Small and Complete, Not Less:

Re-designing a Small Apartment for Two-child Families in Changchun, China

Ge Lin
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A thesis presented in partial fulfilment of the requirements for a Master in Design at Massey University, Wellington, New Zealand

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Abstract

In China, many families living in small apartments are facing the problem of insufficient living space, especially since the implementation of the two-child policy. This project is based on this problem, targeting families in northern China to provide them with possibilities for small apartment living with their two children. At the same time, a malleable design was made for this apartment, that is a design that accommodates changes in the patterns of family life over time. This study explores how to increase the capacity of an existing apartment to meet the needs of the family at all phases of life. Through the analysis of the life phase of each of the family members, the final result is a phased design of three modes applicable to the family. The three phases are: 1) the family model before the second child, 2) the family model after the second child, 3) the family model as the children become adults and leave home. The final design uses movable walls, multi-functional furniture and increased storage space, satisfying the family's changing needs and offering a sense of spaciousness in a relatively small existing apartment.

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Contents

1. Introduction

1.1 Background

In order to control population growth, China has issued several different population policies over the last fifty years (Fig. 1). Family planning was proposed in China's Constitution in 1978, and it encouraged one family to have one child (National People's Congress, 1978). However, China's one-child policy has also brought some problems such as an aging population (Zhang& Goza, 2006). In response, China implemented the two-child policy in 2015 (Standing Committee of China's National People's Congress, 2015). In this newest policy, one couple is allowed and encouraged to have two children.

China is a country with a large population. According to the data in Figure 2, the population of China accounts for 18.59% of the world's population. As of September 2019, China has a population of about 1.4 billion. Since China implemented the two-child policy in 2015, population density has increased with the increase of fertility rate.

Year	Population	Yearly % Change	Yearly Change	Migrants (net)	Median Age	Fertility Rate	Density (P/Km²)	Urban Pop %	Urban Population	Country's Share of World Pop
1995	**1,240,920,535**	1.07 %	12,807,372	−155,996	27.4	1.83	132	30.9 %	383,901,711	21.60 %
1990	**1,176,883,674**	1.82 %	20,258,863	−86,330	24.9	2.73	125	26.3 %	310,022,147	22.09 %
1985	**1,075,589,361**	1.47 %	15,100,025	−40,000	23.5	2.52	115	22.8 %	244,946,241	22.08 %
1980	**1,000,089,235**	1.55 %	14,769,670	−9,401	21.9	3.01	107	19.2 %	192,392,094	22.43 %
1975	**926,240,885**	2.28 %	19,727,898	−221,096	20.3	4.85	99	17.3 %	160,244,444	22.70 %
1970	**827,601,394**	2.70 %	20,676,485	−32,000	19.3	6.30	88	17.3 %	143,513,192	22.36 %

Figure 1. *Population of China* (Worldometers, 2019).

Year	Population	Yearly % Change	Yearly Change	Migrants (net)	Median Age	Fertility Rate	Density (P/Km²)	Urban Pop %	Urban Population	Country's Share of World Pop
2019	**1,433,783,686**	0.43 %	6,135,900	−348,399	37.0	1.65	153	59.7 %	856,409,297	18.59 %
2018	**1,427,647,786**	0.47 %	6,625,995	−348,399	37.0	1.65	152	58.6 %	837,022,095	18.71 %
2017	**1,421,021,791**	0.49 %	6,972,440	−348,399	37.0	1.65	151	57.5 %	816,957,613	18.83 %
2016	**1,414,049,351**	0.51 %	7,201,481	−348,399	37.0	1.65	151	56.3 %	796,289,491	18.94 %
2015	**1,406,847,870**	0.55 %	7,607,451	−310,442	36.7	1.64	150	55.1 %	775,352,918	19.06 %

Figure 2. *Population of China* (Worldometers, 2019).

As the population continues to grow, there will be an increasing shortage of available housing on limited land. Limited land resources are one reason for the housing shortage, which is widespread in China's cities and causes housing prices to rise yearly (Tian et al., 2020). According to the data in Figure 3, the housing price in Changchun was around 9,600 yuan (approximately NZD $2085) per square meter in 2019, and the per capita salary was 6,700 yuan (approximately NZD $1450) per month (Xinchou, 2019). This typically means that young couples with children have to work for at least three years without any expenses to afford a 50-square-meter house. The availability of affordable housing for couples with two children is limited.

1.2 Issues

Low- and middle-income families in Chinese cities can only afford a limited amount of living space. According to the above-mentioned wage level in Changchun, the affordable housing area for such families is about 50 square meters, and the per capita is only about 12-15 square meters. In a house with limited space, one more child can lead to a smaller area per person. Families with two children have different needs for space than families with only one child. As children grow up, they need more storage space, living space frames the need to re-design children's bedroom (Hao & Guan, 2017). This situation sets the phase to redesign the existing housing stock based on one-child per couple to accommodate families with two children. The design challenge is to create a home environment that is flexible to the changing needs of a family in all phases of life, economically feasible of the low-to-middle income family, and spatially small but complete and joyful.

