

THE DESIGN STUDY OF MULTIPLE TOYS FOR PARENT-AUTISM CHILDREN INTERACTION BASED ON SENSORY INTEGRATION

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ABSTRACT

Toys are an important medium to the child development, as well as to these autistic children. In accordance to the Sensory Integration theory, this study provide toys with preprioception stimulus, and then adding tactile, vision, auditory, and olfaction stimulus in sequence. The study consists of experiment plan and execution. (1) Experiment plan has designed the manner of experiment by literature reviews; also it has designed an experiment record of "parent-child interaction" and a questionnaire to investigate "feeling of parents." The prior one is to record how concentrative a child can be, and the latter one is to evaluate the proactive participation of subjects. (2) During the process of the overall experiment, toys with physical characteristics corresponding to sensory stimulus are added in sequence, and five small experiments are conducted. It is observed from the result that: (1) Regarding the "parent-child" interaction, subjects are most concentrative with preprioception stimulus, least concentrative when adding vision stimulation, and become more concentrative when olfaction stimulus is added; (2) regarding the "feeling of parents," children are most willing to participate the game when tactile stimulus is added, but least willing to participate with vision and auditory stimulus; (3) relationship between "parent-children interaction" and "feeling of parents": when given preprioception stimulus, children are obviously more concentrative, but mentally parents tend to under-evaluate its effect. Scores of both parent-child interaction and feeling of parents decrease. In contrast, olfaction stimulus has improved both. It is seen that olfaction stimulus can be a factor designed to improve concentration and proactive participation.

Keywords: autism, sensory integration, toy design, interaction

1. BACKGROUND AND PURPOSE

Autism is a pervasive developmental disorder, and obvious disorder symptoms surface at the toddler period, about two to three years old. Each case is very different from others, and thus each autistic child has a different profile. The major disorders occur in social development, communication, and repetitive behavior. These disorders, however, can only be mitigated through interventions (1).

Dr. A. J. Ayres from the Southern California University has addressed that the basic learning abilities of children, are developed through the process of sensory integration. If child development is observed from the view of sensory integration, an internal drive of a child urges him/her to explore the environment, develop his/her potentials; when his/her brain organizes each sensory and responds appropriately, the integration of sensory experiences provides correct messages to this child.

The multiple dysfunctions of sensory integration disorder usually hinder the development of cognitive learning. In order to mitigate this disorder, most Taiwanese families with autistic children utilize the sensory integration treatment to ease symptoms, and enable these children to adopt the basic behavior in their daily lives gradually.

The concept of early intervention relies on a medical system; nonetheless, the closest and the most reliable assistants to autistic children are their families. The attachment of autistic children toward their parents, and the interactions between parents and children, also helps their development. In the parent-child interactions, toys are utilized to inspire behaviors of children, and thus it is necessary to provide toys with proper sensory stimulations, and enhance the positive feeling between parents and children.

Each toy has different physical characteristics, and therefore they input different sensory to children with different quantities. This study designs toys based on sensory integration theory, and provide proper sensory stimulus to children with deficit sensory integration. Through the study:

1. Discuss how a “parent-child interaction” is impacted when toys provide an opportunity to increase sensory stimulus;
2. Discuss how the “feeling of parents” are impacted when toys provide an opportunity to increase sensory stimulus;
3. Discuss the relation between a “parent-child interaction” and the “feelings of parents.”

2. LITERATURE REVIEW

2.1. Autism

Autism is a pervasive developmental disorder, also abbreviated as PDD. There is no real pathophysiological cause found in neuroanatomy or genetics. Usually obvious symptoms occur in the toddler period, around two or three years old. Each patient can be quite different from other patients, and since the real causes are remained obscure, there is no proven effective treatment established. The only compensations are sensory integration training, cognitive education, and/or communication training.

