding what happens the rest of the life, it is also an extremely important and exciting field.

Everybody who works with children or who has children or plan to have children should be interested in what child development reveals about the process the kids go through. They know what's going on in a child, they can compare with other age mates and, if a deviation occurs they can correct them. The education will be more adequate, they don't over- or under strain them.

It explains why and how a child percept objects. Adult are able to understand children's' abilities. Then they are able to put themself in the position of children.

It is important for schools and institutes first to create tests and then to find out how far developed a child is and then to decide which next step is the best toward the future. Child development provides possibilities to classify and to predict.

In this sense Child Development is even interdisciplinary. Because Pediatricians must know the bodily development it extends into medicine. Child Development is engaged in the Cognitive and Intelligence Development, so it touches the areas of pedagogy. And finally social and moral development is interesting for a Sociologist.

In this report some subbranches of child development are covered.

The Prenatal Development and Birth is sorted by event not by time, whereas physical growth covers all 20 years.

The next chapters are sensation and perception, cognitive development, memory- and intelligence Development.

I don't mention at all other parts such as language, social or moral development due to the limits of this paper.

2 Prenatal Development

Before birth takes place the infant grows first in the mothers womb. This time starts with the conception and lasts 38-40 weeks.

First of all, some definitions:

Gestation is the time from conception to birth seen from the child.

Pregnancy is the same time but from the mother's view.

Embryo is the new being from conception to 8-12 weeks.

Later it is called **fetus** till to the birth.

First it is shown how the body, later how the brain develops. It is discussed separately because it is the most complex organ and the most vulnerable one.

2.1 Body development

The womb is the safest place for a new being to develop in. The environment is warm, dark, silent and protects from illness. It is necessary because the body is vulnerable and needs a calm place and time to grow up.

At conception that starts with one cell, this cell divides uncountable times. After few weeks the cells start to specialize to different organs. For example, the neural tube is build after twenty-two and twenty-eight days. Not much later starts the construction of the central nervous system. The heart starts beating at the end of the first month. At the same time muscles, ribs and the digestive track begin to develop.

In the third month the organs, muscles and nervous system start to become organized and connected.

After the period of 13 weeks all organs are basically formed and just need to enlarge. Eyes are sensitive now.

Lungs mature after 25 weeks and after 23-37 weeks the senses correspond with the brain.

After 26 weeks a baby is able to survive outside the womb, but has still trouble to breathe or to keep the temperature constant, so help from outside is necessary.

2.2 Brain

2.2.1 Development

The development begins relatively late. There are two main growth spurts. The first starts during the third month and lasts two month. During this period the nerve cells increase rapidly. It is also the time where the brain is most vulnerable. The second starts two weeks before birth. In that time the cells differ and the structure between the cells develop. This period lasts until three or four month after birth.

2.2.2 Damages

The damages of the brain are so dangerous because a small deviation in an early period of time grows up as well and causes later big damage.

There are some chemicals and other influences that are able to destroy the structure of the brain.

Everything that can damage the brain is called a teratogen.

A Alcohol

Alcohol causes face and head defects, growth and mental retardation, anomalies of the heart and other organs. Though the danger of alcohol is well known among most woman the prenatal exposure is one of the leading causes of mental retardation. Alcohol is so dangerous because it crosses the placenta easily. If a mother is drunken, the baby is drunken as well. The brain is the most vulnerable organ to alcohol. It directly kills neurons and disrupts the migration of neurons and glia. These cells will not to rebuild they are lost. The questions is how much may a pregnant woman consume. A threshold level where alcohol starts to effect on the fetus is still not known.

B Cigarettes

Cigarettes does not damage the brain but the heart and lungs. In the smoke there are several

teratogens such as nicotine and carbon monoxide. They rushes into the fetal circulation and disturb the breathing dramatically. It ranges then from apnea to rapid breathing. It also increase the risk of sudden infant death syndrome after birth.

The neural receptors are bind by nicotine in a particular way. So the normal development of synaptic communication is blocked by nicotine. That causes behavioral deficits.

A third dander caused by smoke is the delay of growth. Babies infiltrated by smoke have less weight, they are weaker and more vulnerable during birth than normal grown babies.

3 Birth

The birth is the most drastic change a child experiences even for the whole life. No more else changes the situation more than here. The complete environment both physiological and outside is replaced at one sudden moment. The baby is simply separated from the mother. There are so much modifications such as independent breathing, regulate the cardio-vascular system and blood pressure, maintain the right temperature. The nutrition begins, followed by digestion. The motor function alters because the child experiences gravity in a different, more complex way.

3.1 The process

3.1.1 Hormone

The initiator of the entire complex process is the fetus. There is a chain of changes of the level of some hormones that triggers several hormonal changes in the placenta. The fetal nervous system only has all physiological information to judge when the time is ready to born. When all systems are mature enough to survive secure outside then the fetus sends the signal to get born.

The level was already higher since some weeks before birth both to prepare the fetal organs and to strengthens the uterus's contractions. They are not regular and still weak.

The increase of the hormones inside the placenta triggers the next step within the hormonical chain. As result the hormones that are responsible for contractions are on a higher level as well. These increases convert the former irregular coincidental contractions to co operational strong contractions able to expel the fetus.

3.1.2 First Step

When it is time to birth first the cervix opens due to strong, regular and more and more frequent contractions to a clear channel from the uterus into the vagina called birth canal. The opening lasts 6 to 14 hours depending on the amount of former birth. During each contraction the fetus presses with the head against the still not complete opened birth canal.

3.1.3 Second Step

Once the birth canal is fully open, the second step begins. It lasts only 20 to 50 minutes also depending of the amount of former birth. The contraction are very strong now and the mother presses with her whole power the baby out.

3.2 Physical traumas

During each contraction the head of the fetus is pressed against the birth canal. The umbilical cord is squeezed repeatedly. This causes a reduction of baby's supply of oxygen regularly.

If the birth canal is too narrow, the head is molded. This may happen because the skull bones are not fused, they may slide together without severely compressing the fragile content inside.

Sometimes it is possible to see it when the child is born. The head seems to be malformed, but the bones slide back to the normal position soon.

This facts sound dangerous to the fetus, but the fetus is able to compensate those stress factors. They are even beneficial for the babies.

Regarding the compressions the body of the fetus surges the level of a hormone catecholamine. The hormone causes a decrease of the heart rate and paralyzes the muscles to conserve energy and oxygen. The blood can be used just for heart and brain now. More blood is send to the brain to supply the brain with sufficient oxygen. The level of catecholamine rise to twenty times level than normal.

The rise of catecholamine causes additional circumstances. When the breathing is activated right soon after birth the lungs are prepared to absorb the remaining fluid in the bronchial tubes. It also promotes the release of a surfactant to exchange gas in the air cells. Otherwise breathing wouldn't be possible.

The metabolic rate is speeded up by catecholamine. A risen rate helps to regulate the body temperature, builds larger reserves of glucose and other energy sources.

Due to the contractions the fetus has tight contact and touch to the mother's body. This helps to refine synaptic connections. In this way frequently movements promotes enough stimulation to develop the last myelination before being born.

The baby is alerted and fully awake by the high level of stress hormones and the rich stimulation during birth.

The narrow way through the birth canal has another simple mechanical benefit. During the passage through the birth canal the liquid in the lungs is squeezed

But there are still some dangers that are too high to be compensated by baby's hormone system.

3.2.1 Oxygen Deprivation

There is, of course, a threshold in supporting the brain with oxygen without supply from outside. If the breathing doesn't start the baby can survive up to 10 minutes without damage. But if there is no success to start breathing there will be likely a brain damage (Parer, 1998). This circumstance is called Oxygen deprivation and is always dangerous for babies life.