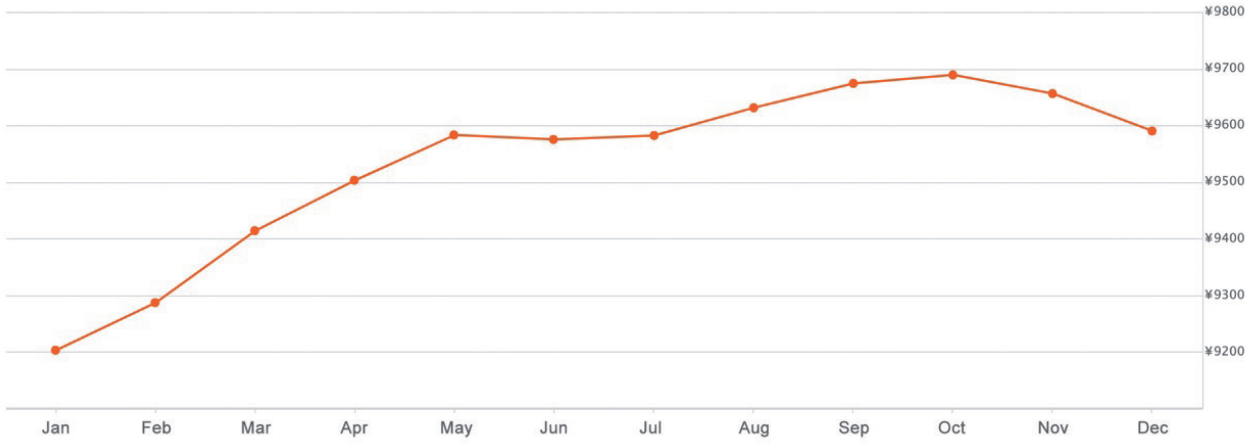


Figure 3. *Changchun housing price trend in 2019* (Anjuke, 2019).

1.3 Research audience and gap

China’s vastness means that the living conditions and living habits of the north and south are different. I am focusing my research on the residential design in Changchun, which I am familiar with (Fig 4). The audience or user group are Changchun low- and middle-income families living in around 50 square meters’ apartment with or wanting to have two children.

China's small space design is just emerging in response to the implementation of the two-child policy and reveals that there is a need for further design research on the design of these interior environments. Although there are studies in this field abroad, such as Japan and Korea, there is very little research specific to Chinese people who grow up in different environments where parents and children get along in different ways, and with different building construction systems, especially in Northern China (Liu, 2011).

Figure 4. *Map of the provinces of China* (n.d., 2013).

1.4 Research questions

1. How to design the living space to meet the low- and middle-income families' needs in Changchun in each phase of life?

2. How to transform the existing small living space so it is suitable for the two-child families?

3. How to improve space utilization in small living space to meet the needs of more family members?

1.5 Research objective

Considering the specific situation of low- and middle-income families in Changchun, my research objective is to improve the utilization rate of small living space by designing an existing apartment and rationally allocating space functions. I aim to design and model a concept that will increase usable area and function, giving more contain capacity in a small living space. This will help such families to see more life possibilities in a small space through some changes, and help them meet their different needs through different phases of design, whether living as a couple, having one child or two children. This will not only help many families facing the problem of having a second child, it will also guide more people to pay attention to the value of small living spaces. To some extent, it may also help the resale of such small apartments.

2. Methodology

This project used literature review and precedents analysis as the theory methods. At the same time, I have used the persona method in the design process, and used 3D max software to draw 3d space renderings as a design test. These methods are common conventions in spatial design.

The literature review and precedents analysis laid a series of theoretical foundations for my design. Hart (2018) proposes that literature review is a comprehensive analysis of related issues of the research project. In this part, I conducted some research on China's building system, some problems faced by Chinese two-child families, and the design methods of small apartment space, etc. In addition, I looked for some foreign small space design works and analysed and obtained design inspiration from them. These provide the feasibility and practical basis for my project.

My design process used the persona and digital test as methods. According to Mulder and Yaar (2006), the persona method helps designers pinpoint the target group and think from the user's perspective. They also propose that the persona method makes designers think about reality all the time. I used this method to set up the occupations and personalities of each character, which helped me imagine and analyse their daily activities at home or outside. It helped me to know the usage time and frequency of each space in this apartment as well as the key points of the design and the problems that need to be solved. Meanwhile, I designed and tested the apartment interior space in 3D Max. It helped me consider the interior atmosphere, texture, materials and colour. Interior design is a complex and practical subject, so designers need to simulate and test the space adequately (Brooker & Stone, 2010). With the intent to renovate and refurbish an existing apartment, I drew a space of equal proportions and added objects such as furniture and users to simulate the use of the space in order to test the design effect and rationality. At the same time, I also set out to increase the joyful atmosphere of the room by changing the brightness and colour of the light and the colour and material of the furniture in the software. Brooker and Stone (2010) also put forward that using technology to show the space can better convey the appearance and atmosphere of the space.

3. Literature review

Chinese building system

There is a great difference between China and foreign countries in the concept and content of the standard of residence. According to Li et al. (2014), foreign living space standards focus on the relationship between population, number of rooms or type of residence and living standards, while the standard system in China is to consider the person's identity rather than the number of people. The authors also make recommendations on the compactness of living space (Fig 5). In China, the type and size of residence is usually planned by the government, and each type usually has a uniform area. According to Zhang (2018), at present there are four main residence types in China: single apartment type, economic type, comfortable type and luxury type, with respective surface areas of 30 square meters, 40-80 square meters, 80-120 square meters and 120-300 square meters. However, the actual area used is relatively smaller. According to Liu Xiaozhong Studio's study on small and medium-sized apartment buildings in large and medium-sized cities in China (2008), the usable floor area of Chinese apartments accounts for about 75% of the total floor area. For instance, living in a 90 square meter apartment, the usable area is only 67.5 square meters. Within the limited usable area, the apartment also needs to include all the space people need for daily living, sleeping space, storage space, cleaning space and kitchen. As a result, each space in a small apartment is small in size, which may make people feel cramped.

recommedation on the compactness of living space						
	1 person	2 people	3 people	4 people	5 people	6 people
smallest type (m^2)	30	40	50	70	80	90
general type (m^2)	37	52	70	87	100	110
comfort type (m^2)	45	60	80	95	110	125

Figure 5. *Recommendations on the compactness of living space* (Li et al., 2014).

