

**Guidelines to Help Designers Incorporate the Parent–Child Factors
into Toy Design**

by

Haoyi Wei

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Approved by

Tin-Man Lau, Chair, Professor of Industrial Design
Christopher Arnold, Associate Professor of Industrial Design
Jerrod Windham, Associate Professor of Industrial Design

Abstract

It is reported by the Toy Industry Association that there is a huge toy market in the global market. The total revenue of the global toy market has increased from 78 billion dollars in 2007 to 89 billion dollars in 2017. Parents like to purchase toys for their children; statistics show that parents spend \$6500 dollars over a child's lifetime on toys. The average home has 71 toys; one-fifth of homes have over 100 toys, and one-tenth of homes have over 200 toys (Toy Industry Association, 2017). However, many parents are unable to play with their children for two primary reasons: pressures from working cause parents to sacrifice family time, and toy designers seldom consider the parent-child factors. Thus parents have a hard time participating in their children's play even if they have time. Though designers cannot change social problems, they can encourage parent-child interaction by designing guidelines for parent-child toys.

This thesis aims at teaching designers how to incorporate the parent-child factors into toy design. Parent-led play, parent-child cooperative play, child-initiated play are three types of play which all have advantages and disadvantages. The range between parent-led play and child-initiated play is called parent-child play. Firstly, I want to provide advantages of three types of toys for designers to help them decide which type of play they want to design. After selecting the type of the play, they can adjust the parent-led factors and child-initiated factors within limits to get a better effect of play. Based on the literature review, I provide all the parent-led factors, the

child-initiated factors and an equation for designers to teach them how to design a parent-child toy with the desired proportion of parent participation to get the better effect of the play.

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I have always enjoyed designing for children. When I began attending Auburn University, I made many friends who share a similar interest with me. While here, I participated in PlayCore studio, which introduced me to another viewpoint of play design, that is playground design. This expands my ideas of play design beyond toy design while still focusing on children. Joining this studio increased my love for play design, and I would like to thank my major professor Tin-Man Lau for expanding my design horizons. I am happy to be here.

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Chapter 1 Introduction

1.1 Problem Statement

The toy industry is a huge market. As Figure 1. 1 shows, the total revenue of the global toy market has ranged from 78 billion dollars in 2007 to 89 billion dollars in 2017 (Toy Industry Association, 2017).

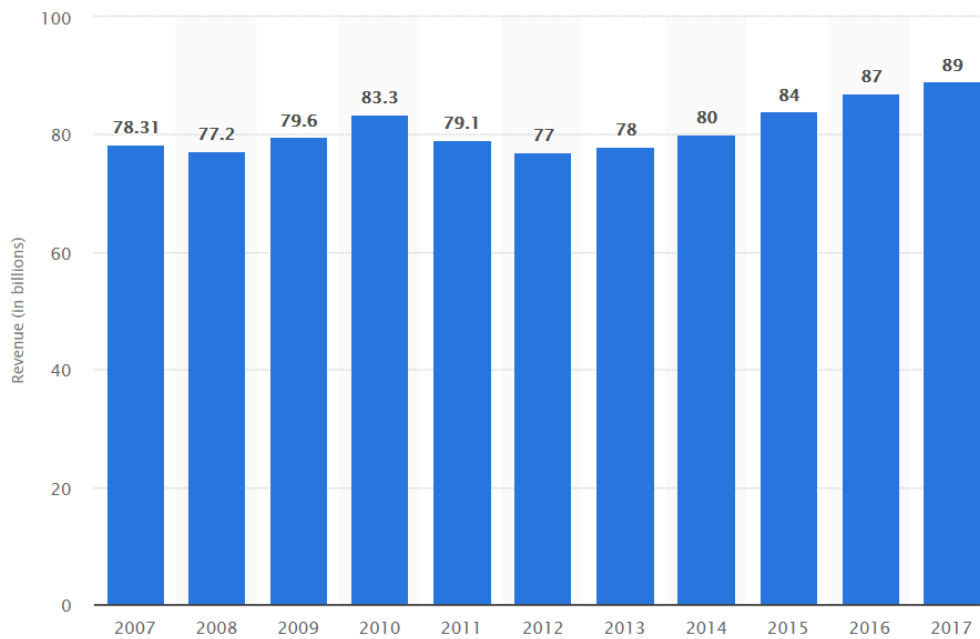


Figure 1. 1 Total Revenue of the Global Toy Market (Toy Industry Association, 2017)

The average American children receive more than \$6,500 worth of toys in their lifetime, according to the research commissioned by the Toy Industry Association (TIA) (2016). The survey found that youngsters have plenty of choices when it comes to toys and playthings, with the average household studied owning 71 toys. One fifth of households possessed more than 100 toys, and more than one in ten homes owned a vast collection of more than 200 toys, the survey found. The average family spends \$581 a year on toys (Toy Industry Association, 2016).

Drawing from this information, in fact, it seems that parents like purchasing toys. Some parents play with their children, while a large amount of parents just leave their child to play alone. Why do so many parents leave their child to play alone?

Reasons are as follow:

Firstly, working pressure from the society makes parents sacrifice the family time. Children are much more likely than not to grow up in a household in which their parents work, and in nearly half of all two-parent families today, both parents work full time, a sharp increase from previous decades. Working parents say they feel stressed, tired, rushed and short on quality time with their children, friends, partners or hobbies, according to a Pew Research Center (2015) survey.

Secondly, from the viewpoint of design, toy designers seldom consider parent-child factors. Thus, parents have a hard time participating in play even though they have time. For the second reason, we can change it by designing toys that encourage parent-child interaction.

1.2 Need for Study

Some designers usually think they can design a parent-child toy by increasing the play-together time. However, this is not enough at all. Some types of toys need to apply more parent-led factors to achieve the better effect of play such as story books. The more parent participation, the better effect of play. However, others need to apply less parent-led factors so that children can have better experience of play such as some free play. Free play can activate children's imagination. If parents limit their children's freedom, it will lead to the bad effect of play. The

following experiment is a good example to explain whether the percentage of parent participation is appropriate or not affects the effect of play. As the experiment shows, too much parent participation in free play may bring about the negative effect; on the contrary, less parent participation can achieve better effect of play

A psychological and brain sciences expert once did a Research on “Sustained Attention to Toys in One-Year-Old Human Infants” (Yu & Smith, 2016).

There were two rounds in this experiment:

First Round of Experiment: The experimenters allowed the parents to play with their baby, and then divided into three categories according to the interaction between the parents and the baby. When the baby played with the toy,

Type A: The parents accompanied the children to play all the time;

Type B: The parents accompanied the baby when he or she needs help, and the parents responded and guided in time;

Type C: The parents paid attention to other things, and had no interaction with the baby from beginning to end (Yu & Smith, 2016). Figure 1. 2 shows, these are three types of parent participation in free play.

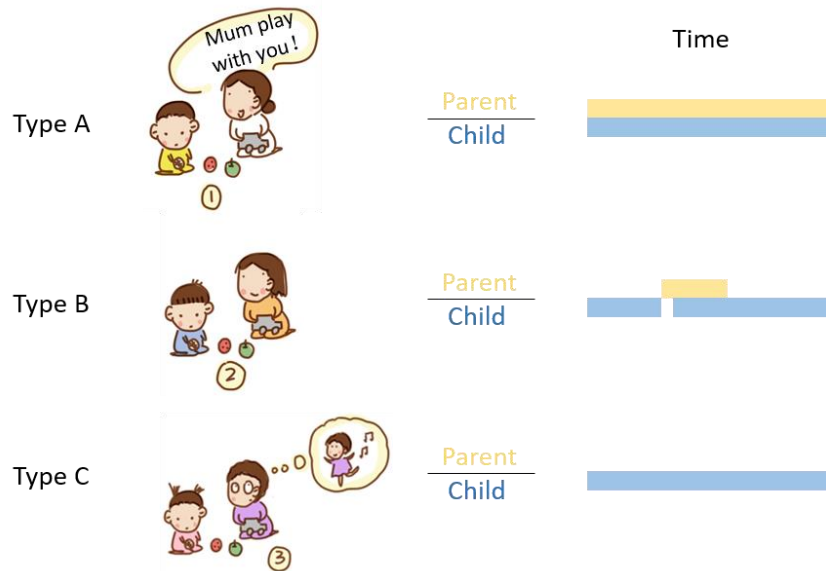


Figure 1. 2 Three Types of Parent Participation in Free Play

Result of Round 1: Type C babies stopped playing first. When children encountered difficulties beyond their ability during the process of playing, the parents did not help him through the difficulties on time. As a result, the child easily lost interest and gave up playing.

Second Round of Experiment: The Type C experimental group was out. The researchers let the Type A and Type B parents' eyes leave for a while.

Result of Round 2: The children of Type A lost interest in this round. Only Type B babies play for a long time in the end (Yu & Smith, 2016).

Many designers have thought that the more participation of parents, the better achievement children will get. However, it depends on which types of play it belongs to. Design of parent-child toys should also consider the appropriate proportion of parent participation according to different types of play. However, in fact, toy designers seldom consider this problem. Therefore, there is a need to study how to consider parent participation into parent-

child toy design. Referring to the mathematical function type, I classify the relationship between parent participation and the effect of play into three types, that is, positive correlation, normal distribution, negative correlation.

Positive Correlation (Parent-Led Play):

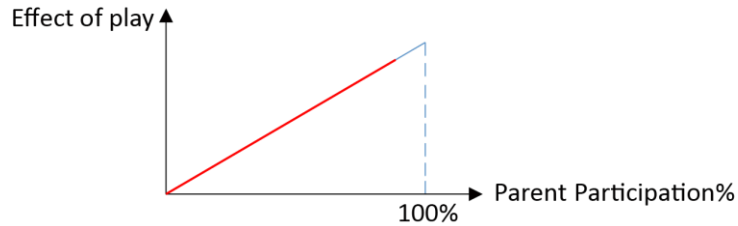


Figure 1. 3 Positive Correlation

The more parent participation, the better effect of play (not including parent participation%=100%). A story book is a good example of this type of play. If parents spend more time telling stories to children, the better effect of play children will achieve.

Normal Distribution (Parent-Child Cooperative Play):

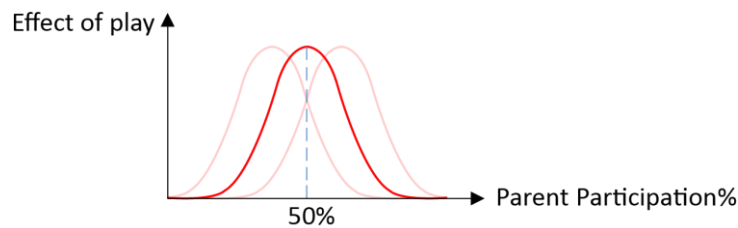


Figure 1. 4 Normal Distribution

Only 50% of parent participation and 50% child participation can get the best effect of play (maximum can float left or right). See-Saw is a great example of this type of play. Only when the child and the parent contribute about the same level of participation on both sides of the seesaw will they get the best effect of play.

Negative Correlation (Free Play):

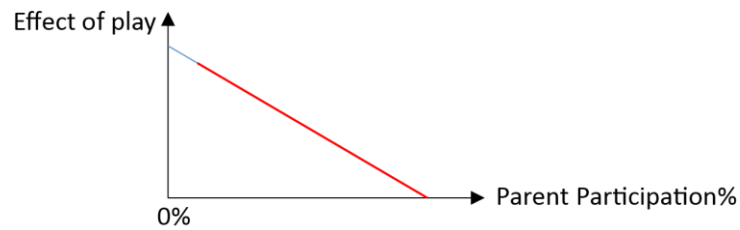


Figure 1. 5 Negative Correlation

The less parent participation, the more freedom children will have, and the better effect of play children will have (not including parent participation percentage=0%). The experiment above belongs to Negative Correlation. As the result of experiment shows, Type C and Type A were both out after two rounds experiment. The failure reason for Type C in the first round is that, there is no parent participation during process; while the failure reason for Type A in the second round is that, parent contribute too much participation in free play, which also leads to the side effect of play. As Figure 1. 5 shows, less parent participation will lead to a better effect in free play (not including parent participation percentage=0%).

In conclusion, there is a need to study how to design guidelines to help toy designers adjust the appropriate parent participation according to three types of parent-child play.

1.3 Objective of Study

- To study the importance of parent-child relationship and the role of play, so that there is a need to design parent-child toys.
- To do research on the development of parent-child relationship in people's lifetime to find out the appropriate age range to establish parent-child relationship and define the age

range of the parent-child toy based on my research.

- To do research on child development, Piaget's stages of cognitive development, and Parten's stages of play so that I can have a better understand on my target users, and apply it into my guidelines.

- To study advantages and characteristics of parent-led play, parent-child cooperative play, and child-initiated play which can help me build the structure of my guidelines later on.

- To determine the parent-led factors and the child-initiated factors.

- To design guidelines to help designers incorporate the parent-child factors into toy design.

1.4 Definition of Terms

Adult-Led Play- Play opportunities and activities which are organized and led by an adult ("Adult-Led Play," n.d.).

Child-Initiated Play-Play in which children choose what and how to play and who to play with ("Child-Initiated Play," n.d.).

Cooperative Play- Cooperative play is where play finally becomes organized into groups and teamwork is seen ("Cooperative Play," n.d.).

Parent-Child- Consists of a combination of behaviors, feelings, and expectations that are unique to a particular parent and a particular child ("Parent-Child," n.d.).

Play- Engage in activity for enjoyment and recreation rather than a serious or practical purpose ("Play," n.d.).

Toy- Something for a child to play with. Toy is something that can be toyed with (“Toy,” n.d.).

1.5 Assumptions of Study

It is assumed that all the research, approaches, methods, theories and data I found are correct.

It is assumed that all the parents pay attention to the parent-child relationship and parent-child play.

It is assumed that parents who purchase parent-child toys are willing to play with their children.

1.6 Scope and Limitations

From birth to six years old is the appropriate age range to develop the parent-child relationship. During this period, children are dependent on parents and have a strong attachment with fathers and mothers. After six years old, children will be detached with their parents with addition of peers and teachers. Thus, the pace to develop parent-child relationship is slower and parent-child play can't reach a higher level of effect than before, not to mention the children after the age of twelve in the youth rebellious period. It is really hard to develop parent-child bond if it has not already been established. Therefore, I target the children whose age range is from birth to six years old and focus on how to incorporate the parent-child factors into toy design.

1.7 Procedures and Methodology

Procedure 1: Study the importance of parent-child relationship so that to show there is a need to design parent-child toys.

- Studying online research, dictionaries, articles and library resources

Procedure 2: Do research on the development of parent-child relationship during people's lifetime and find out the appropriate age range to establish the parent-child relationship in order to define the age range of the parent-child toy.

- Studying online research, dictionaries, articles and library resources

Procedure 3: Study child development from physical, cognitive, social-emotional development, Parten's stages of play, and Piaget's stages of child cognitive development to understand my target users.

- Studying online research, dictionaries, articles and library resources
- Sort and analyze research

Procedure 4: Study advantages, disadvantages and characteristics of parent-led play, child-initiated play, and parent-child cooperative play to build the structure of my guidelines later on.

Procedure 5: Summarize parent-led factors and child-initiated factors based on the literature review.

Procedure 6: Develop guidelines to help designers adjust the parent-led factors and the child-initiated factors into toy design.

Procedure 7: Practice and apply guidelines into toy design.

1.8 Anticipated Outcomes

The primary outcome is to teach designers how to design parent-child toys to achieve a better effect of play and to improve the quality of parent-child interaction by adjusting the parent-led factors and the child-initiated factors.

Chapter 2 Literature Review

2.1 Importance of Parent-Child Relationship

Parents act an important role in child development. British psychologist John Bowlby (2008) pointed out that "attachment" is the physiological needs of the baby, is the instinctive behavior of human beings, and the best candidate for forming an attachment relationship with the baby is the mother. A good and healthy attachment relationship plays an important role in the child's future personality shaping and social adaptation. On the contrary, unhealthy attachment relationships or lack of attachment relationships will make children fall into the unhealthy development from an early age.

In Section 2. 1, I discuss research about the importance of parent-child relationship in order to conclude that there is a need to design parent-child toys.

2.1.1 Parent-Child Relationship and Juvenile Delinquency

60% of students reported parental attitudes of indifference, which led students to delinquency because of feelings of insecurity and cravings for recognition and affection. Parents reported insufficient time and occupational constraints as factors accounting for this inattention (Thilagaraj, 1983).

31.7% of students experienced hostility or rejection due to parental conflicts and lack of cooperation (Thilagaraj, 1983).

17.5% of students reported overly strict or inconsistent parental discipline led to the same proportion of delinquency (Thilagaraj, 1983).

40% of students whose mothers were employed tended to become delinquents because of the absence of maternal supervision. Poor parental health also contributed to this problem (Thilagaraj, 1983).

54% of the parents engaged in constant fighting, while only 21% of parents had a normal relationship. 12.5% of families had separated parents or had been deserted by the male parent (Thilagaraj, 1983).

In conclusion, unharmonious parent-child relationships lead to juvenile delinquency. Thus, there is a need to design the parent-child toy to promote parent-child play which will be good for children's mental health as well as promote harmony in their parental relationships.

2.1.2 Parent Loss Influence on Children

It is found out that children and adolescents think of their dead parents much more and longer than adults; their psychology, academic success and social relationships are affected negatively, as well (Karakartal, 2012). In the literature search done, it is determined that children and adolescents experiencing parent loss tend to have psychological problems in their future life and this risk can be harder in the case the death is so sudden and having no person to replace for the death one.

In conclusion, parent loss will have a negative effect on child development physically, mentally, and socially. Thus, parent participation is of vital for children including children's play. As a result, the parent-child toy design is meaningful for children.

2.1.3 The Role of the Father

Researchers, theorists, and practitioners think that fathers play a number of significant roles—companionship, care providers, spouses, protectors, models, moral guides, teachers, breadwinners (Lamb, 2004).

Subsequent research suggested that the quality of the father-child relationship was more important than the masculinity of the father. Boys seemed to conform to the sex-role standards of their culture when their relationships with their fathers were warm, regardless of how masculine the father were, even though warmth and intimacy have traditionally been seen as feminine characteristics (Lamb, 2004).

Marital harmony is consistent correlate of child development. Researchers concluded that divorce and the transition to fatherlessness might influence children's development. But children can do better when parents are able to maintain meaningful relationship with both parents (Lamb, 2004).

Children with highly involved fathers were characterized by increased cognitive competence, increased empathy, less sex-stereotypes beliefs, and a more internal locus of control (Lamb, 2004).

In conclusion, father attendance is of vital importance for children including children's play. As a result, the parent-child toy design is meaningful for children.

2.1.4 The Role of the Mother

Conduct problems in childhood are significant because they are common, persistent and

place the child at risk for a range of adverse outcomes including delinquency, school failure, substance abuse and later mental health problems. Even when conduct problems begin in the toddler years, they tend to persist over time (Gardner, Ward, Burton & Wilson, 2003). A stronger parent-child relationship can help ameliorate conduct problems when children are young.

Joint play is defined as mother and child actively engaged in the same friendly play or working together (Gardner, 1994). Activities can range from puzzles, drawing, reading, and pretend games to domestic activities such as baking, gardening, and housework together. Joint play consists of optional, potentially fun activities; thus routine child maintenance activities, such as eating, dressing, hairbrushing together, are excluded. On the other hand, for the parent to involve a 3-year-old in household tasks such as baking or laying the table is seen as an optional addition to the mother's work (Gardner, Ward, Burton & Wilson, 2003).

Frequent mother-child joint play at age 3 may make an independent contribution to the development of fewer conduct problems over the preschool years, over and above the contribution of several other important risk factors (Gardner, Ward, Burton & Wilson, 2003).

In conclusion, mother-child joint play is vital for child development. As a result, the parent-child toy design is meaningful for children.

2.1.5 Parent-Child Interaction Therapy

PCIT (Parent-Child Interaction Therapy) is a dyadic treatment based on Play Theory to cure children with behavioral disorders, with developmental delays, with anxiety disorders and so on. It mainly has two phases, the first phase is called CDI (Child-Directed Interaction). The second phase is called PDI (Parent-Directed Interaction) (McNeil & Hembree-Kigin, 2010).

Because two phases of PCIT are based on play theory, I can apply to the content of CDI and PDI into my parent-child toy design. Here are content of two phases:



Figure 2. 1 Parent Child Interaction Therapy (pcit.org, n.d.)

Phase1 (Child-Directed Interaction): During the CDI phase of treatment, the caregiver learns traditional play therapy skills such as following the child's lead, imitating the child's play, providing undivided attention, describing play activities, and expanding on child verbalizations through the PRIDE skills (praise, reflect, imitate, describe, and use enthusiasm). In addition, caregivers learn to selectively reinforce prosocial behaviors while strategically ignoring inappropriate behaviors and stopping the play for clearly dangerous behaviors. PCIT therapists

also coach caregivers to follow the child’s lead by avoiding questions commands, and criticisms during play (Pearl, 2019).

Phase2 (Parent-Directed Interaction): During the PDI phase of treatment, caregivers continue to practice the skills taught during the CDI phase under the guidance of the therapist. In addition, they learn how to effectively incorporate commands to children and how to respond to children’s appropriate or inappropriate behavior. PDI also includes the use of written materials and role-play. Therapy period is usually 10~20 weeks, one hour per week (Pearl, 2009).

I use Figure 2. 2 to summarize the three major changes in the two stages: from child-directed to parent-directed; from disobey to obey; from no command to incorporate command. The characteristics of CDI and PDI can be applied to children-initiated factors and parent-led factors respectively.

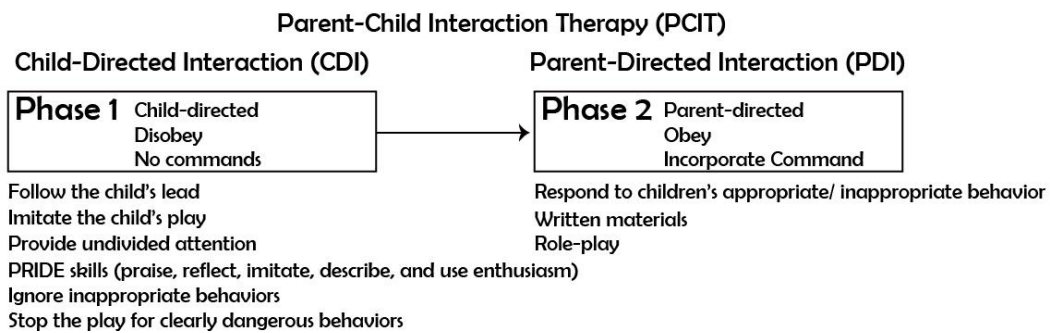


Figure 2. 2 Features and Change of CDI and PDI in PCIT

Besides the reference of two phases of PCIT. I can also refer to the target age range of PCIT. PCIT is developed for use with parents of children between 2.5~7 years of age which means if the child is beyond seven years old, it is hard to reestablish a healthy parent-child relationship (McNeil & Hembree-Kigin, 2010). We can refer to it to define the age range of parent-child toys. However, PCIT targeted children with behavioral disorders. Thus, when it

comes to the healthy children, I should lower the age range. I would find some other sources which are in accordance with the development of the healthy children so that I can define the more reasonable age range for parent-child toys.

In conclusion, I referred to characteristics of CDI and PDI which would be applied to children-initiated factors and parent-led factors respectively. On the other hand, I referred to the age range of target customer of PCIT to define the age range of my parent-child toy and I would combine Section 2. 2 (the development of parent-child relationship) to make appropriate adjustments to the age range of parent-child toys.

2.2 The Development of Parent-Child Relationship

In Section 2. 2, I would show the development of parent-child relationship in people's lifetime. In the end, I would show a graph of the evolution of parent-child relationships, which would be helpful to define the appropriate age range of parent-child toys. At the same time, it would be helpful to narrow the scope of our research later on.

2.2.1 Infancy and Toddlerhood (0~3 Years Old)

The mother is the main caregiver of the baby and the first important person in the survival and development of the baby. In this period, the infant showed obvious attachment, forming a special emotional connection with the mother, while the contact time between the father and the infant was significantly less than that of the mother. But fathers are important playmates of infants, and they are important sources of positive emotional satisfaction, sociality,

personality development, normal development of gender roles and improvement of social skills (Cui, 2009).

2.2.2 Preschool (3~6 Years Old)

Parent-child relationship is the main interpersonal relationship of young children, and it has the greatest impact on the development of young children. This is mainly manifested in the following aspects:

(1) Parents with their own behavior, speech, attitude and other characteristics, provide children with a paradigm of observation and imitation;

(2) Parents through children's behavior to make positive or negative reinforcement, in order to change or consolidate some specific behavior of children;

(3) Parents according to certain social norms directly impart relevant knowledge and skills to children to promote their cognitive and social development;

(4) Children learn from their parents, rely entirely on their parents, regard their parents as learning models, and think that parents are omnipotent (Cui, 2009).

2.2.3 School Age (6~12 Years Old)

Due to the immaturity and dependence of children's mental development, the influence of parent-child relationship still dominates. However, as children enter school, the interaction time between children and their parents decreases, and the influence of teachers and peers begins to increase, compared with that of parents in infancy (Cui, 2009).

Many studies have found that teacher-student relationship can make up for children's unhealthy parent-child relationship and affect their peer interaction initiative, communication ability and social status (Howe Hamilton, Matheson, 1995), which is the most critical factor in children's development and adaptation (Pianta, 1997). Research on self-awareness also shows that teachers' evaluation has a decisive impact on children's self-awareness and peer relationship, and teachers' influence is more than parents and peers. But the relationship between teachers and students is unstable and changeable. With the increase of grade, teachers will change frequently (Cui, 2009).

Peer relationship is a more relatively equal relationship than parent-child relationship and teacher-student relationship, so children are more willing to accept its influence. With the expansion of the scope of children's communication, peer interaction is increasing, children's independence is gradually strengthened, their minds are maturing, their sense of authority to adults is reduced, and the role of peer relationships in children's development is becoming more and more important (Cui, 2009).

2.2.4 Adolescence (12~18 Years Old)

In adolescence, with the increase of children's independence and mental maturity, the sense of authority of adults has been reduced, and the influence of peer relationship has become greater and greater, even surpassing parent-child relationship and teacher-student relationship. But at this time, parent-child relationship still has great influence. At the same time, accompanied by the physiological and psychological changes in adolescence, the individual's

behavior and ideas have undergone tremendous changes, resulting in a "generation gap" between parents and children. This period is a period of tension and conflict between parents and children. One form of conflict is the cold war, in which there is little common language between parents and children, it is difficult to communicate, it seems calm on the surface, and everyone has anxiety in the heart; the other is the surface of the conflict, in which the children think that parents do not understand themselves and parents feel that their children are too disobedient, so they quarrel, and even develop into big fights (Collins, 1990).

However, this is not to say that parents have no or even negative influence on children, but that the nature of this role has changed during this period. Parents' influence on students may be in other aspects of personality, such as interests, attitudes towards occupation, ideals and beliefs, outlook on life, world outlook and so on (Collins, 1990).

2.2.5 Adulthood 1.0 (18~25 Years Old)

In this period, the physical development of children tends to be stable, the psychological development, especially the emotional process, tends to mature, the conflict between children and parents tend to ease, and children begin to understand their parents, but the conflict still exists. At the same time, the communication between children and their parents is not much, but is more superficial, limited to some household topics; emotional communication is very little. Children want to communicate with their parents, but there are difficulties in the process of communication. In the author's investigation, more than half of college students want to

communicate with their parents, but because of the differences between the two generations, it is difficult to communicate in depth (Thornton, Orbuch & Axinn, 1995).