If the oxygen deprivation becomes too severe the blood pressure might become too high leading to a tear of the capillaries, causing bleeding. The bleeding can kill brain cells, the consequences are permanent mental or neurological damage.

Retard breathing is not the only cause for oxygen deprivation. The umbilical cord can be squeezed during a contraction especially when the fetus is in the breech position.

Another cause is placenta abruptio (premature separation of the placenta). The fetus is no longer supplied with oxygen and requires immediately delivery (Ananth et al., 1999)

3.2.2 Subdural hemorrhage

During the passage through the birth canal sometimes occur injuries. Two possible events are to be distinguished. The first, cephalohematoma, is a swelling on the head. Fortunately it doesn't threat the brain because the bleeding is outside the protective membranes that cover the brain, though it looks frightened from outside. The second, subdural hemorrhage, is caused by a more severe damage of the membranes. If the membrane is teared the bleeding take place inside the protection and damages neurons. This bleeding is lethal or leads to lasting cerebral palsy or mental retardation or disability.

3.2.3 Cerebral palsy

A group of syndromes is covered by this expression. They are all caused during birth or early later. The syndromes are disorders of movement or posture. Cerebral palsy (CP) is hard to detect before toddler hood because the movements of a new born are not organized. Depending of the severity the kids show paralysis or spasticity in one or all four extremities. Mental retardation also occur with a half, a third have epilepsy.

3.3 Psychological traumata

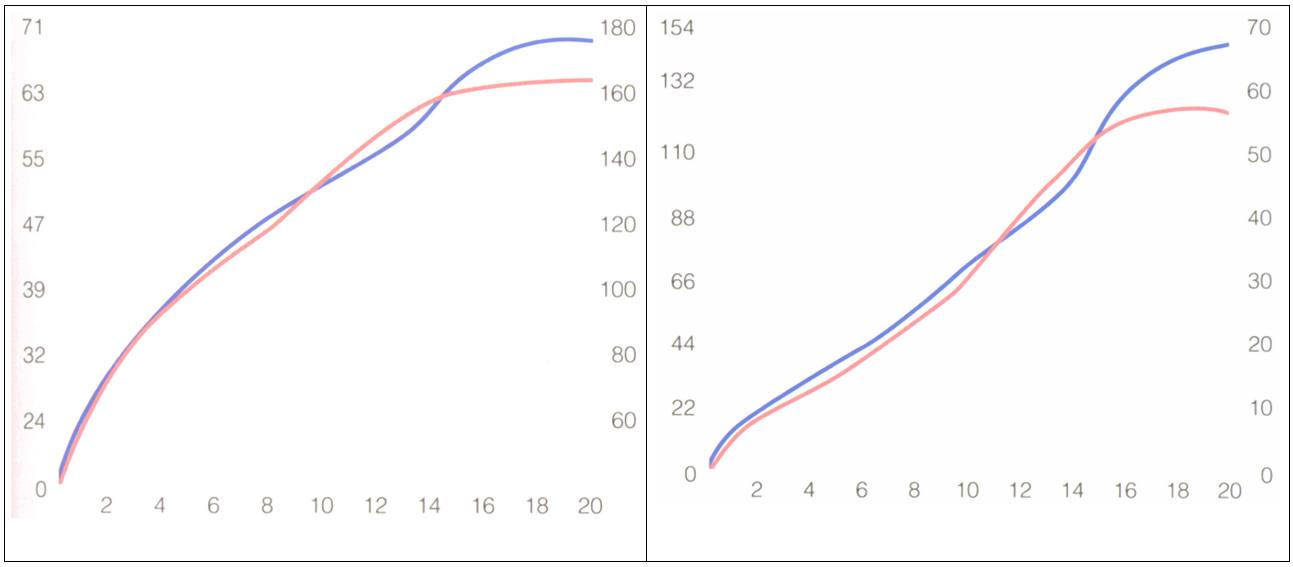
The modifications mentioned above may lead to a psychological trauma, because nearly everything changes. That must be a shock for the baby to be pulled out of the secure, known womb into a bright, endless, cold and loud environment. Rank (1924) and Bernfeld (1925) assumed that this experience caused all later fears. But is this really true? Today's opinion is that it is unlikely that birth produces such bad traumata, because nobody remembers the own birth. It is more likely that a child feels relieved after great labor, stress and efforts. If Rank and Bernfeld opinion were true, everybody would start his life with a trauma and bad experience. A bad precondition to master daily life.

4 Physical Growth

From the first minute after birth the fragile baby grows up, now independent of mother's support. It is a autonomous being. All information to grow up lies in his genetic code. Nobody else or nothing else tells the kid how to get mature concerning the physical development.

4.1 Body Size

From a newborn with a average size of 50 cm to a adult with a size of 170 cm it takes a long time. As adult the person is 3.4 times bigger than a newborn. If we assume a average life time of 75 years and a time of growing of 16 years then it takes about 20% of the life to grow up. The most rapid growth is during the first year. When the child is on year old, the size is 50 % bigger than as a newborn, by 2 years it is 75 % bigger. The weight is doubled after 5 month already. After one year the growth slows down. From age 4 to puberty it increase nearly linear. The last spurt takes place during puberty. The process of growing is finished after puberty. The following diagram shows it



Height and Weight Growth Process (Malina, 1975)

4.2 Skeleton/Skull

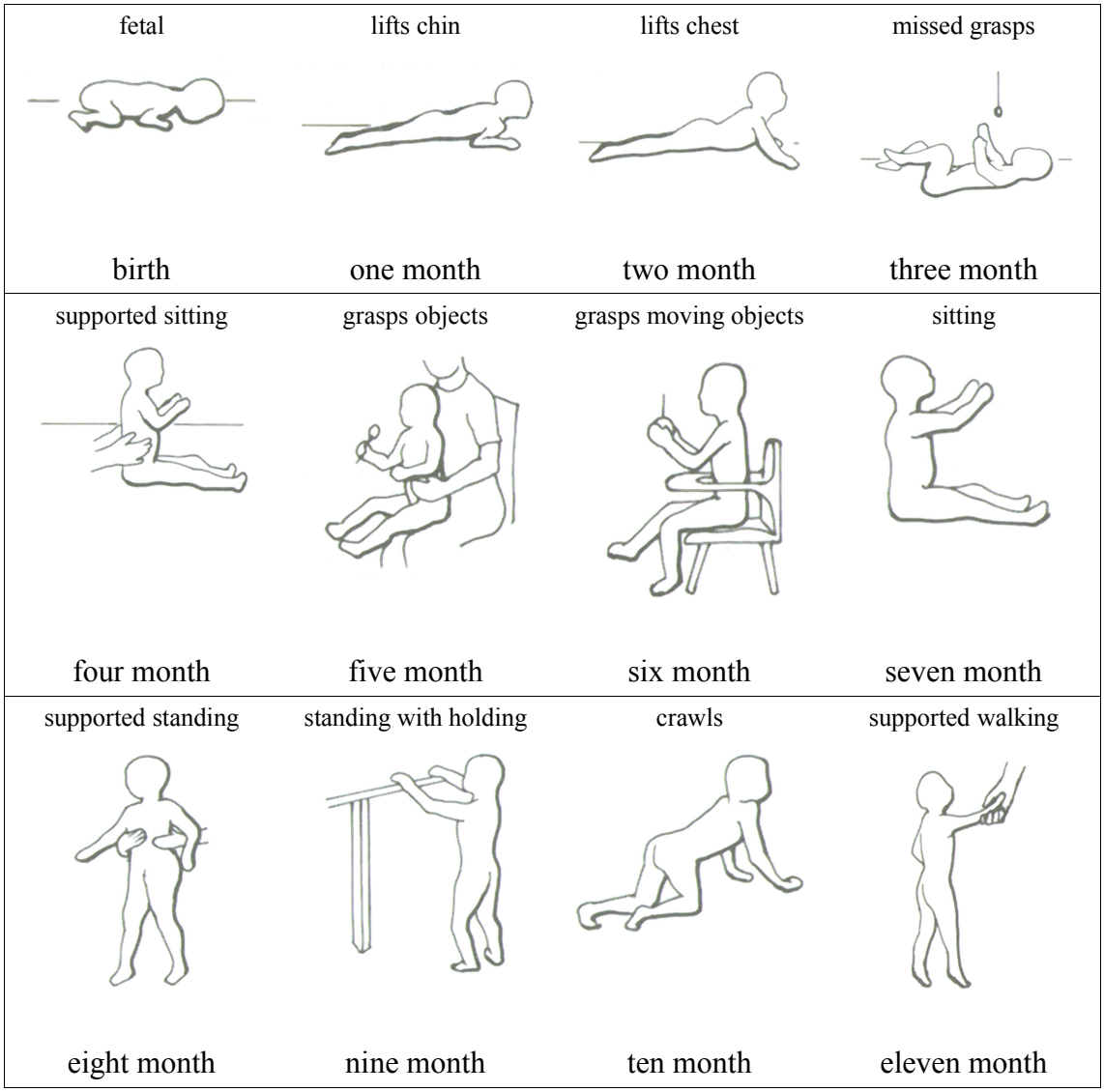
The fetal skeleton is first soft and elastic. Very soon (after six weeks) bones start to harden. This