2.1.1. Major characteristics of autism

- (1) Social development: autistics lack of the basic social capabilities. They may not response to others, do not have eye contact with others, need not to be snuggled, or not afraid of strangers since the toddler period. Without response to others and eye contact, it is difficult for them to have emotional interaction, and they tend to have irresponsive social behavior when interacting with others.
- (2) Communication: autistics have difficulties with verbal and non-verbal communications in different levels. Most common difficulties include developmental retardation of language, grammatical mistakes, and unique usage of language.
- (3) Repetitive behavior: autistics tend to insist the way they use or play objects, and have ritualistic behaviors.

2.1.2. Treatment of autism

Until now, there is no break-through regarding the mechanism of autism, nor its pathosiological, anatomic pathological, and genetic causes. There is no cure to autism, either. However, still there are some methods to mitigate the symptoms effectively, and thus enhance patients to accommodate daily lives.

The multiple sensory integration disorders of autistic children usually obstruct their cognitive learning progress. In order to mitigate this disorder, most Taiwanese families with autistic children utilize the sensory integration treatment to ease symptoms, and enable these children to adopt the basic behaviour in their daily lives gradually.

2.2. Sensory integration theory

Sensory integration is a function of a normal brain. One's learning capabilities, are developed through his/her brain's selective absorptions from all sensory stimulations, and then the brain organize these absorptions to provide the owner correct messages; the brain as well responds in accordance properly (3).

Sensory integration disorder means a dysfunctional brain is unable to integrate the five basic senses including vision, auditory, tactile, vestibular and proprioception, and thus the brain cannot respond properly.

The treatment of sensory integration aims to provide inputs of the mentioned sensory stimulus, and with a proper control, to enable children lead their own behavior by their internal drives, and thus form compliant responses. Autistic children may overcome individual behavioral disorder through the treatment of sensory integration.

Different type, method, and/or strength of sensory stimulus affect human's response. Consequently, toys may provide proper sensory stimulus to autistic children, in order to develop their brains, offer sensory motion experience, and finally enable them to explore their environment proactively.

3. RESEARCH METHOD

3.1. Questionnaire

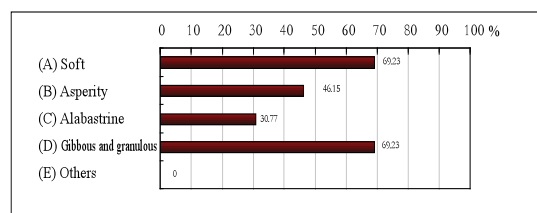
There were two stages of the questionnaire. The first stage aimed to learn the autistic children's favorite physical characteristics of toys. The second stage was to learn that to autistic children, the importance of the five senses, including proprioception, tactile, vision, auditory, and olfaction.

3.1.1. The first stage of questionnaire

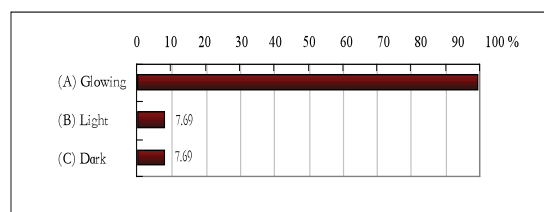
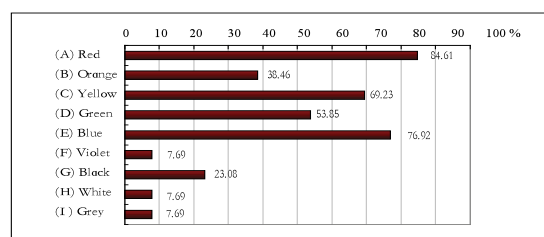
At the primary stage, the purpose of the questionnaire was to learn the favored physical characteristics of toys by autistic children. The questions were designed to focus on the physical characteristics based on vision, tactile, auditory, and olfaction. Parents of these autistic children receiving sensory integration treatment were invited to answer the questionnaire. The effective questionnaires were thirteen.