2.2.6 Adulthood 2.0 (25+ Years Old)

When an individual turns to a stable period and starts a family and becomes a parent, his or her sense of adulthood and responsibility become stronger and stronger. The relationship between an individual and his parents is more stable and moderate. Compared with the past, he or she shows more responsibility and obligation to his parents. At this time, parents seem to show more attachment to their children (Zarit & Eggebeen, 2005).

2.2.7 Summary of Development

During infant, toddler and preschooler periods, children generate attachment with parents; thus, children are dependent on parents. After six years old, they are detached with their parents because of the addition of teachers and peers. So it is not the most effective period to development parent-child relationship. From twelve to eighteen years old, they enter puberty in which is too hard to establish the parent-child relationship any more. After eighteen years old, their relationship recovers and they start to repay parents. I created the chart of parent-child relationship of lifetime below based on Section 2. 2. 1 to 2. 2. 6.

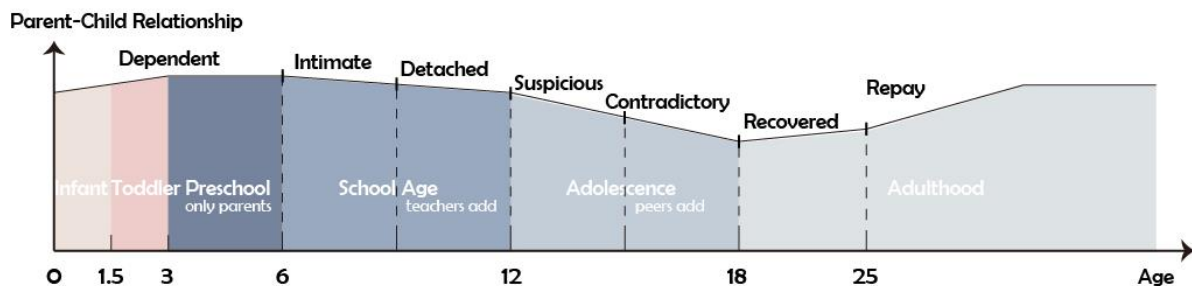


Figure 2. 3 The Development Stage of Parent-Child Relationship

2.2.8 Appropriate Age Range to Develop Parent-Child Relationship

According to the above research, compared with other age ranges, zero to six years old is a period that is more suitable to use parent-child toys to cultivate parent-child relationship.

Therefore, I define the age range of parent-child toys from birth to six years old.

0~3 Years Old: Parents are the main people to get along with. Also it is a key point to set up security; thus this is the best time to develop parent-child relationship.

3~6 Years Old: Parents are also the main people to get along with, even though the child can meet teachers and peers, because parents help children generate their characteristics during this period.

6~12 Years Old: With the addition of classmates and teachers in primary school, they started to detach with their parents. Also characteristics have generated at this period. Thus, development of parent-child relationship is in a slow pace.

12~18 Years Old: When children have entered puberty, it is too hard to establish parent-child relationship any more.

2.3 Child Development

Since I narrow the research age range in Section 2. 2, I focus on the development of target users. Thus, in Section 2. 3, I will do research on child physical, cognitive and social-emotional development from birth to six years old. They include the infant, toddler and preschooler periods. As Figure 2. 4 shows, I list which specific skills each development includes.

After that, tables are created in Section 2.3 which would be used for multiple times in my guidelines.

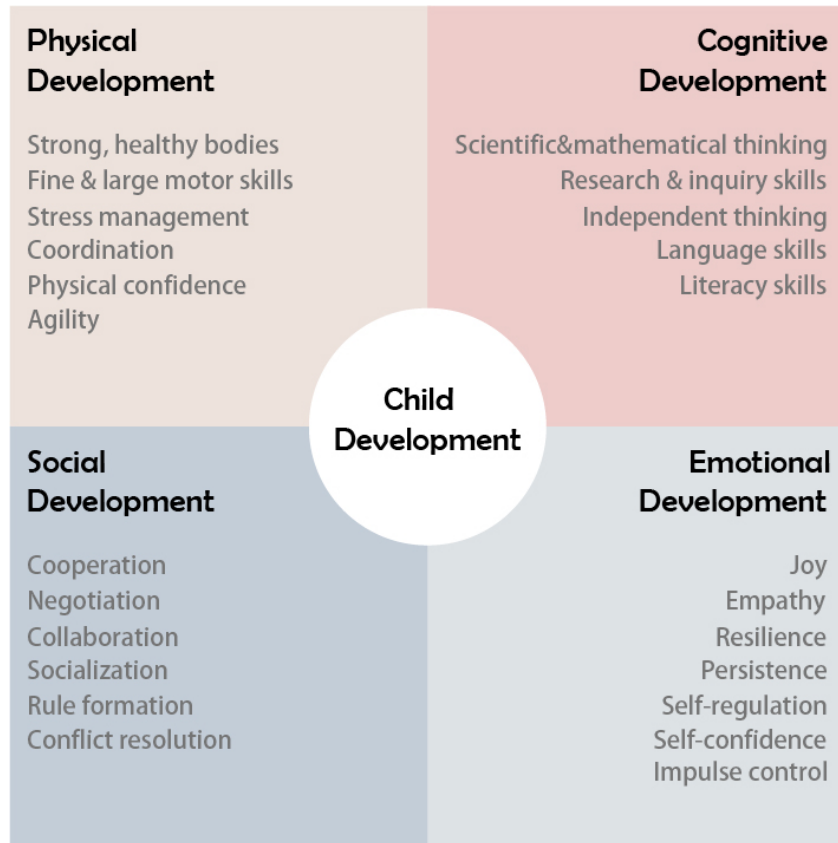


Figure 2.4 Child Development Category (Sokolowski, 2013)

2.3.1 Infant Development (0~1 Years Old)

Table 2.1, Table 2.2, Table 2.3 and Table 2.4 are infant physical development, infant cognitive development, infant social-emotional development and summary of infant development respectively, which will be applied in my guidelines. These tables will help designers check infant development more conveniently while using my guidelines. I got the information from the official website of Fisher-Price (n.d.). Due to the rapid growth of children in the infant period, I studied the characteristics of infant development in three month periods.

2.3.1.1 Infant Physical Development





Infant Physical Development	
 0-3months	<ol style="list-style-type: none"> 1 See objects 8-19 inches away but can't make out details or the full color spectrum 2 Show excitement by waving his or her arms and legs 3 Be able to support oneself on elbows and raise the chest while on his or her tummy
 3-6months	<ol style="list-style-type: none"> 4 Reach for things, with your help 5 Reach out and grasp toys 6 Sit up – with a little support
 6-9months	<ol style="list-style-type: none"> 7 Creep on his or her tummy 8 Crawl in both directions—maybe even while holding something 9 Catch a ball if it's rolled right to him or her
 9-12months	<ol style="list-style-type: none"> 10 Try walking, with hand-holding help from you 11 Stand unassisted and cruise along furniture 12 Move a toy out of the way to get to another one

Table 2. 1 Infant Physical Development (Fisher-Price, n.d.)

2.3.1.2 Infant Cognitive Development





Infant Cognitive Development	
 0-3months	<ol style="list-style-type: none"> 1 Mimic simple facial expressions and, when someone speaks to her, looks intently 2 Learn that one event follows another 3 Know if something is familiar to her
 3-6months	<ol style="list-style-type: none"> 4 Recognize familiar faces and take an interest in others 5 Be able to "multitask"—eg: babbling and reaching for something at the same time 6 Look for something that drops
 6-9months	<ol style="list-style-type: none"> 7 Understand "in and out" 8 Start to connect two behaviors together 9 Use deliberate gestures, like waving bye-bye or lifting arms to say, "Pick me up!"
 9-12months	<ol style="list-style-type: none"> 10 Anticipate the "surprise" phrase in favorite children's songs 11 Understand that smaller objects fit in larger ones 12 Understand much of what you say

Table 2. 2 Infant Cognitive Development (Fisher-Price, n.d.)

2.3.1.3 Infant Social-Emotional Development

Infant Social-Emotional Development	
 0-3months	1 Be comforted by gentle rocking 2 Smile at people and coo 3 Recognize Mommy, and be interested in other faces
 3-6months	4 Laugh, squirm and squeal with delight 5 Smile at other babies—and his own reflection 6 Love peek-a-boo and pat-a-cake
 6-9months	7 Recognize names of people and things 8 Smile back at others 9 Recognize familiar faces
 9-12months	10 Enjoy games like peek-a-boo 11 Babble with inflections of actual language 12 Mimic others' actions, like talking on the phone

Table 2. 3 Infant Social-Emotional Development (Fisher-Price, n.d.)

2.3.1.4 Summary of Infant Development

Infant Physical Development	
Month	Motor Skills
1	Lift their head for a short time while lying on their stomach
3	Have better control of their head and begin to appear fascinated with their hands
4	Control and balance of their head, neck and trunk will allow them to begin to roll over
6-9	Leg and trunk coordination have improved, allowing babies to sit
12	More control over their hands and fingers let babies better grab small objects with thumbs and index fingers. walk independently, babies use furniture to pull themselves up
Infant Cognitive Development	
Sensory	
1-2	Turn heads towards and take an interest in objects and people
3	Anticipate familiar things and to react to them
4	Vision will improve, and most are able to link the senses of sight, taste, hearing and touch together to form an identity of one object or person,
6-9	Recognize those familiar sights, sounds and touches
9-12	Watch others and exploring objects and environments. Curiosity, emotion become apparent As they start to learn and interact with all their senses, babies put objects in their mouth
Language	
1-2	Use certain cries to express different needs, such as hungry or sleepiness
3	Baby talk, watch speaking mouths and respond
5	Babbling, or repeating sounds for attention and expression, recognize their names
6-9	Imitate sounds and rhythms of speech, still babble to communicate but can recognize “no,” respond when told to “wave bye-bye”, begin to understand simple commands
9-12	Watch others and explore objects and environments. Curiosity and emotion become more apparent
Infant Social-Emotional Development	
1	Express their feelings (often with alert, widened eyes and a rounded mouth) the bond between parents and baby strengthens
2	Interact with you by smiling along with making eye contact and moving arms
2-4	Grow attached to familiar caregivers
4-6	Become social, facial expressions can readily express emotion, such as anger and happiness
6-9	Use expressions to communicate preference for caregivers and anxiety at their absence. Cry, turn away or become upset when separated from caregivers, called separation anxiety, or act uneasy around strangers, called stranger anxiety.
6-9	Separation anxiety and stranger anxiety may decrease, while babies have preference and affection for caregivers. Independence also increases as your baby may begin to explore.

Table 2. 4 Summary of Infant Development

2.3.2 Toddler Development (1~3 Years Old)

Table 2. 5, Table 2. 6, Table 2. 7 and Table 2. 8 are toddler physical development, toddler cognitive development, toddler social-emotional development and summary of toddler development respectively which will be applied in my guidelines. These tables will help designers check toddler development more conveniently while using my guidelines. Due to the growth pace of toddler, I studied the characteristics of toddler development by half year.

2.3.2.1 Toddler Physical Development



Toddler Physical Development		
 1~1.5years	1~1.5	Become a confident walker
 1.5~3years	1.5~2	Be on the move, walking and running
	2~2.5	Build with blocks and tuck a stuffed animal into bed
	2.5~3	Hop, jump and climb stairs one foot at a time

Table 2. 5 Toddler Physical Development (Fisher-Price, n.d.)

2.3.2.2 Toddler Cognitive Development



Toddler Cognitive Development		
 1~1.5years	1~1.5	Be better at entertaining herself, and more deliberate in exploring
 1.5~3years	1.5~2	Have a vocabulary of 50 to 200 words
	2~2.5	Know the difference between safe and dangerous
	2.5~3	Create simple sentences and use the words "I," "me" and "you"

Table 2. 6 Toddler Cognitive Development (Fisher-Price, n.d.)

2.3.2.3 Toddler Social-Emotional Development



Toddler Social-Emotional Development		
	1-1.5years	1-1.5 Show affection with hugs, kisses, smiles and pats
	1.5-3years	1.5~2 Express a range of moods, from joy to frustration to jealousy
		2~2.5 Become more social with other children
		2.5~3 Enjoy mimicking the actions of others

Table 2. 7 Toddler Social-Emotional Development (Fisher-Price, n.d.)

2.3.2.4 Summary of Toddler Development

Toddler Physical Development	
Years	Motor Skills
1	Quickly master walking and move on to running, jumping and climbing
2	Navigate stairs, kick or throw a ball and draw simple lines. During this time, children may still stumble frequently and be accident prone
3	Balance will get better and, they will be able to do things they hadn't been able to before
Toddler Cognitive Development	
	Learning
1-2	Be better able to recall recent events, imitate others and will become much more imaginative, especially during play time
3	Ability to think and understand grows as children learn letters, numbers, symbols and colors
	Language
1-1.5	Know 10 times more words than they can verbally communicate
2	Vocabularies can span between 50 and 100 words and children begin using two or more words in combination
3	Understand 1000 or more words
Toddler Social-Emotional Development	
1-2	Continue to develop strong bonds with their loved ones, while at the same time wanting to be more independent.
2~3	Begin to like to "do it myself" and will want to make more choices on his or her own

Table 2. 8 Summary of Toddler Development

2.3.3 Preschooler Development (3~6 Years Old)

Table 2. 9, Table 2. 10, Table 2. 11 and Table 2. 12 are preschooler physical development, preschooler cognitive development, preschooler social-emotional development and summary of

preschooler development respectively which will be applied in my guidelines. These tables will help designers check toddler development more conveniently while using my guidelines.

2.3.3.1 Preschooler Physical Development


Preschooler Physical Development		
 3~6years	3~4	Love to move—and even find it hard to be still!
	4~5	Learn to swim, skate, dance, ski and bounce on a trampoline
	5~6	Have better physical coordination for more complex actions

Table 2. 9 Preschooler Physical Development (Fisher-Price, n.d.)

2.3.3.2 Preschooler Cognitive Development


Preschooler Cognitive Development		
 3~6years	3~4	Begin to compare and contrast herself with others
	4~5	Have a longer attention span for engaging in new activities
	5~6	Solve problems and explain things

Table 2. 10 Preschooler Cognitive Development (Fisher-Price, n.d.)

2.3.3.3 Preschooler Social-Emotional Development


Preschooler Social-Emotional Development		
 3~6years	3~4	Like to dress up or pretend to be someone else
	4~5	Begin to grasp that people have different experiences and feelings
	5~6	Develop stronger friendships

Table 2. 11 Preschooler Social-Emotional Development (Fisher-Price, n.d.)

2.3.3.4 Summary of Preschooler Development

Preschooler Physical Development	
Years	Motor Skills
3~4	Jump and hop higher as leg muscles grow stronger, catch and throw fast and accurately
4~5	They also have more control when riding their tricycles
5~6	Enjoy learning to play organized sports such as soccer, basketball or swimming. Like to participate in physical extracurricular activities such as karate, gymnastics, or dance.
Preschooler Cognitive Development	
3~4	Use more complex sentences, understand the basic rules of language
4~5	Comprehend the essential ideas of counting, the alphabet, size relationships (big vs small), and the names of geometric shapes, enjoy singing, rhyming, and making up words
5~6	Vocabulary increasing to approximately 2,000 words, interested in cause and effect, develops simple problem-solving ability
Preschooler Social-Emotional Development	
3~4	Cooperate with his or her friends, take turns, and show some problem-solving skills
4~5	Play happily with other children and enjoy lots of physical games as well as stories
5~6	Like to be recognized for their achievements and it is especially pronounced when receiving evaluation from school for their academic performance.

Table 2. 12 Summary of Preschooler Development (Fisher-Price, n.d.)

2.3.4 Sensitive Period in Child Development

Montessori Sensitive Period Theory talks about sensitive periods in childhood development from birth to six years old and how the child is guided by inner forces that shape their developmental needs. Eleven sensitive periods are listed below:

Movement (0~1 Years Old): Random movements become coordinated and controlled: grasping, touching, turning, balancing, crawling, and walking (Montessori, 2013). Parents usually select toys which can help children develop their gross and fine motor skills. As Figure 2.5 shows below, there are a lot of infant hand toys that children can bite, shake, grasp and touch.

At this sensitive period, children are more likely to play by themselves, and parent participation is only an aid.



Figure 2. 5 Infant Hand Toys

Language (0~6 Years Old): Use of words to communicate: a progression from babble to words to phrases to sentences, with a continuously expanding vocabulary and comprehension (Montessori, 2013). Parents like to select toys which can help children develop their language skills; thus, I would extract a lot of design elements from the story book in my guidelines for designers to apply them into parent-child toys later on. At this sensitive period, children need to follow parents' lead in a sense. Thus, designers need add more parent participation theoretically.

Small Objects (1~4 Years Old): A fixation on small objects and tiny details (Montessori, 2013). I would extract some design elements for designers to apply small objects into parent-child toys. At this sensitive period, children are more likely to play by themselves, because more parent participation would interrupt children's play and reduce their attention.

Order (2~4 Years Old): Characterized by a desire for consistency and repetition and a passionate love for established routines. Children can become deeply disturbed by disorder. The

environment must be carefully ordered with a place for everything and with carefully established ground rules (Montessori, 2013).

Music (2~6 Years Old): Spontaneous interest in and the development of pitch, rhythm, and melody (Montessori, 2013). At this sensitive period, children are more likely to pick up music via playing some musical toys. Thus, I will extract some design elements for designers to apply music into parent-child toy design later on.

Grace & Courtesy (2~6 Years Old): Imitation of polite and considerate behavior lead to an internalization of these qualities into the personality (Montessori, 2013). Parents like to develop children's grace and courtesy by modeling themselves. I will extract some design elements to apply grace and courtesy into parent-child toy design in a more interesting way.

Refinement of the Senses (2~6 Years Old): Fascination with sensorial experiences (taste, sound, touch, weight, smell) resulting with children learning to observe and with making increasingly refined sensorial discriminations (Montessori, 2013). At this period, children consciously and constantly improve their senses. I will extract some design elements for designers to apply mixtures of sight, hearing, smell, taste and touch into parent-child toy design.

Writing (3~4 Years Old): Fascination with the attempt to reproduce letters and numbers with pencil or pen and paper. Montessori discovered that writing precedes reading (Montessori, 2013). I would also refer to the best-selling storybook and try to make writing fun.

Reading (3~5 Years Old): Spontaneous interest in the symbolic representations of the sounds of each letter and in the formation of words (Montessori, 2013). I would also refer to the best-selling storybook and try to make reading fun.

Spatial Relationships (4~6 Years Old): Forming cognitive impressions about relationships in space, including the layout of familiar places. Children become more able to find their way around their neighborhoods, and they are increasingly able to work complex puzzles (Montessori, 2013).

Mathematics (4~6 Years Old): Formation of the concepts of quantity and operations from the uses of concrete material aids (Montessori, 2013). At this period, children will generate interest if parents guide them a little bit. I would extract some design elements for designers to combine simple mathematics problem with entertainment.

After introducing so many sensitive periods, I have roughly summarized two types of sensitive periods. The first type is that interests which need to be stimulated by parents' teaching, such as **Writing, Reading, Language, Mathematics** and **Grace & Courtesy**; The second type is that spontaneous interests which can be attracted by toys directly, such as **Movement, Small Objects, Music** and **Refinement of the Senses**. The rest of the sensitive periods are **Order** and **Spatial Relationships**. Since there is nothing to do with parent-child toy design, I would not do further research on these two sensitive periods. In short, Montessori Sensitive Period Theory is a very important methodology to support my guidelines.

2.4 Role of Play

Play is important to child development, parent's pleasant mood and parent-child relationship. In Section 2.4.1, I talk about the importance of play in general; In Section 2.4.2, I talk about the benefits of parent-child play for children and parents. Based on them, I clarify the meaning of designing a parent-child toy. In Section 2.4.3, I talked about stages of play; in Section 2.4.4, I talk about stages of children cognitive development. Based on them, I summarize their characteristics for each stage to apply them into my guidelines. Finally, in Section 2.4.5, I list different classification methods for playing. We can also learn from the characteristics and benefits of all types of play to apply to my guidelines.

2.4.1 Importance of Play

Play is essential to development because it contributes to the cognitive, physical, social and emotional well-being of children and youth. Play also offers an ideal opportunity for parents to engage fully with their children. There are many benefits derived from play for both children and parents (Ginsburg, 2007). Play can't include some negative activities, such as playing video games, playing computer or watch TV (Wang, 2016) As a result, play things such as toys and playgrounds are more important to children.

Child Development: Play allows children to use their creativity while developing their imagination, dexterity, and physical, cognitive, and emotional strength. Play is important to healthy brain development. It is through play that children at a very early age engage and interact in the world around them. Play allows children to create and explore a world they can master,

conquering their fears while practicing adult roles, sometimes in conjunction with other children or adult caregivers. As they master their world, play helps children develop new competencies that lead to enhanced confidence and the resiliency they will need to face future challenges. Undirected play allows children to learn how to work in groups, to share, to negotiate, to resolve conflicts, and to learn self-advocacy skills. When play is allowed to be child driven, children practice decision-making skills, move at their own pace, discover their own areas of interest, and ultimately engage fully in the passions they wish to pursue. Ideally, much of play involves adults, but when play is controlled by adults, children acquiesce to adult rules and concerns and lose some of the benefits play offers them, particularly in developing creativity, leadership, and group skills. In contrast to passive entertainment, play builds active, healthy bodies. In fact, it has been suggested that encouraging unstructured play may be an exceptional way to increase physical activity levels in children, which is one important strategy in the resolution of the obesity epidemic. Perhaps above all, play is a simple joy that is a cherished part of childhood (Ginsburg, 2007).

Play is integral to the academic environment. It ensures that the school setting attends to the social and emotional development of children as well as their cognitive development. It has been shown to help children adjust to the school setting and even to enhance children's learning readiness, learning behaviors, and problem-solving skills. Social-emotional learning is best integrated with academic learning; it is concerning if some of the forces that enhance children's ability to learn are elevated at the expense of others. Play and unscheduled time that allow for

peer interactions are important components of social-emotional learning (Ginsburg, 2007).

Parent-Child Relationship: Children’s developmental trajectory is critically mediated by appropriate, affective relationships with loving and consistent caregivers as they relate to children through play. When parents observe their children in play or join with them in child-driven play, they are given a unique opportunity to see the world from their child’s vantage point as the child navigates a world perfectly created just to fit his or her needs. (The word “parent” is used in this report to represent the wide range of adult caregivers who raise children.) The interactions that occur through play tell children that parents are fully paying attention to them and help to build enduring relationships. Parents who have the opportunity to glimpse into their children’s world learn to communicate more effectively with their children and are given another setting to offer gentle, nurturing guidance. Less verbal children may be able to express their views, experiences, and even frustrations through play, allowing their parents an opportunity to gain a fuller understanding of their perspective. Quite simply, play offers parents a wonderful opportunity to engage fully with their children (Ginsburg, 2007).

2.4.2 Importance of Parent-Child Play

As Section 2. 4. 1 says, play can improve the parent-child relationship. Thus, parent-child play is very important. Parent-child play is a win-win in a sense. Both parent and children can achieve benefits from them. Thus, there is a need to design parent-child toys.

2.4.2.1 Benefits for Parents

Oxytocin levels increase when mothers engage in affectionate play with their infant and when fathers engage in stimulatory play with their infants. When parents play with children, oxytocin is released in them. It is a relaxing message for parents' mind (Gordon, Zagoory-Sharon, Leckman & Feldman, 2010).

2.4.2.2 Benefits for Children

Play is one way to help develop social and self-control skill sets. Interactions with parents and others have helped them develop many tools or skills needed to build a bright future (Narvaez, 2014).

Parent-child pretend and physical play is linked with the child's competence, gross motor skills, peer group leadership, and cognitive development. Interactive play can also help a child learn how to regulate their emotions better. Lastly, providing the child with an "enriched environment" through play can lower their stress chemicals (Narvaez, 2014).

Parent-child play has been shown to contribute more to a child's ability to give structure to early social interactions than play with siblings. Parents can offer a child more mature and varied play than can siblings. Of course, adults know more about the world than any child and often can widen imagination in ways that other children cannot (Narvaez, 2014).

2.4.3 Stages of Play

Stages of Play is a theory and classification of children's participation in play developed by Mildred Parten Newhall in her 1929 dissertation. Parten observed American preschool age (ages 0 to 5) children at free play (defined as anything unrelated to survival, production or profit) (Wikipedia, n.d.). There are six stages, as Figure 2. 6 shows below. I will introduce the six stages respectively. When designers design parent-child toys for different ages, they should check for compliance with stages of play. Therefore, stages of play is one of the most important methodology in my guidelines and I will use it frequently.



Figure 2. 6 Parten's Stage of Play

2.4.3.1 Unoccupied (0~3 Months Old)

This is when the child is not playing, just observing. A child may be standing in one spot or performing random movements (Parten, 1929).

2.4.3.2 Solitary Play (0~2 Years Old)

Children play alone, with their own toys. They do not get close to or interact with other children. Solitary play should be encouraged because it builds skills for working independently (Parten, 1929).



Figure 2. 7 Solitary Play

2.4.3.3 Onlooker Play (2~2.5 Years Old)

When a child watches other children playing but makes no attempt to join in (Parten, 1929).



Figure 2. 8 Onlooker Play

2.4.3.4 Parallel Play (2.5~3 Years Old)

Children continue to play on their own, but they are beside children and may be using the same toys (Parten, 1929).



Figure 2. 9 Parallel Play

2.4.3.5 Associative Play (3~4 Years Old)

Children begin to truly play with others. They share play materials but may be following their own story line (Parten, 1929).



Figure 2. 10 Associative Play

2.4.3.6 Cooperative Play (4~6 Years Old)

The highest level of social play where children play in groups and everyone is cooperating to achieve a common goal. This type of play involves negotiation among children. This happens when children change “roles” in the play and/or take turns making suggestions about the plot (Parten, 1929).



Figure 2. 11 Cooperative Play

2.4.4 Piaget’s Stages of Cognitive Development

Piaget's theory of cognitive development is a comprehensive theory about the nature and development of human intelligence. It was first created by the Swiss developmental psychologist Jean Piaget. The theory deals with the nature of knowledge itself and how humans gradually come to acquire, construct, and use it. In his theory of Cognitive development, Jean Piaget proposed that humans progress through four developmental stages: the sensorimotor, preoperational, concrete operational and formal operational period. As Figure 2. 12 shows below, there are four stages of cognitive development. I will introduce them respectively. When designers design parent-child toys for different ages, they should check for compliance with

stages of cognitive development. Therefore, stages of cognitive development is one of the most important methodology in my guidelines and I will use it frequently.

