Research on the Design of Cross-Age Interaction Toys

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Abstract. In response to the aging society and change of family structure, intergenerational learning: getting help from the children, has become a new trend of elderly care. However, the elders and children differ a lot in body function, physical perception and mental cognition, and few studies take into account the physical and mental condition of both groups. Products designed for the elders and children to interact and play are even rarer. The study investigates the physical and mental capacity and prerequisite knowledge of the elders and children, analyze the overlapping characteristics of their physical and mental capacity, and provide cross-age body-mind interaction product design guidelines, including: (1)Reviving motor function, (2)Divergent creativity, (3)Intergenerational learning, and(4) Safety. With this product, both groups can strengthen their physical and mental capacity through the joyful game playing process, optimizing the development of synesthesia, and build friendship among them, as well as reducing the cost of social resources for long-term caring.

Keywords: Cross-Age, Elderly Toys, Interaction, Product Design.

1 Introduction

With the economy and society going through transformation and the trend of aging population, the family structure has changed rapidly. Besides, people nowadays are busy with their work and mostly form dual-earner families. The phenomenon of "grandparent family" is becoming increasingly common, and grandparents and grandchildren (elderly and children) are spending more and more time together, which makes it mostly the elderly and children keeping each other's company at home. In the leisure activities of the elderly in Taiwan, playing with their grandchildren accounts for 50% to 60% (Chen, 2001). Toys suitable for both the elderly and children become an important medium of physical and mental interaction between them, which can further serve as a platform for greater family intimacy, so cross-age toy design gradually shows its significance under the new social trend.

In general, "grandparents capable of child care" are aged 50-70, while the children cared for are about 3-12 years old, indicating that the average age gap between

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grandparents and grandchildren are 40-60 years. The two groups differ a lot in physical and mental condition, as well as in their body function and respective need for mental cognitive development. As a result, this kind of toy design has to take into account both groups' physical and mental development in various stages, which needs more open thinking and room for discussion.

2 Literature Reviews

The WHO estimates that in 2050, the elderly aged over 60 will account for 22% of the world population. According to the Ministry of Education in Taiwan, the average age when Taiwanese nationals first become grandparents is 53, so if compared with Taiwanese people's average life expectancy of 79.15 years in 2010, the time of being a grandparent could be as long as 26 years. The get-along between the elderly and children has been an indispensible part of family relationship. When the grandparents and grandchildren spend time together and play games, the elderly often view the roles they play in a positive way (Lu & Chen, 2002). The grandparents place great importance on the interaction with their grandchildren, whereby they can get a sense of life continuity. Positive interaction can increase the intimacy between the grandparents and grandchildren, and on the other hand, the children can also learn life experience from their elders, which is the energy of "intergenerational learning" derived from good interaction between the elderly and children (Kazemek & Logas, 2000; Hannon, 2004).

2.1 Physical and Mental Functioning of the Elderly

Changes that come with aging are the degeneration of senses and slower movement (Wang,2009), among which the most obvious include: (1)Skeletal muscle: reduced bone density, (2)Muscular strength and muscular coordination (Kawakami, Inoue, and Kumashiro, 1999; Lin, 2008); (3)Action: change of reflex time and response speed; (3)acuity: lower visual and hearing acuity and hearing impairment; (4)Balance: one of the important indicators of the aging process, normally people aged over 60 would begin to show initial signs of impaired balance, especially the degeneration of bones, joints and muscular system would all affect gait biomechanics, lowering the stability of gait (Wu & Chan, 2009); (5)Body coordination: hand-brain and hand-leg coordination deteriorate. Therefore, the elderly doing activity should keep using their muscles and joints to prevent the loss of muscular strength and pliability, and they need a sense of safety when doing physical activity (Lu and Li, 2001). They can increase lower body muscle and strengthen muscular endurance by simply walking or knee bend. Besides, exercises can improve the balance of the elderly, especially those with instant vertical or horizontal movement can help with the sense of balance

Mentally, the elderly also go through some apparent changes with age, including poorer memory and judgment, and failure to achieve what they are originally familiar with (Hsieh, 2007). The mental characteristics of the elderly are as follows: (1) logic: logical reasoning is an important indicator of understanding cognitive development and intelligence (Bjorklund, 2000; Siegler, 1998); (2) memory: poorer memory, failure to achieve what they are originally familiar with; (3) creativity: when people get older, the ability to repress gets weaker, which unleashes their creativity and makes them stronger artistically.