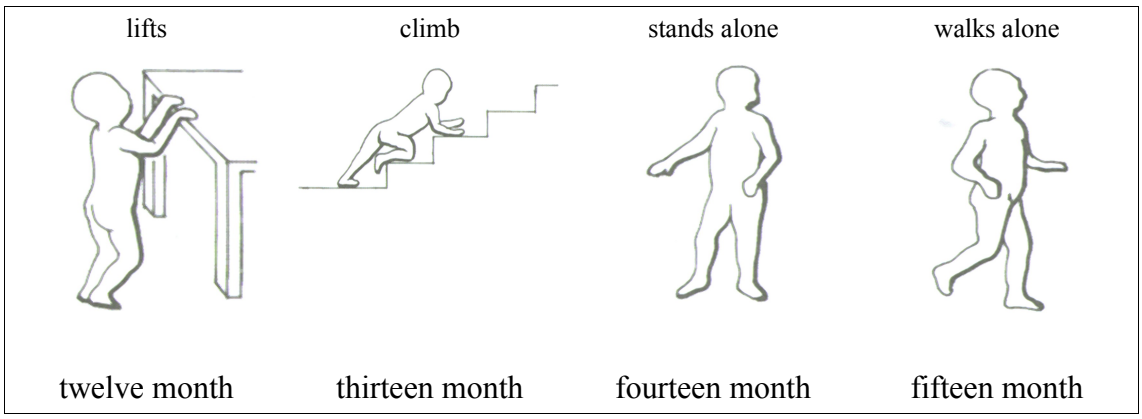
process lasts until adolescence (Tanner, Healy & Cameron, 2001). That's the reason why small kids never or rarely brake bones.
Especially long bones have a special way to grow. They don't grow everywhere, they have certain centers to grow. They are located at the two end and called epiphyses. They get thinner and finally disappear. The size of the epiphyses are a good measure to ascertain the estimated final body size.

One exception is the skull. It grows in the first two year very fast, because the brain gets greater. Additionally the skull has six gaps called fontanels. These gaps make it possible to overlap during birth. The gaps are closed after two years forming sutures. The sutures disappear after puberty. Later no growth is possible. The question arise whether it wouldn't be dangerous to have such big gaps on the head where the fragile brain is located. Obviously it is not a problem, because there are no or seldom accidents of toddlers at the head.

4.3 Walking

It is in particular interesting how a toddler starts walking. The ability of walking is such a complex process, we learned it when we tried to program roboters to walk. (Honda, 1991). Children are able to do so after one and a half year. That is an astonishing achievement. The steps from birth to the first steps are shown in the figure "Steps to walking".





Steps to walking

4.4 Gross motor skills

The development of Gross motor skill depends not only in the physical growth namely the skeleton and strength, but also on the cognitive capabilities and the perception. New ranges of reachability (by strength) offers more possibilities to perceive and discover something or someone new. As next step these new experiences trigger the brain to develop in the three dimensional orientation. The new neuronal capabilities can be used again to get more mobile or to learn new steps in movement based on the old ones (Gibson, 1988). Here the circle is closed. Now here is the emphasis on the physical development.

The step from birth to age 2 are shown above. By age 2, the gaits gets more smooth. The next step is running and jumping on one spot. By age 3 and 6 a child starts to jump during running (Getchell & Robertson, 1989). In the same age a child is able to throw a object.

Later on all movements are improved and refined. Now they are able to play sport games that helps a lot to improve the motor skills and to get more strength in a pleasant way. All these capabilities are going to be improved until adolescence.

4.5 Puberty

4.5.1 Process

There is a special time during the way to adolescence called puberty. Girls start earlier then boys. They start puberty at an average of 11 and last 3 or 4 years (Tanner, 1990; Wheeler, 1991). Boys start at an age of 12 and it lasts also 3 to 4 years.
During puberty there are many bodily changes for both girls and boys. The maturing of the sexual organs is accompanied by the rapid growth of the body. There is the last spurt before arriving adolescence. The feminine development of the sexual organs don't start with the menarche, it is embedded instead. The changes are thoroughly. The masculine development is additional accompanied by the deepening of the voice.

4.5.2 Beginning

A Influences

What influences the time of beginning?
First it is determined by heredity. That is shown by identical twins who begin with just one month difference whereas fraternal twins have a difference of up to 12 month (Kaprio et al., 1995).
The second factor is nutrition. When a girl eats fat food the puberty starts earlier. The opposite, if girls eats few or take sport exercise the puberty starts later (Rees, 1993).

Third, the health conditions also contribute an early beginning. In developed nations the menarche starts at about the same time: all countries have nearly the same medical scheme and care. (Morabia et al., 1998). In poor countries the menarche starts later. But if there is a rich family who can afford higher medical care the girls start earlier.
Fourth, when children grow up safe and protected menarche starts later. In other words bad, deep going experience and persistent difficulties accelerate puberty. Children from intact environments begin later. (Ellis & Garber, 2000; Moffitt et al., 1992).

B Ideal timing

When is the ideal time to begin puberty. Early or late? It depends on the gender and attitude of other peers and adults. Early matured boys are seen as self-confident, strong and physically handsome. Compared to age mates they are in leader positions. Instead late maturer are considered as fearful (Brooks-Gunn, 1988; Clausen, 1975; Jones, 1965). That's what the environment expect but the psychological stress is higher even though they are admired(Ge, Conger & Elder, 2001).

Concerning girls it's just the opposite: early mature girls are considered as unself-confidence and withdrawn and are seldom in leader positions, they show more a negative behavior and a worser school achievement's, but late starter are seen in the same way like early boys: attractive and guiding Caspi et al., 1993; Dick et al., 2000).

But what is the best timing for them? Because of the pay a lot of attention to the feedback from others. The early boys and late girls have an easier way through puberty to adolescence. They did not learn to handle difficulties and their painful experiences. They are later as adults inflexible and discontent whereas the other group is independent, flexible and satisfied (Livson & Peshkin, 1980; Macfarlane, 1971).