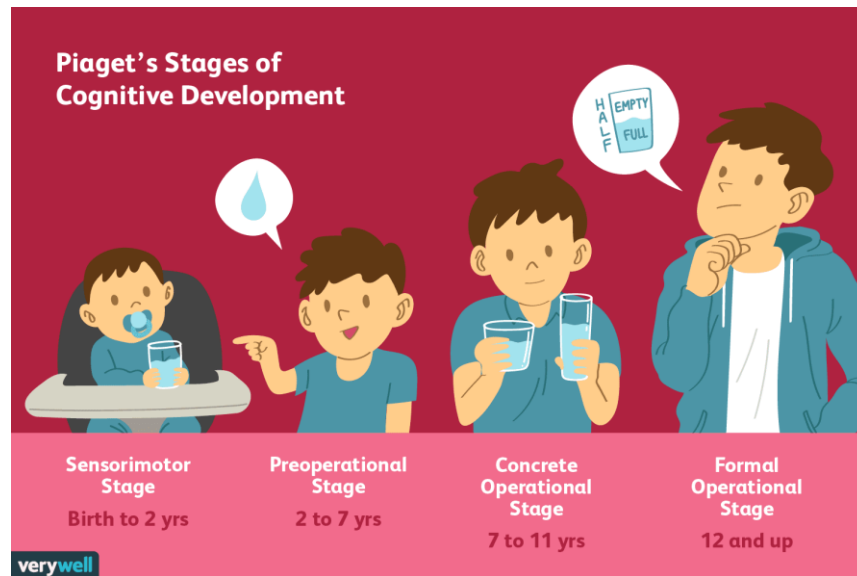


Figure 2. 12 Stages of Cognitive Development

2.4.4.1 Sensorimotor Stage (0~2 Years Old)

The sensorimotor stage is the earliest in Piaget's theory of cognitive development. Piaget described this period as a time of tremendous growth and change. During this initial phase of development, children utilize skills and abilities they were born with (such as looking, sucking, grasping, and listening) to learn more about the environment. In other words, they experience the world and gain knowledge through their senses and motor movements. As children interact with their environments, they go through an astonishing amount of cognitive growth in a relatively short period of time—the sensorimotor stage lasts from birth to approximately age 2 (Piaget, 1962). I would consider these characteristics and apply them to infant and toddler toy design.

2.4.4.1.1 Substages

The sensorimotor stage can be divided into six separate sub-stages that are characterized by the development of a new skill, so I would do research on the specific development for each substage:

Reflexes (0~1 Month Old): During this substage, the child understands the environment purely through inborn reflexes such as sucking and looking (Piaget, 1962).

Primary Circular Reactions (1~4 Month Old): This substage involves coordinating sensation and new schemas. For example, a child may suck his or her thumb by accident and then later intentionally repeat the action. These actions are repeated because the infant finds them pleasurable (Piaget, 1962).

Secondary Circular Reactions (4~8 Month Old): During this substage, the child becomes more focused on the world and begins to intentionally repeat an action in order to trigger a response in the environment. For example, a child will purposefully pick up a toy in order to put it in his or her mouth (Piaget, 1962).

Coordination of Reactions (8~12 Months Old): During this substage, the child starts to show clearly intentional actions. The child may also combine schemas in order to achieve a desired effect. Children begin exploring the environment around them and will often imitate the observed behavior of others. The understanding of objects also begins during this time and children begin to recognize certain objects as having specific qualities. For example, a child might realize that a rattle will make a sound when shaken (Piaget, 1962).

Tertiary Circular Reactions (12~18 Months Old): Children begin a period of trial-and-error experimentation during the fifth substage. For example, a child may try out different sounds or actions as a way of getting attention from a caregiver (Piaget, 1962).

Early Representational Thought (18~24 Months Old): Children begin to develop symbols to represent events or objects in the world in the final sensorimotor substage. During this time, children begin to move towards understanding the world through mental operations rather than purely through actions (Piaget, 1962). As Figure 2. 13 shows, illustrators represent these characteristics of children from 1 to 4 months; 4~8months, 12~18 months.

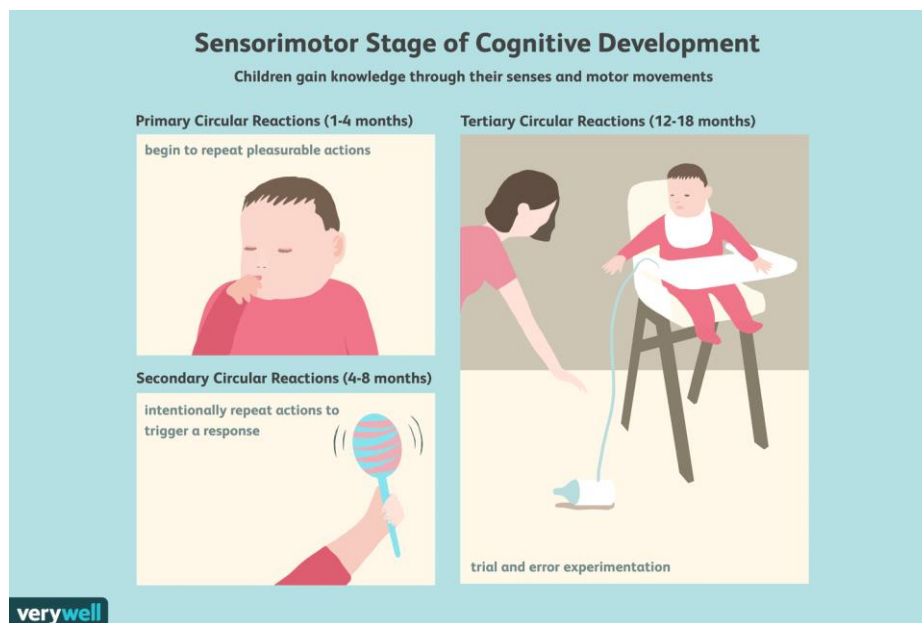


Figure 2. 13 Sensorimotor Stage

2.4.4.1.2 Object Permanence

According to Piaget, developing object permanence is one of the most important accomplishments at the sensorimotor stage of development. Object permanence is a child's

understanding that objects continue to exist even though they cannot be seen or heard (Piaget, 1962).

2.4.4.2 Preoperational Stage (2~7 Years Old)

The preoperational stage is the second stage in Piaget's theory of cognitive development. This stage begins around age 2, as children start to talk, and lasts until approximately age 7. During this stage, children begin to engage in symbolic play and learn to manipulate symbols. However, Piaget noted that they do not yet understand concrete logic (Piaget, 1962). I would consider these characteristics and apply them to toddler and preschooler toy design.

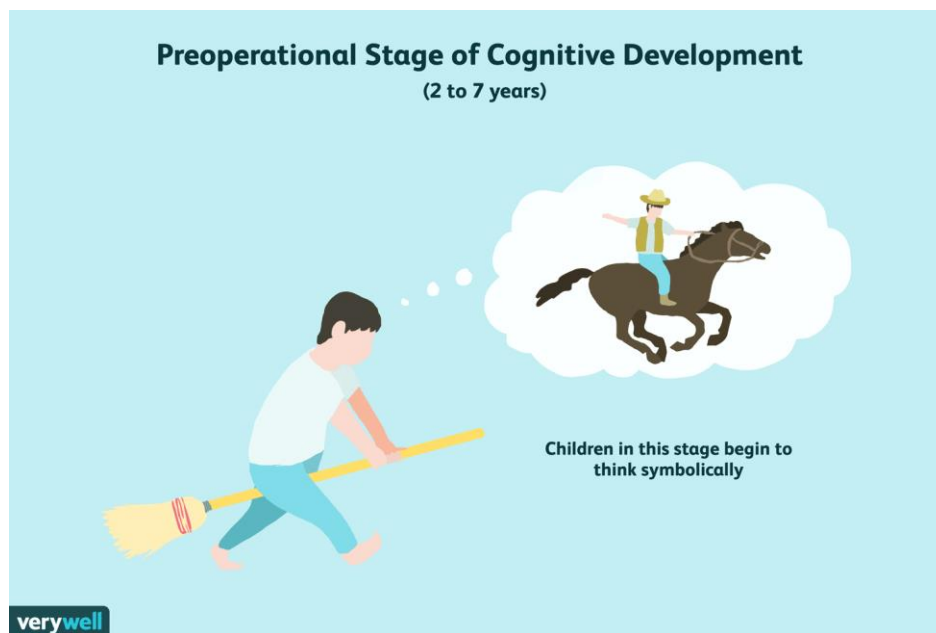


Figure 2. 14 Preoperational Stage

2.4.4.2.1 Major Characteristics

Language Development: Language development is one of the hallmarks of this period (Piaget, 1962).

Pretend Play: During the preoperational stage, children also become increasingly adept at using symbols, as evidenced by the increase in playing and pretending. For example, a child is able to use an object to represent something else, such as pretending a broom is a horse (Piaget, 1962).

Role-playing: Role-playing also becomes important— Children often play the roles of "mommy," "daddy," "doctor," and many other characters (Piaget, 1962).

2.4.4.2.2 Not Understanding Egocentrism

Piaget used a number of creative and clever techniques to study the mental abilities of children. One of the famous techniques to demonstrate egocentrism involved using a three-dimensional display of a mountain scene. Often referred to as the "Three Mountain Task," children are asked to choose a picture that showed the scene they had observed. Most children are able to do this with little difficulty. Next, children are asked to select a picture showing what someone else would have observed when looking at the mountain from a different viewpoint. Invariably, children almost always choose the scene showing their own view of the mountain scene. According to Piaget, children experience this difficulty because they are unable to take on another person's perspective (Piaget, 1962).

Other researchers have also conducted similar experiments. In one study, children were shown a room in a small dollhouse. Children were able to see in the dollhouse that a toy was hidden behind a piece of furniture. Children were then taken into a full-size room that was an

exact replica of the dollhouse. Very young children did not understand to look behind the couch to find the toy, while slightly older children immediately searched for the toy (Piaget, 1962).

2.4.4.2.3 Not Understanding Conservation

Another well-known experiment involves demonstrating a child's understanding of conservation. In one conservation experiment, equal amounts of liquid are poured into two identical containers. The liquid in one container is then poured into a differently shaped cup, such as a tall and thin cup or a short and wide cup. Children are then asked which cup holds the most liquid. Despite seeing that the liquid amounts were equal, children almost always choose the cup that appears fuller (Piaget, 1962).

2.4.4.3 Concrete Operational Stage (7~11 Years Old)

The concrete operational stage is the third stage in Piaget's theory of cognitive development. This period spans the time of middle childhood—it begins around age 7 and continues until approximately age 11—and is characterized by the development of logical thought. Thinking still tends to be very concrete, children become much more logical and sophisticated in their thinking during this stage of development. While this is an important stage in and of itself, it also serves as an important transition between earlier stages of development and the coming stage where kids will learn how to think more abstractly and hypothetically (Piaget, 1962). We only need to understand this stage in general, because it is beyond the age range we are studying, but we can reverse some design elements for zero to six-year-old children according to this stage.

2.4.4.3.1 Understanding Logic

Piaget determined that children in the concrete operational stage were fairly good at the use of inductive logic (inductive reasoning). Inductive logic involves going from a specific experience to a general principle. An example of inductive logic would be noticing that every time you are around a cat, you have itchy eyes, a runny nose, and a swollen throat. You might then reason from that experience that you are allergic to cats (Piaget, 1962).



Figure 2. 15 Concrete Operational Stage

On the other hand, children at this age have difficulty using deductive logic, which involves using a general principle to determine the outcome of a specific event. For example, a child might learn that $A=B$, and $B=C$, but might still struggle to understand that $A=C$ (Piaget, 1962).

2.4.4.3.2 Understanding Reversibility

One of the most important developments in this stage is an understanding of reversibility or awareness that actions can be reversed. An example of this is being able to reverse the order of relationships between mental categories (Piaget, 1962).

2.4.4.3.3 Understanding Conservation

Another key development at this stage is the understanding that when something changes in shape or appearance it is still the same, a concept known as conservation. Kids at this stage understand that if you break a candy bar up into smaller pieces it is still the same amount as when the candy was whole. This is a contrast to younger children who often believe that pouring the same amount of liquid into two cups means that there is more (Piaget, 1962).

For example, imagine that you have two candy bars of the exact same size. You break one candy bar up into two equally sized pieces and the other candy bar up into four smaller but equally sized sections. A child who is in the concrete operational stage will understand that both candy bars are still the same amount, whereas a younger child will believe that the candy bar that has more pieces is larger than the one with only two pieces (Piaget, 1962).

2.4.4.3.4 Understanding Egocentrism

In Piaget's Three-Mountain Task, for example, children in the concrete operational stage can describe how a mountain scene would look to an observer seated opposite them. In other words, kids are not only able to start thinking about how other people view and experience the

world, they even start to use this type of information when making decisions or solving problems (Piaget, 1962).

2.4.4.4 Formal Operational Stage (12+ years old)

The formal operational stage is the fourth and final stage of Jean Piaget's theory of cognitive development. It begins at approximately age 12 and lasts into adulthood. At this point in development, thinking becomes much more sophisticated and advanced. Kids can think about abstract and theoretical concepts and use logic to come up with creative solutions to problems. Skills such as logical thought, deductive reasoning, and systematic planning also emerge during this stage (Piaget, 1962). We only need to know about this stage in general, because it is beyond the age range we are studying.

2.4.5 Types of Play

2.4.5.1 Piaget's Types of Play

According to Piaget, children engage in types of play that reflect their level of cognitive development: functional play, constructive play, symbolic/fantasy play, and games with rules (Johnson, Christie & Wardle 2005).

Functional play: Functional play is the use of bodily movements, with or without objects, such as running and jumping, sliding, gathering and dumping, manipulating and stacking objects, and informal games without rules (Piaget, 1962). The age range of functional play corresponds to the age range of the Sensorimotor Stage (0~2 years old) which is within the age range of my parent-child toy.

Constructive play: Constructive play uses objects—blocks, Legos, Tinkertoys, or different materials (sand, modeling clay, paint, blocks)—in an organized, goal-oriented way to make something (Piaget, 1962). The age range of constructive play corresponds to the age range of the Preoperational Stage (2~7 years old) which is within the age range of my parent-child toy.



Figure 2. 16 Magnetic Tiles Building Set

Symbolic/Fantasy play: Symbolic play is role playing or make-believe play, such as pretending to be a baby, firefighter, superhero, or monster, and make believe actions, such as driving a car by moving a pretend steering wheel, or using a block of wood as a cell phone

(Piaget, 1962). The age range of symbolic/fantasy play corresponds to the age range of the Preoperational Stage (2~7 years old) which is within the age range of my parent-child toy.



Figure 2. 17 Melissa & Doug's Cutting Food Set

Games with rules: Games with rules are games with peers that are controlled by pre-established rules (Piaget, 1962). The age range of games with rules corresponds to the age range of the Concrete Operational Stage which is 7 to 11 years old, because before 7 years old, children are too self-centered to play games with rules with peers. However, if parents and child play games with rules together, this will reduce the age range. Although children find it hard to share or cooperative with other children, it is easier to cooperate with their own parents because of their intimate relationship.

2.4.5.2 Games with Rules VS. Free Play

Games with rules and free play are two kinds of completely different types of play. Free play means that it enables children to play according to their wishes. Free play is also called

child-initiated play; they can choose to play by themselves or learn to share toys with other peers during play so that to learn more about social skills. Games with rules are quite different. Children need to comply rules from instruction, or authoritative parents set goals for their children. I mainly compare free play and games with rules from process, outcome, rule definition and experience, as Figure 2. 18 shows below. I will explain them respectively next.

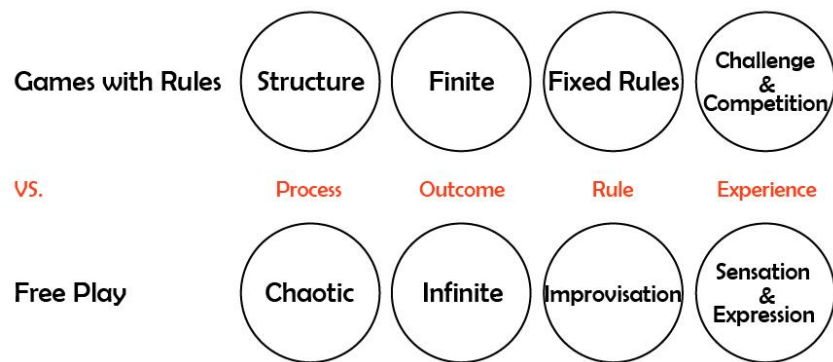


Figure 2. 18 Game with Rules VS. Free Play

2.4.5.2.1 Games with Rules

Process (Structure): Games often have a fixed structure that the designers defined beforehand. Players have to behave and move within the boundaries of this structure (Valk, 2015).

Outcomes (Finite): In general, games with rules aim at certain end goals that imply that there is a winner of the game. This is also part of the structure of the game, as described above. While playing a game, players expect a conclusion or a final act (Carse, 2011). They obey the rules to come to this achievement. When a game has ended, players cannot resume a game; they

can only start a new (occasion of the) game (Valk, 2015). Carse summarizes the finite game like this:

- The purpose is to win the game
- Includes only select people
- Each player is needed and must always be alert, to relax is dangerous
- Players try to replicate the winning strategies of the past and assume the past reoccurs
- The rules must not change for the duration of the game
- Provokes replication (Carse 2011)

Rule Definition (Fixed Rules): Games include fixed or official rules that players have to follow to play the game. Defining these rules is not done by the player but is a task of the game designers, although players are free to add their own rules to a game, influenced by for instance the social context or the mood they are in.

Experience (Challenge & Competition): Games often embrace some element of challenge that provokes players and makes it more difficult for them to reach the end goal. This is sometimes made even harder by adding an element of competition. In this way, games aim at evoking playful experiences such as challenge and competition (Korhonen et al., 2009).

2.4.5.2.2 Free Play

Process (Chaotic): Free play emphasizes the freedom that players have when they want to play with anything at any time and location. In free play, changes within play are also encouraged, making free play a rather chaotic and dynamic process (Valk, 2015).

Outcomes (Infinite): Free play mostly resemble infinite ‘games’, in which the ending point continually changes in order to carry on with the play. This relates to the chaotic nature of free play in which play constantly changes and adapts. Players bend the rules while playing and their play is not bounded by time (Valk, 2015). Carse summarizes the finite game like this:

- The purpose is to continue the game
- Invites others in
- Any single player is not needed and cannot finish the game
- Looks to the future and does not assume the past will reoccur
- The rules must change over time or the game will cease
- Provokes creativity (Carse, 2011)

Rule Definition (Improvisation): Free play supports improvisation and lets players spontaneously create their own play, unrestricted by any fixed rules. In free play, defining the rules is a responsibility of the players. They can decide not only on the content of the rules, but also on how many rules are applied and when they are used. In this process, players are influenced by their everyday experiences; they might have seen a television show with characters they want to act out, just as musicians are inspired by a tune they heard that day (Valk, 2015).

Experience (Sensation & Expression): In free play the emphasis is much more on the sensation of play and the ability for players to express themselves. Free play aims at stimulating playful experiences such as sensation and expression (Korhonen et al., 2009). In relation to this, Karoff (2013) mentions four play moods, which are different ways of being in play and concern

how players engage with the world and other players and people around them. The four play moods are devotion, intensity, tension and euphoria. In devotion, players experience a feeling of being in a flow and continuously being in the moment. They are concentrated and focused in their play. An example of devotion is children who are playing with a set of LEGO blocks. Intensity relates to experiences of “your bodily being as ready and excited for more” (Karoff, 2013, p. 84). This is especially the case in physical play situations on a slide or a swing. In tension, players are ready to show and express themselves and are aware of others doing the same. For example, when a group of girls is dancing together they share this mood and all are aware of the moves and style they express. Euphoria, lastly, is the most open-minded play mood. In euphoria, players experience an intensive expectation of silliness. Examples include water fights and teasing each other.

2.4.5.3 Adult-Led Play VS. Child-Initiated Play

UK Early years settings include both ways of structuring play because it is thought that both of them can contribute to children’s development. They are adult-led play and child-initiated play. Each type of structure has its advantages and disadvantages. Adult-led play is one of games with rules I mentioned before. Children should follow parents’ or teachers’ lead to play the games, whereas, child-initiated play is one of free play I mentioned before. Children initiate the play without restriction from rules or parents. These two types of play belongs to parent-child play. Thus the research on the advantages and disadvantages of them respectively which will be helpful to build the framework of my guidelines.

2.4.5.3.1 Adult-Led Play

This is the type of play where the adult plans, organizes and shows or tells the children what they need to do. Examples of adult-led play include playing picture lotto or a musical game such as ‘Hokey Cokey’. The adult tells children what to do and how to play. Adults might also do some cooking or gardening with children. With babies, adult-led play is very important.

Adults might play peek-a-boo or stack up some beakers for the child to knock down (Batt, 2013).



Figure 2. 19 Peek-a-boo

2.4.5.3.1.1 Advantages of Adult-Led Play

It allows higher-risk activities: Adult-led play allows children to carry out activities that otherwise they would not be able to manage by themselves. A good example of this would be cooking or some types of art and crafts where equipment such as knives or scissors would not be safe for children to use alone. In these types of activities adults also will teach children how to use the equipment (Batt, 2013).

It enables children to learn new skills and concepts: Adult-led play is also used so that children can learn specific skills and concepts. A good example of this is playing a board game. By playing a board game with an adult, a child might start to recognize numbers on the dice and start to count. If an outing is arranged, children may also learn about things that are new to them. For example, an outing to a zoo or a farm will help them learn about animals (Batt, 2013).

It helps language development: Adult-led play also helps children's language development. This is particularly important when children are learning to talk. From making a fruit salad, children might learn the names of fruit and so add this to their vocabulary. Adult-led activities with older children can also lead to discussions. By visiting a supermarket and buying ingredients to make a soup, children might talk about favorite foods (Batt, 2013).

In conclusion, adult-led play has many advantages; if children only have child-initiated play, they can't get advantages from adult-led play. Parent-child play gets a balance between parent participation and children participation, allowing play to have more advantages.

2.4.5.3.1.2 Disadvantages of Adult-Led Play

Learning is not always effective: Disadvantages of adult-led play include the fact that sometimes learning is not very effective. It may be that children have not had enough time to solve problems, practice skills or develop their own ideas. This can be the case when adult-led play is taking place with large groups. Other children might shout out or use the equipment before a child has the chance to get involved. Some children may also lack concentration because they are not interested in the activity (Batt, 2013).

Learning may be limited: In adult-led play there is also a danger that learning might be limited. If the adult has planned an activity where children are all meant to be making the same card or picture, children will not have the chance to use their own imagination or creativity. There may not be an opportunity for the child to ask questions or to do things their own way. This prevents children from showing their independence (Batt, 2013).

2.4.5.3.2 Child-Initiated Play

Child-initiated play is sometimes called ‘free play’. This is because children are free to choose resources and toys and decide how to play with them. Early years settings encourage this type of play by making it easy for children to help themselves to resources or ‘self-serve’. What children choose to do during child-initiated play varies according to their age and stage of development, but also according to what is available. It is common to see children mix resources, for example, putting grass into a bucket of water and pretending to cook with it or taking dough into a home corner. This means that it is not always a very tidy way of playing. In child-initiated play adults can join in with children, but they have to do what children ask of them (Batt, 2013).

2.4.5.3.2.1 Advantages of Child-Initiated Play

It helps concentration: Many adults notice that children concentrate for quite long periods during child-initiated play. It is not uncommon for three and four year olds to focus for an hour or so on making models, creating dens or just playing with sensory materials. Children often have a clear purpose and idea of what they are doing and why. Being able to concentrate for long periods is good for children’s cognitive development (Batt, 2013).

It helps social development: By playing independently of adults, children have the chance to practice their social skills. They might squabble or raise their voices at times, but most children from three years or so are able to work things out themselves. Learning to take turns and cooperate helps children's social skills (Batt, 2013).

In conclusion, child-initiated play also has many advantages that parent-led play can't achieve. Therefore, we should consider parent-led factors and child-initiated factors at the same time. In Chapter 3, I will show how to add parent-led factors and child-initiated factor into parent-child toy design.

2.4.5.4.3.1 Disadvantages of Child-Initiated Play

It Limits development of skills: Children often have strong play preferences and so may not choose from the whole range of play opportunities. This means that their development may be affected as they will not be gaining a wide range of skills. In some settings not enough equipment or resources are put out and so children's play is repetitive or quite limited (Batt, 2013).

Learning may be limited: The main disadvantage of child-initiated play is that learning may be limited because children may not want adults to be involved in their play. As we have seen, adults can help children learn concepts such as numbers or problem solving. Adults also help children complete complex tasks such as building a den (Batt, 2013).

2.4.5.4 Parent-Child Cooperative Play

Imagine what happens when we design a parent-child toy that is not biased towards parent-led factor or child-initiated factor. Such parent-child play will be a more equal form, which is between a parent-led parent-child play and a child-initiated parent-child play. I call this parent-child cooperative play. I use cooperative play as a reference for parent-child cooperative play, and add unique features of parent-child play at the same time. This is the third type of play which belongs to parent-child play, that is, 50% parent participation and 50% children participation. Research on the advantages of parent-child cooperative play will be helpful to build the framework of my guidelines.

2.4.5.4.1 Advantages and Tips of Parent-Child Cooperative Play

Cooperative play develops several important skills, such as sharing, taking turns and following instructions, all of which help them get along with others in social situations (Loebenberg, 2013). Children can learn the following benefits by playing parent-child cooperative play:

Sharing: It helps the child know how to share with parents or others (Ryan, 2018).

Taking turns: It helps the child know about how to take turns with other, although it takes a great deal of impulse control for a young child to be able to give up something they want and wait. Parents can start small by taking turns rolling a ball back and forth, which will help toddler understand that they will get a chance very soon (Ryan, 2018).

Obeying rules: It's a good way to introduce the fact that all games have rules and everyone needs to follow them, although it may frustrate the child sometimes and it may seem a bit cruel. One of the best ways to teach toddlers about rules is to not let them win all the time (Ryan, 2018).

Teamwork: It helps develop children's teamwork via parent-child cooperative play. The child might not be old enough to help with household chores, but parents can promote collaborative behavior by picking up toys together (Ryan, 2018).

Negotiating: Children can pick up how to negotiate with others via parent-child cooperative play. This is a skill that is best learned through modeling. Give the child a cracker and reach for their slice of cheese. It will take a while for a child to understand the give and take, but eventually, it will become ingrained (Ryan, 2018).

2.4.5.4.2 A Good Example of Parent-Child Cooperative Play

Doing chores together is a good example of parent-child cooperative play in daily life. Parents should show children the importance of cooperation by giving their small tasks around the home. "Children learn how to be responsible and cooperative by having responsibilities around the house," says Dr. Susan Smith Kuczmariski (2014, p. n.d.) Parent and the child can do chores together such as cleaning up toys, setting the table, sorting the laundry. As Table 2. 14 shows, this is the chore chart that children can try from two to seven years old.

Chore Chart		
2~3 years old	4~5 years old	6~7 years old
	Previous chores plus	
Help make bed	Make bed	Sort laundry and put in drawers
Put clothes in hamper	Help clear table	Help make& pack lunch
Pick up and put away books and toys	Empty wastebaskets	Help set & clear table
Fill pet's dish	Water flowers	Help put groceries away
	Help unload utensils	Sweep floors
	Fiz bowl of cereal	Help load dishwasher

Table 2. 13 Chore Chart for 2~7-Year-Old Children (Our Behavior Chart Team, 2017)

I set some examples of chores for 2~3-year-old, 4~5-year-old, 6~7-year-old respectively:

Toy Clean Up (2~3 years old) - Create a “stop” and “go” command to set up the goal for children. For instance, challenge them to pick up as many toys as they can in five minutes.

During this game, children can learn to sort toys by color or group them by style and how to put each in a certain place (Rock, 2019).



Figure 2. 20 Toydozer

Yard Work (4~5 years old) - Challenge your preschooler to pick up as many small twigs as they can after a wind storm. Parents can ask them to help plant flowers or seeds in the

garden and explain which vegetables they get to eat when the plant grows. They can continue to help in small ways as the garden matures (pulling weeds) and learn the cycles of nature (Rock, 2019).



