# Designing Cross-Age Interaction Toys for Older Adults and Children

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**Abstract.** This paper describes the process of using a co-participatory design method to produce a toy prototype for children and adults. Based on suggestions from both groups, co-participatory design activities were organized around a single guiding principle: to construct an interesting and creative toy to help both generations interact with each other. Our findings support the usefulness and necessity of this design method and illustrate how designers could implement them in future work. Two industrial designers, six older adults (three male and three female, aged 65–75), and six children (3 male and 3 female, aged 6–10) were involved in the co-participatory design process, which was conducted via daily dialogue, scenario creation, and semi-structured interviews. This research described a co-participatory design process that included designers, children, and older adults. Data gathered from the process revealed that children had creative design ideas that considerably improved the interactive toy. This enabled the designer team to achieve a better empathic understanding of older and younger users, and to work on a project that was grounded in the interests of both target groups.

**Keywords:** Co-participatory design · Older adults · Children · Toy

## 1 Introduction

The global trend of an aging population, the market of older consumer market is increasingly large. According to Ministry of Interior predicts that the next 40 years, Taiwan will accelerate the aging of the forecast, Table 1 is the stream of the aging in Taiwan. Related to age and type of product consumption in the rapid increases in older industries is a growing potential market. Characteristics of research and development for the elderly, and the function of reasonable, good quality products have become competitive in the market for development opportunities. From the ergonomic point of view, give full consideration to older people's physical characteristics, psychological characteristics, designed for the elderly to use the comfortable, convenient, safe, healthy products is the social development needs.

**Table 1.** The stream of the aging in Taiwan

| Year | Total population (million persons) | Age structure (%) | | | Dependency ratio | | |
|---|---|---|---|---|---|---|---|
| | | 0–14 years | 15–64 years | 65 years and over | (%) | Young age population ratio (%) | Old age population ratio (%) |
| 2006 | 22.9 | 18.17 | 71.88 | 9.95 | 39.13 | 25.28 | 13.85 |
| 2018 | 23.3 | 12.50 | 73.14 | 14.36 | 36.73 | 17.10 | 19.63 |
| 2030 | 22.8 | 10.59 | 65.56 | 23.85 | 52.54 | 16.16 | 36.38 |
| 2050 | 18.9 | 7.85 | 55.43 | 36.72 | 80.42 | 14.17 | 66.25 |

With the economy and society going through transformation and the trend of aging population, the family structure has changed rapidly (Fig. 1). 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. However, while children and older people are gaining influence they can still be considered in a broad sense as groups of vulnerable people. In many cases, they have less control of their lives and are more dependent on others to help out with various kinds of things than the average population. In addition to this, they may also have various kinds of cognitive and physical restrictions. For these reasons the term "vulnerable generations" will be used to denote the group of children and elderly as a whole. In line with their increased influence, there is a growing awareness of the needs of vulnerable generations. Innovative use of design specifically targeted towards these groups' special needs can contribute greatly to the improvement of their wellbeing, preventing them from facing difficult or stressful situations. Moreover, less work has been spent on developing teaching modules for design methods and practices aiming at
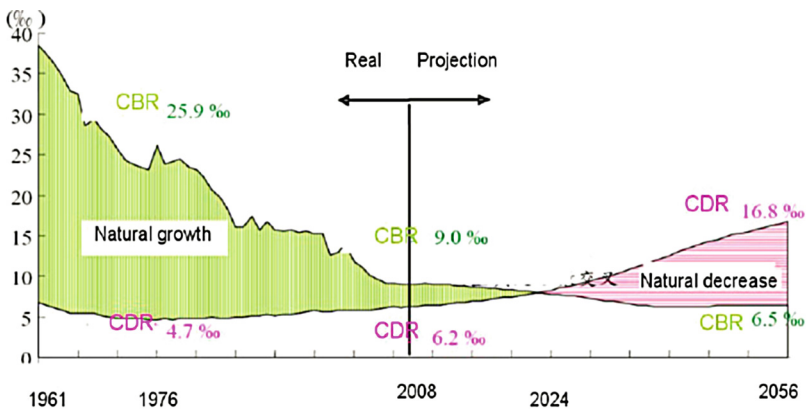


**Fig. 1.** Population changes and projection in taiwan: 1961-2056 (Source: population projection 2008-2056 in Taiwan, R.O.C., Council of economic planning and development, 2008.)

covering the needs of elderly and children. Accordingly, more work is needed on design for these groups. To improve the design practice in the area of design for elderly and children it is necessary to not only study and improve methodology, but also how to transfer the gained knowledge to new generations of designers to ensure its use in design. A combination of current research practices and design explorations and methods can be used to suggest new approaches to design for children and older people and to modernize the design curriculum with a specific focus on both older people and children.