4.5.3 Psychological impacts

Because of the deep changes the puberty influence not only the bodily conditions. Normally a person who experience the changes of puberty is made insecure and reacts with a mixture of positive and negative feelings. A way to prevent such deep changes is to prepare and inform the kids before the first changes start and to accompany them during their difficult time. An important role plays the father of his daughter who ideally is interested in her changes and takes care of her because of a deep relationship established in earlier years. Unfortunately many fathers fear a deeper relationship during puberty because of their own insecurity how to handle a maturing girl. They don't support the daughter but drop her. The result are more deeper and worser emotions because of their own insecurity and their suddenly lost of support. They feel unloved because of their changes and try to go against it with even worser results concerning the relationship.
Well prepared boys and girls do better then surprised and carelessed. The better, opener and more confident the relationship between parents and their children before puberty is, the better goes the child though this time, because it can trust in them and rely on their support.

5 Sensation and Perception

5.1 Perception during Infancy

Child's development has been studied in about 90% in the age of infancy. Scientists put so high emphasis on this period for several reasons:

1. The perception is later more tied with cognitive processes and therefore more difficult to distinguish or to analyze (Oerter et al., 2002).
2. The senses are well developed after one year. There are no more differences to adult. So there is no need to perform further investigations. The ability to perceive will be improved during child's growth, of course, but there are no or only few changes concerning the senses.

5.1.1 Smell

From the very beginning an infant is able to smell. This sense might be underestimated, but for a newborn is to necessary to survival. The reaction (positive and negative) can be measured by observing the facial expression and the breathing rate. When a piece of cotton wool is hold to the nose the reaction is informative enough to reveal the ability and intensity how an infant smells.

The smell of banana-, strawberry- or vanilla causes a positive reaction and addle eggs and even fish are not accepted by newborn (Rieser et al., 1976; Steiner, 1979). After five days the sensitivity will be more different. After one week the baby is able to differ the smell of mother's breast from others (MacFarlaine, 1975). So a child can distinguish the mother from others just by the sensitivity of smell after one week.

If a newborn smells something negative it is able to localize it and to turn away to the other directions (Reiser, Yonas, & Wikner, 1976).

5.1.2 Tasting

Already two hours after birth the baby tastes sweet, salty and bitter liquids. The taste causes fast or slow sucking depending on babies preferences. The preferences change fast because after four month the salty taste seems to be preferred. The preference is a bit changeable and able to influence. When a child alter likes salty food it might have the origin in the first months of live.

5.1.3 Touch

The sense of touch is may be the most important sense of the lower senses. It is important and essential to construct and establish emotional relationships between the infant and the parents. The touch also helps to stimulate physical growth. No wonder that this sense is the most well developed. Especially the mouth, the palms and the soles of the feet are sensitive (Humphrey, 1978). When a adult touch and caress a baby the baby respond with smiling and pay attention to that person (Stack & Muir, 1992). It is good to observe that babies “see” with the touch sense. They put everything new in the mouth and investigate it. Babies are ables to distinguish objects by touch (Streri, Lhote & Dutilleul, 2000).

5.1.4 Hearing

A Beginning

One property of sound is that it penetrates the womb. The fetus is already able to hear here what were not possible for visibility. Studies show that music played during pregnancy is recognized after birth. As the fetus grows it hears continuously it's mother's voice. That sound is already differed from other voice after 4 days of life (DeCasper & Fifer, 1980). This is not valid for father's voice, because his sound or voice was not known earlier.

B Congenital Capability

Babies seem to have a congenital capability to distinguish acoustic pattern that are similar to human language. This is important for development of the own language. The baby likes obviously more complex sounds than pure sounds (e.g. A pure sinus tone). Already after one month the child is able to differ between all existent language sounds of the world and after six month the baby can differ only those sounds that exist in the own language. It get lost for the rest of languages (Cooper & Aslin, 1989). In that age of six month the baby differs the sound pattern as well as an adult (Olsho et al., 1987). It prefers the rhythm of normal sentences more than sequences with irregular breaks. (Hirsh-Pasek et al., 1987).

C Recalibration

Even a baby is able to ascertain where a sound comes from. This is possible because one ear is farther than the other and the waves arrive a bit later. As the child grows the head and the offset grows as well. The offset of the waves increases and the brain has to recalibrate it in order to get again the right direction of the sound. Because of these changes a young child has problems to locate the origin of a sound, but the capabilities are still noticeable.

5.1.5 Vision

A Sensation

Unlike the lower senses and the hearing the vision sense isn't developed well by birth. Several functions are still under construction.

1. The muscles of the lens that is responsible for the sharpness are still weak. So it isn't possible for the newborn to see clear and focused.
2. The retina contain lesser cells than the retina of an adult. That causes a lower density of the whole acuity.
3. The cells are still not mature. The ability to see in colors doesn't exist. In other words the baby sees gray not colored.
4. The way to the brain that are the optic nerve are underdeveloped as well as the visual cortex. Even if the eye could send exact signals to the brain, they couldn't processed adequate. (Banks & Bennet, 1988)
5. The acuity is smaller than an adult like. They see only objects right in front of the eyes, though they turns the eyes and head in the right direction

Because of these fact a newborn sees gray, unfocused and limited. It changes rapidly after one to six month. After three month the focus is developed as well as adult like. And already after two months the color perception is so discriminated that the eye can see all spectrum colors.

At birth the best distance to see most focused for a baby is 20-30cm. It is the same distance from the breast to mother's head. When the child is being feeded it can see the mother with the most sharpness ever possible.

B Perception

a Depth perception

I Development

Depth perception of little children was investigated by Eleanor Gibson and Richard Walk 1960 the first time. Because of the lack of ability to see like an adult, it seems to be that babies cannot perceive depth. The question arise when and how far is the development processed.
A 3-4 months old baby can already figure out the things are not flat. How do they do it, when they don't see focused? One hint is called kinetic depth or cues. The important information of depth is gained by the motion if the child and/or the surroundings move (Arterberry, Craton & Yonas, 1993). Test using looming shows that babies at age 1 month already use kinetic cues (Petterson et al., 1980)
When the development processes the infant is able to use binocular depth cues assumed that the development is far enough. Kinetic cues provides a relative correlation of two or more objects but not a absolute measure. When a babies uses binocular cues it can distinguish absolute length and distances. That's necessary to grasp or reach near objects.

II Coordination of Hand and Eye

As seen above binocular cues are used to determine reachable length. It has to be determined the distance of the hand and the distance of the object. A baby can grasp systematic at age of 4 -5

month. But already at birth there is a rudimentary link of eyes and hands. That proofed von Hofsten (1982) and was confirmed by Ennouri & Bloch (1996). Trials of grasping are not successful until the third month. But they get better and better.
When a baby is 4-5 month old, the first step is that the baby observes it's own hand and compares it with the desired object until the grasp is successful (Piaget, 1936/1973).
The ability to grasp sure is completed after 8 -9 month. They can even grasp a object that changes the direction of speed of movement. Unexpected delays or deviations can be compensated regularly after 34-36 weeks (von Hofsten, 1983).

III Crawling and depth perception

As the baby turns around and discovers more and more of it's environment the depth perception is trained. There is a difference if someone is driven or goes himself. To be his own demands a higher awareness of orientation and memory. To find a way back it is necessary to remind passed objects. While moving the picture on the retina changes depending on the own movements. This experience also strengthens the coordination of the own movements and the depth perception. It is also a cognitive process. Experiments have proofed the higher activity of the brain while crawling (Bell & Fox, 1996).
Actually it is a circle: When the body is strong enough to move first trials of moving stimulate the perception and brain processes, these processes enlarge the cognitive functions. As they are developed enough the baby is able to refine the own movements. The gross and fine motoric skills are improved and they get more strength. So they are able to move better and farther. Here is the circle closed.

b Pattern perception

A pattern is recognizable by its contrast. A contrast is a sharp difference in the brightness of two or more adjacent borders. Even newborns prefer to look at patterned rather than plain objects. As they get older, they prefer more complex patterns (Brennan, Ames & Moore, 1966). The ability to detect contrasts is precondition to recognize pattern. This sensitivity of detecting lesser contrasts improves during infancy and childhood (Gwiazda & Birch, 2001; Teller, 1997). A 1-month-old infant discovers sharp contrasted pattern whereas a 2 month infant explores even internal features (Bronson, 1991). When 4 month passed since birth an infant detects an organization and perceive boundaries that in reality doesn't exist. The perception is so progressed that the imagination is higher than the real sensation.