Figure 2. 21 Yard Work

Laundry (6~7 years old) - Folding the laundry with parents can teach them how to identify a matching pair of socks and sort one family member's clothes from another (Rock, 2019).



Figure 2. 22 A Child is Matching Socks

2.5 Types of Toy

2.5.1 Infant Toy

Parents: Parents are the best developmental toy for infants. Especially during the first three months, –face, touch, voice – are the best “toy”. In fact, one-on-one time is important for kids of all ages. The Canadian Mental Health Association says spending time with parents and grandparents helps children develop healthy self-esteem and self-confidence. Feeling connected with other family members, and knowing their family history and heritage provides a strong foundation that encourages children and teens to explore the world and try new things (Viau, 2017).

Rattles, Bath Toys, Stuffed Animals: Sounds and textures are essential elements of sensory development. Toys like rattles and stuffed animals offer babies sensory response activities to help develop hand-eye coordination, and a first understanding of the spatial environment surrounding them. Even newborns enjoy exploring the feeling of new textures. Bath toys come with a bonus – babies love playing in water (Viau, 2017).

Hand Puppets: Hand puppets are a delightful way to encourage interaction and communication in even very young children. Hand puppets can be “guides” to all sorts of learning adventures, and enhance the bonding process with parents and grandparents (Viau, 2017).



Figure 2. 23 Hand Puppet

Cloth and “Board” Books: Books with simple images and bright colors accomplished with parents’ attractive voice (Viau, 2017).

2.5.2 Toddler Toy

Sorting and Nesting Toys, Buckets, Blocks, Stacking Rings, Shape Sorters, Pop-Up Toys, Simple Puzzles: These kinds of toys help kids learn to make choices, understand patterns, solve problems and develop competence and confidence. They can be simple toys that require learning new motor skills, sequence or color recognition or hand-eye coordination – for example: turning a jack-in-the-box handle, or putting things in a bucket and taking them out again (Viau, 2017).

“People” Play Sets & Playing House Toys: Play sets with little “people” or dolls, animals, houses and cars expand toddler’s language and communication skills, and help them make sense of their world by imitating adult behavior. They encourage imaginative play, the development of fine motor skills and problem-solving (Viau, 2017).

Musical Toys: Musical toys encourage creativity and artistic expression, and can help encourage a life-long love of music (Viau, 2017).

Simple Board and Card Games: At this age, children are beginning to learn what it means to take turns and play by the rules, important elements of successful social interaction. Simple, colorful interactive games which don't take too long to play can make it fun (Viau, 2017).

2.5.3 Preschooler Toy

Dress-Up Clothes and Toys for “Pretend Play”: A knight or a pirate, a princess, a superhero or a fairy. When kids get into dress-up, their imaginations grow and blossom, and creativity is an essential part of the story-based play (Viau, 2017).

Dress-Up Play is actually critically important to a child's development. It fosters the imaginative processes and allows for play without rules or scripts. Dressing up means experimentation, fantasy and role playing. But it can also help parents and caregivers learn about inner conflicts or difficulties a child may be experiencing, depending on the roles they assume and how they handle conflicts and problem-solving in their “make believe” world (Viau, 2017).

Crayons, Pencils, Paints, Modeling Clay and Other Art Supplies: Along with encouraging the development of fine motor skills, open-ended creative play – blank paper and crayons or paints, modelling clay, building blocks – encourages children to use their imaginations, inspiring creativity and self-confidence (Viau, 2017).

Books: Books provided the vocabulary which is age-appropriate, encourage communication skills and promote imagination and literacy (Viau, 2017).

Dolls & Dollhouses: The world of pretend play is very important for children in the early developmental years. It provides a chance for them to use their imaginations in reality-based settings, and they get to be “in charge”, to make their doll’s world work the way they’d like it to go. All the while, as they’re just being kids and having fun, they’re practicing and developing new social skills and reinforcing the values they’ve learned.

“Non-Electric” Cars, Trucks, Tractors, Trains and Airplanes: Encourage imagination and creativity.

Simple Puzzles: Choose puzzles with large pieces that are easy-to-fit-together. From 9 to 64 piece puzzles are ideal, depending on the age, attention span and dexterity of the child.

Chapter 3 Guidelines

Based on the literature review, guidelines are designed to help designers incorporate the parent-child factors into toy design.

These guidelines can help toy designers to choose what kind of parent-child toy they want to design, based on the chosen advantages of parent-led play, parent-child cooperative play and child-initiated play. Then they can adjust the parent-led factors and child-initiated factors to let the toy have a better effect of play. Figure 3. 1 is the guidelines. Due to the limited space, the expansion of each factor is shown in Figure 3. 2 and Figure 3. 3 and the specific methods will be explained in Section 3. 4. 1 and Section 3. 4. 2.

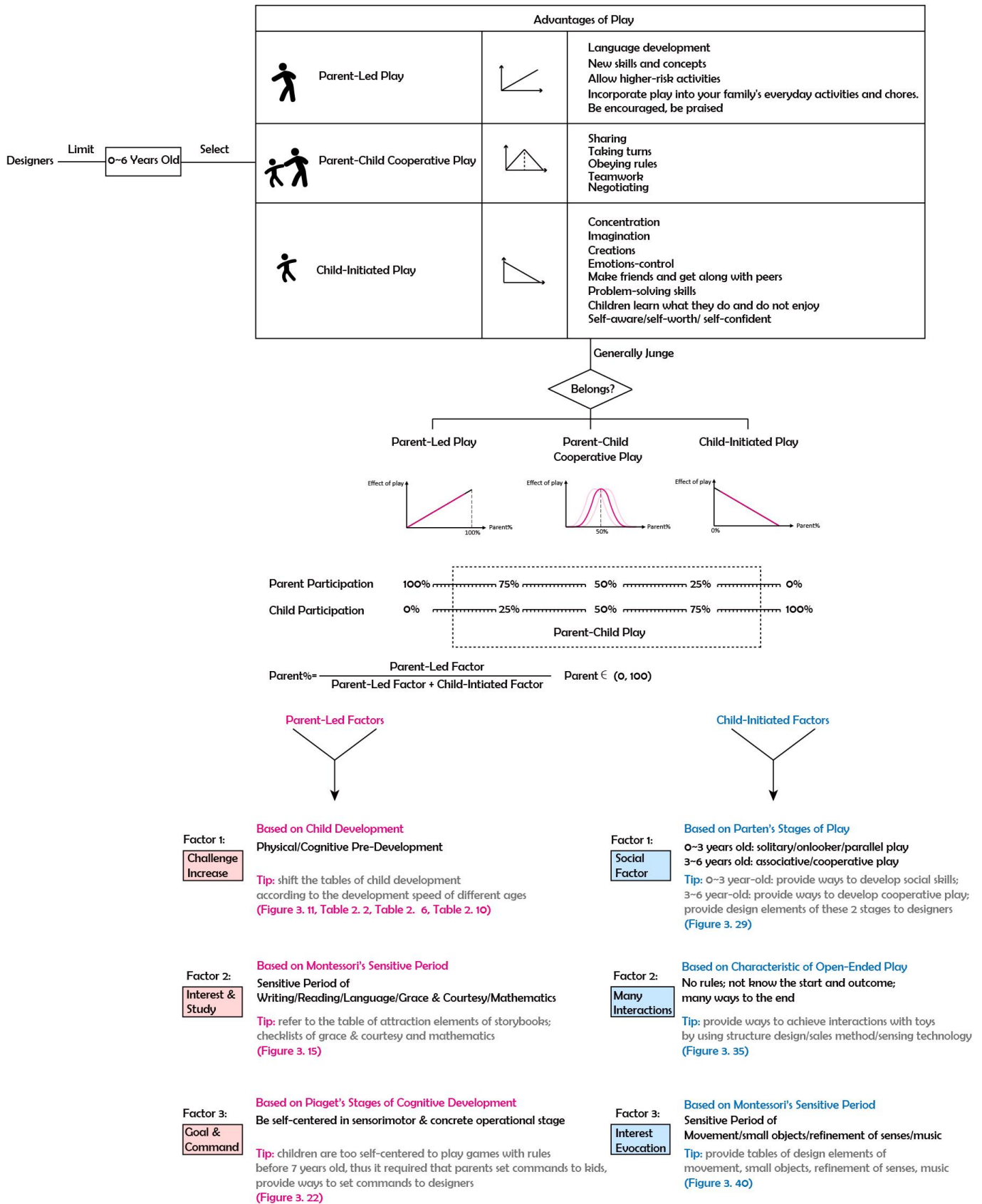


Figure 3. 1 Guidelines to Incorporate Parent-Child Factors in Toy Design

Factor 1:
Challenge Increase

Based on Child Development
Physical/Cognitive Pre-Development

Tip: shift the tables of child development according to the development speed of different ages (Figure 3.11, Table 2.2, Table 2.6, Table 2.10)

Infant Physical Development		Infant Physical Development	
0-3months	1 See objects 8-19 inches away but can't make out details or the full color spectrum	0-3months	1 See objects 8-19 inches away but can't make out details or the full color spectrum
	2 Show excitement by waving his or her arms and legs		2 Show excitement by waving his or her arms and legs
	3 Be able to support oneself on elbows and raise the chest while on his or her tummy		3 Be able to support oneself on elbows and raise the chest while on his or her tummy
3-6months	4 Reach for things, with your help	3-6months	4 Reach for things, with your help
	5 Reach out and grasp toys		5 Reach out and grasp toys
	6 Sit up - with a little support		6 Sit up - with a little support
6-9months	7 Creep on his or her tummy	6-9months	7 Creep on his or her tummy
	8 Crawl in both directions—maybe even while holding something		8 Crawl in both directions—maybe even while holding something
	9 Catch a ball if it's rolled right to him or her		9 Catch a ball if it's rolled right to him or her
9-12months	10 Try walking, with hand-holding help from you	9-12months	10 Try walking, with hand-holding help from you
	11 Stand unassisted and cruise along furniture		11 Stand unassisted and cruise along furniture
	12 Move a toy out of the way to get to another one		12 Move a toy out of the way to get to another one

Toddler Physical Development		Toddler Physical Development	
1-1.5years	1-1.5 Become a confident walker	1-1.5	1-1.5 Become a confident walker
	1.5-2 Be on the move, walking and running		1.5-2 Be on the move, walking and running
1.5-3years	2-2.5 Build with blocks and tuck a stuffed animal into bed	1.5-3	2-2.5 Build with blocks and tuck a stuffed animal into bed
	2.5-3 Hop, jump and climb stairs one foot at a time		2.5-3 Hop, jump and climb stairs one foot at a time

Preschooler Physical Development		Preschooler Physical Development	
3-6years	3-4 Love to move—and even find it hard to be still!	3-4	3-4 Love to move—and even find it hard to be still!
	4-5 Learn to swim, skate, dance, ski and bounce on a trampoline		4-5 Learn to swim, skate, dance, ski and bounce on a trampoline
	5-6 Have better physical coordination for more complex actions		5-6 Have better physical coordination for more complex actions

Factor 2:
Interest & Study

Based on Montessori's Sensitive Period
Sensitive Period of Writing/Reading/Language/Grace & Courtesy/Mathematics

Tip: refer to the table of attraction elements of storybooks, checklists of grace & courtesy and mathematics (Figure 3.15)

Step 1: Select One Interest which Need to be Stimulated by Parents' Teaching

Step 2: Refer to Design Elements that Children are Attracted by Writing/ Reading/ Language

Story Reader	Physical Development	Cognitive Development	Social-Emotional Development
Infant	Develop fine motor skill	Soft cloth, high contrast, bright color chewed on, tossed, dragged around, pulled on to develop sensory skill	
Older Infant		Soft and furry with lots of texture, scents and even mirrors	Dee-dee-boo, pop-up or lift-the-flap books, books with hidden surprises
Toddler		Imagination, learning	Mealtime, saying goodbye and other routine activities.
Preschooler		ABC books, counting books, simple information books about dinosaurs, trains, trucks, animals, insects, geography or construction	Problem-solving, real-life circumstances, sharing, friendship

Step 3: Refer to Additional Checklists

Additional Checklist for Grace & Courtesy

- Demonstration is the most important technique
- Role-playing is another useful technique
- Discussion is effective
- Practical-life activities can easily be prepared for a home
- Silence game is also helpful
- Parents should always praise instead of criticize

Additional Checklist for Mathematics

- Understanding size, shape, and patterns
- Ability to count verbally
- Recognizing numbers
- Identifying more and less of a quantity
- Understanding one-to-one correspondence

Factor 3:
Goal & Command

Based on Piaget's Stages of Cognitive Development
Be self-centered in sensorimotor & concrete operational stage

Tip: children are too self-centered to play games with rules before 7 years old, thus it required that parents set commands to kids, provide ways to set commands to designers (Figure 3.22)

Step 1: Choose One Way to Incorporate Parents' Commands During Play

Step 2: Check if It Meets Tips for Parents' Commands

- Be direct
- Be close
- Use clear and specific commands
- Give age-appropriate instructions
- Give instructions one at a time
- Keep explanations simple
- Give kids time to process

Figure 3. 2 The Expansion of Three Parent-Led Factors












Factor 1:

Social Factor

Based on Parten's Stages of Play

0-3 years old: solitary/onlooker/parallel play
3-6 years old: associative/cooperative play

Tip: 0-3 year-old: provide ways to develop social skills;
3-6 year-old: provide ways to develop cooperative play;
provide design elements of these 2 stages to designers (Figure 3. 29)

Social-Emotional Development (0-6 Years Old)		Design Elements
Month Infant (0-1 Years Old)		Infant Toy Design
 0-3months  3-6months  6-9months  9-12months	1 Be comforted by gentle rocking 2 Smile at people and coo 3 Recognize Mommy, and be interested in other faces 4 Laugh, squirm and squeal with delight 5 Smile at other babies—and his own reflection 6 Love peek-a-boo and pat-a-cake 7 Recognize names of people and things 8 Smile back at others 9 Recognize familiar faces 10 Enjoy games like peek-a-boo 11 Babble with inflections of actual language 12 Mimic others' actions, like talking on the phone	Mirror
	Year Toddler (1-3 Years Old)	Toddler Toy Design
	 1-1.5years  1.5-2years  2-2.5years  2.5-3years	1-1.5 Show affection with hugs, kisses, smiles and pats 1.5-2 Express a range of moods, from joy to frustration to jealousy 2-2.5 Become more social with other children 2.5-3 Enjoy mimicking the actions of others
Year Preschooler (3-6 Years Old)	Preschooler Toy Design	
 3-4years  4-5years  5-6years	3-4 Like to dress up or pretend to be someone else 4-5 Begin to grasp that people have different experiences and feelings 5-6 Develop stronger friendships, empathy developed	Role-play, dress-up clothes Sharing Take turns, cooperate

Factor 2:

Many Interactions

Based on Characteristic of Open-Ended Play

No rules; not know the start and outcome;
many ways to the end

Tip: provide ways to achieve interactions with toys
by using structure design/sales method/sensing technology (Figure 3. 35)

Ways to Apply Many Interactions during Play

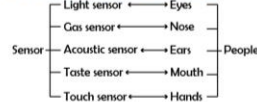
Interactions based on structure

Modularity
Transformation

Interactions based on sales

Expansion Set

Interactions based on sensing technology



Factor 3:

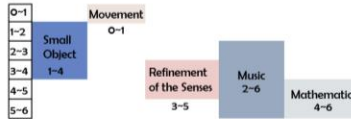
Interest Evocation

Based on Montessori's Sensitive Period

Sensitive Period of Movement/small objects/refinement of senses/music

Tip: provide tables of design elements of movement, small objects, refinement of senses, music (Figure 3. 40)

Step 1: Select One Spontaneous Interest which can be Attracted by Toys



Step 2: Select corresponding design points

Small Object		
Outdoor insects, pebbles, stones and grass	Life materials spot on father's tie, a specs of lint on the carpet	Toy brick, model animal, puzzle, fishing game, stick game
Action pinch, pick up, put in mouth, smell, taste, observe, match, pile up, balance, align, sort		
Interest point observe nature, details explore new things love different texture		
parents,	home decoration,	bright color,
surrounding environment		high contrast, animals hand-eye coordination
Requirement safe, nontoxic, not easy to lose,		
Movement		
Grasping ring, handle, cord, squeeze, bell, circle, hang	Touching button, texture, textile toy, rubber	Turning rattle, music
Balancing walker, bouncing chair	Crawling play tunnel, crawl rollerbar, wheeled toy	Walking walking toy, push and pull
Requirement easy to take, safe, nontoxic, stimulate senses, smooth and rounded		
Refinement of the Senses		
Sight bright, contrast primary colors, drawing	Hearing music, keyboard mallet loud speaker,	Smell nontoxic
Taste biteable	Touch rounded, smooth, shapes, modeling clay	
Requirement Follow cognitive development: mix multiple senses at the same time		
Music		
Singing microphone, singing doll, melody, rhythm	Listening loud speaker, button to switch	Action mallet, drum, biteable play the instrument dance with music
Shape Shape of music instrument & action figure		
Requirement Cheerful; hearing protection;		

Step 1 (Age Range Limitation): As Figure 3. 4 shows, the first step is to choose the target users between zero and six years old. As it is mentioned in Chapter 2, compared with other age ranges, zero to six years old is a period that is more suitable to use parent-child toys to cultivate parent-child relationship. Thus parent-child toy designer should limit the target users within 0~6 years old. However, designers can choose whatever age range is required. For example, designers can choose 2~4 years old as their target users.

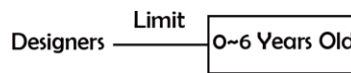


Figure 3. 4 Step 1 of Guidelines

Step 2 (Choice of Advantages): As Figure 3. 5 shows, the second step is to provide the advantages of parent-led play, parent-child cooperative play and child-initiated play to let designer select what types of play they want to design. According to the result of the chosen advantages, designers can decide on which type of parent-child play they want to design.

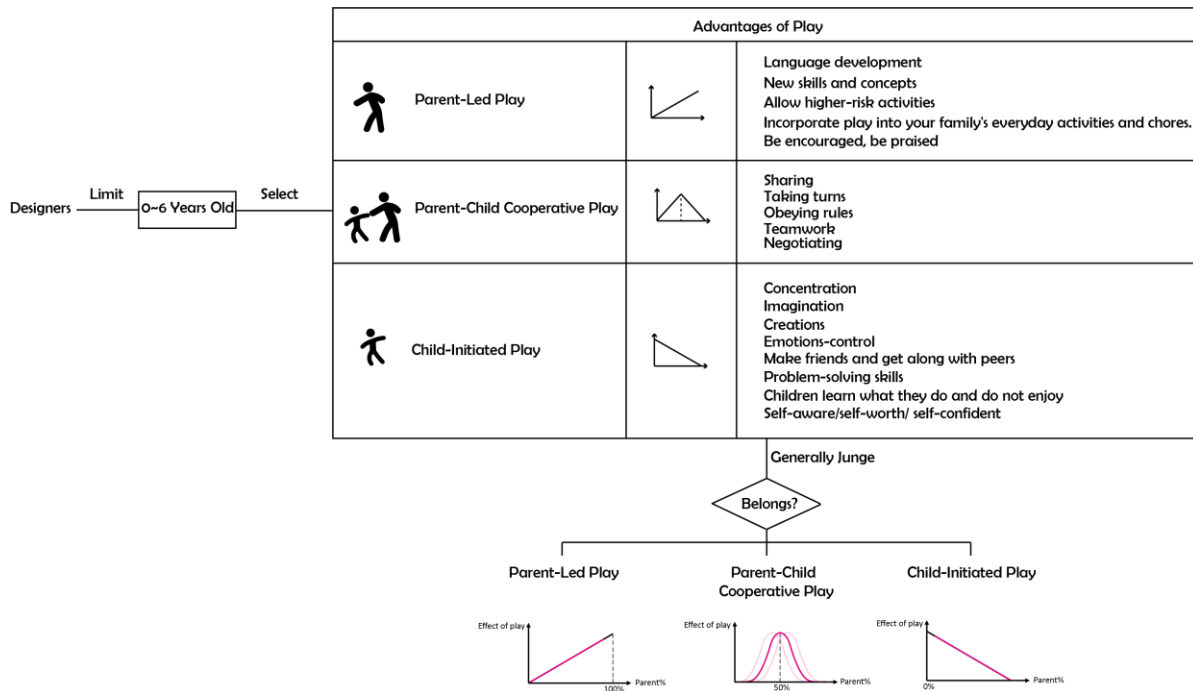


Figure 3. 5 Step 1 & Step 2 of Guidelines

Step 3 (Parent-Led & Child-Initiated Factors Adjustment): As Figure 3. 6 shows, after the designer has decided on which type of play they want to design, the third step is that they can adjust the parent-led factors and child-initiated factors they want to apply.

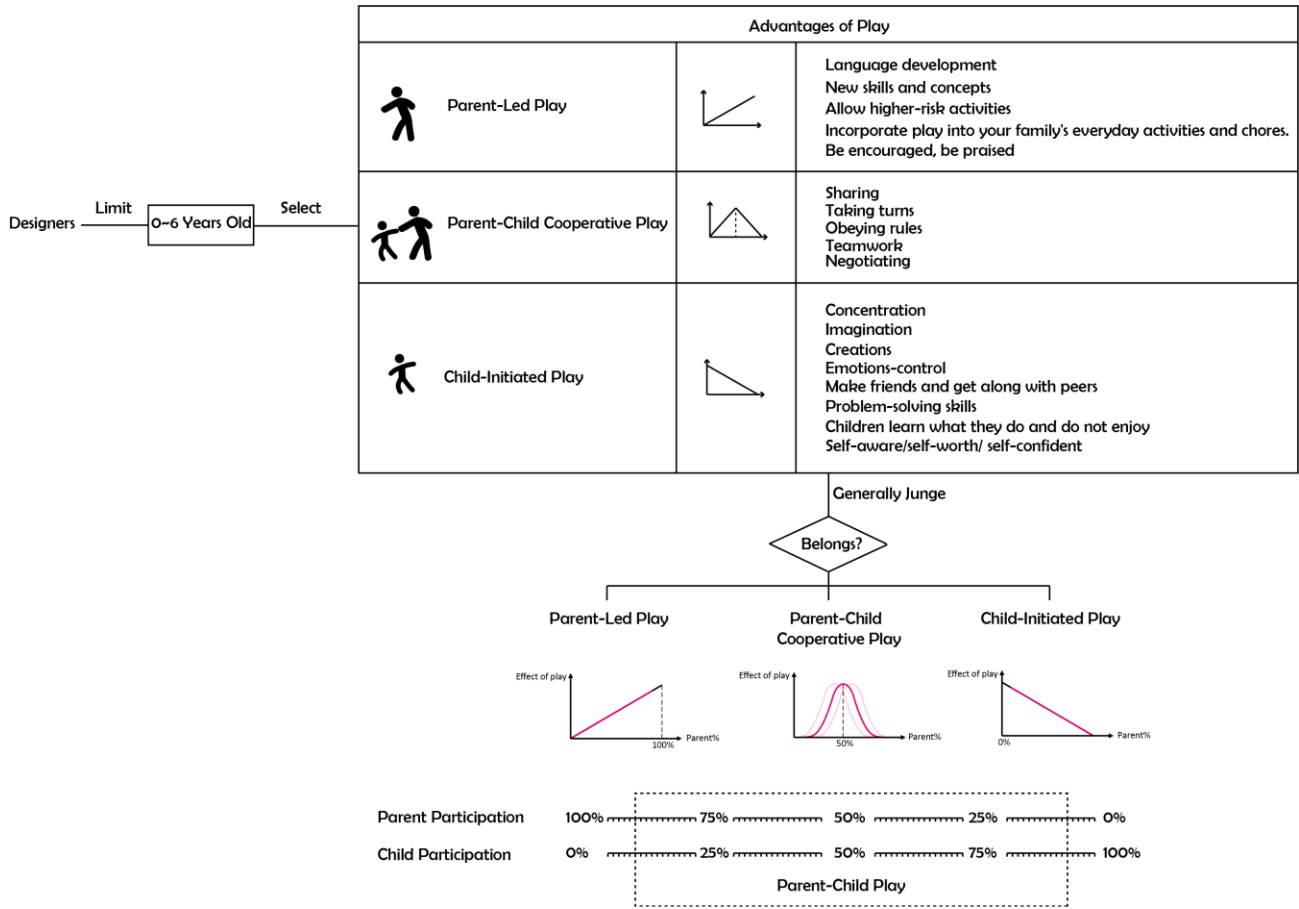


Figure 3. 6 Step1, Step 2 & Step 3 of Guidelines

Step 4 (Percentage Parent-Led Decision): As Figure 3. 7 shows, the fourth step is that designers decide on the parent% for the parent-child toy and choose the corresponding number of parent-led factors and the corresponding number of child-initiated factors. Designers can choose whatever parent-led factors and whatever child-initiated factors they want to achieve the ratios they anticipate.

Step 4 includes **3 Parent-Led Factors** (Challenge Increase/ Interest and Study/ Goal & Command) and **3 Child-Initiated Factors** (Social/ Much Interaction with Toys/ Interest Evocation) to decide on the equation; How each factor is derived and what the designer will do after selecting one of the factors will be explained in detail.

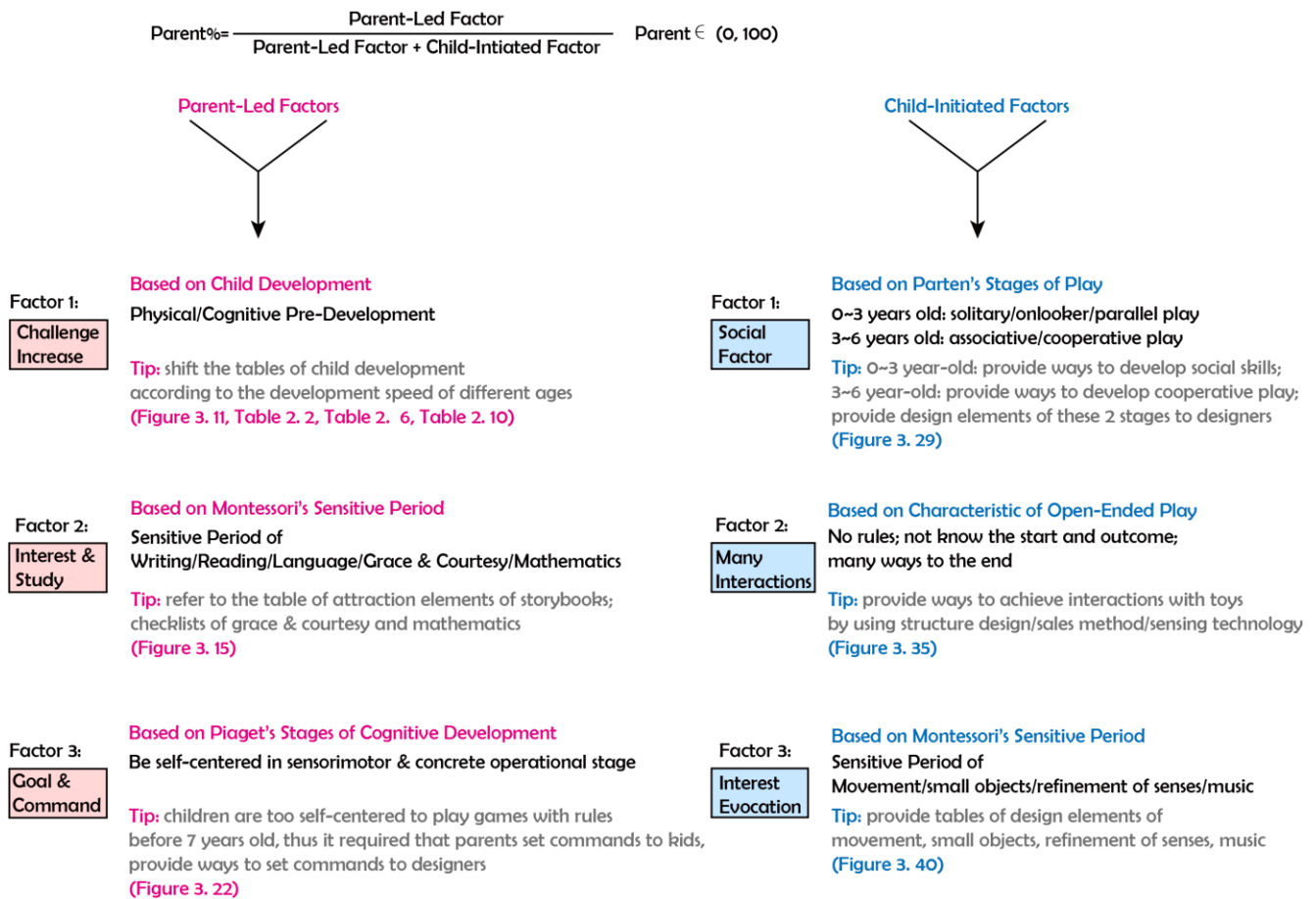


Figure 3. 7 Step 4 of Guidelines

3.1 Step 1 (Age Range Limitation)

In Step 1, designers decide on the age range for the parent-child toy.