## 2  Literature Reviews

### 2.1  Toy Design for the Aged and Trans-Generational Society

Seniors toy that is developed specifically for older toys, and some activities can help the elderly wrist, waist, and some have educational functions, for old hands-on brain, slow thinking, degradation, prevention of Alzheimer's disease. Psychologists believe that staying at home for elderly people have a tendency to a return to innocence. The curiosity of the elderly with special emphasis on toys to satisfy their spiritual needs; some of the elderly living alone, if they can cultivate interest in favorite toys, flavoring agents will increase the number of life for people with mild dementia of the elderly, not only can improve the quality of life, but also promote health and longevity. In Western countries developed for adults and older toys, toy market has become hot. In the United States, 40 percent of the toys are specifically designed for adults. Japan is also a lot of toys in the development of new features for the elderly, such as electric toys, playground common "combat crocodile," attach a blood pressure measurement function, as both entertainment and sports features, not only for stroke patients future nursing home can also be used. In this respect, Taiwan is still in the blank.

### 2.2  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 (14); (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.

## 2.3    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 10-year-olds have the abstract spatial and temporal concepts

# 3    Co-Participatory Toy Design and Development

## 3.1    Co-Participatory Toy Design and Development

We recruited older adults by sending flyers to community associations. People who were interested then called us and we conducted a phone interview with each one to understand their family structure. We collected a small amount of demographic data during these interviews and subsequently invited them to join us for a pilot session.

In total, ten grandparent families came to the first session. Two weeks later, six grandparent families agreed to join the whole participatory design. The sample participants consisted of married older adults and spread over urban and rural locations in Taiwan with different socio-economic backgrounds. Participants missed a few design meetings due to scheduling conflicts. This step involved identifying key groups of end-users and forming a participatory design team of intended users. The goal of this step was to open chances of cooperation between intended users and the designers.

Two industrial designers, Six grandparent families: including six older adults (three male and three female, aged 65–75), and six children (3 male and 3 female, aged 6–10) were involved in the participatory design .The methods employed here were dialogue, scenario creation, and asking semi-structured interviews. As none of the participants have experienced a participatory design session in their lives, almost all were very shy at the beginning. The designers had to make them imagine themselves in some related scenarios to be able to start the session. Narratives and metaphors were considered positive language use for this activity to elicit tacit knowledge and to allow the designers to gain insight into the mindset of the users. The participants provided ideas and defined their exact needs and preferences towards the current interaction toy design based on their past using experiences and scenario creation with their own words.

How do we access co-participatory design?

There are many ways we can learn from older adults and children about their ideas, memories, their current experiences and their ideal experiences:

- We can listen to what older adults and children say.
- We can interpret what older adults and children express, and make inferences about what they think.
- We can watch what older adults and children do.
- We can observe what older adults and children use.
- We can uncover what older adults and children know.
- We can reach toward understanding what older adults and children feel.
- We can appreciate what older adults and children dream.

Through analysis from the conducted dialogue, scenario creation, and asking semi-structured interviews, this research proposes the design concepts for toys targeted at older adults and children, and then conducts toy design accordingly. The concepts are as follows:

(1) Safety first (10 clues from the Coding Scheme)
    To varying degrees, the judgment, cognitive ability and ability to respond of the old people weaken and children, thus in the process of using the product, they inevitably make mistakes. In case a threat to physical and mental health occurs, they usually are unable to escape the danger. Therefore, toys for the seniors and children should be fault-tolerant. So that, the old people and children even make a mistake, there will be no danger. Here the reduction of operation process and the set of message for safe operation is an effective way to ensure the safety of the seniors with toys for these two generations.

(2) Moderate difficult (12 clues from the Coding Scheme)

The design of toys for the old and children should be of moderate difficulty, and the purpose is to arouse their interest in playing. If too simple, it would not enhance the interest of the seniors and children and thus would not achieve the aim of exercising the brain; if too difficult, it would be strenuous for them to learn, and consequently cause a sense of failure which is not conducive to their mental health.

(3) Easy to identify (8 clues from the Coding Scheme)

The interaction toy should have a familiar form and an understandable functional theory for the old and children. It should also be equipped with an interface in keeping with the experience and habits of the seniors and children. Besides, the toys that need interface design, should take into account the graphic symbols, size, color, clarity of sound, light intensity.

(4) Facilitate communication (13 clues from the Coding Scheme)

People's feelings need to vent and exchange, especially for the seniors and children. For them, emotional communication is indispensable to maintain their vitality, and improve the quality of life. Playing with toys, there are many ways for the old and young to choose, such as: taking turns to participate, working together and racing in the game. The development of multiple-persons playing toys is to create a harmonious environment in which they can talk when play. So the core of toy-development is to involve the participants as much as possible. For the participating ways, common collaborative participatory approach is the best, which is more conducive to conversation, and get to know some new friends. In this way the seniors and children can expand their social circle with emotional exchange.

(5) The effect for keeping fitness and developing intelligence (15 clues from the Coding Scheme)

Increasing with age, people's organ recession becomes an objective physiological phenomenon. In order to maintain good physical function and mental state, and improve the quality of life, fitness puzzle is a very important content in the lives of older persons and children. Body-building that can achieve with playing toys is the most basic needs of older persons. Old people and children by playing intellectual toys can effectively prevent Alzheimer's disease and enhance eye-hand coordination, so to maintain the flexibility of the seniors and children mind is the main direction of the toy development.