People's residence & Home

Housing is one of the basic needs of people, and it often has a different meaning from home. Having a house fulfils basic subsistence needs (Adams, 1984), such as the need for shelter. Adams also points out that Americans usually think that housing is a space that can provide living conditions for people, and it is defined as a home under the conditions that people feel comfortable, satisfied, safe and endowed with emotion. This definition is recognized in China and yet it carries additional meaning. According to Tan (1999), the property of housing is a private living space different from the outside world. He also points out that the home is considered to be everything to Chinese people, as well as the main living space and activity place. At the same time, Chinese people have a clear psychological division of the scope of their home. According to the survey conducted by Pitts and Gao (2014) in China, people generally believe that the entrance door is the differentiating medium between the home and the outside world, the apartment belonging to one's own is defined

as home regardless of its size, while the space outside is public place. Moreover, people define home in relation to emotions and personal thoughts. Adams (1984) proposes that in America, housing carries people's emotions and also has a spiritual significance, and they also retain property by buying homes, which is also a status symbol. The same applies to China. The Chinese usually attach great affection to the family. Chinese people especially advocate the affinity of family; home is the base and background for the survival and development of all its members, as well as the psychological comfort and spiritual support of family members; home makes the limited existence of an individual obtain meaning beyond the individual (Tan, 1999). It seems that the house itself is an architectural body, but with the addition of human life and emotion, it becomes a home. While people often construct the meaning of home on the basis of residence, for interior design, emotions may also need to be taken into account.

Chinese demand for living space

People in different countries and regions may have different needs for space due to differences in growth environment, living habits and depending on their age or family members (Lu, 1999). According to Minggao (2008), people are the core of interior design, the design should meet people's physiological, psychological, material and spiritual needs, and pay attention to the function of space. He also proposes that design involves thoughts, emotions, artistic conception as well as ethnic, regional, and cultural elements. Regardless of the size of the living space, it should provide the basic functions that people need every day. According to Sima's (2015) study about apartments in China, the house needs to provide people with rest space, storage space, kitchen space, clean space, work and study space, communication and entertainment space. Especially for parents of two-child families, every space in the room needs to be considered for their children. Through surveys and interviews with Chinese people, Sima (2015) reports that people who live in small apartments are concerned about the size of personal areas, and young people prefer the roomy and bright bedroom space. This may be due to the fact that young people see the home as a place to relax and the comfortable and bright environment can enable them to enjoy life better. Sima (2015) also proposes that people of different ages and genders and occupations have different needs. Sima (2015) reports that in China, non-open kitchens and south-facing living rooms are preferred. Acceptance of non-open kitchen forms may be related to traditional cooking methods, such as decoct and fry. The southern direction of the living room is probably because it receives the most sunlight. Moreover, with the development of economy and technology, people seem to pay more and more attention to the sense of design. People are more likely to remember creative designs (Sima, 2015).

Happiness and satisfaction of living space

Whether or not the success of the design of the living space can be measured by the residents' happiness and satisfaction, living space is the place where people spend the most time every day. According to a 2018 survey on Chinese people's time use by the National Bureau of Statistics (2019), Chinese people spend about 12 hours at home every day, of which the average sleep time is about 9 hours. Therefore, the residents' satisfaction with the residence is important. People's satisfaction with housing can be understood as the evaluation of housing based on needs and desires, if reality meets expectations, then people are satisfied; if

people complain about housing, then satisfaction is insufficient (Lu, 1999). According to Foye's (2017) study of British people, British people's satisfaction with their house will rise with the increase of the house area, but it will level off as time goes by. He also found that smaller homes make people less happy, but larger homes don't make people happier either. Moreover, Chinese people's satisfaction with their small apartment is mainly through the perception of overall atmosphere, comfort and creativity (Sima, 2015). According to Hu and Coulter's research (2017), the Chinese people's happiness and satisfaction is closely related to the size of the living space and living conditions. They also propose that Chinese people's expectations of space have increased due to a range of reasons, such as economic development, changes in family patterns or individual thinking. In addition, some early built apartments in China generally only have basic interior decoration, and the decoration materials and facilities are limited (Pitts & Gao, 2014). Therefore, in order to make today's people live comfortably, such apartments need to be redecorated to meet people's needs. It can be seen that, through the means of space design, there is an opportunity for people to improve their happiness in a small living space.

Problems faced by two-child families

After the birth of their second child, families living in small apartments will face new difficulties. The two-child policy was promulgated at the fifth plenary session of the 18th CPC Central Committee in 2015 and has since been implemented; it satisfies the desire of many parents for two children to accompany each other in the future (Hao & Guan, 2017). Therefore, the space problems of two-child families need attention. Through the research of Sima (2015) and Li et al. (2014) based on the traditional Chinese family pattern, changes in time and policy would lead to more design details to be considered. According to Yang (2019), in 2018, 24.3% of Chinese home buyers had an average living area of less than 20 square meters, equivalent to less than 60 square meters for a family of three, while only 9.3% had an average living area of more than 50 square meters. Before the second child, the space is reasonably designed and big enough. However, after the birth of the second child, the space does not work as well for them. For example, most people add an extra bed to a child's room or give a second child space in a parent's bedroom (Fig 6). In this way, both children and parents will feel the house is very crowded. For this type of family, on an economic basis, the best practice of apartment living should be to minimize the addition of new furniture, reuse, and extend the use of furniture (Nelson, 2018).

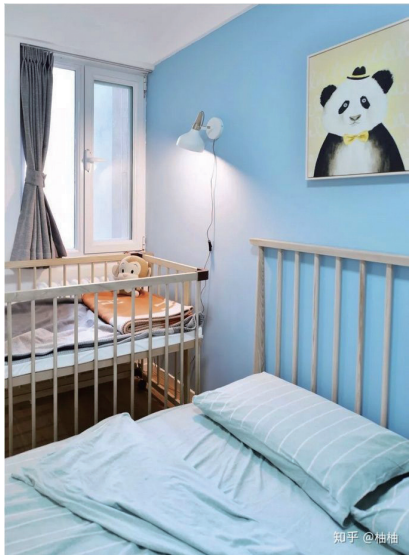


Figure 6. A two-child family room in China (n.d. 2018).