From the research on the parent-child relationship during people's lifetime, 0~3 years old is the period to set up security. During this time the child and the parents will generate a powerful attachment. At 3~6 years old, children are generating characteristics that will be present for their whole life; thus a good parent-child relationship is very important for the child's development. Between 6~12 years old, with the characteristics have generated at this time; also, with the addition of peers and teaching, children become detached from their parents. From 12~18 years old, children enter puberty, and it is hard to develop parent-child relationship for a variety reasons. From 18~25 years, their relationship recovers. After 25 years old, they give back to their parents. According to this information, Figure 3. 8 is created to describe the development stage of parent-child relationship in the literature review.

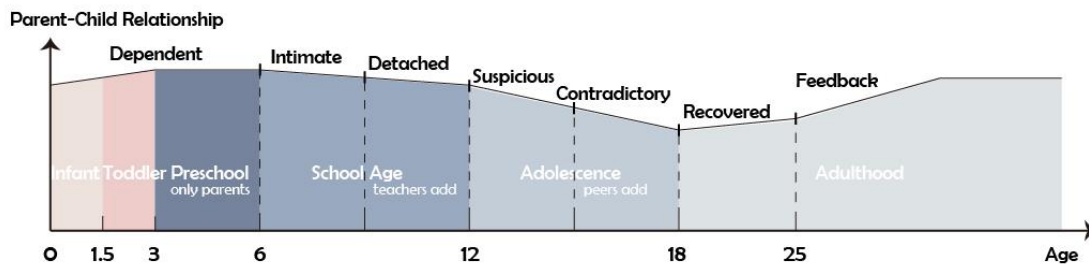


Figure 3. 8 The Development Stage of Parent-Child Relationship

Finally, according to the above research, compared with other age ranges, 0 to 6 years old is a period that is more suitable to use parent-child toys to cultivate parent-child relationship.

Designers can subdivide age ranges according to their need. They can subdivide into infant period (0~1 years old), toddler period (2~3 years old), preschooler period (3~6 years old). They can subdivide in other ways as long as the range is within 0~6 years old.

3.2 Step 2 (Choice of Advantages)

The second step is to provide the advantages of parent-led play, parent-child cooperative play and child-initiated play to let designer select what types of play they want to design.

According to the result of the chosen advantages, designers can decide on which type of parent-child play they want to design. Here, a table of advantages of three kinds of parent-child play are created. Designers can choose what kind of advantages they anticipate their toys to have.







Advantages		
 Parent-Led Play		Language development New skills and concepts Allow higher-risk activities Incorporate play into your family's everyday activities and chores. Be encouraged, be praised
 Parent-Child Cooperative Play		Sharing Taking turns Obeying rules Teamwork Negotiating
 Child-Initiated Play		Concentration Imagination Creations Emotions-control Make friends and get along with peers Problem-solving skills Children learn what they do and do not enjoy Self-aware/self-worth/ self-confident

Table 3. 1 Advantages of Three Kinds of Parent-Child Play

3.3 Step 3 (Parent-Led & Child-Initiated Factors Adjustment)

There are three types of play. They are parent-led, parent-child cooperative play, child-initiated play. To the extreme, the parent-led play has 100% of parent-led factors and 0% of child-initiated factor. Also to the extreme, the child-initiated play has 0% of parent-led factor and 100% of child-initiated factors. The parent-child cooperative play has 50% of parent-led factors and child-initiated factors. Within the range of dotted lines belong to parent-child play. Parent-led parent-child play, parent-child cooperative play, and child-initiated parent-child have their

spectra respectively. For example, if designers select 4 advantages of parent-led play, 2 advantages of parent-child cooperative play and 1 advantage of child-initiated play, designers should apply more parent-led factors to control the parent percentage between 50% and 100% (not including 50% and 100%).

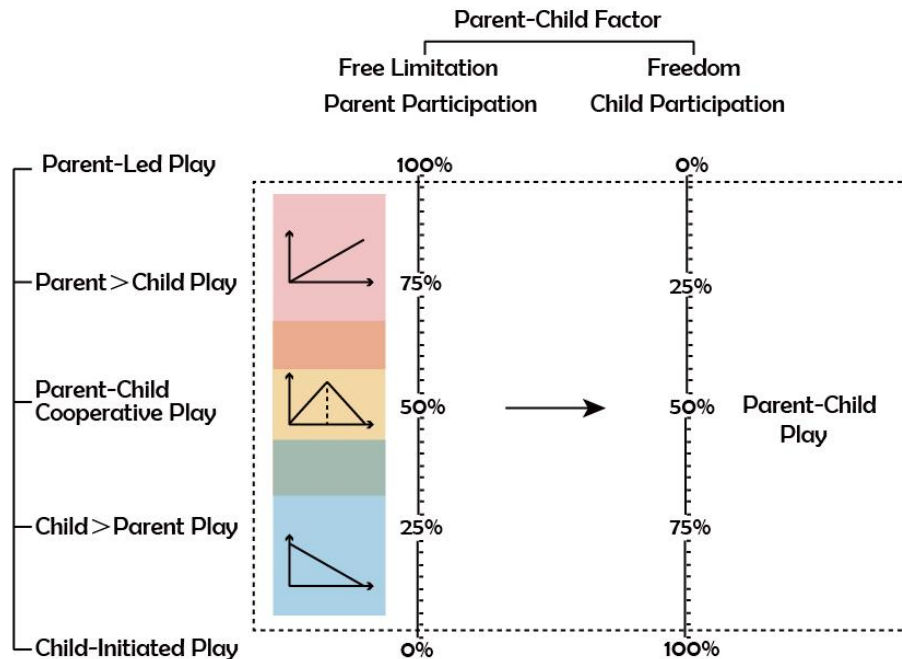


Figure 3. 9 Spectra of Parent-Child Play

Parent-Led Parent-Child Play: The red area belongs to parent-led parent-child play whose parent percentage is more than 50% (not including 50%) and less than 100% (not including 100%). The designer can judge whether the expected toy belongs to the red area according to the chosen advantages and adjust the parent-led factors and child-initiated factors relatively freely.

Parent-Child Cooperative Play: The yellow area belongs to parent-child cooperative play whose parent percentage is around 50%. The designer can judge whether the expected toy

belongs to the yellow area according to the chosen advantages and adjust the parent-led factors and child-initiated factors relatively freely. If there are some advantages of parent-led play besides advantages of parent-child cooperative play, designers can make the parent-child cooperative play more parent-led; or if there are some advantages of child-initiated play besides advantages of parent-child cooperative play, designers can make the parent-child cooperative play more child-initiated. But it is still regarded as parent-child cooperative play. It is important to note that parent-child cooperative play is different from cooperative play with others. Parent-child cooperative play can start from the infancy period. Babies begin to engage in back-and-forth interactions -- the building blocks to cooperation -- at around six to nine months (National Research Council, 2015). Dr. Loebenberg (2013) suggests taking this opportunity to encourage turn-taking as a parent plays with the child, playing back-and-forth games, such as peekaboo and pat-a-cake.

Child-Initiated Parent-Child Play: The blue area belongs to child-initiated parent-child play whose parent percentage is more than 0% (not including 0%) and less than 50% (not including 50%). The designer can judge whether the expected toy belongs to the blue area according to the chosen advantages and adjust the parent-led factors and child-initiated factors relatively freely.

Four examples are used to explain how to use that spectrum above (Figure 3. 9) when the designer is designing a parent-child toy.

Designer A: Designer A wants to design a parent-child story book (story book belongs to parent-led play). He or she can slide down to reduce parent-led factors to add child-initiated factors to make story book become a parent-child product.

Designer B: Designer B wants to design a parent-child open-ended game (open-ended game belongs to child-initiated play). He or she can slide up to add parent-led factors to reduce child-initiated factors to make the open-ended game become a parent-child game.

Designer C: Designer C wants to design a parent-led parent-child cooperative game. He or she can add more parent-led factors than child-initiated factors to achieve a parent-led parent-child cooperative game.

Designer D: Designer D wants to design a child-initiated cooperative game. He or she can add more child-initiated factors than parent-led factors to achieve a child-initiated parent-child cooperative game.

3.4 Step 4 (Decision on Parent Percentage)

After designers have decided on which type of play they want to design, they can adjust the parent-led factors and child-initiated factors according to the equation.

$$\text{Parent\%} = \frac{\text{Parent-Led Factor}}{\text{Parent-Led Factor} + \text{Child-Initiated Factor}} \quad \text{Parent} \in (0, 100)$$

Figure 3. 10 Equation of Parent-Child Play

Designers can get the exact parent % they want by choosing ratios of parent-led factors and child-initiated factors. For example, if a designer wants to have 25% parent-led factors to parent-child play, the designer can choose whatever one of parent-led factors and whatever three

of child-initiated factors to make the ratios 1:4. How each factor is derived and what the designer will do after selecting one of the factors will be explained in detail in Section 3.4.1 and Section 3.4.2.

3.4.1 Parent-Led Factors

3.4.1.1 Parent-Led Factor 1 (Challenge Increase):

Parent-led Factor 1 is concluded based on two aspects from the literature review, that is, advantages of parent-led play and child development. Firstly, advantages of parent-led play are listed. It has many advantages that child-initiated play cannot replace. Secondly, tables of child development are listed and some relations between advantages of parent-led play and child physical and cognitive development are found. After listing these two aspects, the method will be shown to designers how to use parent-led Factor 1 (Challenge Increase) if they choose it.

3.4.1.1.1 Derivation Process of Parent-Led Factor 1 (Challenge Increase)

3.4.1.1.1.1 Advantages of Parent-Led Play

There are three advantages of Parent-Led Play, they are:

It allows higher-risk activities

It enables children to learn new skills and concepts

It helps language development

In conclusion, parent-led factors can be added into parent-child toy if designers increase the challenge of the toy.

3.4.1.1.1.2 Child Development

The advantages of parent-led play correspond to the child physical and cognitive development. Firstly, parent-led play allows higher-risk activities. The activities here mainly refer to physical activities. So, the first advantage has some relations with child physical development. Secondly, parent-led play enables children to learn new skills and concepts and helps children’s language development. So, the second and third advantages have some relations with child cognitive development. As a result, designers can increase the challenge of toys by shifting the table of the child physical and cognitive development. In Section 2. 3, many tables of children physical and cognitive development have been made, so designers can use those tables.

As the Table 3. 2 shows, when infants are 10 months old, they can try walking with hand-holding help from parents. As a result, if designers want to design a parent-child toy for infants younger than 10 months old, they can put factors of walking into toy design because children can challenge higher-risk activities with the help of parents according to the first advantage of parent-led play.





Infant Physical Development	
 0~3months	<ol style="list-style-type: none"> 1 See objects 8-19 inches away but can't make out details or the full color spectrum 2 Show excitement by waving his or her arms and legs 3 Be able to support oneself on elbows and raise the chest while on his or her tummy
 3~6months	<ol style="list-style-type: none"> 4 Reach for things, with your help 5 Reach out and grasp toys 6 Sit up – with a little support
 6~9months	<ol style="list-style-type: none"> 7 Creep on his or her tummy 8 Crawl in both directions—maybe even while holding something 9 Catch a ball if it's rolled right to him or her
 9~12months	<ol style="list-style-type: none"> 10 Try walking, with hand-holding help from you 11 Stand unassisted and cruise along furniture 12 Move a toy out of the way to get to another one

Table 3. 2 Infant Physical Development (Fisher-Price, n.d.)

As the Table 3. 3 shows, when infants are 11 months old, they can understand that smaller objects fit in larger ones. As a result, if designers want to design a parent-child toy for infants younger than 11 months old, they can put factors of volume sensing ability into toy design because children can learn new concepts with the help of parents according to the second and third advantages of parent-led play.





Infant Cognitive Development	
 0~3months	1 Mimic simple facial expressions and, when someone speaks to her, looks intently 2 Learn that one event follows another 3 Know if something is familiar to her
 3~6months	4 Recognize familiar faces and take an interest in others 5 Be able to "multitask"—eg: babbling and reaching for something at the same time 6 Look for something that drops
 6~9months	7 Understand "in and out" 8 Start to connect two behaviors together 9 Use deliberate gestures, like waving bye-bye or lifting arms to say, "Pick me up!"
 9~12months	10 Anticipate the "surprise" phrase in favorite children's songs 11 Understand that smaller objects fit in larger ones 12 Understand much of what you say

Table 3. 3 Infant Cognitive Development (Fisher-Price, n.d.)

All the tables of infant, toddler and preschooler physical and cognitive development can be applied in this way.

3.4.1.1.2 Using Method with Parent-Led Factor 1 (Challenge Increase)

As a result parent-led Factor 1 is concluded as “challenge increase”. If designers choose this factor, they can increase the challenge of the toy to add the parent-led factor into toy design.

As Figure 3. 11 shows, the method is to shift the table of physical and cognitive development according to the need of design.

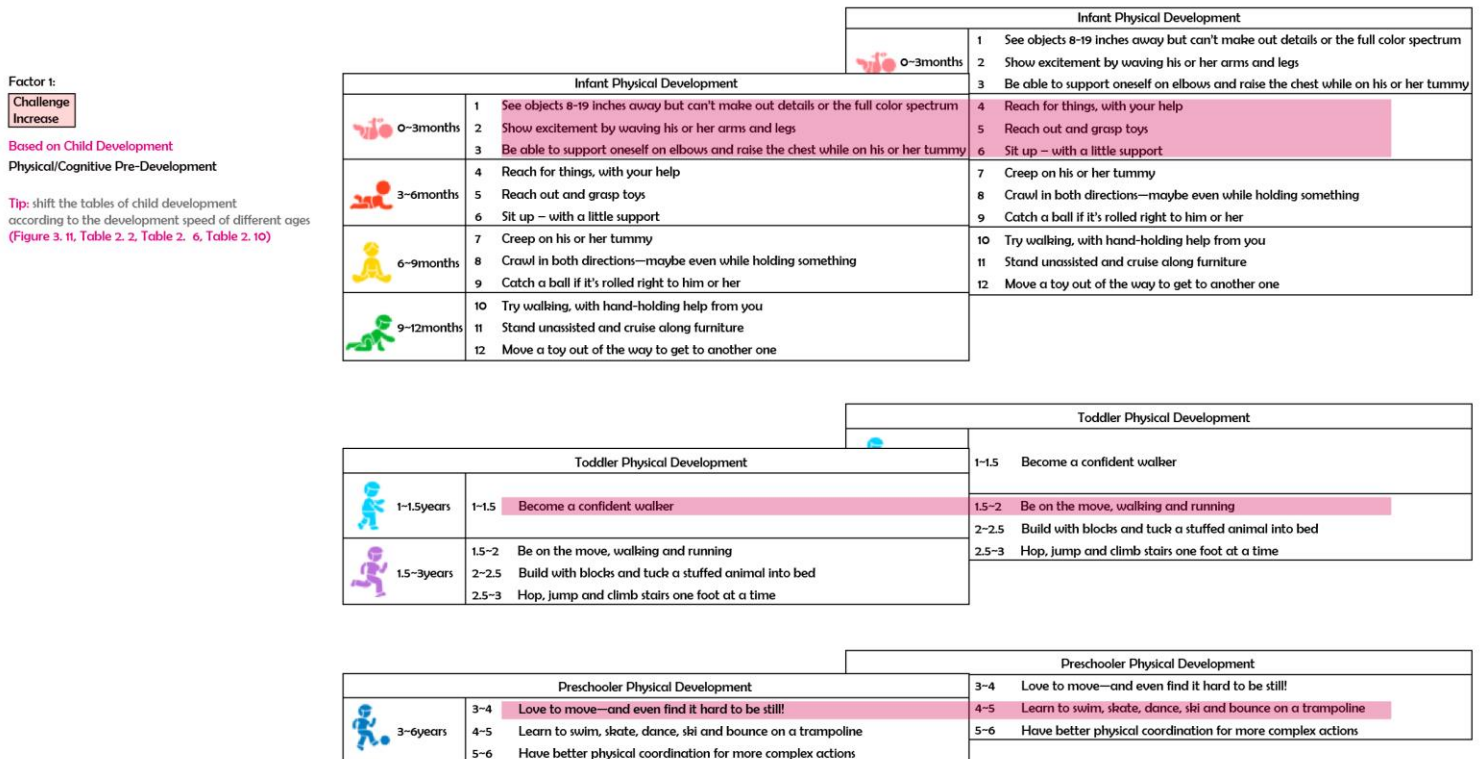


Figure 3. 11 Ways to Use Parent-Led Factor 1

For example, if designers want to design a parent-child toy for three to six-month-old infants, they can shift the table of physical and cognitive development by three months and check the development stage of six to nine-month-old infants on the table to increase the challenge of the toy. How many months designers should move forward requires designers to decide based on the specific types of toys and the specific age range of target users (children). Usually, the

younger the child, the greater the change. Thus from zero to six years old, the shift of the child development should go from less to more.

Also, designers should design the challenge step by step so that parents can adjust the challenge for children according to their reaction and acceptability. As Figure 3. 12 shows. The first column is the actual month of the child. Designers can shift the infant development by one month, two months or three months according to specific demand. However, it is worth noting if designers choose to shift the development by three months, designers had better provide the step-by-step challenge so that parents can control the challenge of the toy according to kids’ reaction and acceptability during the play. Because infant has individual differences, some infants can accept a shift by three months while others can’t. Parents are the best controller during parent-child play.

Actual Month	1 Month↑		2 Month↑		3 Month↑	
	1	2	1	2	1	2
1	2	3	4	5	6	See objects 8-19 inches away but can't make out details or the full color spectrum
2	3	4	5	6	7	Show excitement by waving his or her arms and legs
3	4	5	6	7	8	Be able to support oneself on elbows and raise the chest while on his or her tummy
						Reach for things, with your help
						Reach out and grasp toys
						Sit up – with a little support

Figure 3. 12 Challenge Increase of Infant Toys

3.4.1.2 Parent-Led Factor 2 (Edutainment/ Interest and Study):

Parent-led Factor 2 is concluded based on five aspects from the literature review, that is, Montessori’s Sensitive Period, design elements that children are attracted by story books, checklists of grace and courtesy, checklists of mathematics and Piaget’s Stages of Cognitive Development. Firstly, children’s sensitive period of learning, such as sensitive period of Writing,

Reading, Language, Grace & Courtesy, Mathematics which need to be stimulated by parents' teaching are listed. Secondly, story books for different ages are been studied, because it is a good example to incorporate parents' teaching into parent-child products. The design elements are summarized in the form of the table. Designers can find elements to attract children to learn via this table. Thirdly, checklists of grace and courtesy will be shown to designers if they choose grace and courtesy as attraction. Fourthly, checklists of mathematics will be shown to designers if they choose mathematics as attraction. Fifthly, the first two stages of cognitive development are listed to check if it meets child development. After listing these five aspects, the method will be shown to designers how to use parent-led Factor 2 (Edutainment/ Interest and Study) if they choose it.

3.4.1.2.1 Derivation Process of Parent-Led Factor 2 (Edutainment/ Interest and Study)

3.4.1.2.1.1 Montessori's Sensitive Period

Montessori sensitive periods refer to a period of time when a child's interests are focused on developing a particular skill or knowledge area. Maria Montessori (2013) describes as the child's absorbent mind, birth to age 6, as when most sensitive periods occur. This is exactly in line with my pre-set parent-child toy age range. There are five interests which need parents' lead to activate the interest of children. They are sensitive periods of **Writing, Reading, Language, Mathematics, Grace & Courtesy.**

Writing (3~4 Years Old) - Fascination with the attempt to reproduce letters and numbers with pencil or pen and paper. Montessori discovered that writing precedes reading (Montessori, 2013).

Reading (3~5 Years Old) - Spontaneous interest in the symbolic representations of the sounds of each letter and in the formation of words (Montessori, 2013).

Language (0~6 Years Old) - Use of words to communicate: a progression from babble to words to phrases to sentences, with a continuously expanding vocabulary and comprehension (Montessori, 2013).

Grace & Courtesy (2~6 Years Old) - Imitation of polite and considerate behavior lead to an internalization of these qualities into the personality (Montessori, 2013).

Mathematics (4~6 Years Old) - Formation of the concepts of quantity and operations from the uses of concrete material aids (Montessori, 2013).

As Table 3. 4 shows, the age spans of five different sensitive periods are marked. Designers can choose one of the interests according to the according to the age range of the target users. Ways to teach children to learn will be explained respectively next.

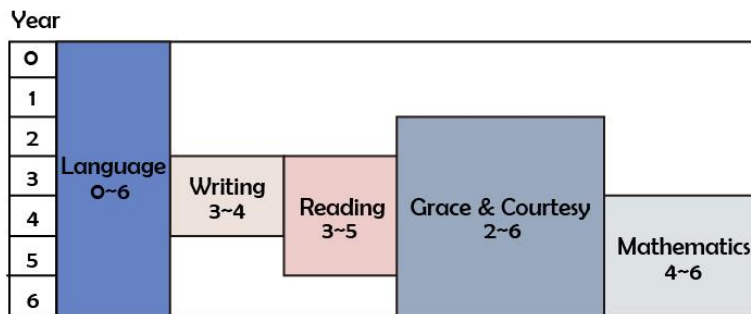


Table 3. 4 Sensitive Periods of Language, Writing, Reading, Grace & Courtesy, Mathematics

3.4.1.2.1.2 Design Elements that Children are Attracted by Story Books

Story books for different ages are been studied, because it is a good example to incorporate parent-led factors into parent-child products. Story books are divided into infant, older infant, toddler, preschooler story books and the specific attraction to children with different ages are been summarized in the form of the table in order to conclude attraction to parents' teaching (writing, reading, language, grace & courtesy, mathematics).

Books for Infants:

Sensory Development (Cognitive Development): Books with black-and-white designs or with bright colors and highly contrasting images would make it easier for infants to focus as children's eyes grow stronger (Nemours, n.d.).

Fine Motor Skill (Physical Development): Soft vinyl or cloth books are ones that infants can use in the bath. Books should be durable since they are chewed on, tossed, dragged around and pulled on (Nemours, n.d.).



Figure 3. 13 Cloth Book

Books for Older Infants:

Social-Emotional Development: Older babies enjoy peek-a-boo, pop-up or lift-the-flap books, as well as books with hidden surprises (Nemours, n.d.).

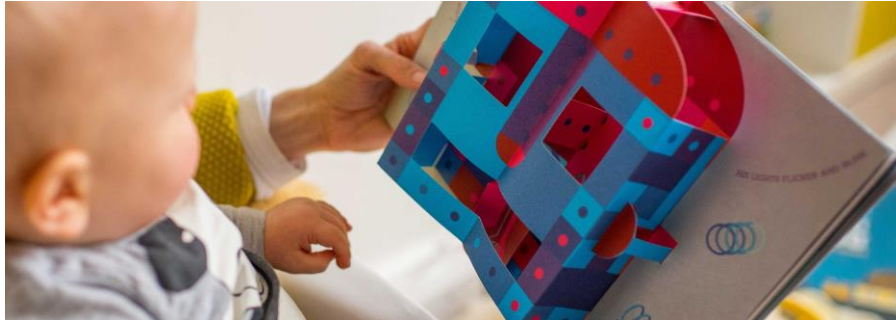


Figure 3. 14 Lift-The-Flap Story Book

Sensory Development (Cognitive Development): They like books that are soft and furry with lots of texture, scents and even mirrors (Nemours, n.d.).

Books for Toddlers (1~3 Years Old):

Imagination (Cognitive Development): Toddlers like small sturdy board books with a few or no words on the page. Books with no words allow children to make up their own stories and develop their imagination (Nemours, n.d.).

Learning (Cognitive Development): Concept books launch topics like animals, feelings, colors, numbers, shapes and letters. Predictable text, rhymes and stories with funny sounding words are all fun to read (Nemours, n.d.).

Social-Emotional Development: Books should be about familiar and comforting things like mealtime, saying goodbye and other routine activities (Nemours, n.d.).

Books for Preschoolers (3~6 Years Old):

Social-Emotional Development: Books should be selected that promote imagination and solve problems in a creative way. Young children enjoy books about real-life circumstances that

mirror their concerns. They enjoy stories about going to school, playing with friends and sharing with others (Nemours, n.d.).

Cognitive Development: ABC books, counting books and simple information books about dinosaurs, trains, trucks, animals, insects, geography or construction all promote cognitive development. A soothing bedtime story for sweet dreams is always a nice way to end the day.

Table 3. 5 is created to summarize the design elements of story books based on the above information. Designers can refer to it when they select parent-led Factor 2 (Interest and Study).

Story Reader	Physical Development	Cognitive Development	Social-Emotional Development
Infant	develop fine motor skill	high contrast color, bright color soft, gentle,durable, edible five senses stimulation	
Older Infant		soft, gentle with scents, with mirrors	peek-a-boo, pop-up or lift-the-flap, with hidden surprises
Toddler		imagination , learning words, with funny sounding words	routine activities about mealtime, saying goodbye
Preschooler		ABC books, counting books, simple information books about dinosaurs, trains, trucks, animals, insects, geography, construction	problem-solving, real-life circumstances , sharing, friendship

Table 3. 5 Design Elements that Children are Attracted by Story Books

For example, as Table 3. 5 shows, during the infancy period, infants are easily attracted by contrasting colors, thus designers should design parent-child toy with high contrast colors. Because infants like to chew on, toss, drag around and pull on anything, designers should design parent-child toy durable, edible. For another example, because toddlers like story books with a few or no words on the page, thus designers should design parent-child toys which can leave

space to help develop toddlers' imagination. Besides Table 3. 5, checklists of grace & courtesy and mathematics are provided next if designers mathematics and grace & courtesy as attraction.