(6) Cultural connotations (9 clues from the Coding Scheme)

Life experiences bring the old people with more comprehensive concept of life, and good inheritance for the children, thus toys with a certain ideological and cultural depth usually put them in recollecting and thinking of issues. While the old emphasize the toy's inherent fun, and show great interest in the toys with cultural connotations. Of course, this culture must be familiar with the elderly and children has gone deep into the ideological deep.

According to the above results and considering the revival of motor function and divergent creativity, the cross-age interaction toy design (Fig. 2) in the study is set up as a pieces assembled toy for three reasons: (1) the process of different game type

**Fig. 2.** Cross-age interaction toys: game house

involves movement of the whole body; (2) the process of different game type can develop the users' creative thinking; (3) the different game type of the game can be determined by the users' physical strength, which makes it suitable for both the elderly and children. The toy feature are as follows:

1. The game starts with spinning the spinner.
2. Four different types of games are available.
3. Different turntables are designed for a variety of game combinations.
4. The direction of the spinner shall define the structure of the game.
5. The wood texture gives forth a warm and safe impression.
6. The cake-shaped toy attracts curiosity of little children, evoking their interest to play (Figs. 3 and 4, Table 2).
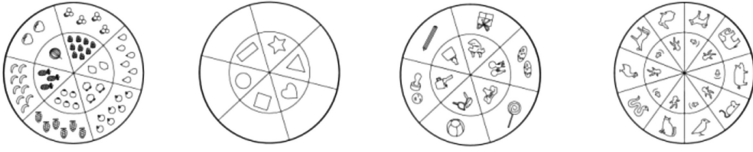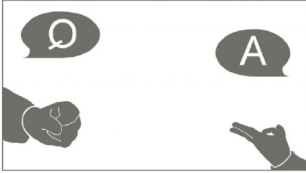


**Fig. 3.** Playing and interaction scenario

**Fig. 4.** Game type: from left to right: arithmetic games, mapping games of color and shape, reward games of action activity, copy games of charades

**Table 2.** Use process

| Illustration | description |
|---|---|
|  | Process1: selecting the game type and set aside the tuning panel |
|  | Process2: then play rock-paper scissor game to make the order |
|  | Process3: turning the panel to choose different test question |
|  | Process4: Starting the game |

## 4   Conclusion

In the Taiwan aging society, elderly population grows, and many elders take the responsibility of taking care of children in the family. Thus, childhood of many are filled with wonderful memories shares with their grandparents. With such background, this design seeks to find fun and creative elements that benefit both elders and children: interactive educational toys simulate brain exercise of the elders, prevent degeneration of their brain function, and at the same time, inspire the imagination of children, and

strengthen hand-eye coordination. This toy is designed to enhance the relationship between the elders and their grandchildren and build good memories.

# References

Birren, J.E., Schroots, J.F.: Handbook of the Psychology of Aging, 6th edn. Academic Press, Waltham (2005)

Bjorklund, D.F.: Children's Thinking: Developmental Function and Individual Difference, 3rd edn. Wadsworth / Thomson Learning, Belmont (2000)

Chen, C.N.: Leisure activities and life satisfaction among taiwanese elderly. J. Popul. Stud. **26**, 96–136 (2001)

Dickinson, A., Arnott, J., Prior, S.: Methods for human-computer interaction research with older people. Behav. Inf. Technol. **26**(4), 343–352 (2007)

Fisk, A.D., Rogers, W.A., Neil, C., Czaja, S.J., Joseph, S.: Designing for Older Adults-Principles and Creative Human Factors Approaches. CRC Press, USA (2004)

Freudenthal, A.: The Design of Home Appliance for Young and Old Consumer. Delft University, Netherlands (1999)

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)

Kawakami, M., Inoue, F., Kumashiro, M.: Design of a work system considering the needs of aged workers. Exp. Aging Res. **25**(4), 477–483 (1999)

Kazemek, F., Logas, B.: Spiders, kid curlers, and white shoes: telling and writing stories across generations. Read. Teach. **53**(6), 446–451 (2000)

Kline, D.W., Scialfa, C.T.: Sensory and perceptual function: basic research and human factors implication. In: Fisk, A.D., Rogers, W.A. (eds.) Handbook of Human Factors and the Older Adult, vol. 3, pp. 27–54. Academic Press, San Diego (1997)

Kosnik, W., Winslow, L., Kline, D., Rasinski, K., Sekuler, R.: Visual changes in daily life throughout adulthood. J. Gerontol. Psychol. Sci. **43**, 63–70 (1988)

Lu, L., Chen, H.H.: An exploratory study on role adjustment and intergenerational relationships among the elderly in the changing taiwan. Res. Appl. Psychol. **12**, 221–249 (2002)

Wang, H.S.: Exercise and physical activity for older adults. Am. Coll. Sports Med. MSSE **41**(7), 1510–1530 (2009)

Wu, M.T., Chan, Y.S.: The effects of aging and exercise intervention on balance control in the elderly. Taiwanese Gerontol. Forum. **2**, 1–12 (2009)