Problems of two-children space and sharing system for two-child families

The one-child policy caused parents to devote themselves fully to their child, which resulted in certain psychological and behavioural problems. For example, many children are accustomed to having their own bedroom. According to Blake (1981), the only-child in America is more self-centred and does not like to share, they do not accept their parents' allocation of attention to others and they do not like to cooperate with others. In terms of space allocation, more attention should be paid to the shared space, such as the living room. In addition, children and adults have different priorities, therefore they have different spatial needs. For children, they need more space to play and study. Young children often rely on their parents. Thus, sharing family space is important for them. According to the data in Figure 7, most Chinese parents spend less than 4 hours per day with their children, which is also reduced as the child gets older. This means that their time to spend together is very limited. Having the living room as the main design part of the home may help family members share time and space. In this way, children can easily accept each other and create a harmonious atmosphere in the family. In addition, according to Collins (2009), play is an important way for children's intellectual and physical development. She also proposes that this activity usually requires parents to supervise and care, and the living room is the most functional space in the home. Thus, children can get more care and discovery when they play in the living room.

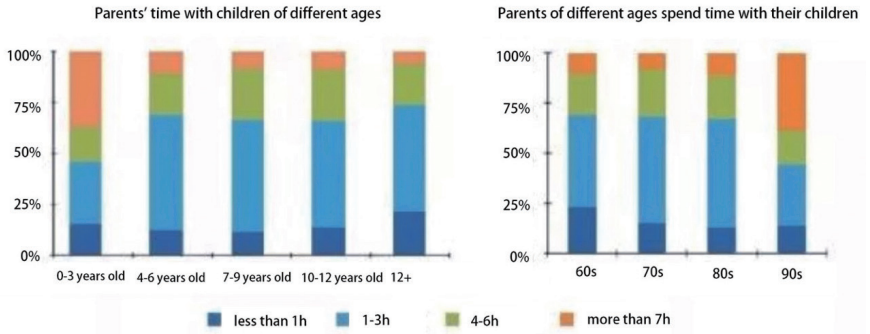


Figure 7. Chinese parents spending time with children of different ages (Jiazhangbang & Mamabang, 2017).

The privacy of children's rooms

Private space has an important effect on children. Liu (2016) proposes that in a two-child family, not only the parents but also the privacy of the two children in the same space should be considered. This means that private spaces should be reserved for children's rooms that need to be shared. Evans et al. (1996) report that long-term exposure to non-personal space can lead to certain psychological problems, such as social fear and communication barriers. As a result, people who have private space are less socially stressed than people who do not. Moreover, the privacy of the children's room may also affect the child's physical and mental health. According to Feng and Meng (2002), a comfortable living space for children is helpful to cultivate their self-esteem, self-confidence and self-reliance. Liu (2016) also proposes that giving children privacy in space is a recognition of children's self-identity,

which helps children establish their own interpersonal relationships; on the other hand, it is helpful to improve children's self-worth, promote their physical and mental health, and shape their healthy personality. Chinese culture pursues collectivism, which is mainly manifested in that collectivism always takes precedence over individuals and individuals in the society are interdependent, and people are encouraged to rely on each other (Wang & Zheng, 2016). When the floor area is insufficient, it is easy for Chinese families to ignore the benefits of children having private space such as their own bedroom. According to Hao and Guan (2017), in the previous family model of one child, the child only needs to have a separate room, and its privacy is only unilateral privacy for parents and elders. For families with two children, or more than that, there needs to be privacy between the children as well. The Chinese government housing plans tend to have a small floor area consisting of two bedrooms and one living room. Moroney (2019) points out that adults in the United States have their own rooms, and this issue should also be considered with children. In a similar manner, China's housing design should pay more attention to the material and psychological needs of children especially as more and more families have two children.

Small apartment design method

Due to the limited space of small apartments, space-saving design methods need to be used as much as possible. According to Zhang and Liu (2010), the internal elements and operation links of small apartments have the relationship of mutual influence and restriction, and the contradiction between the reduction of living space and the increasingly diversified living behaviour pattern of modern people needs to be solved. Therefore, it is necessary to use various design methods to increase usable area in small space. Removing the walls allows the space to be spacious and open, as well as creating interconnected interior spaces (Brooker & Stone, 2010). According to Zhang and Liu (2010), the space can be divided by furniture instead of walls, for example, by tall furniture, sliding doors or curtains. They also propose that this method allows the spaces to intersect each other so as to reduce the sense of constraint. Furthermore, Zhang and Liu (2010) suggest that small apartments should use decorative and transitional materials to divide the space, such as plants and colours. They also propose that combining space with similar functions, separating space with opposite or different properties, and increasing the versatility of a space can save space effectively. A survey by Pitts and Gao (2014) of Chinese people living in small apartment showed that people prefer multiple uses in one space. For example, they may use the bedroom as a temporary living room, or the kitchen as a dining room. It also showed that people generally have storage space in the kitchen or on the stairs outside. Dividing small spaces is also a design strategy. According to Collins' (2009) research, Australians prefer to separate quiet spaces such as bedrooms from service spaces such as recreation rooms. Therefore, space can be divided not only by function, but also by properties, such as dynamic and static areas. On the other hand, the choice of furniture can also achieve the purpose of saving space. According to Bian (2010), there are several types of furniture that can save space, such as pieced-together furniture, hidden type furniture and foldable furniture.