3.4.1.2.1.3 Checklists of Grace & Courtesy

Besides referring to Table 3. 5, designers also need to pay attention to other aspects if designers choose grace and courtesy as attraction. From the Montessori method of education, there are a number of techniques that a parent or teacher can use in teaching children social graces. Methods are as follows (Chitwood, 2015):

Firstly, **demonstration** is the most important technique (Chitwood, 2015).

Secondly, **role-playing** is another useful technique (Chitwood, 2015).

Thirdly, **discussion** is effective. For example, parents can ask, “what should I say if I accidentally bump into someone?” Parents can make a discussion more interesting to the child by adding a silly twist to it (Chitwood, 2015).

Fourthly, **practical-life activities** can easily be prepared for a home (Chitwood, 2015).

Fifthly, **silence game** is also helpful, for example, parents can begin silence game by seeing who can sit the stillest (Chitwood, 2015).

Sixthly, parents should always **praise** instead of criticize (Chitwood, 2015).

In conclusion, **role-play** based on **practical-life activities** is attraction to grace and courtesy. If designers incorporate it into play, learning grace and courtesy will become a natural and fun process. Designers can refer to regulation of role play if they choose grace and courtesy as attraction.

3.4.1.2.1.4 Checklists of Mathematics

Besides referring to Table 3. 5, designers also need to pay attention to other aspects if they choose mathematics as attraction. Before children start school, they develop an understanding of addition and subtraction through everyday interactions; thus designers should learn what informal activities give children a head start when they start learning math in school. Children will study early mathematical concepts and skills in the first-grade which includes (Bowman et al., 2001):

Understanding size, shape, and patterns

Ability to count verbally (first forward, then backward)

Recognizing numerals

Identifying more and less of a quantity

Understanding one-to-one correspondence (i.e., matching sets, or knowing which group has four and which has five)

National Association for the Education of Young Child said, in high-quality mathematics education for three to six-year-old children, teachers and parents should:

Firstly, enhance children's natural **interest** in mathematics and their disposition to use it to make sense of their physical and social worlds (National Association for the Education of Young Child, 2010).

Secondly, provide for children's deep and **sustained** interaction with key mathematical ideas (National Association for the Education of Young Child, 2010).

Thirdly, **integrate mathematics with other activities** and other activities with mathematics (National Association for the Education of Young Child, 2010).

In conclusion, designers should enhance children's natural interest in mathematics by combining education with fun activities by referring to Table 3. 5, and provide for children's sustained interaction with mathematics. To be specific, toys should help children understand size, shape, and patterns; develop ability to count verbally; recognize numerals; identify more and less of a quantity; understand one-to-one correspondence before children enter primary school.

3.4.1.2.1.5 Piaget's Stages of Cognitive Development

Piaget's Stages of cognitive development (birth to six years old) are mentioned again in order to double check if it meets child cognitive development.

Stage 1: Sensorimotor Stage (0~2years)

During this initial phase of development, children utilize skills and abilities they were born with (such as looking, sucking, grasping, and listening) to learn more about the environment. In other words, they experience the world and gain knowledge through their senses and motor movements.

Stage 2: Preoperational Stage (2~7years)

During the preoperational stage, children also become increasingly adept at using symbols, as evidenced by the increase in playing and pretending. For example, a child is able to use an object to represent something else, such as pretending a broom is a horse.

3.4.1.2.2 Using Method with Parent-Led Factor 2 (Edutainment/ Interest and Study)

As a result parent-led Factor 2 is concluded as “attraction and study”. If designers choose this factor, they can incorporate parents’ teaching into toy design to add the parent-led factor into toy design. The method is to let designers choose one of the aspects that attracts children firstly (Writing, Reading, Language, Grace & Courtesy, Mathematics) and refer to Table 3.5 to find out ways to attract children to follow parents’ teaching in play.

In addition, Mathematics, grace and courtesy have some additional checklists to follow. Finally, designers should check if it meets Piaget’s Stages of cognitive development (birth to six years old). Figure 3. 15 is the specific method.

Factor 2:

Interest & Study

Based on Montessori's Sensitive Period

Sensitive Period of Writing/Reading/Language/Grace & Courtesy/Mathematics

Tip: refer to the table of attraction elements of storybooks; checklists of grace & courtesy and mathematics (Figure 3. 15)

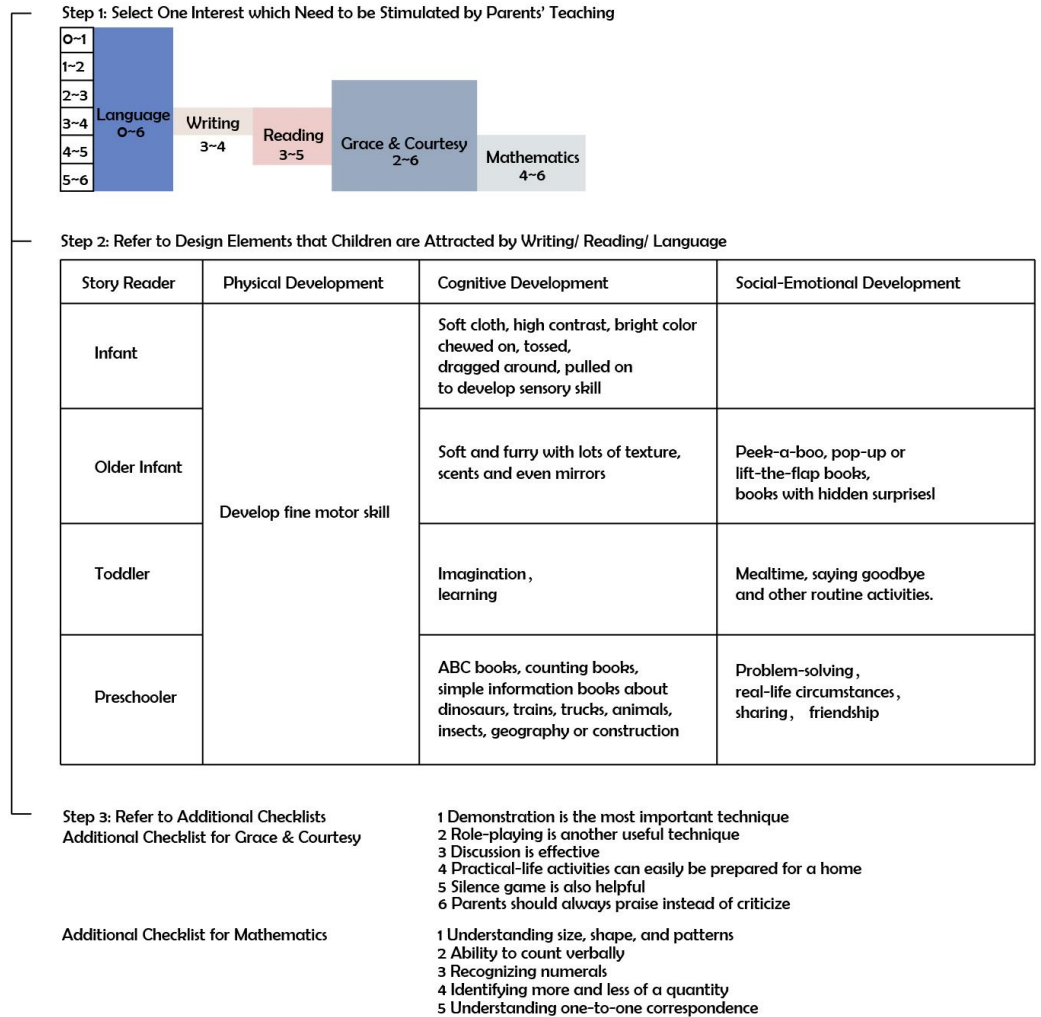


Figure 3. 15 Ways to Use Parent-Led Factor 2 (Edutainment/ Interest and Study)

For example, in terms of reading (3~5 years old): If designers choose reading as attraction, they should target children from three to five years old. As Table 3. 5 shows, the toy needs space to activate children's imagination. It also says, children are attracted to routine activities. These are both important design elements which designers can apply to the parent-child toy design. Finally, designers should check if it meets cognitive development from three to five years old.

For example, in terms of grace and courtesy (2~6 years old): If designers choose grace and courtesy as attraction, they should target children from two to six years old. Table 3. 5 shows that children like learning wording. It also says, children are attracted by grace of mealtime or saying goodbye. Also in checklists of Grace and Courtesy, role-play is a good approach to teach grace and courtesy with fun. These are all important design elements designers can apply to the parent-child toy design. Finally, designers should check if it meets Piaget's cognitive development from two to six years old. As Figure 3. 16 shows, Laugh & Learn® Servin' Up Fun Food Truck is a good example to apply to the above design elements (learning words, mealtime, role-play).



Figure 3. 16 Laugh & Learn® Servin' Up Fun Food Truck

For example, in terms of Mathematics (4~6 years old): If designers choose mathematics as attraction, they should target children from four to six years old. As Table 3. 5 says, children like counting and animals. It also says, children like problem-solving. Also in checklists of Mathematics, parents should provide for children’s sustained interaction with mathematics. To be specific, parents should help them understand size, shape, and patterns; develop ability to count verbally; recognize numerals; identify more and less of a quantity; understand one-to-one correspondence. These are all important design elements which designers can apply to the parent-child toy design. Finally, designers should check if it meets cognitive development from four to six years old. As Figure 3. 17 shows, Rainbow Counting Bears with Matching Sorting Cups is a good example to apply to the above design elements (counting, animal, count verbally, understand one-to-one correspondence).



Figure 3. 17 Rainbow Counting Bears with Matching Sorting Cups

3.4.1.3 Parent-Led Factor 3 (Goal & Command):

The parent-led Factor 3 is concluded based on four aspects from the literature review, that is, Piaget's type of play, Parent-Child Interaction Therapy/ PCIT, way to set commands, tips for parents' commands.

Firstly, games with rules are considered a type of game after seven years old; however, because of the intimate relationship with parents, children can play games with rules with parents earlier than six years old if parents set goals or commands for them. Thus, Goal & Command Setting is one way to incorporate the parent-led factor into toy. Secondly, two phases of PCIT are mentioned. By comparison, three changes happened in two phases, that is, from child-directed to parent-directed; from disobey to obey; from avoid command to incorporate command. It also strongly proved that parent-led factors can be applied to toy design by setting parents' goals and commands. Thirdly, ways are introduced to help parents set goals and commands to their children. Fourthly, tips are provided for parents' commands. Designers can also get some design elements on how to incorporate parents' commands to the parent-child play. After listing these four aspects, the method will be shown to designers how to use parent-led Factor 3 (Goal & Command) if they choose it.

3.4.1.3.1 Derivation Process of Parent-Led Factor 3 (Goal & Command)

3.4.1.3.1.1 Piaget's Types of Play

Piaget said when the highest category of play was games with rules emerging in children between the ages of seven and twelve. It appears in the third stage of cognitive development, that is, concrete operational stage (Piaget, 1962).

Concrete Operational Stage: It is the third stages proposed by Jean Piaget. The concrete operational stage is characterized by the development of organized and rational thinking. Considered by Piaget as a turning point in children's cognitive development, the beginning of logical thought shows the children are mature enough to use operations (rules) to solve problems in a logical fashion (McLeod, 2018).

Games with rules (Concrete Operational Stage): Games with rules are games with peers that are controlled by pre-established rules (Piaget, 1962).

The children aged from birth to six years old are very self-centered; thus, it is hard to play games with rules with other children according to Piaget's cognitive development. However, because of the attachment with parents, children can play games of rules with parents earlier than six years old if parents set goals and commands for children in parent-child play (Piaget, 1962).

3.4.1.3.1.2 Parent-Child Interaction Therapy/ PCIT

As the literature review says, there are two phases of therapy, that is, Child-Directed Interaction (CDI) and then Parent-Directed (PDI).

Child-Directed Interaction (CDI): During the CDI phase of treatment, the caregiver learns traditional play therapy skills such as following the child's lead, imitating the child's play, providing undivided attention, describing play activities, and expanding on child verbalizations through the PRIDE skills (praise, reflect, imitate, describe, and use enthusiasm). In addition, caregivers learn to selectively reinforce prosocial behaviors while strategically ignoring inappropriate behaviors and stopping the play for clearly dangerous behaviors. PCIT therapists also coach caregivers to follow the child's lead by avoiding questions commands, and criticisms during play (Pearl, 2019).

Parent-Directed Interaction (PDI): During the PDI phase of treatment, caregivers continue to practice the skills taught during the CDI phase under the guidance of the therapist. In addition, parents learn how to effectively incorporate commands to children and how to respond to children's appropriate or inappropriate behavior. PDI also includes the use of written materials and role-play. The therapy period is usually 10~20 weeks, one hour per week (Pearl, 2009).

By comparison, three changes happened in two phases, as Figure 3. 18 shows below, that is, from child-directed to parent-directed; from disobey to obey; from avoid command to incorporate command. It also strongly proved that parent-led factors can be applied to toy design by setting parents' goals and commands.

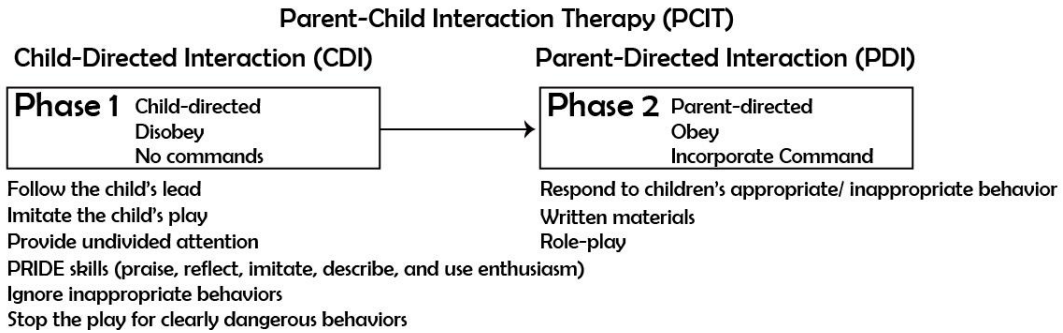


Figure 3. 18 Features and Change of CDI and PDI in PCIT

3.4.1.3.1.3 Way to Set Commands

Although children from birth to six years old are too self-centered to play the rule of the game with peers, they can play it if parents set commands for them, three ways are provided to help parents set commands and goals for children based on games with rules.

Roll the Dice: Players can receive commands by rolling the dice. This is the most accepted way in games with rules because of its fairness. As Figure 3. 19 shows, parents and children take turns to play by rolling the dice. These kinds of games usually have a goal before playing. Children easily accept this kind of play. Parents can command children by rolling the dice.



Figure 3. 19 Giant Snakes and Ladders

Spin the Spinner: Spinning the spinner is also one way for players to receive the commands. As Figure 3. 20 shows, Pie Face is a popular family game. Parents and children can have a lot of fun during Family Game Night. The steps of each player are decided by the number the spinner lands on. Thus, it is quite a fair way to play as well.



Figure 3. 20 Pie Face

Draw Lots: Drawing lots is also one of the fairest ways because parents and children will not know which one they will get.



Figure 3. 21 Draw a Card

3.4.1.3.1.4 Tips for Parents' Commands

When parents command children, in order to make commands more achievable, parents should:

Be direct

Be close

Use clear and specific commands

Give age-appropriate instructions

Give instructions one at a time

Keep explanations simple

Give kids time to process (Child Mind Institute, n.d.)

3.4.1.3.2 Using Method with Parent-Led Factor 3 (Goal & Command)

As a result parent-led Factor 3 is concluded as “Goal & Command”. If designers choose this factor, they can incorporate parents’ commands to children into toy design to add the parent-led factor into toy design. Three ways are listed, that is, rolling the dice, spinning the spinner and drawing lots to let parents set commands to their children. Children more easily accept it because it is fair. Lastly, tips are provided for designers to check if it is an appropriate command. As Figure 3. 22 shows, this is the method with using parent-led Factors 3.

Factor 3:

Goal &
Command

Based on Piaget's Stages of Cognitive Development

Be self-centered in sensorimotor & concrete operational stage

Tip: children are too self-centered to play games with rules before 7 years old, thus it required that parents set commands to kids, provide ways to set commands to designers (Figure 3. 22)

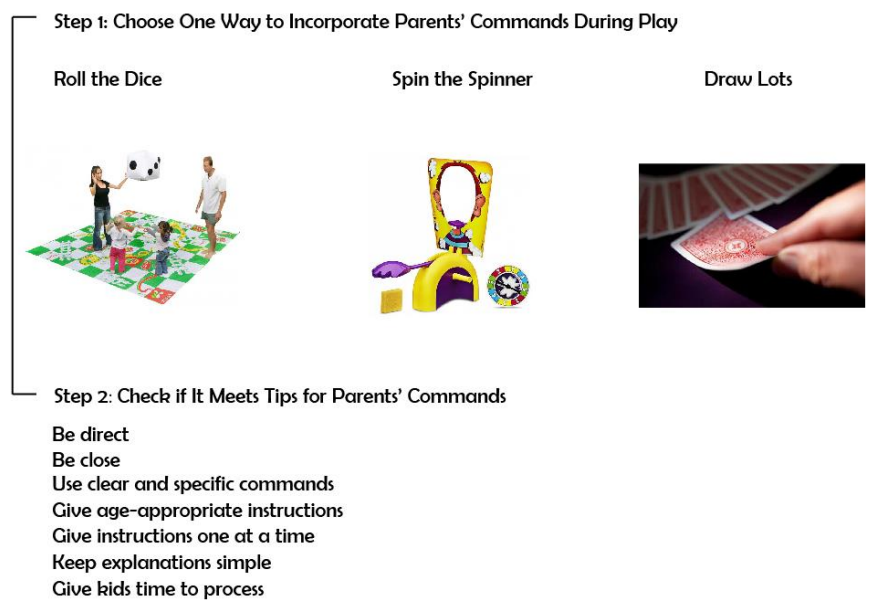


Figure 3. 22 Ways to Use Parent-Led Factor 2 (Command & Goal Setting)

3.4.2 Child-Initiated Factors

3.4.2.1 Child-Initiated Factor 1 (Social):

Child-initiated Factor 1 is concluded based on three aspects from the literature review, that is, advantage of child-initiated play, Parten's stages of play, and the social-emotional development from birth to six years old.

Firstly, advantages of child-initiated play are listed and social skills is important in child-initiated play. Secondly, Parten's stages of play are studied. It is divided into two parts, before three years old, designers should design toys to develop children's social skills since children have no ability to cooperate with or share toys with other peers; after three years old, besides social development, designers should also provide children with opportunities to join with more children to play together. Thirdly, the part of social development on the table of child social development is marked blue in order to help designers find out design elements. After listing

these three aspects, the method will be shown to designers how to use child-initiated Factor 1 (Social) if they choose it.

3.4.2.1.1 Derivation Process of Child-Initiated Factor 1 (Social)

3.4.2.1.1.1 Advantages of Child-Initiated Play

It said that by playing independently of adults, children have the chance to practice their social skill while taking turns or cooperating with others. So, social is an important factor which designers should consider if they want to add the child-initiated factor.

3.4.2.1.1.2 Parten’s Stages of Play

Age	Type of Play	Description of Play
0 –2 years	Solitary Play	During this stage, a child will play on their own. For example, a child may be in a room full of children but will choose to play blocks on their own.
2–2.5 years	Spectator Play	Child will observe other children playing
2.5–3 years	Parallel Play	During parallel play, children play next to each other but will not share the same activity.
3 –4 years	Associate Play	During associate play, children will be playing the same game or activity but will not be working together or making connections with peers.
4–6 years	Cooperative Play	During cooperate play, children learn to play with their peers. They start to use social skills and interact with their friends.

Figure 3. 23 Stages of Play

As Figure 3. 23 shows, three years old is an important watershed where stages of play is divided into two parts.

Infant and Toddler (0~3 Years Old):

The children desire to cooperate with peers but have no ability because of undeveloped social skills. Designers should design toys to help social development so that children can prepare to be social.

Preschooler (3~6 Years Old):

Children already entered associate play period. Thus they have had the ability to get along with others, how to take turns, how to share with others, how to cooperate with others. Also the children start to get in touch with a lot of peers in preschool. Being movable and being easily transported to other's house or preschool are important elements.

As a result, suggestion to designers will be given in two segments. Before three years old, designers had better design toys which can develop and initiate children's social skills for later on social play; after three years old, besides social development, designers had better also design toys to make associative and collaborative play go smoothly.

3.4.2.1.1.3 The Social-Emotional Development from Birth to Six Years Old

Then, the social part on the table of child social-emotional development is marked blue.

Designer can get design elements according to characteristics of social development.








Social-Emotional Development (0-6 Years Old)	
Month	Infant (0-1 Years Old)
 0-3months	1 Be comforted by gentle rocking
	2 Smile at people and coo
	3 Recognize Mommy, and be interested in other faces
 3-6months	4 Laugh, squirm and squeal with delight
	5 Smile at other babies—and his own reflection
	6 Love peek-a-boo and pat-a-cake
 6-9months	7 Recognize names of people and things
	8 Smile back at others
	9 Recognize familiar faces
 9-12months	10 Enjoy games like peek-a-boo
	11 Babble with inflections of actual language
	12 Mimic others' actions, like talking on the phone
Year	Toddler (1-3 Years Old)
 1-1.5years	1-1.5 Show affection with hugs, kisses, smiles and pats
 1.5-3years	1.5-2 Express a range of moods, from joy to frustration to jealousy
	2-2.5 Become more social with other children
	2.5-3 Enjoy mimicking the actions of others
Year	Preschooler (3-6 Years Old)
 3-6years	3-4 Like to dress up or pretend to be someone else
	4-5 Begin to grasp that people have different experiences and feelings
	5-6 Develop stronger friendships, empathy developed

Table 3. 6 Social Development from Birth to Six Years Old (Fisher-Price, n.d.)

According to Table 3. 6, some design elements about child social development are summarized. Designers can refer to the following design elements or extract more design elements based on this table. Some design elements for different ages are listed below:

Infant Toy:

Design Element 1 (Mirror): For example, if designers want to design a toy for five-month-old baby, designers can check this table. It said **infants like to smile at other babies and their own reflection**. When they looked in the mirror before five months old, they didn't know that the face staring back was their own; after five months old, they will recognize that the baby in the mirror is them, and they may touch their own face when they see themselves. They will also be starting to show an understanding of some of their body parts and may extend an arm or a finger to show objects of interest (care.com, 2017). As a result, having a mirror is a good design element which can help social development. For example, as Figure 3. 24 shows, there is a toy with a mirror called Laugh & Learn® Let's Get Ready Sink which helps infant social development (Fisher-Price, n.d.).



Figure 3. 24 Laugh & Learn® Let's Get Ready Sink (Fisher-Price, n.d.)

Design Element 2 (Sound): For another example, if designers want to design a toy for a 12-month-old baby, designers can check this table. It says **children like to mimic others' action, like talking on the phone**. As a result, having sound in a toy is a good design element to

help infant social development. As Figure 3. 25 shows, this toy smartphone uses sound to develop children’s social skills (Fisher-Price, n.d.).



Figure 3. 25 Smart Phone (Fisher-Price, n.d.)

Toddler Toy:

Design Element 1 (Pretend Things): For another example, if designers want to design a toy for two-year-old baby, designers can check this table. It says **children like to mimic the action of others**. As a result, pretend things in a toy is a good idea to help toddler social development. Two-year-old children love playing with pretend food because they like to mimic parents’ behavior. As Figure 3. 26 shows, it is a cutting food setting. It really feels like they are cutting food apart. Children serve parents various assortments of veggies, meats, fruits and more. This toy uses pretend things to develop children’s social skills



Figure 3. 26 Cutting Food Setting

Preschooler Toy:

Design Element 1 (Empathy): For another example, if designers want to design a toy for five-year-old baby, designers can check this table. It says children's **empathy developed**. As a result, empathy is a good design element for a toddler toy. For example, role-play as a nurse or doctor in play helps toddler social development. Kids who receive a lot of empathy for their own feelings from the adults in their lives are the earliest to develop empathy for others, and research has shown that empathy for others is the cornerstone of successful interpersonal relationships (Markham, n.d.). As Figure 3. 27 shows, a little girl plays a role of doctor to take care of a patient, which uses this element.



Figure 3. 27 Doc McStuffins Hospital Bag

Design Element 2 (Take Turns):

For another example, if designers want to design a toy for six-year-old children, designers can check this table. It says children will set up **strong friendship**. As a result, taking turns is a good design element to help preschooler social development. Kids need to feel secure in their ownership before they can share. Designers should introduce the concept of taking turns (Markham, n.d.). For example, as Figure 3. 28 shows, playing the slide helps children develop skills of taking turns in playground design.



Figure 3. 28 Play Slides

3.4.2.1.2 Using Method with Child-Initiated Factor 1 (Social)

As a result child-initiated Factor 1 is concluded as “social”. If designers choose this factor, they can add the child-initiated factor into toy design by incorporating social development. As Figure 3. 29, the method is that, designers extract design elements from the blue part. Some design elements have been extracted above.

Factor 1:

Social Factor

Based on Parten's Stages of Play

0-3 years old: solitary/onlooker/parallel play

3-6 years old: associative/cooperative play

Tip: 0-3 year-old: provide ways to develop social skills;
3-6 year-old: provide ways to develop cooperative play;
provide design elements of these 2 stages to designers
(Figure 3. 29)








Social-Emotional Development (0-6 Years Old)		Design Elements	
Month Infant (0-1 Years Old)		Infant Toy Design	
 0-3 months	1 Be comforted by gentle rocking	Mirror	
	2 Smile at people and coo		
	3 Recognize Mommy, and be interested in other faces		
 3-6 months	4 Laugh, squirm and squeal with delight		
	5 Smile at other babies—and his own reflection		
	6 Love peek-a-boo and pat-a-cake		
 6-9 months	7 Recognize names of people and things		
	8 Smile back at others		
	9 Recognize familiar faces		
 9-12 months	10 Enjoy games like peek-a-boo		Have Sound
	11 Babble with inflections of actual language		
	12 Mimic others' actions, like talking on the phone		
Year Toddler (1-3 Years Old)		Toddler Toy Design	
 1-1.5 years	1-1.5 Show affection with hugs, kisses, smiles and pats	Pretend things	
	 1.5-3 years		1.5-2 Express a range of moods, from joy to frustration to jealousy
2-2.5 Become more social with other children			
2.5-3 Enjoy mimicking the actions of others			
Year Preschooler (3-6 Years Old)		Preschooler Toy Design	
 3-6 years	3-4 Like to dress up or pretend to be someone else	Role-play, dress-up clothes Sharing Take turns, cooperate	
	4-5 Begin to grasp that people have different experiences and feelings		
	5-6 Develop stronger friendships, empathy developed		

Figure 3. 29 Ways to Use Child-Initiated Factor 1 (Social)

3.4.2.2 Child-Initiated Factor 2 (Many Interactions with Toys):

Child-initiated Factor 2 is concluded based on three aspects from the literature review, that is, characteristics of open-ended play, games with rules vs. free play and ways to apply many interactions during play.

Firstly, characteristics of open-ended play are listed and one of the characteristics is that free play has many ways to the end because of the absence of parents. Thus it is concluded that children's having many interactions with toys is another important child-initiated factor.

Secondly, guidelines for open-ended play are studied by comparing free play and games with rules. Thirdly, ways to add many interactions in one toy are listed. After listing these three aspects, the method will be shown to designers how to use child-initiated Factor 2 (Many Interactions with Toys) if they choose it.