Because of the maturation of acuity, sharpness and cells also the pattern perception increases soon and gets higher as the lifetime goes on.

c Face perception

One special pattern is the human face. Newborns already show higher interest in pattern that look like a face. Faces that are upside doen or unnaturally are not preferred. Is seems that they have a natural tendency to recognize faces. They look even longer to faces that are attractive to adults than to ugly faces. It is believed that this built-in ability the given to select the own species from others. (Johnson, 2001; Slater & Quinn, 2001). Another reason might be the frequency of seeing a human face from the very beginning of life.

6 Cognitive Development

Piaget (1896-1980) who was first a zoologist became a cognitive theorist. He researched the cognitive development his entire live and came up with uncountable ideas to study observations wrote a lot of papers. So, he is a base person in cognitive psychology and his works were a signal to continue to study this branch of psychology.

His theory will be introduced now.

He has a flavor of biology. He assumes that each individual gains it's cognitive knowledge from the own active learning. At the beginning there is no knowledge. The child gets everything later after adding new and refining old components.

He has given some definitions that are essential for his theory.

6.1 Definitions

Adaptation

Adaptation is a process of creating new psychological structures called schemes. Whenever there takes place a change in the environment, the kid tries to adapt it through direct interaction with the environment. There are two possible ways that are complementary: *assimilation* and *accommodation*.

Assimilation

The own way to process changes in the environment is to use own, individual schemes and compare and interpret the external world until it fits. Sometimes the results are really strange. This kind of way works until there is nothing that fits in the own schemes. Then the second way is used.

Accommodation

If there is nothing fit able a new structure is created or an old one is adjusted. In this way the scheme has to be revised and renewed. The child learns completely new.

Equilibrium

When over a certain period of time someone more assimilate more than accommodate this state is called equilibrium or being in a comfortable condition.

Disequilibrium

When new information is given that doesn't match they accommodate more than assimilate. This is called Disequilibrium or cognitive discomfort. After settling down the new schemes the state changes again to equilibrium.

Equilibration

The changes between equilibrium and disequilibrium over time is called equilibration.

6.2 Stages

According to Piaget every child goes through four stages: sensorimotor, preoperational, concrete operational and formal operational. All four stages are introduced here shortly.

6.2.1 Sensorimotor

The first stage lasts from birth to the second year of life. They know so less about the world like a blank sheet. That means that at the very beginning they adapt the first schemes only by accommodation. But it starts by baby's own activity. The child gets the environment by chance and refines it by trying again and again.

During the first two years there are so many changes that it is necessary to divide it into six substages. These are:

A Reflexive scheme

This substage lasts from birth to the first month. It consists of only reflexes. The child can suck, grasp and look.

B Primary circular reactions

After around one month starts substage 2 and lasts until the forth month. As in substage one a baby is just able to perform very basic movements, but now they get more and more controlled and repeated. During this substages the movements are still basic but are done voluntary. Imitations starts as well during this period, but all movements are done toward their own body.

C Secondary circular reactions

After being able to sit up the activity changes from the own body to the environment. A child reaches and hits or grasp object near around. But it is still the same sequence. It causes a change by chance and repeats the movement again and again. After a while it refines the movements and use the new experience to gain even more complex movements. This time period starts from the fourth month and takes four month.

D Coordination of secondary circular reactions

From age 8 to 12 month babies act now more intentional or directing to a self given goal. The last stage the activity was led by random. Now a baby is even able to solve simple problems. Piaget found out that the babies already gain to master object permanence which means they remember an object at the moment not visible as before. But they still make the A-not-B-mistake. They still search for a hidden object at place A even though seeing it be moved to a second place B. That shows a not complete object permanence.

E Tertiary circular reaction

Toddlers do in this stages several tries to solve a problem. This is an evident that it is able to perform more complex actions. The kids also imitate others or actions seen from others. The A-not-B-mistake doesn't occur any more. To sum up the action are more refined and advanced now. This substage emerges from 12 and lasts again 6 months.

F Mental representation

The main difference to the former substage is that the children try to solve the problem in their brain first and then they perform the action. In the former stage they tried it by trail-and-error actions. Now they use more the mental capabilities. Two other evidences are the deferred imitation (imitating behavior of persons not present), and performing imaginary plays or games.

Many examples and studies made by Piaget support this theory of stages. They are completely ommited due to the small range of this paper.

6.2.2 Preoperational Stage

The preoperational stage lasts from 2 to 7 years. The mental representation increases during this time obviously and steadily. Of curse, it's still a process, which means that the performance is sometimes few perfectly.

Some signs are usable to proof how far the mental representation is developed. These are language and thoughts, make-believe games and drawings.

A Language and thoughts

Dealing with language provides a more abstract thinking. Using a language divides the situation from thoughts. Thoughts can be repeated without doing something again and again. So, thoughts can be repeated in different tenses independent from the described situation. This circumstance helps to detach the daily life or actions from creating some creative ideas or plans.

B Make-believe games

Make-believe games show or proof the capability of thinking without seeing the same. Or is provides an independent thinking of the reality.

Three views shows how a child grows and masters a symbolic world:

a Detaching

The association is more and more detached from the real world. A cup is used as a cup first or a simple car is played as a car first. Children less 2 years don't use a cup as a hat (Tomasello, Striano & Rochat, 1999). Later they are able to use everything as everything (Corrigan, 1987; O'Reilly, 1995)

b Center

In early years the child itself stand in the center of the play. The direction is directed toward the self. Later it changes toward other objects. And more later there are several objects that the child pretends. The child learns that pretending plays are not necessarily depend on them self. (McCune, 1993).

c Complexity

The play gets more complex during the growing. First only one action or idea is pretended. Later more action at the same time are played.. They create also more roles or themes.

d Advantages

One advantage of playing make-believe games is that they contribute to the cognitive and even social skills. The make-believe games are played later in a group, not only as stand-alone games. So, kids who played a lot these games are later able to be social competent at school . It must not be said that the other skills, such as memory, logical thinking, language and creativity also are increased by playing those games. (Bergen & Mauer, 2000; Dias & Harris, 1990)

C Drawing

Another markable sign is what children draw on paper. Three steps are processed:

a Scribbles

The very first drawings are made in western countries at age 2. But the drawings are unreadable. After explanations from the drawer the meaning can be guessed. (Winner, 1986)

b Shapes and forms

Children learns that lines can be used as boundaries of objects. The discovering permits drawings of shaped and intended drawings. At first the drawings are still hard to understand, also because of the inability to draw straight. But during the process the lines get more accurate and the drawings get more complex. A face doesn't consist of only a circle but also eyes, nose, mouth and hairs.

c Realistic drawings

A drawing from a 6-years-old child look already really realistic. Now also other details are used. Legs and arm have different length, even depth cues. It shows that the child starts to organize spatial capabilities. As already said, the progress is still not at the end and the skills are still being improved. (Case & Okamoto, 1996)

6.2.3 Concrete Operational Stage

At age 7 – 11 years there are a lot of change concerning the cognitive development. The thoughts

and cognitive ability resembles more an adult than the thoughts of younger children. The thoughts are more logical, complex, organized and flexible than at lesser age. There are also some signs that indicates a growth during that period: conservation, hierarchical thinking, seriation and spatial capability. They will be introduced shortly as well.