The colour of living space

Colour has many functions in space and plays an important role in design. Different colours can affect the visual and physical feeling of a plane in space (Brooker & Stone, 2010). According to Shi (2015), colour can decorate a space, convey atmosphere and regulate the space. Moreover, the choice of interior space colour should consider the person's physiology and psychology needs (Feng, 2008). He also puts forward that colour perception is a physiological phenomenon of people; it has the potential of produce reveries. Meerwein et al. (2007) enumerate some of the different impressions and messages that colour conveys, such as yellow gives people excitement and provides a bright impression, conveying a sense of openness; blue provides a calm and cool impression, conveying seriousness and aloofness. For families with children, when choosing a space colour, the child's colour preference and the impact of the colour on the child should be considered. Colour is an important design element for children (Read & Upington, 2007). According to the research of Liu et al. (2004) on the indoor environment colour preference of Chinese children aged 4-6 years, red is their favourite colour and grey is their least favourite colour. However, Jiang & Wang (2010) in the later research on the same subject found that while grey is still their least favourite colour, red is listed as one of the colours they dislike. Thus, it can be inferred that grey may not be suitable for children's space design. There is a significant difference in preference for red, which may be related to people's acceptance of the visual effects of colour. The research by Read and Upington (2007) show that children prefer red and purple. Purple is a colour between warm and cold, this may be a colour attribute that children prefer (Read & Upington, 2009). Furthermore, gender and age may also influence children's colour preferences. According to Jiang and Wang (2010), children of different genders and ages have a significant difference in their preference colour for indoor environments. Boys and girls have great differences in preference for green and grey, while children of different ages have great differences in choice of yellow and grey (Jiang & Wang, 2010). In terms of colour selection in children's bedrooms, Jiang and Wang (2010) suggest using peaceful colours as background colour in children’s bedroom, such as blue. This kind of colour tends to give children a sense of security and help children’s emotional stability (Jiang & Wang, 2010). Gao (2017) proposes that the colour of children's bedrooms should change with their visual development, so there should not be a large area of fixed colour. In addition, Song (2018) puts forward that single colour is not conducive to the development of children’s lively personalities. Thus, she suggests that children's bedrooms should choose lively colours to convey warm, comfortable, hearty, healthy, and sunny emotions. Therefore, children's living space may need a variety of colours, lively colours as well as gentle colours.

4. Precedents

No.1 Case background
Project: Modular furniture
Place: Japan
Designer: Naoto Mitsumto & Naoko Hamana

Modular furniture makes the study, sleep and storage space a separate space, improving the efficiency of the use of small space. This is likely to be the future of interior layouts, where modular furniture can be moved around as needed. This modular design concept is suitable for my project, especially in the second phase. It made me think more about the applicability of variable movable furniture for small space. In my design, I considered this design method both in the design of the movable wall and the design of children's room. This design method can save space better. It makes full use of the upper, middle and lower parts of the space, which not only has a significant advantage in space saving, but also increases the interest of children. Having such an independent space in a small apartment can play a role in the visual isolation of family members when they are doing different things to some extent.

Figure 8. *Stacks B - 壁にもなる書斎小屋* [Study hut that can also be a wall] (Mitsumto & Hamana, n.d.).

No.2 Case background
Project: Maid rooms in Paris
Place: XVlle district (France)
Year: 2014
Architect: Kitoko stuidio
Building area: 8 square meters

This design modularizes all functional furniture into a large cabinet, each cabinet has its purpose. It contains beds, storages, tables, closets and stairs. This furniture can be pulled out and used when needed. It maximizes the use of space. All furniture is hidden when not in use to enlarge the active area of the room. This design method of combining overlapping spaces is suitable for the design of my project, especially the second phase with two children. The bed is designed above the overall space, so that the space below can be fully utilized, and the height of the below storage space is also convenient to pick up items, especially for children. In addition, the height of the upper bed means that the people standing on the ground are out of sight, which visually increases the privacy of the sleeping space. This design method was considered and used in my project. Under limited space conditions, I try to use the visual height difference to increase the sense of privacy and try to use lower space as storage space to increase the capacity of the space.

Figure 9. *Maid rooms in Paris* (Kitoko studio, 2014).

No.3 Case background
Project: Crate House 1990
Place: Hagen, Germany
Year: 1990
Designer: Allan Wexler

This design combines functional furniture together to create a living box. It contains functions such as sleep, work, storage and kitchen. People can pull out the corresponding box to use when needed. This design greatly saves space. It looks practical in a limited living space. It enables the small space to have a certain degree of scalability, so as to realize the diversification of the use of small spaces.

In my design, the combined concept of this design was adopted to design the movable wall, and the dining table and TV were gathered on one of the movable walls, which effectively saved the space occupied by the fixed dining table and the TV cabinet. On the basis of saving space, placing them in corresponding locations when needed also limits the function of the space at different times. For example, in China, dinner time is regarded as an important time by most families. Family members sitting around the dining table to eat and communicate are considered reunited. At this time, placing the dining table in the main position of the home and occupying most of the central area can satisfy the living habits of the Chinese.

Figure 10. *Crate House* (Wexler, 1990).

No.4 Case background
Year: 2018
Designer: Gulimaidou Zhu

This is the design of a Chinese children's room. In this case, the privacy of the children's room was well preserved, and the upper and lower bunk beds were used to allocate space for two children. The upper level of the small space is also not wasted. In addition, the passage of the upper bunk beds was hidden behind the wardrobe and made into a drawer type to increase the storage space.

In my design, I used the design method of making the stairs into drawers for storage to save limited space. For the placement of the bed, I did not adopt the style in this design, but placed the bed on a staggered level, so that each child's small space is independent in the vertical direction. I try to make the children feel more private and not interfere with each other. In addition, in the design of the clothing storage area, since the height of children is limited, I lowered the height of the clothing storage area in the children's room to meet the needs of children.

Figure 11. A children's room in a Chinese family (Zhu, 2018).