3.4.2.2.1 Derivation Process of Child-Initiated Factor 2 (Many Interactions with Toys)

3.4.2.2.1.1 Characteristics of Open-Ended Play

As a designer of open-ended play designs, one does not know at the start of the project what the eventual outcome will be. Children can play with the developed design in a novel, unexpected manner. **Free play has many ways to the end.** Because no one knows what the eventual outcome will be, in order not to cause chaos during the process, designers should design the experience of playing open-ended play (Valk, 2015). As a result, children's having many interactions with a toy is of vital important.

3.4.2.2.1.2 Games with Rules VS. Free Play

According to Section 2. 4. 5. 2, free play has some features that are totally different from the rules of the game. As Figure 3. 30 shows, free play is chaotic, infinite, improvised, full of sensation and expressive (Valk, 2015).

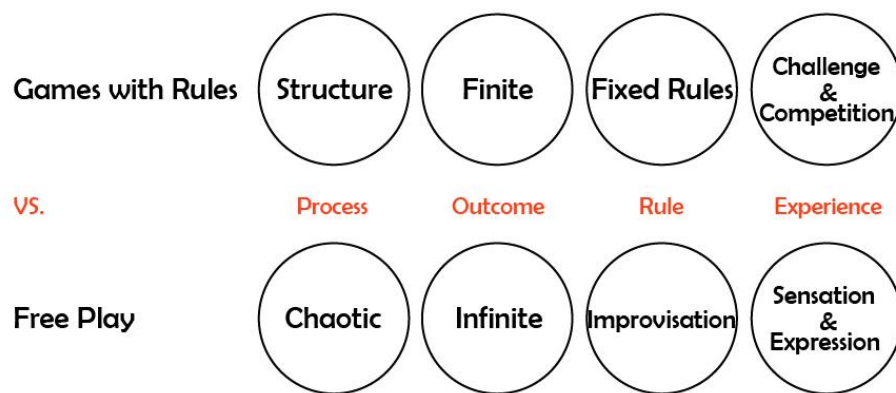


Figure 3. 30 Game with Rules VS. Free Play

After comparing games with rules with free play, two characteristics of free play are summarized, firstly, open-ended play aims at **supporting a variety of play experiences** and

moods so that each player can decide which experience or mood they prefer, whether this relates to games or to free play; secondly, open-ended play encourages players to **shift from one experience or mood to another** whenever desirable in order to create a natural flow in play with repeating and exceeding play situations (Valk, 2015). Therefore, designers need to pay attention to something while designing open-ended toys, firstly, **attract children to participate in play** by providing as many interactions as possible; secondly, **let children switch to another play freely**, if the chosen way can't go on and there are no parents to give them a hand.

3.4.2.2.1.3 Ways to Apply Many Interactions during Play

Because parents will not come to help children solve the problem, child-initiated play should support a variety of play experience to make children generate intense interest; it should shift from one experience to another smoothly. As a result, ways to apply many interactions during play are important. Ways are as follows:

Many Interactions Based on Structure Design

As the characteristics of free play, it should have many ways to the end. If one way doesn't work, players can shift to another way of play smoothly. As a result, in open-ended toy design, designers tend to provide multiple ways to the end. Ways are listed below.

Way 1 (Modularity): For example, block toys are suitable for children to play with from twelve months to twelve years; “they probably have the longest life of any toys” (Newson & Newson, 1979, p. 84). The reason why blocks live longer than others is that children at different

ages have different ways to play blocks. Because of its modularity, there are many interactions during play.

Way 2 (Transformation): For example, the premise behind the Transformers toy line is that an individual toy's parts can be shifted about to change it from a vehicle, a device, or an animal, to a robot action figure and back again. Thus children can transform the toy to whatever they want during play (Wikipedia, n.d.). Transformation is also a good way to apply many interactions in one toy.



Figure 3. 31 Transformer

Many Interactions Based on Sales Method

Way 3 (Expansion Set): For example, Mattel released the Barbie with 30 hair colors, 22 eye colors and 7 skin tones. Children can also purchase additional fashions for Barbie. As Figure 3. 32 shows, children can select a wardrobe for Barbie. As a result, children have many interactions with the Barbie.



Figure 3. 32 Wardrobe for Barbie

Many Interactions Based on Sensing Technology

Way 4 (Sensing Technology): Innovative design of assistive tools based on sensing technology can stimulate children to spontaneously invest and explore games, enabling individuals to gain important abilities and concepts under the motivation of active learning: physical and mental health, creativity, self-confidence, compassion, imagination, social skills, balance, time and space concepts, finger flexibility, logical thinking, choice and judgment, and language skills (Wang, 2016). Figure 3. 33 shows the popular sensing technology. These sensors have some relationships with different senses.

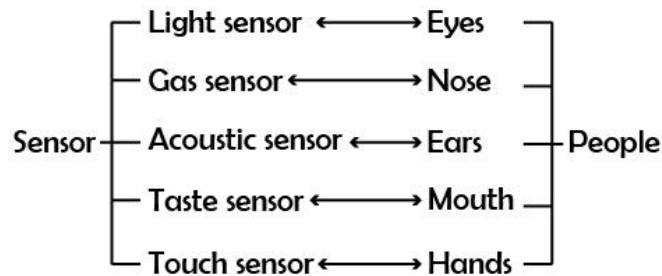


Figure 3. 33 Relationship between Sensor and Human Sense

“Pathway,” is a good example which uses Way 4. It is consist of two wooden beams and a series of pressure sensitive pads. The distance between the pressure sensitive pads is the normal step size of four-year-old children. Each pressure sensitive pad is connected to the corresponding motor of the wooden beams on both sides. When the child steps on the pressure sensitive pad, the circuit runs through, and the motors on the opposite sides start to work such as color bars or bells are rotated. According to the observation of free play, in a variety of environments, in addition to stepping, running, jumping and standing on multiple pressure sensitive pads, children can trigger multiple pressure sensitive pads, such as flipping, crawling, rolling, pushing and riding toy cars. The more complex activities of the article are also motivated, and the children also connect multiple interactive “step” equipment to get a longer path interaction experience, such as the track as a train.



Figure 3. 34 Interactive Pathway

3.4.2.2.2 Using Method with Child-Initiated Factor 2 (Many Interactions with Toys)

As a result child-initiated Factor 2 is concluded as “Many Interaction with Toys”. If designers choose this factor, they can add the child-initiated factor into toy design by incorporating many interactions. The specific method is that, designers select one way to make children have more interactions with toys while adding child-initiated Factor 2 into toy design. Ways include adding interactions based on structure design, sales method. With the development of the society, sensing technology is applied as well in order to add interactions of play or to increase more experience for child-initiated play. If designers choose child-initiated Factor 2, they can use the above three traditional ways or sensing technologies such as light, gas, acoustic, taste, touch and so on to achieve more interactions. As Figure 3. 35 shows, this is the method with using child-initiated Factors 2.

Factor 2:

Many Interactions

Based on Characteristic of Open-Ended Play

No rules; not know the start and outcome;
many ways to the end

Tip: provide ways to achieve interactions with toys
by using structure design/sales method/sensing technology
(Figure 3. 35)

Ways to Apply Many Interactions during Play

Interactions based on structure

Modularity
Transformation

Interactions based on sales

Expansion Set

Interactions based on sensing technology

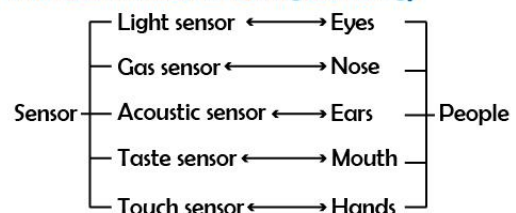


Figure 3. 35 Ways to Use Child-Initiated Factor 2 (Many Interactions with Toys)

3.4.2.3 Child-Initiated Factor 3 (Interest Evocation):

Child-initiated Factor 3 is concluded based on three aspects from the literature review, that is, experiment on sustained attention to toys in one-year-old infant, characteristics of free play and Montessori's sensitive period.

Firstly, an experiment are mentioned in Chapter 1. According to the result of the experiment, allowing children to express interest in free play is important. Secondly, characteristics of free play is studied and being spontaneous is one of its characteristics; thus there is a need to stimulate children's interest to initiate the play. Thirdly, Montessori's four sensitive periods are listed to explain that the spontaneous interest can evoke children's interest to initiate the play. Designers can evoke children's interest from it. After listing these three aspects, the method will be shown to designers how to use child-initiated Factor 3 (Interest Evocation) if they choose it.

3.4.2.3.1 Derivation Process of Child-Initiated Factor 3 (Interest Evocation)

3.4.2.3.1.1 Experiment on Sustained Attention to Toys in One-Year-Old Infants

Based on the result of experiment, Yu and Smith (2016) said, in child-initiated play, parents should follow their child's lead as they play and allow the child to express interest in a toy first. Then, the parent can expand that interest by naming the toy and encouraging play, thus, it is important to allow the child to express interest in a toy in child-initiated play.

3.4.2.3.1.2 Characteristics of Free Play

Free play is spontaneous. Thus, it is important to design toys which can interest children to start playing. Designer should evoke children's free play (Valk, 2015). Ways to evoke children's interests to initiate the play will be introduced next.

3.4.2.3.1.3 Montessori's Sensitive Period

Montessori's sensitive periods refer to a period of time when a child's interests are focused on developing a particular skill or knowledge area. During what Maria Montessori describes as the child's absorbent mind, birth to age six, is when most sensitive periods occur. Among them, four sensitive periods explain the spontaneous interest that children can initiate the play (Montessori, 2013). Some spontaneous interests which can be stimulated by toys themselves instead of parent's teaching. They are:

Movement (0~1 Years Old): Random movements become coordinated and controlled: grasping, touching, turning, balancing, crawling, and walking (Montessori, 2013).

Small Objects (1~4 Years Old): A fixation on small objects and tiny details (Montessori, 2013).

Refinement of the Senses (2~6 Years Old): Fascination with sensorial experiences (taste, sound, touch, weight, smell) resulting with children learning to observe and with making increasingly refined sensorial discriminations (Montessori, 2013).

Music (2~6 Years Old): Spontaneous interest in and the development of pitch, rhythm, and melody (Montessori, 2013).

3.4.2.2.2 Using Method with Child-Initiated Factor 3 (Interest Evocation)

As a result child-initiated Factor 3 is concluded as “Interest Evocation”. If designers choose this factor, they can add the child-initiated factor into toy design by evoking children to initiate the play. The method is that, designers select one spontaneous interest which including **movement, small objects, refinement of the senses, and music** and select corresponding design elements. Design elements of **movement, small objects, refinement of the senses, and music** will be introduced respectively in the following paragraphs.

Movement: If designers choose movement as design elements, they can add movement to evoke children’s interest. The movement is subdivided into grasping, touching turning, balancing, crawling and walking respectively and each movement is studied by doing research on toys which can arouse children’s interest to movement. As the Figure 3. 36 shows, the design elements of movement are listed, which designers can get inspiration from them.

Movement (0~1 Years Old)					
Grasping	Touching	Turning	Balancing	Crawling	Walking
ring, handle, cord, squeeze, bell, circle, hang	button, texture, textile toy, rubber	rattle, music	walker bouncing chair	play tunnel, crawl rollerbar, wheeled toy	walking toy, push and pull
Requirement					
easy to take, safe, nontoxic, stimulate senses, smooth and rounded					

Figure 3. 36 Design Elements of Movement

Sensitive period of movement belongs to the infant period; thus infant toys are studied in Section 2. 5. 1. For example, rattles are popular during infant period, which can help develop grasping skills. When babies are in Sensorimotor Stage, sounds and textures are essential elements of sensory development. Toys like rattles offer babies sensory response activities to

help develop grasping skills. Thus, having bells or rings are good elements. Also, it trains children's grasping skills; thus, the handle design should be considered as a design element because it helps children grasp easily and comfortably (Viau, 2017).

Designers can apply to these elements when they use child-initiated Factor 3 to parent-child toy. Figure 3. 36 is provided for them if they select movement to arouse children's interest.

Small Object: If designers choose small object as design elements, they can add small objects to evoke children's interest. There are many children's favorite small objects from outdoors, daily life and toys. As the Figure 3. 37 shows, the design elements of small objects are listed, which designers can get inspiration from them.

Small Object (1-4 Years Old)		
Outdoor	Life materials	Toy
insects, pebbles, stones and grass	spot on father's tie, a speck of lint on the carpet	brick, model animal, puzzle, fishing game, stick game
Action		
pinch, pick up, put in mouth, smell, taste, observe, match, pile up, balance, align, sort		
Interest point		
observe nature, details explore new things love different texture	parents, home decoration, surrounding environment	bright color, high contrast, animals hand-eye coordination
Requirement		
safe, nontoxic, not easy to lose,		

Figure 3. 37 Design Elements of Small Objects

For example, children are interested in insects, pebbles, stone and grass, so observing nature, exploring new things and different textures are design elements. For another example children like spot on father's tie, so observing details is a design element. Because children like toys which have small objects, so practicing hand-eye coordination is a design element.

Designers can refer to Figure 3. 37, if they select child-initiated Factor 3 and choose small objects as attraction to children.

Refinement of the Senses: If designers choose refinement of the senses as design elements, they can add sensory stimulation from sight, hearing, smell, taste and touch to evoke children’s interest. As the Figure 3. 38 shows below, the design elements of refinement of the senses are listed. Designers can pay attention to the design elements for each sense if they want to use refinement of the senses to arouse children’s interest. They can also mix multiple senses in one toy.

Refinement of the Senses (2~6 Years Old)				
Sight	Hearing	Smell	Taste	Touch
bright, contrast primary colors, drawing	music, keyboard mallet loud speaker,	nontoxic	biteable	rounded, smooth, shapes, modeling clay
Requirement				
Follow cognitive development; mix multiple senses at the same time				

Figure 3. 38 Design Elements of Refinement of Senses

Music: If designers choose music to evoke children’s interest, they can add design elements of music to evoke children’s interest. As the Figure 3. 39 shows, music is subdivided into singing, listening and related action. The listed design elements are provided for designers to get inspiration from them if they choose child-initiated Factor 3.

Music (2~6 Years Old)

Singing	Listening	Action
microphone, singing doll, melody, rhythm	loud speaker, button to switch	mallet, drum, biteable play the instrument dance with music
Shape		
Shape of music instrument & action figure		
Requirement		
Cheerful; hearing protection;		

Figure 3. 39 Design Elements of Music

In conclusion, Figure 3. 40 is the summary of design elements of interest evocation. If designers choose child-initiated Factor 3 (interest evocation), they can select one of the spontaneous interests first, then refer to the corresponding design elements.

Factor 3:

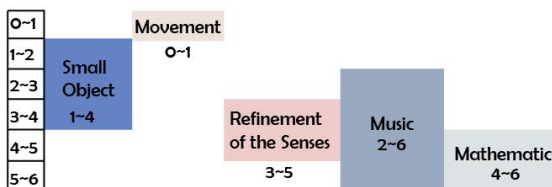
Interest
Evocation

Based on Montessori's Sensitive Period

Sensitive Period of
Movement/small objects/refinement of senses/music

Tip: provide tables of design elements of
movement, small objects, refinement of senses, music
(Figure 3. 40)

Step 1: Select One Spontaneous Interest which can be Attracted by Toys



Step 2: Select corresponding design points

Small Object					
Outdoor		Life materials		Toy	
insects, pebbles, stones and grass		spot on father's tie, a speck of lint on the carpet		brick, model animal, puzzle, fishing game, stick game	
Action					
pinch, pick up, put in mouth, smell, taste, observe, match, pile up, balance, align, sort					
Interest point					
observe nature, details explore new things love different texture		parents, home decoration, surrounding environment		bright color, high contrast, animals hand-eye coordination	
Requirement					
safe, nontoxic, not easy to lose,					
Movement					
Grasping	Touching	Turning	Balancing	Crawling	Walking
ring, handle, cord, squeeze, bell, circle, hang	button, texture, textile toy, rubber	rattle, music	walker bouncing chair	play tunnel, crawl rollerbar, wheeled toy	walking toy, push and pull
Requirement					
easy to take, safe, nontoxic, stimulate senses, smooth and rounded					
Refinement of the Senses					
Sight	Hearing	Smell	Taste	Touch	
bright, contrast primary colors, drawing	music, keyboard mallet loud speaker,	nontoxic	biteable	rounded, smooth, shapes, modeling clay	
Requirement					
Follow cognitive development; mix multiple senses at the same time					
Music					
Singing	Listening	Action			
microphone, singing doll, melody, rhythm	loud speaker, button to switch	mallet, drum, biteable play the instrument dance with music			
Shape					
Shape of music instrument & action figure					
Requirement					
Cheerful; hearing protection;					

Figure 3. 40 Ways to Use Child-Initiated Factor 3 (Interest Evocation)

Chapter 4 Design Application

In this chapter, I design a parent-child toy to demonstrate my guidelines.

4.1 Step 1 (Age Range Limitation)

In the age range between zero and six years old, I choose two to four years old as my target users, thus my task is to design a parent-child toy for two to four-year-old children and their parents. Because it is a parent-child toy, my goal is to allow parents to play with children, but for practical reasons, children can play part of the toy without parents as well.

4.2 Step 2 (Choice of Advantages)







Advantages		
 Parent-Led Play		Language development New skills and concepts Allow higher-risk activities Incorporate play into your family's everyday activities and chores. Be encouraged, be praised
 Parent-Child Cooperative Play		Sharing Taking turns Obeying rules Teamwork Negotiating
 Child-Initiated Play		Concentration Imagination Creations Emotions-control Make friends and get along with peers Problem-solving skills Children learn what they do and do not enjoy Self-aware/self-worth/ self-confident

Table 4. 1 Advantages of Three Kinds of Parent-Child Play

Table 4. 1 is the table I created in Chapter 3, which lists the advantages of parent-led play, parent-child cooperative play and child-initiated play. I selected language development, new skills and concept, higher risk activities, be encouraged, obey rules, teamwork,

concentration and problem-solving skill. This is what I want to develop in the child via my parent-child toy.

4.3 Step 3 (Parent-Led & Child-Initiated Factors Adjustment)

According to the chosen advantages, they are mostly concentrated in parent-led play. After general judgement, I decided on the range of parent percentage. The parent participation percentage of my toy design should be from 50% to 100% (not including 50% and 100%). But I should also consider the advantages of child-initiated play because I also choose some advantages of child-initiated play. Therefore, I should consider some child-initiated factors as well as some parent-led factors.

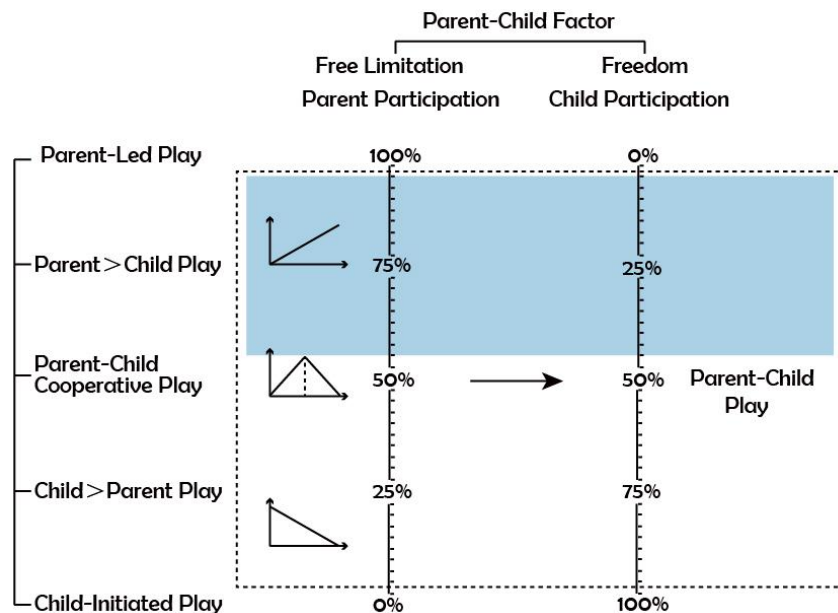


Figure 4. 1 Spectra of Parent-Child Play

4.3.1 Toys for Target Users

I want to design a parent-child toy for two to four-year-old children; thus I list all types of toys within this age range as a reference. According to the literature review, there are:

- 1 Sorting and Nesting Toys, Buckets, Blocks, Stacking Rings, Shape Sorters, Pop-Up Toys, Simple Puzzles;
- 2 “People” Play Sets & Playing House Toys;
- 3 Musical Toys;
- 4 Simple Board and Card Games;
- 5 Dress-Up Clothes and Toys for “Pretend Play”;
- 6 Crayons, Pencils, Paints, Modeling Clay and Other Art Supplies;
- 7 Books;
- 8 Dolls & Dollhouses;
- 9 “Non-Electric” Cars, Trucks, Tractors, Trains and Airplanes (Viau, 2017).

4.4 Step 4(Decision on Parent Percentage)

I select Type 1 “Shape Sorters” as the design direction of my parent-child toy design for two to four-year old children. I first did a competitive analysis. As Figure 4. 2 shows, the toy chosen for analysis is a shape sorting toy called Melissa & Doug® Shape Sorting Cube.



Figure 4. 2 Melissa & Doug® Shape Sorting Cube

After my analysis, I found out the Melissa & Doug® Shape Sorting Cube meets the child-initiated Factor 2 (many interactions) and the child-initiated Factors 3 (interest evocation). A shape can correspond to several holes; thus, there are many interactions. In this way, the child can complete the play smoothly even without parents. This point perfectly matches the child-initiated Factor 2 (many interactions). On the other hand, Melissa & Doug® selected small objects as interest evocation to design the toy, which perfectly match child-initiated Factor 3 (interest evocation). However, it doesn't include the child-initiated Factor 1 (social). Also, it doesn't apply to any parent-led factors. Therefore, it belongs to free play (the parent percentage is 0%). Children can play with the colors and shapes freely.

I want to refer to this toy and also apply child-initiated Factor 2 (many interactions) and child-initiated Factor 3 (interest evocation) to my parent-child toy. What I need to do is to select some parent-led factors to let it become a parent-child toy between parent-child cooperative play and parent-led play which is 50~100% parent participation percentage.

I decided to select parent-led Factor 1 (challenge increase), parent-led Factor 2 (edutainment/ interest and study) and parent-led Factor 3 (goal and command) as parent-led factors to make the parent participation percentage between 50% and 100%.

4.5 Concept

This is my parent-child toy for which I got inspiration from Melissa & Doug® Shape Sorting Cube. Next, I would introduce how I apply child-initiated Factor 2, 3 and parent-led

factor 1, 2, 3 to my parent-child toy design respectively so that to make the parent participation percentage between 50% and 100%.

As for child-initiated Factor 2 (many interactions), my parent-child toy has many interactions with the children. A shape can correspond to several holes. In this way, I provided many ways to the end and the children can stuff blocks into any appropriate hole.

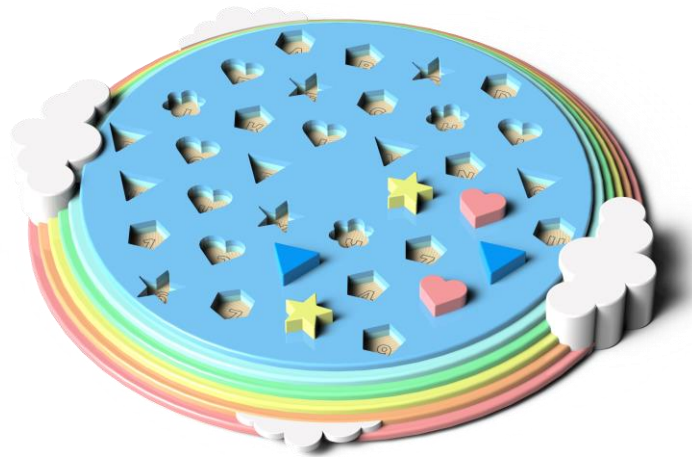


Figure 4. 3 Stuff Blocks into Any Appropriate Holes (Many Interactions)

As for child-initiated Factor 3 (interest evocation), my parent-child toy has many small objects with six different colors, which meet:

Small Objects (1~4 Years Old): A fixation on small objects and tiny details (Montessori, 2013). As Figure 4. 4 shows, I select small bricks as my design elements of small objects.

Small Object (1~4 Years Old)		
Outdoor	Life materials	Toy
insects, pebbles, stones and grass	spot on father's tie, a speck of lint on the carpet	brick, model animal, puzzle, fishing game, stick game
Action		
pinch, pick up, put in mouth, smell, taste, observe, match, pile up, balance, align, sort		
Interest point		
observe nature, details explore new things love different texture	parents, home decoration, surrounding environment	bright color, high contrast, animals hand-eye coordination
Requirement		
safe, nontoxic, not easy to lose,		

Figure 4. 4 Design Elements of Small Objects

Refinement of the Senses (2~6 Years Old): Fascination with sensorial experiences (taste, sound, touch, weight, smell) resulting with children learning to observe and with making increasingly refined sensorial discriminations (Montessori, 2013). As Figure 4. 5 shows, I select bright colors and shapes as my design elements of refinement of the senses.

Refinement of the Senses (2~6 Years Old)				
Sight	Hearing	Smell	Taste	Touch
bright, contrast primary colors, drawing	music, keyboard mallet loud speaker,	nontoxic	biteable	rounded, smooth, shapes, modeling clay
Requirement				
Follow cognitive development; mix multiple senses at the same time				

Figure 4. 5 Design Elements of Refinement of the Senses

As Figure 4. 6 shows, I designed it with six colors and shapes, they are yellow five-pointed star, peach heart shape, orange hexagon, white cloud shape, green pentagon, blue triangle. Because two to six years old is in the period of the refinement of senses, I choose some similar colors and similar shape to help sensory development. In terms of similar colors, peach and orange are similar colors; in terms of similar shapes, pentagon and hexagon are similar shapes.

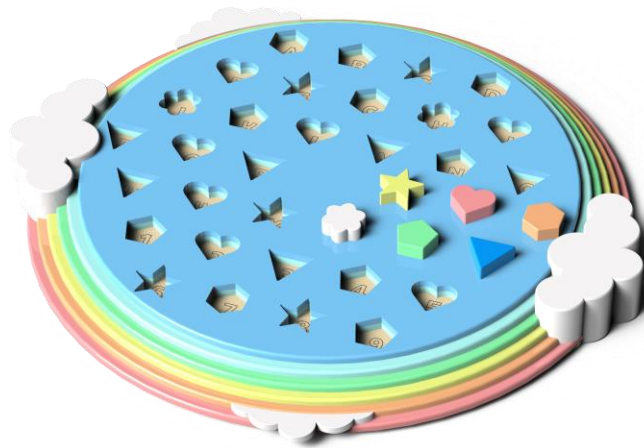


Figure 4. 6 Six Kinds of Shapes and Colors

In addition to putting the bricks into the correct holes; children can also play with them as balancing blocks to further train their hand-eye coordination.



Figure 4. 7 Balancing Blocks

As for the parent-led Factor 3 (goal & command), I choose the way of rolling the dice as commands. This is one of the fairest way to let parents set the command for kids. Also I designed six shapes so that each shape can get one side of the dice. The children need to find out the corresponding shapes according to the command of rolling the dice. As Figure 4. 8 shows, I design the dice for this parent-child toy.