Analysis of the outcome of "corresponding physical characteristic to senses":

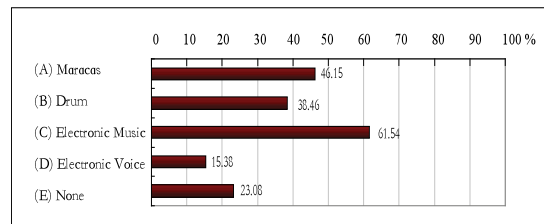
- (1) Corresponding physical characteristic to proprioception: through the literature review and suggestions from experts, "weight" was chosen for the corresponding characteristic to proprioception of this compound toy.
- (2) Corresponding physical characteristic to tactile: "soft surface" and "grainy surface" were chosen for the corresponding characteristic to tactile of this compound toy.



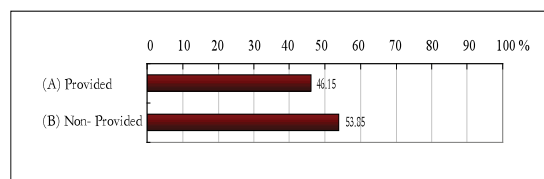
- (3) Corresponding physical characteristic to vision: all parents chose "glowing" colors, mainly "red," "yellow," and "blue."



- (4) Corresponding physical characteristic to auditory: the major characteristics were “electronic music,” “maracas,” and “drum.”

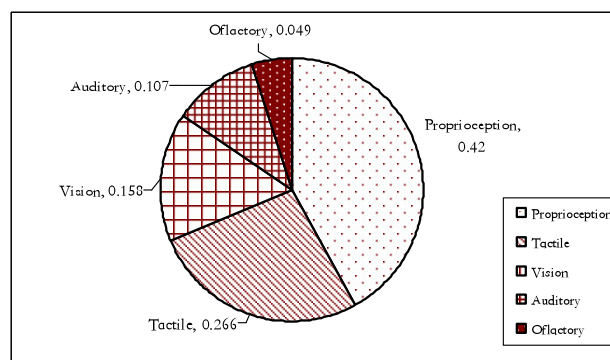


- (5) Corresponding physical characteristic to olfaction: more than a half of parents said “no” when asked if children felt odours pleasant. This study attempted to apply the physical characters corresponding to olfaction to the compound toy.



3.1.2. The second stage of questionnaire

The second stage of questionnaire was developed through the literature review. Its purpose was to distinguish the importance of the five senses, including proprioception, tactile, vision, auditory and olfaction, to autistic children, while excluding individual variation but based on sensory integration theory, so that the way to compound the designed toy was understood. The questionnaires were answered by teachers from Occupational Therapy department in national universities and occupational therapists. There were three effective questionnaires. The result was analyzed with Analytic hierarchy Process, each sensory system was weighted as the following: proprioception 42%, tactile 26.6%, vision 15.8%, auditory 10.7%, and olfaction 4.9%.



3.2. Limitation of design

Among sensory systems, vestibular system, taste, and proprioception were not included in the questionnaire. Most play wares for vestibular system are large-size, for example, suspension systems or rope. Due to its size and safety concern, and the limitation of space and manpower, big-size play ware is not taken into account. Taste, on the other hand, is not included because it involves mastication and thus has safety concern. Proprioception is a

deep feeling of muscles and joints, and it is difficult for parents to answer. Consequently, the design relating to proprioception was not included, but discussed with experts respectively.

3.3. Manners of the compound toy

Through the analysis of this two-stage questionnaire, this study conducted an experiment including five parent-child interaction games. The manners to compound the experimental toy were by “increasing sensory stimulus in one-way,” and “decreasing the importance of sensory stimulus gradually.”