No.5 Case background
Project: El Refugio
Place: Spain
Year: 2014
Architect: Castroferro Arquitectos
Building area: 12 square meters

This case uses movable furniture to save space. In this space, the homeowner can turn the bed down from the wall to become a bedroom. They can put the bed back on wall when it is not needed during the day, and turn the table off the wall to transform this space into a dining room. Thus, by using movable furniture to overlap the use of space, this design expands the limited area. This design method seems suitable for small space design.

In my design, I used this design method for reference, which is reflected in the use of movable walls to define the size of the space, the bed that can be transformed into a sofa turns the bedroom into a living room or activity room, and the dining table that can be pulled out to flexibly define the dining area. The variability of it according to conditions and needs gives my project more possibilities in the limited space, so it saves costs without expanding the area.

Figure 12. *El Refugio* [The shelter] (Castroferro Arquitectos, 2014).

No.6 Case background
Project: Home and Office for a Graphic Designer
Place: U.S.A.
Year: 2001
Architect: Roger Hirsch Architect
Building area: 55.7 square meters

The design of this apartment divides the office space with movable walls. The moving wall provides two space types to the small indoor space. It slides to open to transform the living room into an office, and all things related to work (computers, printers, and files) are displayed. When it is closed, the sofa slides back with the wall, and the function of the living room is turned on. In the living space, some functional areas cannot be used at the same time, so using movable walls to change the functions in the same space seems an effective way to solve the problem of insufficient space in small apartments.

This case inspired the design of the two children phase of my project. I separated the two children's study area with a movable wall and a display cabinet from the sleeping area. The movable wall can close the passage to create a complete learning area, so that the enclosed area helps children concentrate on learning. In a small space, the same medium is used for two partitions, which increases the functionality of the space and saves costs.

Figure 13. *Wing Chan (*Roger Hirsch Architect, 2001, as cited in Bartolucci, 2003).

No.7 Case background
Project: The studio of Leslie Hoffman
Place: U.S.A.
Designer: Leslie Hoffman
Building area: 41.8 square meters

This design puts the bed into the ceiling and has a dressing table and storage space under the bed. The bed occupies a large part of the space at home. The use of this electronic pulley system completely overlaps the space of the bed with storage and dresser, which is practical in a small apartment.

I used this method for reference when designing the second phase of the parents' and children's bedroom. Given that the area of the bedroom is limited, I can only consider the vertical design of the functions that the bedroom needs to have. Therefore, I used the same concept to raise the bed but removed the electronic pulley to reduce costs. The space under the bed is used for storage, and the ladder on the bed is also designed into a drawer storage space.

Figure 14. *Leslie Hoffman* (as cited in Bartolucci, 2003).

5. My design project

5.1 Current status of the apartment

The apartment I redesigned is an existing apartment for sale in Changchun Yuanda Community. The area of this apartment is 55 square meters, the usable area is only 37.6 square meters. The price is 510,000 yuan (NZD $110,870). Both size and price are suitable for the target group I studied. Apartments of this size and type are common in China and the interior decoration is simple, so its cost is low. The following pictures show the current interior of this apartment.

This corridor is occupied by the dining table, chairs and cabinet so that the passage is narrow (Fig 15). This simple decoration and the placement of furniture means that the decoration cost of this apartment low, so this kind of decoration is common in this type of apartment in China. However, in terms of daily use, it can only meet people's daily needs, but it cannot enhance the user's sense of satisfaction and joy.

Figure 15. The corridor combined with dining and living room function (Beike, 2020).

The layout of this bedroom is simple, with a double bed, sofa and a wardrobe built into the wall (Fig 16). This enclosed wardrobe occupies a large part of the space, which reduces the sense of space for apartments with limited area and makes the space look smaller. This bedroom seems to be just a sleeping place but lacks warmth. For couples, this space also lacks capacity for entertainment. For children, this space looks cold, inactive, and does not have the daily needs of two children, such as a relatively private sleeping space and a learning space.