2.2 Physical and Mental Condition of the Children

The study looks into the physical and mental condition of 3-12-year-old children raised by cross-generational parenting. This stage lays the foundation for children's growth physically, mentally or in character development. So if their physical and mental growth can be enhanced through the interactive toys for grandparents and grandchildren, it will be very beneficial to their future development (Marcus, Selby & Rossi, 1992). The movement skills developed by children aged 3-7 are basic locomotor and non-locomotor skills, such as running, sliding, bending, turning, hopping on one foot and hopping on both feet, jumping over, dodging, swaying, swinging, and stretching. When they turn 8-9 years old, they perform these fundamental skills more easily and efficiently, and start to develop complicated locomotor, non-locomotor, and manual skills. In the meantime, due to an increase in body strength during this period, accompanied by growth in perception and cognition, children are able to complete coordinated movement more quickly and accurately. 10- to 12-year-olds emphasize more special movement skills needed in competition, dancing or gymnastics (Lin, 2004).

In terms of psychological development theory, with regard to creativity: children aged over 3 years have endless inspiration, and 3- to 5-year-olds can find association between different concepts, expressing their imagination or ideas through analogy and comparison; 4- to 6-year-olds try to turn analogical concepts into actual concepts that apply to the outside world. In respect of spatial perception: 3- to 7-year-olds can use themselves as the center to feel the things in the surrounding, and gradually develop spatial concepts. A 3-year-old child can already distinguish the direction of up and down; a 4-year-old can distinguish front and back; a 5-year-old can start using himself/herself as the center to distinguish left and right; and a 6-year-old can correctly distinguish up and down, front and back. 6- to 12-year-olds have the abstract spatial and temporal concepts.

3 Product Design

Through references analysis, the study first proposes the design guidelines for toys targeted at grandparents and grandchildren, and then conducts product design accordingly. The guidelines are as follows:

3.1 Design Guidelines of Cross-Age Toy

1. Reviving motor function: the elderly are faced with the degeneration of senses, during which they gradually lose muscular strength, while the children are going through muscular and skeletal growth. Therefore, toys for grandparents and grandchildren should make both groups' bones and muscles feel refreshed in the game process, enhancing physiological movement functions such as hand-eye training, muscular strength, and body coordination.
2. Divergent creativity: In order to prevent the intellectual deterioration of the elderly and to train the children's creative thinking, toys for grandparents and grandchildren should have the quality of divergent creativity, enabling both groups to brainstorm and improvise to create toys that fit in their own scenarios.

3. Intergenerational learning: the elderly are experienced and skilled, while the children have good memory and flexibility, so the toys should use both groups' characteristics to help them complement each other, and increase the sense of participation, making the grandparents feel recognized in the game.
4. Safety: Since the target users are the elderly and children, the product should not have sharp corners, and should be made of soft material or have protection measures, in order to lower the risk of accident during the game.

3.2 Cross-Age Toy Design and Development

According to the above design guidelines and considering the revival of motor function and divergent creativity, the cross-age toy design in the study is set up as a large assembled toy for three reasons: (1) the process of assembly involves movement of the whole body; (2) the process of assembly can develop the users' creative thinking; (3) the scale of the game can be determined by the users' physical strength, which makes it suitable for both the elderly and children. The design of the cross-age toy components is shown below:

1. The unit pieces are hexagon-shaped like honeycomb cells for the maximum possibility of assembling.
2. There are three kinds of unit pieces with different-sized raised spots respectively, used to assemble a variety of obstacle courses.
3. The unit pieces are made of EVA soft material and the reverse is covered with slip-resistant material, which makes them quite safe and reduces injury from falls or bumps.
4. Each unit piece has hidden blocks at the edges, which can be taken out, turned 90 degrees and inserted back into the original groove, so they become curbs that prevent the ball from rolling out of range. The game can proceed without being interrupted and causing a waste of energy (Figure 2).

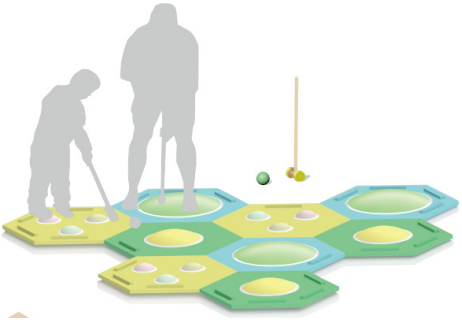

Fig. 1. The design of unit pieces

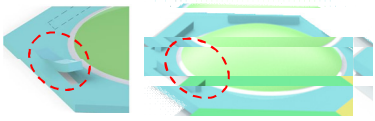

Fig. 2. The design of hidden blocks

Before the game, the grandparents and grandchildren can assemble three kinds of unit pieces together to form a variety of obstacle courses. The ways of assembly can be adjusted according to their creativity and surroundings, by means of which the elderly and

children can develop creative thinking. During the game, both sides strike the ball with the mallet, making it move along the courses surrounded by raised spots, even choosing different colors to alter the difficulty level of the game, which leads the elderly and children to think and react. The game is simple but can be played in a variety of ways, making it quite flexible. For example: you can request the course of the ball to include the yellow area or exclude the yellow area (the latter is more difficult), and the person who reaches the goal is counted as successful. The product features are as follows:

1. Developing motor function: the process of assembly can help the elderly and children develop motor function such as limb movement and improve concentration, increasing hand-eye coordination and balanced development of small muscles and extensor muscles.
2. Encouraging creative thinking: the number of unit pieces can increase freely, and there are a variety of ways to play the game. The product is expandable, and it can train the users' ability of spatial planning through the process of assembly, which is helpful to the grandparents and grandchildren's creative development.
3. Developing color vision: the product is colored in yellow, green and blue to help develop the elderly and children's ability of color discrimination, as well as left and right brain stimulation.
4. Building family ties: through playing the game together, the grandparents and grandchildren develop the relation of mutual support, which not only reduces the gap of physical functions, but also strengthens their interaction and care for each other, building family ties.
5. Suitable for grandparents and grandchildren to play together or on their own: considering that the grandparents do not always have time to play with their grandchildren, the product allows the grandparents or children to play individually, with the same effect of physical and mental development. The product's usage rate can also be increased.

4 Conclusion

From the preparation of physical and mental prerequisite knowledge of the elderly and children, the study finds the overlapping characteristics of their physical and mental capacity, and develops the interaction toy for both groups accordingly. Through working together in the game, the grandparents can train their physical and mental functions, reducing the speed of aging; for the children, they can develop physical strength and mental growth. Both groups can enhance their physical and mental capacity, optimizing the development of synesthesia and, most important of all, improving their interaction relationship to become closer to each other.

In terms of the production process, the product is made of EVA, which is bendable, non-toxic, low cost in material, easy to process, and recyclable, so the feasibility of production is very high.

In terms of commercial potential, products targeted at the elderly and children have a big market with a lot of consumers. The product spans the industries for the elderly and children, and covers the physical and mental development of both groups, making it possible for family members to play together, which leads to promising commercial potential.

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References

1. Chen, C.N.: Leisure Activities and Life Satisfaction Among Taiwanese Elderly. Journal of Population Studies 26, 96–136 (2001)
2. Lu, L., Chen, H.H.: An Exploratory Study on Role Adjustment and Intergenerational Relationships among the Elderly in the Changing Taiwan. Research in Applied Psychology 12, 221–249 (2002)
3. Kazemek, F., Logas, B.: Spiders, Kid Curlers, and White Shoes: Telling and Writing Stories across Generations. The Reading Teacher 53(6), 446–451 (2000)
4. Hannon, P.O.: An Investigation of the Impact of Short-Term Quality Intergenerational Contact on Children's Attitudes toward Older Adults. Unpublished doctoral dissertation. The university of Pennsylvania State (2004)
5. Wang, H.S.: Exercise and Physical Activity for Older Adults. American College of Sports Medicine MSSE 41(7), 1510–1530 (2009)
6. Kawakami, M., Inoue, F., Kumashiro, M.: Design of a Work System Considering the Needs of Aged Workers. Experimental Aging Research 25(4), 477–483 (1999)
7. Lin, G.U.: Aging effect on the elderly workers. Newsletters of Labor Safety and Health 91, 17 (2008)
8. Wu, M.T., Chan, Y.S.: The Effects of Aging and Exercise Intervention on Balance Control in the Elderly. Taiwanese Gerontological Forum 2, 1–12 (2009)
9. Lu, Y.J., Li, M.R.: Exploration of Socialization Development and Needs of Leisure Stage. National Taiwan University of Physical Education and Sport 8, 97–112 (2001)
10. Hsieh, K.J.: Feasible ways to slow communication fear of elderly learners. Quarterly Journal of Community Development 120, 283–295 (2007)
11. Bjorklund, D.F.: Children's Thinking: Developmental Function and Individual Difference, 3rd edn. Wadsworth/Thomson Learning, Belmont (2000)
12. Siegler, R.S.: Children's thinking. Prentice-Hall, Englewood Cliffs (1998)
13. Lin, F.G.: Physical and Mental Development of Children. Bimonthly Journal of School Sports 80, 18–24 (2004)