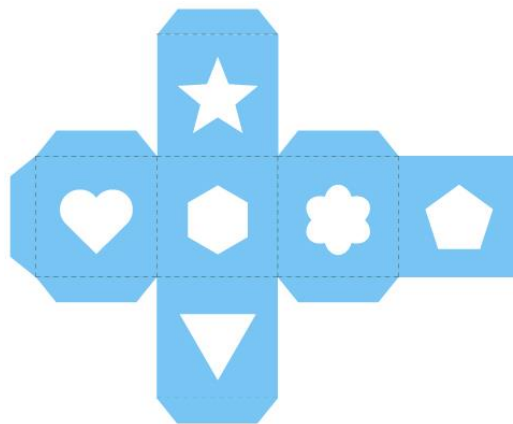


Figure 4. 8 Expanded View of the Dice

The toy became a take-turns toy if it added to with two dices. The parents can set commands for the child, that is, roll the dice for the child and he or she can play with the toy according to the result of the dices. As a result, parents can participate in it. The parents can also give some encouragement to their children and praise them when they finished it. Right now the toy has 1 parent-led factor and 2 child-initiated factors. The parent participation percentage is 33.3%.

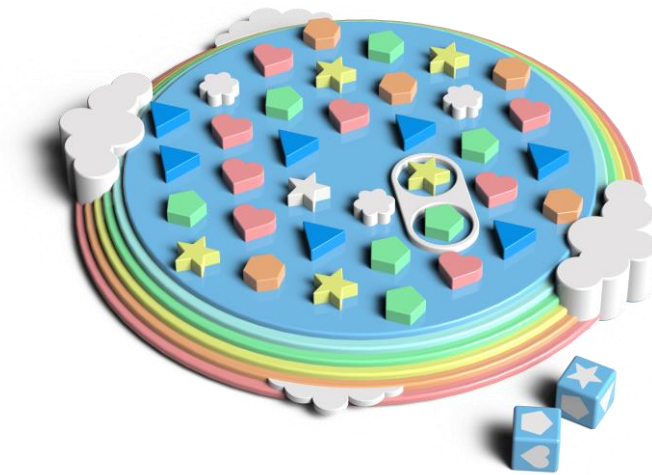


Figure 4. 9 Parents' Commands to Children

As for the parent-led Factor 1 (challenge increase), I continue adding parent participation percentage by increasing the challenge. At this time, I add parent-led Factor 1 (challenge increase), so the parent participation percentage will turn to 50%. I provide some ways to help parents add the difficulty during play. As I said before, designers had better provide the step-by-step challenge so that parents can control the challenge of toy according to kids' reaction and acceptability during the play because each infant has individual differences. Only their intimate parents are the best candidate to control the challenge during parent-child play. In my parent-child toy, I increase the challenge by adding the amount of the white double-rings and

dices step by step. Parents can just command their child to find the two shapes. That is the easiest step of the parent-child toy. If children can accept it, parents can increase challenge by adding one double-rings and two dices. In this condition, children need to find four corresponding shapes at the same time. Parents can help children overcome this challenge, that is, the parent and the child can cooperate to find the four shapes together and each one has one double-rings. As Figure 4. 10 shows, parents can find out whatever two of them with one double-rings, then the children try to find another two with another double-rings. This is a good way to achieve the effect of parent-child cooperative play. At this time, my parent-child toy has 2 parent-led factors and 2 child-initiated factors and the parent participation percentage of my parent-child toy has turned from 33.3% to 50%.

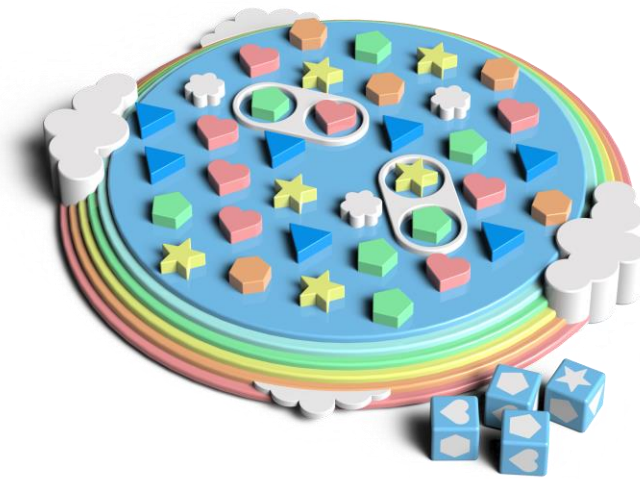


Figure 4. 10 Increase Challenges

Besides adding more double-rings and dices, parents can also pull out some blocks to increase the challenge as well. As Figure 4. 11 shows, children will have a hard time finding the correct shapes because of fewer shape toys. Parents can give children a reminder to overcome the challenge.

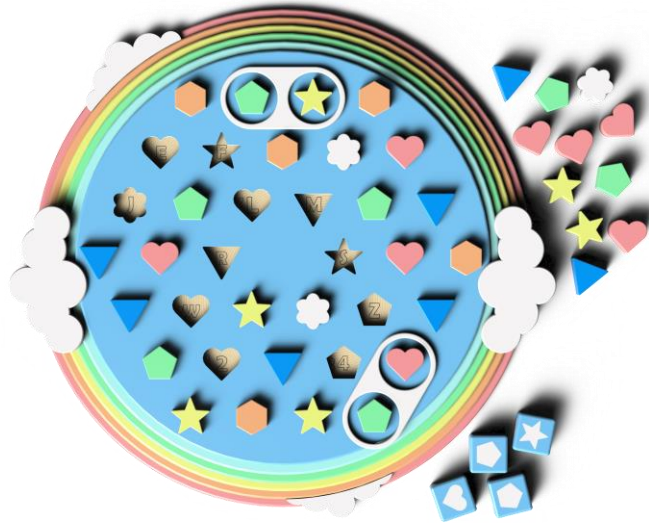


Figure 4. 11 Increase Challenges Step by Step

As for the parent-led Factor 2 (interest and study), I increased alphabet from A to Z and numbers from zero to nine in the holes. As I mentioned before, three to four years old is the sensitive period of writing, the children like to reproduce and write down letters and numbers (Montessori, 2013). As a result, the parent participation percentage changed again. Right now there are three parent-led factors and two child-initiated factors; thus, the parent participation percentage turns to 60%. When the wood alphabet and letters appeared, parents can teach children in the process of playing. As Figure 4. 12 shows, there are alphabet and numbers under the small shape toys. Parents can teach them to make more parent-child interaction. At this time,

my parent-child toy has 3 parent-led factor and 2 child-initiated factors and the parent participation percentage of my parent-child toy has turned from 50% to 60%.

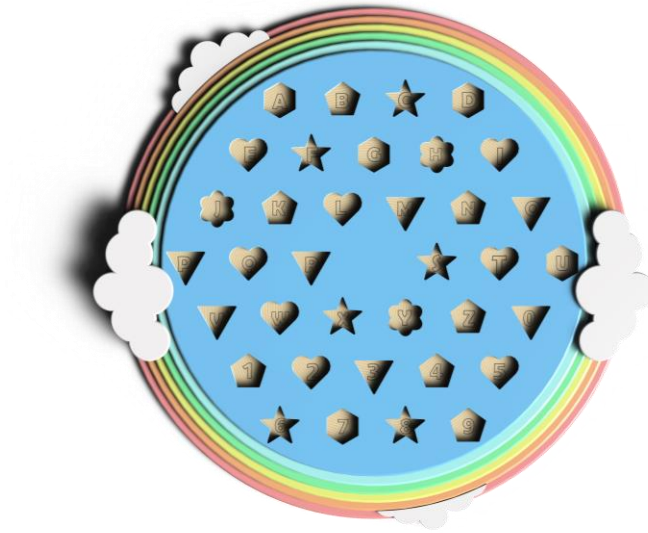


Figure 4. 12 Alphabet and Numbers

In conclusion, the parent percentage of my parent-child toy is 60% which is between 50% and 100%. I made it more like parent-led play to achieve the most of the chosen advantages. At the same time, I also consider adding some child-initiated factors to achieve the advantages of child-initiated play I selected.

4.6 Details

4.6.1 Wooden Alphabet and Numbers

As Figure 4. 13 shows, I carve six kinds of shapes on the top. Parents and children can see the original wooden materials and parents can teach children the alphabet and numbers. The holes are 1/4 inch deep.



Figure 4. 13 Wooden Alphabet and Numbers

4.6.2 White Double Rings

As Figure 4. 14 shows, they are white double-rings. Children can put it in the correct place according to the result of parents' rolling dices. Or parents and children can cooperate to put two double-rings in the correct place by rolling four dices. As Figure 4. 15 shows, this is the detail of the white double-rings.

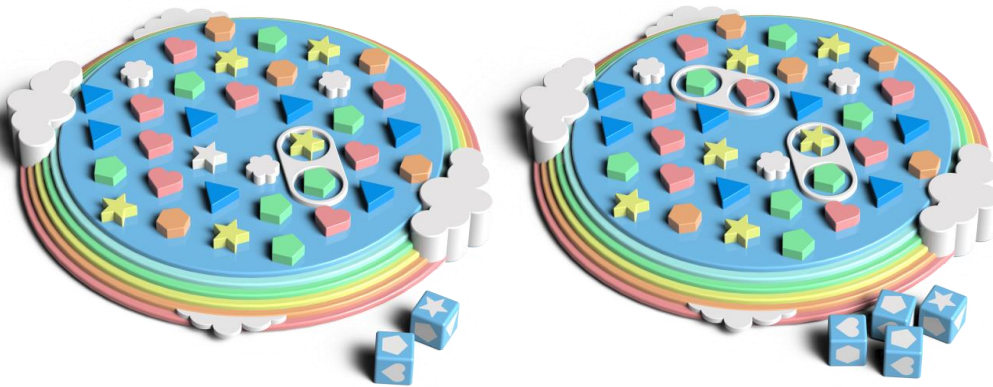


Figure 4. 14 White Double Rings

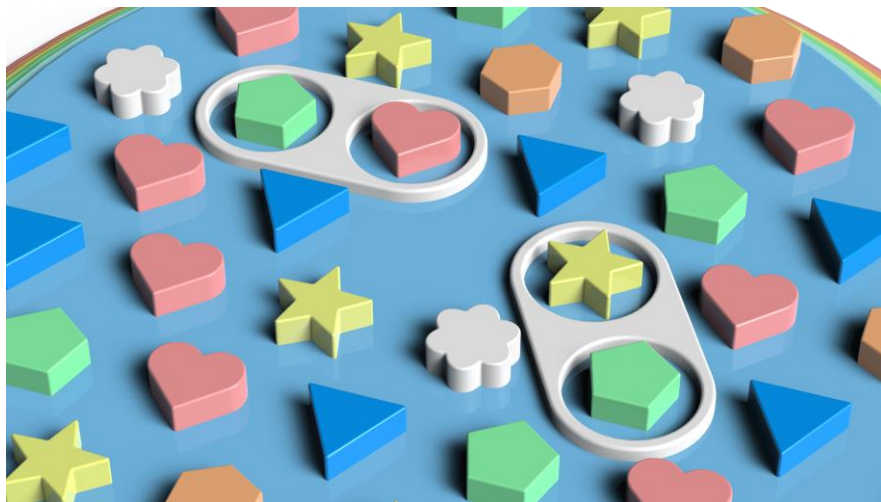


Figure 4. 15 The Detail of White Double Rings

4.6.3 Symmetrical Cloud Shaped Handles

I design symmetrical handles to make it easy for children to take and hold. The shape of the cloud of the handle echoes the sky blue of the upper part of the toy. As Figure 4. 16 shows, there are the handles on both sides.

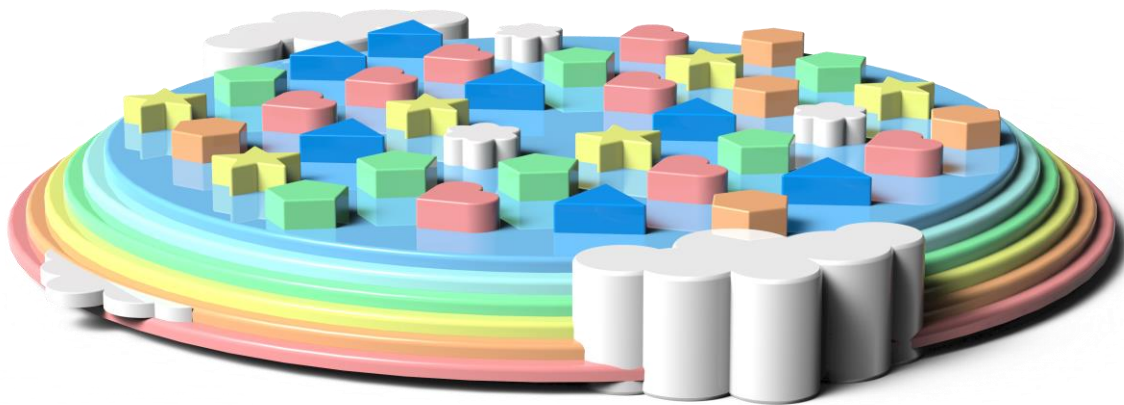


Figure 4. 16 Symmetrical Cloud Shaped Handles

4.6.4 Appropriate Height and Safe Edges

As Figure 4. 17 shows, shape toys stick out 1/4 inch, so that children can easily put in and take out. The thickness of the main body this toy is 3/4 inch so that children can easily hold it. Also, I round up all the edges that children might touch to make sure of children's safety.

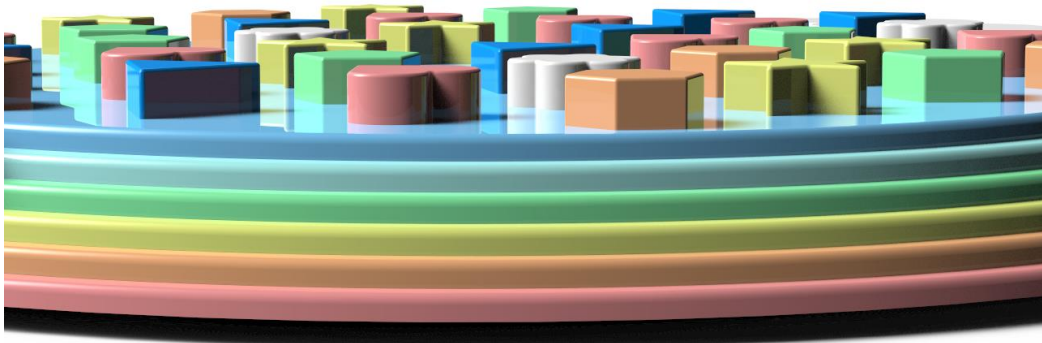


Figure 4. 17 Appropriate Height and Safe Edges

4.6.5 Size Description

As Figure 4. 18 shows, this is the size of all the shape toys, the dice, the cloud shaped handle and the white double-rings.

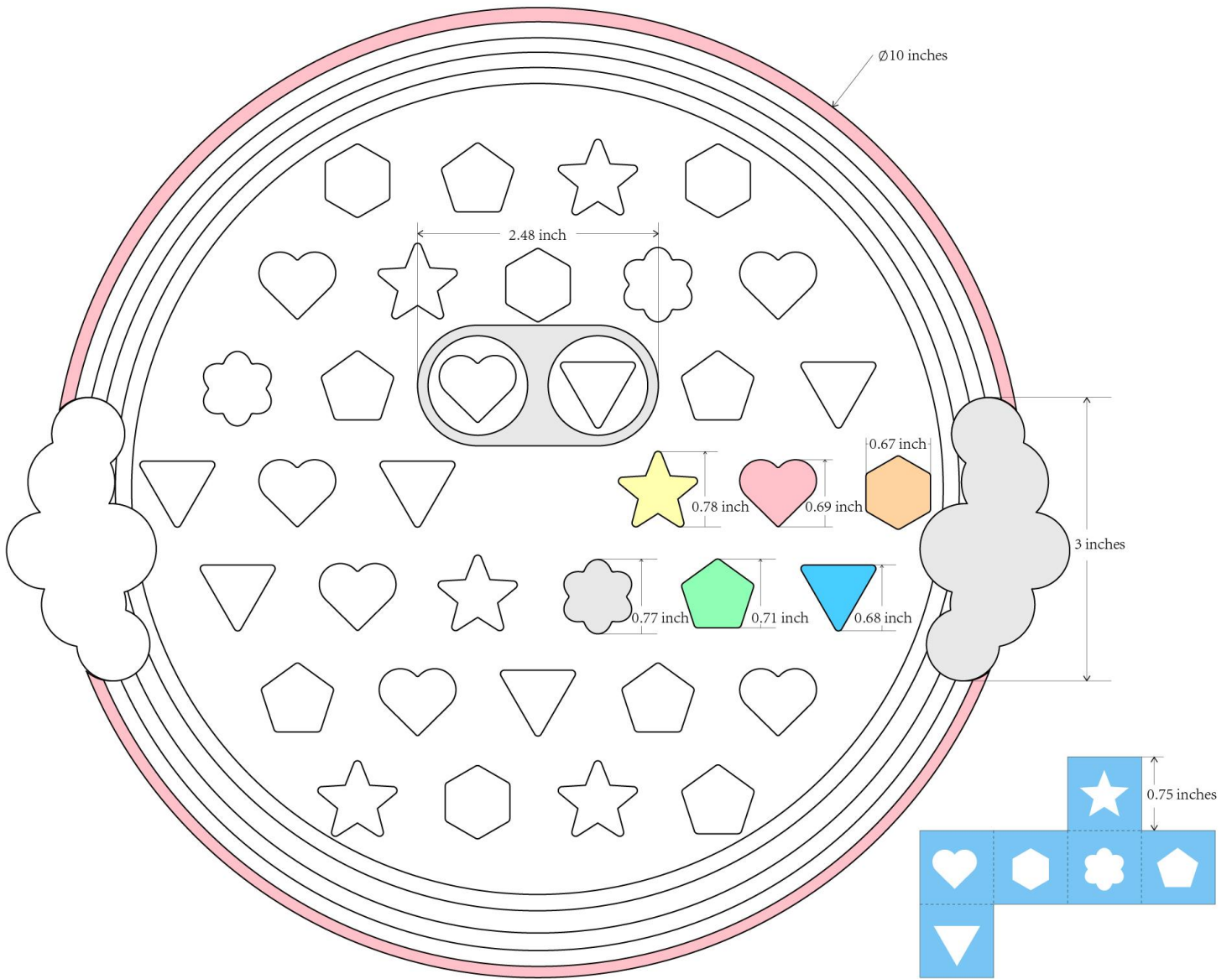


Figure 4. 18 Size

4.7 Model Making



Figure 4. 18 Model-Making

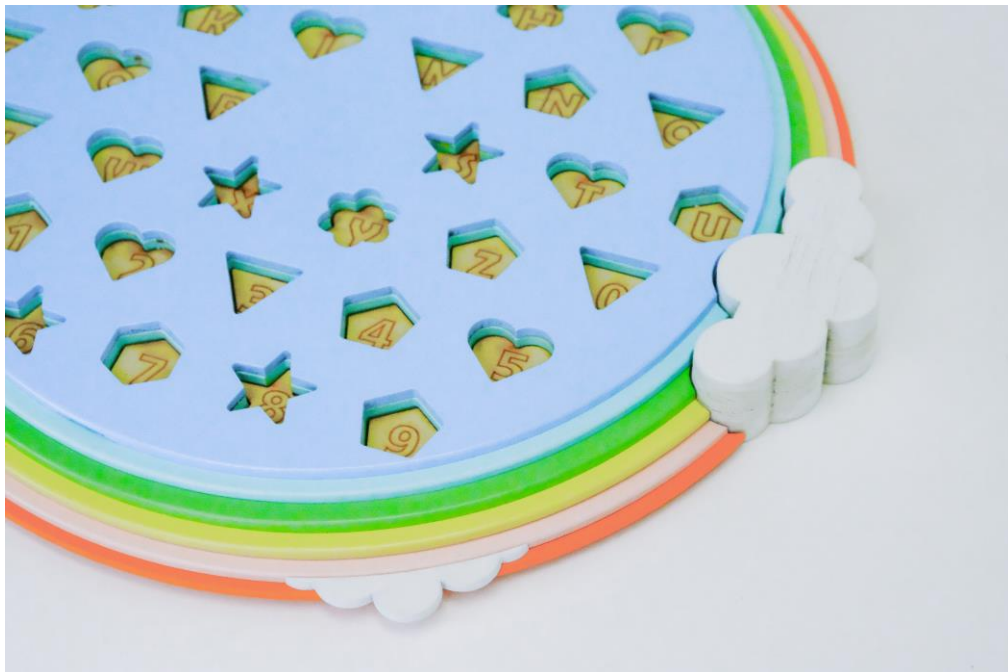


Figure 4. 19 Model-Making

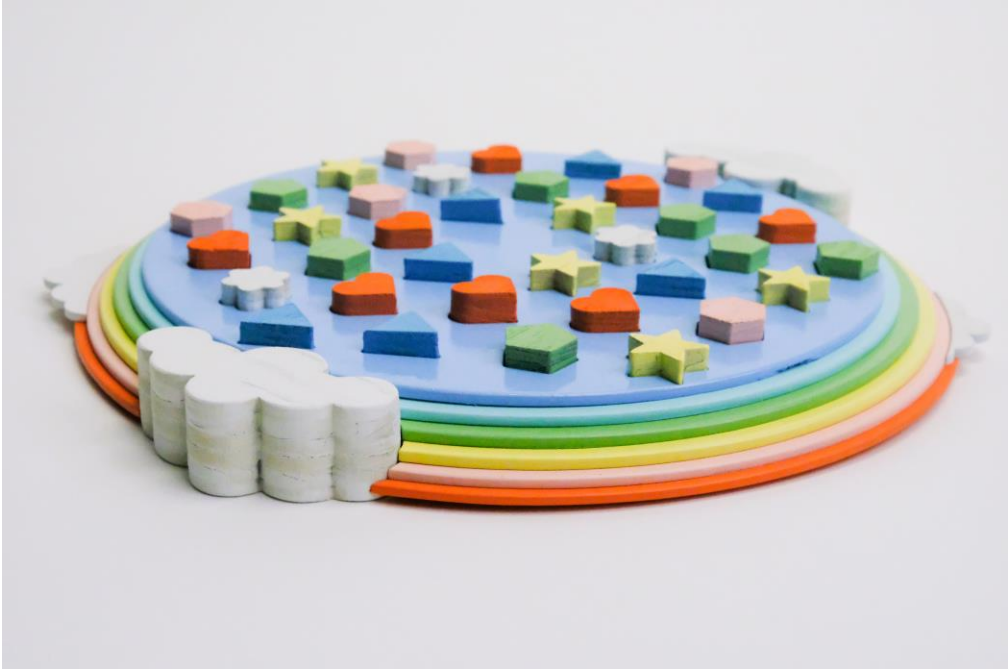


Figure 4. 20 Model-Making



Figure 4. 21 Model-Making

Chapter 5 Conclusion

5.1 Conclusion

The goal of my thesis is to develop guidelines for designers to incorporate the parent-child factors into toy design.

Firstly, I target the users. As it shows in the literature, from birth to six years old is the appropriate age range to develop parent-child relationship. Thus I would like to design parent-child toys for parents and children whose age range is from birth to six years old. Designers should limit their design within this range, if they want to use my guidelines, but they can decide on the specific age range.

Secondly, I provide advantages of parent-led play, parent-child cooperative play and child-initiated play. Designers can select advantages of them.

Thirdly, according to the selection of advantages, they can limit the parent participation percentage to a range.

Finally, designers freely choose the amount of parent-led factors and child-initiated factors respectively to achieve the expected parent participation percentage.

5.2 Further Development

In my thesis, children whose age range are from birth to six years old are studied. According to the research, if parents miss the appropriate age range (0~6 years old) to establish parent-child relationship, 6 to 12 years old might also make up for the parent-child relationship.

As a result, I will keep doing research on the children whose age range is from six to twelve years old.

However this period is quite complicated, because children's social network is increasing continuously with the addition of teachers and other classmates. The children connect with family, classmates, teachers, neighbor, society and so on. As the study shows, the good teacher-child relationship even can compensate the unhealthy parent-child relationship. Thus parent-child relationship is not indispensable in a sense. A bad parent-child relationship is not fatal. Instead, children like to deal with teachers and classmates at this time. This is the reason why the parent-child toy is not as meaningful for 6 to 12 year-old children. These overlapping factors all increased difficulty to do research on the parent-child relationship.

But actually, some of the children still need to develop parent-child relationship from 6 to 12 years old as well. For example, children with mental disorders may be afraid to get in touch with the outside world; thus parent-child toys may help them alleviate the disorder and encourage them to return to the society with confidence. The survey suggested that ADHD, behavior problems, anxiety, and depression have been the most commonly diagnosed mental disorders in children (Centers for Disease Control and Prevention, 2019).

The survey suggested that 9.4% of children aged 2-17 years (approximately 6.1 million) have received an ADHD diagnosis; 7.4% of children aged 3-17 years (approximately 4.5 million) have a diagnosed behavior problem; 7.1% of children aged 3-17 years (approximately

4.4 million) have diagnosed anxiety; 3.2% of children aged 3-17 years (approximately 1.9 million) have diagnosed depression (Centers for Disease Control and Prevention, 2019).

As Figure 5. 1 shows, behavior problems are more common among children aged 6–11 years than children younger or older (Centers for Disease Control and Prevention, 2019).

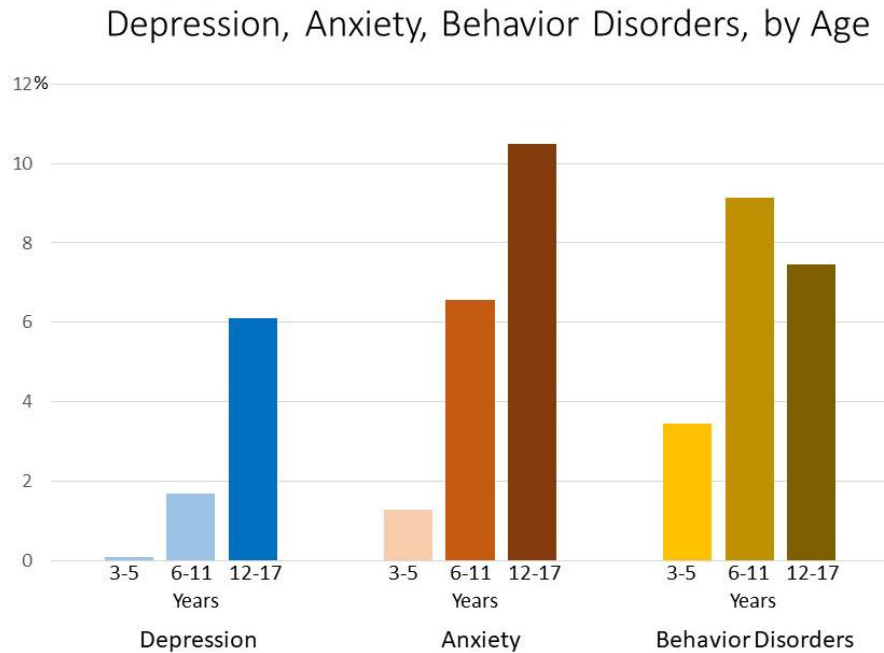


Figure 5. 1 Age Distribution of Depression, Anxiety and Behavior Disorders

Therefore there is also a need to design parent-child toys for 6 to 12-year-old children (Centers for Disease Control and Prevention, 2019).

Although all kinds of data show that the design of the parent-child toy from 6 to 12 years old is very difficult to study, it is also very significant for children with mental disorders. So if my thesis has further research, this will be a very important research direction for the next stage.

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