A Conservation

In this stage the kid is able to perform conservation tasks. It is possible now to conserve a certain amount of changeable object such as water or gas. When water is poured into a taller glass the child recognize the same amount of water. When it is poured back the child again recognized it right. That's a sign is reversibility. The child doesn't concentrate just to one dimension but to more. That proofs the capability of decentration that is the same as conservation. It doesn't concentrate on just one dimension.

B Hierarchical thinking

A given amount of different objects can be classified by 7-10 old children. They can categorize it in several kinds. They can even classify it hierarchical that means not only in one level, but classifying in more tiers.

C Seriation

Imagine a child given some sticks with different length each. A child from age 6 or 7 is able to put them in the right order. Older children are able to do to even mentally. This capability is called transitive inference. The performance is still improved until age 8. (Andrews & Halford, 1998; Markovitz et al, 1995). To order something mentally some problems arise. The child has to keep in mind each length. Then it has to compare them silently to each other. The result, still mentally, must lead them to put them in the right order. The most work to processed in the brain.

D Spatial capability

School-ages kids get a more accurate skill in 3D orientation. Three different examples proof it:

a Distance

A school-age child can easily grasp the estimation of two or more different far objects. When for example there are two objects on a table at different distances, a preschool-age child is able to distinguish the distance only if there is a path marked between them, but a school-age child can distinguish the right distance without help. 4-years-old can estimate it only if the scene is very familiar because then they can fall back on other (own) experience. (Fabricius & Wellmann, 1993)

b Direction

For this proof children can be divided in three groups. The first, age 5-6, are not able to put themself in the position of a remote object. If they had to go a path that turns to the right they cannot determine the new layout after turning to the right. They will give wrong information about the new locations of other objects more far. When a object is on the right ahd side before turning, and on the left hand side after turning to the right, they are unable to choose the right direction. A 7-8-aged child starts to be able to imagine it right because they imagine the scene as if they walked the way virtually. From age 8 children can tell always and securely the right directions but still walk the way virtually.

c Maps

Sometimes children try to draw their environment like a map on a paper. It is characteristic for preschoolers that they use landmarks. Young school-age children perform is better, but still have problems with rotated maps (or original). Then they are not perform it accurately (Liben & Downs, 1993). The reverse direction (finding objects guided by a map) can be improved remarkable when

the landmarks on the map are connected as a meaningful pattern. Then they can use the analogy of original and pattern when they go through the original. (Uttal et al., 2001)

6.2.4 Formal Operational Stage

The last stage according to Piaget is called formal operational stage and marks the beginning of attract thinking. It starts around age 11 and lasts until adolescence. They don't need a concrete or touchable object to imagine a situation or problem. They use general and abstract thought independent of real objects or amounts.

The logical thinking is being developed in that stage. A child in the former stages needs to use real-world objects to evaluate given statements or propositions whereas children belonging to this stage don't need or need lesser real objects to compare their own answer to the given statement.

Logical thinking assumed two skills to be developed. First the language skill has to be so far progressed that the child is able to express complex correlations. The second is the ability to solve mathematical or logical problems.

6.3 Critism and Evaluation

Piaget made a lot of studies and observations even with his own children. Based on this he developed his theory. But still he assumed distinctive points of views for he was a former zoologist. Therefore some statements can be queried, even because some other studies emphasize an opposite sight. Some of them are introduced here.

6.3.1 Sensorimotor Stage

According to Piaget's theory the secondary circular reaction starts at the fourth month. He says that the child starts to explore the environment. In fact, they do it right after being born.

The discussion about object permanence is controversial. Some researchers had made studies that proofs an earlier capability of object permanence. Indeed other researchers cannot confirm such results and disagreed the former researchers.

Another case where Piaget's was definitely wrong is mental representation. He claims that infants cannot mentally represent experience prior to an age of 18 month. But already 8-month old children are able to do it. (McDonough, 1999). It is proofed by new studies that younger infants are capable to do it.

When Piaget studied deferred Imitation he did it on his own children. But he might have missed many instances therefore he had been led into a fallacy. Because newer studies have shown that deferred imitation occurs already at the early age of six weeks. (Meltzoff & Moore, 1994)

All these examples let suggest that many tasks can be successfully done earlier than Piaget stated. But also the strict order of the stages is not always valid. For example, the deferred imitation occurs earlier than the object-hiding solution, but Piaget stated that all representational capacities begin at the same time. Thus the clear given order of stages is obviously disordered.

6.3.2 Preoperational Stage

Egocentricity leads the children in that stage to look on their own and even ignore others, believed Piaget. But later studies have proved that just the opposite happens. Children at age 4 use a simpler language when speaking to two-years-old than speaking to adults. They use an appropriate vocabulary and adapt to the counterpart depending on their capabilities far before entering in this stage.

Concerning the illogical thinking that Piaget saw in the preoperational stage, many newer studies have contradict his statements. The crux of the matter is that he used too unfamiliar object. Performing the same tests which familiar object or situations already 3-or-4 old children are able to

give correct answers. (Rosen & Rozin, 1993; Ruffman, 1999)

Piaget also stated that preschoolers have difficulties with classification. Even though already 6-12-month old infants use classification. The categories are not so fine organized like that from older children, yet they categories not depending on their appearance. 2-5-year-olds can classify objects despite they emerge in different shape.

To sum up, children are basically earlier able to think logically than Piaget assumed, but they still need to develop the skills over time.

6.3.3 Concrete Operational Stage

The entrance into this stage is far more dependent on external influences than assumed by Piaget. Here is another example than the stages cannot be ordered as neat as in a laboratory. Some influences that affect the ability to apply mental skills are the environment which the children live in. Children who grow up in tribal or village societies where the children are not sent to a school have a delay in conservation. They enter not until age 11 (Fahrmeier, 1978).

Yet non-schooled children are capable of mental problems when they do similar tasks as demanded in Piaget's studies. Then they are used to do resembled tasks and perform an even better result than normal age mates (Ceci & Roazzi, 1994).

6.3.4 Formal Operational Stage

Here it is the same case like the stage before. The reaching depends on external influences and the environment. The questions arises whether even all adults reach this stage.

Again, many tribal and village societies never master formal operational tasks (Cole, 1990).They refuse to think in a formal or abstract way.

We are normally only in that fields able to think strong abstract enough where we could gather rich experience. Some of Piaget's tests are so general and therefore difficult even to well-educated adults that likely 40-60 percent will fail (Keating, 1979). Our skills are mostly attached to our daily experience our profession.

7 Memory Development

The memory is the crucial thing without we are not able to survive. If we remembered nothing, we couldn't recognize nothing, not only our familiar persons but also not all things around us. We couldn't know how to eat, how to drink, how to walk and so on. So, the memory is essential for our daily life. Even the youngest child is able and needs to be able to memorize.

The expressions used here have to be defined or refined. Hence there are some definitions given:

Recognition: Assumed that an item is known then regognition means the remembrance of that item after a stimulation from outside. Another person or object or situation reminds someone and then the remembrance is aware. Recognition is used when someone shows some items and we remember the right one.

Recall: Assuming the same knowledge someone remembers the item oneself. The stimulation comes not from outside, no example is given to recognize.

Implicit memory: This memory stores information at a unconscious or unaware level. Here is all our skills, habits and motions stored. It takes a longer time until a skill or movement like driving or playing a music instrument is memorized. But once stored, however, it is unforgettable burned in. Because of the longer period of committing to memory, we are not able to tell a exact date when we learned it.