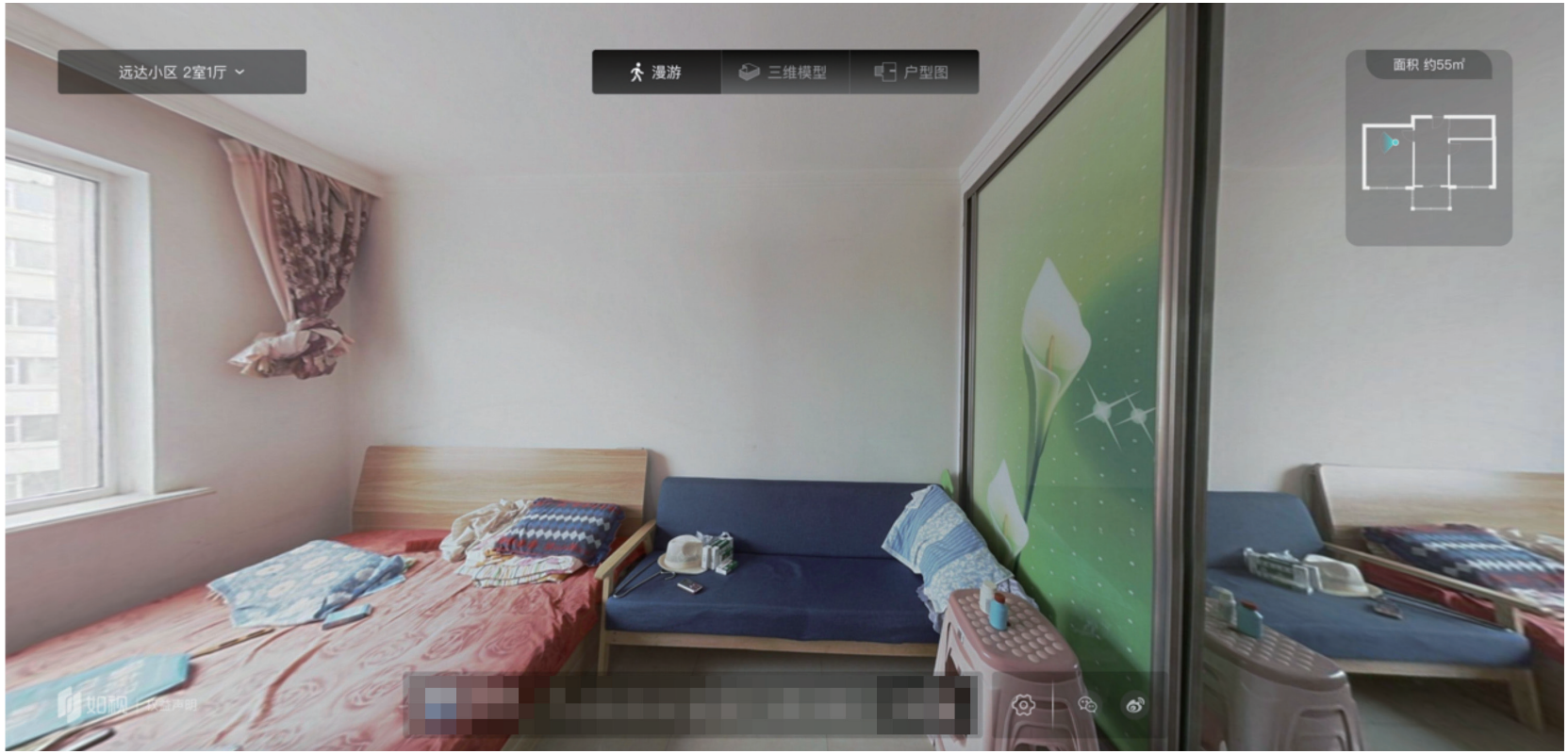


Figure 16. Main bedroom with simple double bed, sofa and closet (Beike, 2020).

This second bedroom seems to be assigned to only one person, otherwise this room will not be private (Fig 17). And the picture shows the lack of storage space so that many items are placed on the ground, which gives a sense of chaos. This space, whether used as a children's room or a parent's room, only has sleeping and a small amount of storage space, without the feeling of joy. Children need space for activities. The cluttered rooms will not only affect the appearance, but also bring obstacles to children's activities in the room.

Figure 17. Second bedroom with simple bed and closet (Beike, 2020).

In the design of this kitchen, the current apartment only uses its lower floor space to store kitchenware, so many kitchen utensils are placed beside the dining table outside the kitchen, which fully reflects the shortcomings of insufficient storage space in the current kitchen (Fig 18). In my design, the kitchen should have more area and more storage space. I tried to change the color and size of the space to make the kitchen look more joyful and the cooking time more enjoyable.

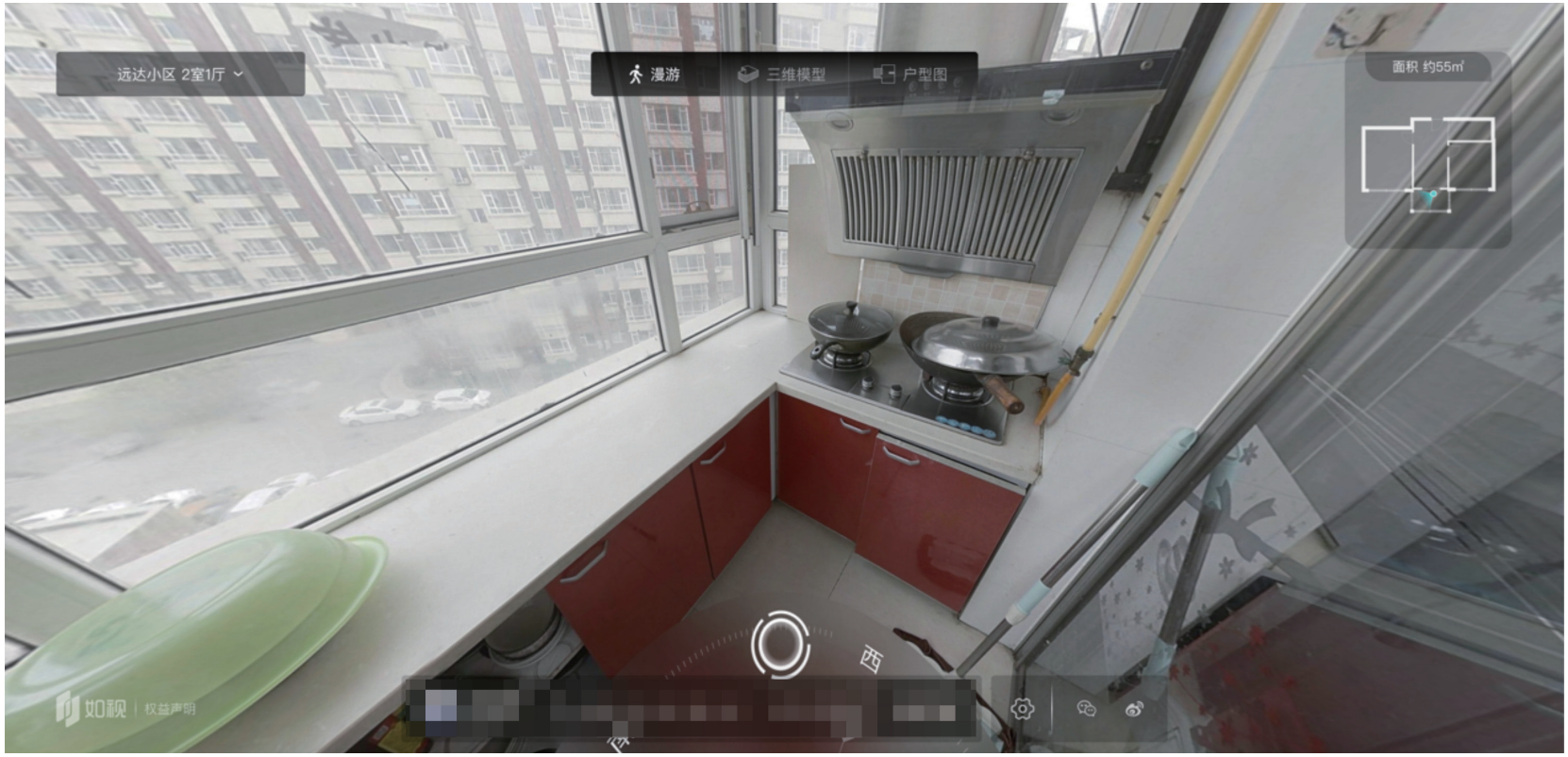


Figure 18. Kitchen (Beike, 2020).