Trails	Manner of compound	Description
1	Proprioception	300 grams, two layers of red wrap, and the core is a polylon ball
2	Proprioception+tactile	300 grams, one layer of red wrap, and the core is a polylon ball
3	Proprioception+tactile+vision	300 grams, one layer of red wrap to wrap a polylon ball, and three LED devices
4	Proprioception+tactile+vision+auditory	300 grams, one layer of red wrap to wrap a polylon ball, three LED devices, and a bell
5	Proprioception+tactile+vision+auditory+olfaction	300 grams, one layer of red wrap to wrap a polylon ball, three LED devices, a bell, and a lemon scent bag

4. EXPERIMENT DESIGN AND EXECUTION

This study aims to obtain the outcome resulted by the sensory inputs generated from different physical characteristics included in the toy, as well as the parent-child interaction in families with autistic children. Each experiment was carried out for twenty to thirty minutes, and conducted at the same period of time in a week. Parents might evaluate the mental and physical conditions of their children, in order to have a consistent experiment. The experimental subjects are described as the following:

Experimental Subject	Gender	Age	Leader/Observer	Function Validation
Child A	male	Seven years and six months old	Mother / Father	Low-functioning
Child B	male	Six years and two months old	Father / Mother	High-functioning
Child C	male	Five years and seven months old	Father / Mother	High-functioning
Child D	male	Five years and six months old	Father / Mother	High-functioning
Child E	male	Eight years and eleven years old	Mother / Father	High-functioning

The experiment consists of two parts of questionnaire:

- (1) The record of “parent-child interaction” experiment: This records child’s actions and eye contacts, which were behaviours occur only when parents and children play balls or other games, and communicate with each other. In every five-minute segment, child’s concentration is graded as “strong, mild, weak, and none.” “Strong” was given four points, and “None” gets no point. Finally the total score is calculated.
- (2) The questionnaire of “parents’ feeling”: During the process of playing, parents subjectively evaluated how they feel about their child’s willingness to participate the game. This included that if the child concentrated in the process and proactively demands playing, but not behaved slackly. Likert’s Scale was applied for grading. 1 means very bad, and 9 means excellent.



5. OUTCOME AND ANALYSIS

Through the five experiments, the study aims to obtain:

- (1) Relationship between increasing sensory stimulus and parent-child interactions
- (2) Relationship between increasing sensory stimulus and parents’ feeling during the parent-child interaction
- (3) Relationships between parent-child interactions and parents’ feeling

5.1. Outcome analysis of “parent-child interaction behaviours”:

Through the description the average value in the statistics, the overall presentations of the five subjects are discussed (Table 1); by standard deviation and coefficient of variation, the variation of the overall experiments is grasped. Also, the variation and correlations among each experiment is checked by the t-test.

Table 1: Score for Concentration

	Mean	Std.Deviation	coefficient of variation
Trial 1	7.2**	3.42	.48
Trial 2	6.4	3.58**	.56**
Trial 3	5.2*	2.28*	.44*
Trial 4	5.6	2.88	.51
Trial 5	5.8	3.19	.55

The highest concentration is achieved at Trial 1 (preprioception stimulus), and the lowest is at Trial 3 when vision stimulus is added; then it is increased again at Trial 5 when olfaction stimulus is added.

In Trial 3, the standard deviation and the coefficient of variation are the lowest, and thus it is the least varied one.

In the pair-correlation of concentration experiment (Table 2), Trial 2 and 3 are highly correlated.

Table 2: Concentration Experiment – Pair-Correlation

Experiment	N	R	Sig.
Trial 1-Trial 2	5	.48	.41
Trial 2-Trial 3	5	.91	.03
Trial 3-Trial 4	5	.78	.12
Trial 4-Trial 5	5	.45	.45

5.2. Outcome analysis of “feeling of parents”:

For the proactive participation, the most proactively participated experiment is Trial 2 (tactile stimulus added). Trial 3 (vision stimulus added) and 4 (auditory stimulus added) are the least proactively participated. (Table 3)

Table 3: Average of proactive participation

	Mean	Std.Deviation	coefficient of variation
Trial 1	6.4	1.2	.19
Trial 2	6.6**	1.36	.21
Trial 3	6.2*	.98*	.16*
Trial 4	6.2*	1.47	.24
Trial 5	6.4	1.7**	.27**

Parents believes that regarding their children’s proactive participation, the preprioception stimulus is good, and combining tactile and olfaction stimulus are more effective.