Short term memory: Short time memory is the first part of our memory. It stores information for a short time (about 45 sec) only. The amount of the information is also limited. It is used to process

sensory input, to store called items from the long term memory or the result of mental processes.

Long term memory: This part of memory is unlimited concerning time and storage. Information passes short time memory to long term memory not automatically. To attain to the long term memory either the information is very impressive or repeated several times. The latter process we do while learning.

7.1 Memory development

Some parts of the memory or brain complex system grows up earlier then other parts. The basal ganglia and cerebellum grow early and fast during early infancy. Sub cortical areas grow slower, but the cerebral cortex takes a long time to mature. The first mentioned areas are the medium of the implicit memory. But the cortex contains all explicit information. Because of the late maturation it is clear that children starts late and gradually emerge the control over the explicit memory.

7.1.1 Fetal Memory

During pregnancy the brain develops from the very beginning. But how can the development of memory be measured? It is even more difficult to ascertain the progress of a hidden and not speaking object. Yet there are two possibilities to find it out, this is habituation and classical conditioning.

Habituation starts as soon as the baby begins to hear. While sending a particular sound through the abdomen a reaction of movements can be observed by ultrasound. When the stimulus is repeated regularly, e.g. twenty seconds, the reactions gets lesser and lesser as if the stimulus belongs to the natural environment. Finally it ceases to react. Habituation takes place. The first habituation was observed in the 23rd week.

Reflecting the importance of habituation it seems to be very important. Imaging habituation doesn't exist: Then each sound, each movement causes a new exciting reaction. The baby would newer find rest. So, habituation is like a filter to provide a restful time despite sounds around.

But the base of habituation is memory. The memory must work before habituation takes place. Otherwise the baby cannot recognize already heard sounds and filter it.

Habituation is therefore also a good indicator for diagnostic purposes. If habituation still not occur far later than normal, a damage of the memory area or a delay of maturation can be concluded.

The next process where memory is used for it classical conditioning, the learned association between stimuli. Mothers are asked to calm down whenever a certain piece of music is played. Later the fetus calm down just by hearing the same piece of music. Even after birth the baby becomes calm whenever the music is played. Obviously it remembers not only the music, but also the association between music and calmness. (Berk, 2003)

7.1.2 The first six month

It is far more easier to study newborns memory because the reaction of them is visible and thus more different. Newborn are able to learn by operant conditioning. This type of learning provides a good method of probing how well and how long the memory remains information. After numerousness studies it is proved that 2-months-olds keep information one or two days. Between two and six month remember still after one week and 6-month-olds can remind information after two weeks.

7.2 Capacity of memory

Till now the memory hasn't been measured except time. That's too inaccurate. Two suggestions have been made to measure the brain capacity.

7.2.1 Memory span

The first kind of measure is called memory span. A person is shown several items in a certain order. The task is to reproduce as much items as possible in the right order again. The amount of items that can be reproduced right is the measure of memory span. At age 6 children have the memory span of 4 and 12-years-old can remember 5 items. (Dempster, 1985)

7.2.2 Central memory unit

The idea of this measure is that the memory has a given finite amount of capacity. The model is like the memory in a computer where the capacity is limited by the inserted chips. In this model the capacity doesn't change at any age. Two parts, operating space and storage space, have to share the capacity. The operating space is that part of the memory where cognitive processes take place, whereas the storage space the short term memory is. During getting older just the allocation or arrangement of these two parts changes toward the storage space because it is lesser and lesser memory demanded to do the cognitive processes. Therefore there is more free space left for the storage space. (Case, 1985)

7.3 Meta memory

Meta memory is simply the knowledge about someone's own memory and the processes in the memory. The question here is: do children have meta memory and if how far it is used to improve given tasks.

Studies have shown that already young children know at least basic facts about their own memory. The more older the more specific is the meta memory. It increases linear during childhood and the rising depends on how often and how intensive strategies are used to solve mental tasks (Joyner & Kurtz-Costes, 1997; Schneider, 1999; Schneider & Pressley, 1997).

This type of meta memory is called declarative meta cognitive memory. It is conscious, explicit and valuable even by the own person.

The other part is procedural meta cognitive knowledge which is implicit, unconscious and not influence able. It is used to regulate or control the own activities. This knowledge is not easy to measure. Surveys have been made to find out how sensible children are about their own memory and cognitive skills. So, they know whether a task is easy or takes a lot of effort to solve it (Kreutzer et al., 1975).

7.4 Infantile amnesia

In interesting thing concerning the memory development is the fact that nobody remember the first years of the own life. Nobody remembers events that happened before the first three and a half years. Except very very specific and dramatic events after age 2 is everything else lost. This phenomenon is called infantile amnesia.

The question is now why we cannot remember these events. Is it a problem of recalling or is it a problem of maturation which means the brain and memory wasn't able to memorize it.

The first group of scientists who agree to the former opinion think that the information is stored, but inaccessible. It just cannot be recalled or be retrieved even by extern stimulation.

The reason why it cannot be retrieved is that the information is stored in another way than language. They guess that is it stored as script. This script language is later not known any more and hence impossible to find. (Case 1985, Leichtman und Ceci 1993). But the language is learnt before 3 and a half year. So, the earliest remembrance must begin 3 and a half year..

Other scientists believe that infantile amnesia is not a retrieval problem but a problem of the storage. The memory is still not as mature as being able to store information along time. All studies involve the short term memory, but never the long term memory. Because of this reason they

believe that the long term memory isn't matured yet before 3 and a half year.

8 Intelligence Development

8.1 Bodily development

Our intelligence is performed in our brain, no other organ. At time of birth the brain weights 250g. Already after one year the weight increases to the triple, 750g. When the child is five years old the size is as big as an adult one, 1300g. But, of course, the volume it weight of the brain doesn't make a person intelligent. There are studies about it that proof no correlation.

The speed of the mental process is more deciding whether someone is intelligent. According to Elloit (1999) reacts brighter people faster than others at simple tasks. The correlation of reaction with the IQ score is about 0.5. But this is obviously, because a faster comprehending brain can either receive and process more information in the same time or takes shorter time for the same information. If the amount of information is equal there is therefore more time left to do other things or to go already further. There are less efforts to take.

How gains the speed in childhood? When children are still young the react very slow. But the older they are the faster they perform mental processes. The greatest gain during childhood takes place between age 5 and 11. When a child is twelve years old it reacts still as half as an adult. The greatest gain speed at all is at age 15.

The speed of the mental performance has also been measured by electrical measurements. This tests proves the processing speed in the brain. A newborn brain processes or the signal takes three times slower or longer than an adult.

But not only speed is a considerable measure, also the efficiency of the process itself. This has nothing to do with the speed as shown above. The way how the information goes through the brain gets more and more efficient. It can be said that the information finds newer, shortener ways than before. Studies have shown that the involved areas in a 7-years-olds brain are larger than in an adult's brain to fulfill the same task. It shows that the ways are concentrated and therefore more efficient.

8.2 Strategies

Case (1985) studied this phenomena and found out that there are three mechanisms to refine the performance of the brain.

8.2.1 Mechanism

A Automation

The first way to speed up is the simply way of automation of always repeated actions. First it takes a long time and a lot of effort to do something, but after automation a task takes no longer effort and goes faster and doesn't need as large memory size as before. The new gained space, time and effort can be used for other tasks now.

The process of learning how to read shows automation impressive. First each letter is read hard, but later even complete word are read fluently. The saved time and effort can be applied to understand the word just read.

B Myelinisation

Each System in the brain grows up by Myelinisation. While a child is still little the Myelinisation is not completed yet. It is obvious, that systems still not completed cannot work perfect. When this process is completed each system is ready to work at highest speed level.

C Generalization

Case & Griffin (1990) mentioned that similar situations and structures are generalized. The already structured networks will be reorganized and/or reconnected according to the experience to more general networks. They proofed by many studies that generalization improves the speed and efficiency as well.

8.2.2 Development of strategies

Everybody of us uses strategies to solve a problem. But first of all we must define what a problem is.

A Definition of problem and strategy

A problem takes place when a person wants to do something, but doesn't know how to perform at least one step or doesn't know in which order the several steps have to be done. (Newell & Simon, 1972).

The strategy is fully intended and planned way to solve this problem and to reach successful the given final goal.

A strategy is, like the performance, at the first time very exhausting and takes a long time. The first times the strategy is applied conscious, but gets automated after a while. Later the strategy is applied unconscious, fast and without any effort. (Bjorklund et al., 1990)

The improvement of the application of a strategy happens by experience. Often more than one strategy is applied and the most successfully is used then. So, the child learns by comparing the strategies and choose the best strategy. It is easier if there are a rich amount f possibilities or actions available. The problem solver can combine them in order to find out the best strategy. 12-month-olds are already able to chose the best strategy despite the noticed situation that might mislead to the wrong way (Olson, 1966; Diamond, 1988)

B Strategies at preschool age

As example for different ways to solve the same task calculating is taken. Children at preschool age are already able to count or calculate very simple numbers. Siegler & Robinson (1982) studied 4-5 old children by asking them easy adding problems. They observed four strategies:

a Recall from memory

When a child the solution already knows it recall it from memory. 64 percent of all tries were solved by this way. The solution was found after 4 seconds and 66 percent of all solutions were right.

b Presentation by using fingers

The fingers of the hand are used to present the numbers, but they don't count the fingers together. Rather they attached both hands together to show the result. 13 percent of all tries are performed in such a way. It took 6.6 seconds and 89 percent were solved right.

c Counting

The children counted the numbers silent or whispering without any help (fingers). 8 percent of all solutions are found by this method. The time was 9 seconds and 54 percent of all answers were right.

d Counting fingers

The difference to b is that now the fingers are counted together. It takes the longest time (14 sec), but was quite a sure strategy: 87 percent of all solutions were right.

It is interesting that the children used all methods, not only one, even at the same time. This shows that the children are able to choose between several strategies, but not always decide which one is the best.

C Strategies at school age

During school age is is easy to observe how the pupils learn to use different ways to read a text. At the very beginning the learn the letters and very small words containing these letters. At first grade of elementary school they stay on a point on the text 0.33 sec on the average (fixation). An adult fixates only 0.24 sec. The difference is not much. But an adult grasps more then double time words per fixation, which means that an adult gathers more information at one glance.

But 6-years-old have to correct very often what they read. It is observable how often they turns the eyes back to an already read word. This happens quite often, about the half of all read words. This amount diminishes very fast. An adult seldom turns the eyes back to read something again. I child reads 80 words per minute and an adult 280 words (Taylor et al., 1960). There are some people who read 800-900 words per minute.

This examples show not how a person reads and which steps are necessary to perform reading, but shows how a human being improves steadily the skill of reading.

8.3 Influences

8.3.1 Environment / Heredity

The discussion about heredity/environment touches also the influences of intelligence. How do they affect the individual intelligence? Bouchard & McGue (1981) and Scarr (1997) reported correlations between several different pair that can be compared easily and significant.

Pair	*Average Correlation*	*Total number of pairs*
Identical twins reared together	.86	4,672
Identical twins reared apart	.76	158
Fraternal Twins reared together	.55	8,600
Fraternal Twins reared apart	.35	112
Siblings reared together	.47	26,473
Siblings reared apart	.24	203
Parent-biological child living together	.42	8,433
Parent-biological child living apart	.22	814
Parent adopted child	.19	1,397

Correlations of several pairs.

The comparison between the same kind of pair but different rearing clearly shows an influence of the environment because the genetical background is the same. But the greater the genetic similarity is, the more resembles their IQ correlation. Another point is important because those who reared together had the same environment *and* heredity. So, the two parameters have to be added. This table shows the it is not possible to say or judge what and how much really impact the IQ of a child.

8.3.2 Familiar environment

A from the entire family

This kind of influence is called *shared environment influences* because they are "shared" or experienced by all family members. They affect all children in the same way and intensity.

E.g. when parents takes care about their children's development and contribute and support them on their way, it improves the intelligence development enormously. When parents talk often to their young children the language developments is demanded. That triggers also other realms and contributes to a higher achievement in school (Hart & Risley, 1995). Later, when kids are in school age, the support of parents is very important. The support not only consists of helping at homework, but also in motivating, choosing to go the right next step and so on. And parents who know how important education is especially contribute them. The result are better achievements (Kao, 2000).

B given different

But as much as they try to treat each child in the same manner, there are still differences. The oldest child is always treated different than the youngest. So, the position among siblings emerges inevitable differences. The oldest gets always the most attention (just because the parents are unexperienced and therefore more fearful to make a mistake). But surprisingly these facts don't impact the IQ (Rodgers, 2001).

8.4 Predicting IQ

Why it is important to know a child's IQ score? Is it just for fun or just to find out the actual achievement potential? Is a IQ test able to predict the ability in the future? Many studies has been performed to figure this out.

Parents wants to know how intelligent is their child and the IQ score is important to classify each pupil.

8.4.1 Reliability of predictions

Tests can be performed already between age 2-8 month. (Berk, 1999). At that age only visual tests possible. This test correlates by factor 0.4 to IQ score at age eight. Other tests at age one year, such as memory recognition, discrimination and object permanence, show the direction, but the correlation is not very high. They are still not egibile to support an exact score.

At age two or three the correlation between a test score and later IQ starts to be higher, but before are five or six it is still too insecure.

One reason why such an early test is unreliable is that they are based on motor and perceptual skill whereas later other skills are more important. Verbal and spatial skill are more used at school and associated with intelligence. So, tests are based on different not comparable skills.

8.4.2 Stability

As already seen it doesn't make sense to test too early, otherwise the correlation is too low. The best age to start with predictable test is at age 6. Or more general: the older the child, the more reliable to predict the test is. (Hayslip, 1994; Humphreys 1989)

When a testee is tested two times, the time between those tests is also remarkable. The closer the time the more they correlate to each other. Let's see the extreme examples: if the time between the two tests is two years (age 4 and age 6) the correlation is .62 and if the time difference is 14 years (age 4 and age 18) the correlation drops to .42 (Honzik, Macfarlane & Allen, 1948).

When a child is tested regularly through childhood the IQ score often changes to more or less than 10 to 20 points (McCall, 1993). The reason why the scores are so volatile is their environment.

Children who gain IQ score are more independent. The parents paid more attention to their children's success and intervene when necessary. Decliners have either parents who didn't take care of their children or the children don't have enough discipline.

So, timetimes the deviations are not a failure of the tests but a result of the environment.

9 Summary

Of course, each chapter never covers but only touched the wide and interesting fields of child development. Additionally, studies are not mentioned. Each part is based on numerous studies, some confirm earlier studies, some contradict. The followed discussions with pros and cons cannot be mentioned as well.

But it hopefully helps to understand how child development wants to examine and what all belongs to it. I was really surprised that there are so many parts and even these parts are still huge fields to consider.

Especially parents should be interested in child development for it provides all necessary information worthful for education, prevention and prediction. They are able to compare each step and might be happy when their children reaches the next step. But they can also be prepared well when the offspring reaches a period that is not easy to handle with. No one will be a perfect parent, but it provides helpful information to educate better and more effective.

But also others, such as teachers, carer or attendants, find helpful information about the world children live in.

Therefore child development is an important and interesting, because applicable, parts in the science of psychology.

List of figures

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