5.3. Outcome analysis of “parent-child interaction” and “feeling of parents”:

When given preprioception stimulus, children are obviously more concentrative, but mentally parents tend to under-evaluate its effect. Scores of both parent-child interaction and feeling of parents decrease. In contrast, olfaction stimulus has improved both. It is seen that olfaction stimulus can be designed to improve concentration and proactive participation. When adding both vision and olfaction stimulus, “concentration” and “proactive participation” are more consistent. Adding only vision stimulus, the score decreases; adding olfaction, on the other hand, the score increases. (Figure 1)

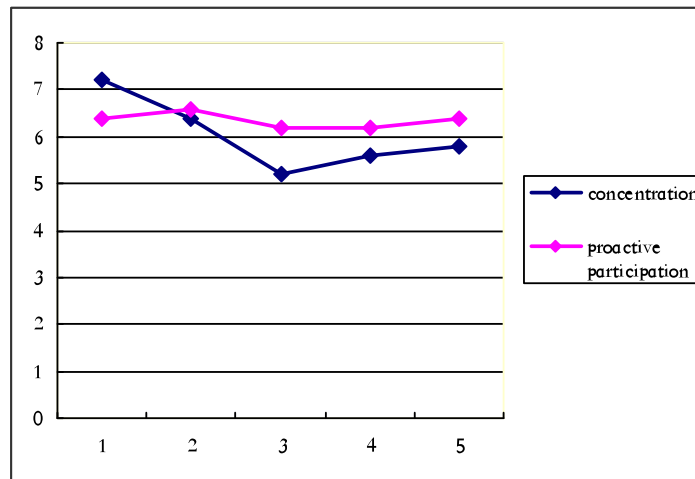


Figure 1: How sensory stimulus changes “parent-children interaction/feeling of parents”

6. DISCUSSION AND CONCLUSION

This study is to discuss toy design, sensory integration, and the parent-child interaction in families with autistic child. The discussion is concluded as the following:

- (1) According to the outcome of a weights allocation of senses, the first one is preprioception, and then tactile, vision, auditory, and olfaction. The importance of each sense is sought by the weights allocation, and the outcome is the base of the compound toy design.
- (2) It is observed that preprioception stimulus is good to a child’s concentration. Auditory and olfaction stimulus are also helpful. On the other hand, vision stimulus decreases the effect.
- (3) “Vision stimulus attracts children, and enhances their concentration.” (Michaud et al. (2003)) However, this study observes that with a purpose of parent-child interaction, a physical vision stimulus tend to distract their attention.
- (4) Kunieda & Jingu(2005) have found that “different olfaction stimulus has apparently various effects to elders’ pleasure, amuse, willingness, and concentration.” This study suggests the applicability of olfaction stimulus. Our study also recognizes that the invisible olfaction stimulus does not tend to distract the parent-child interaction, but improves their pleasure.
- (5) Parents consider that preprioception stimulus has nice effect to their children’s proactive participation. With tactile and olfaction stimulus, the effect is even better.

Early intervention, training of sensory actions, and parent-child interactions are all considered to help the development of autistic children. The study develops toys based on sensory integration theory; we also combine toys with children’s favourite sensory stimulus and their tendency of expectable repetitiveness. With a family intervention and a familiar environment, the parent-child relationship is improved. In the future, sensory input toys will

be provided to stimulate other target behaviours, in order to help autistic children and their family to mitigate their disorder by a wonderful parent-child interaction.

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