Currently, the bathroom in this apartment is open between the sink, toilet, washing machine and shower, so that only one person can use the bathroom at a time (Fig 19). For families with two children, the bathroom can be further improved to separate it from wet and dry areas, and to store cleaning supplies separately from the bathroom. In addition, the washing machine and shower are located in close proximity, which may cause electrical safety hazards.

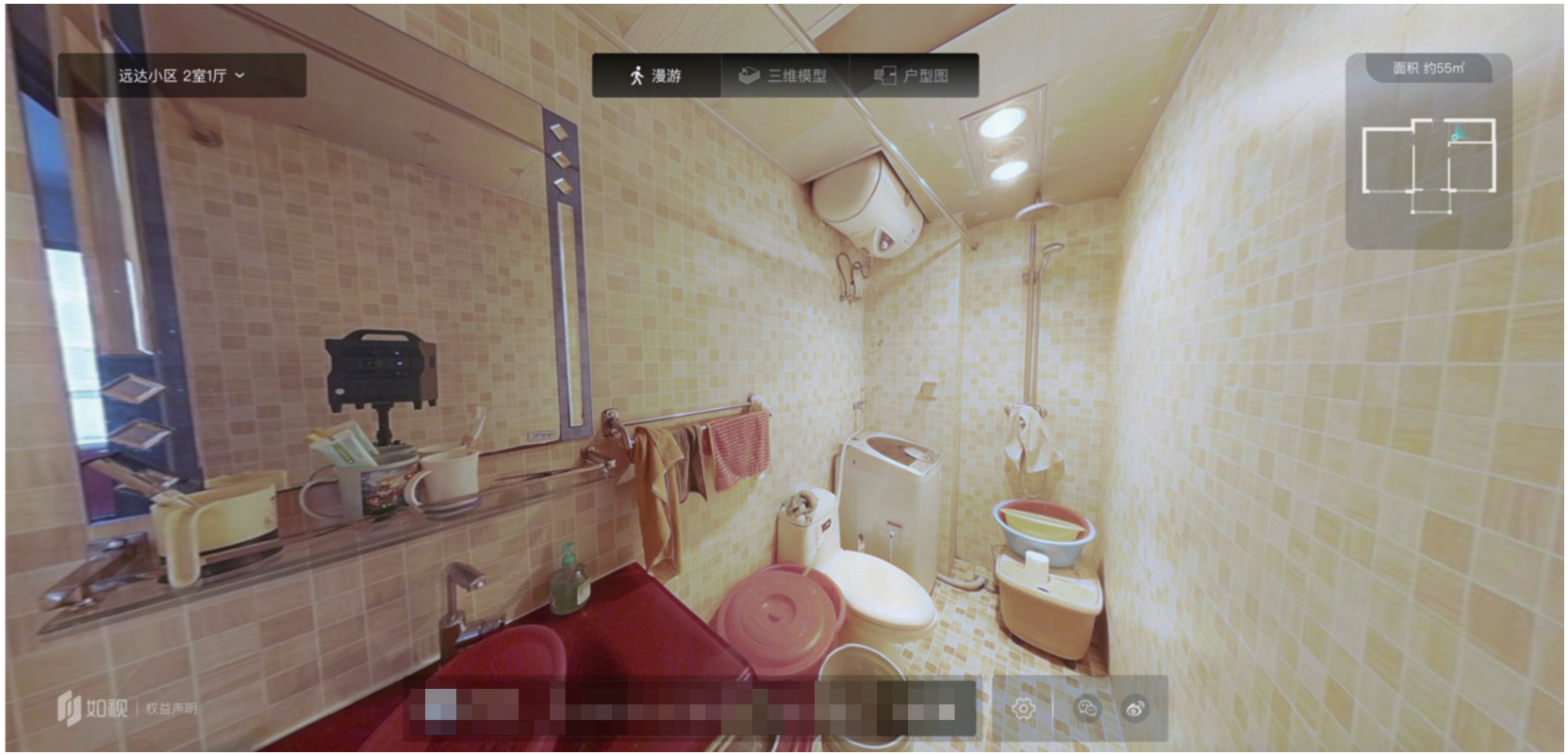


Figure 19. Bathroom with various functional items (Beike, 2020).

The current status of this apartment can only meet people's basic accommodation needs. Its decoration and layout are too simple to lack the warmth and joy of family. These two points are particularly important for families, especially those with children. Therefore, it is not suitable for today's two-child families.

Figure 20. Floor plan of the whole apartment (Beike, 2020).

When a family has children, the living condition of the family will change. These changes are:

1) The area of the apartment is limited but more furniture needs to be added, such as bed and desk.

2) Children have more belongings than before, such as clothes, toys or books.

3) The frequency of use of each space will increase, such as living room and bathroom.

4) Another child in the family will increase the sound levels in the apartment such as crying and playing.

5) Children will also run and jump in the apartment, so the passage of the apartment needs to be clearer and more spacious.

The changes brought by the child will be taken into consideration in my design, so as to design an apartment that is warm and joyful.

5.2 Redesign apartment

Over time, the number of people in the apartment will change, so I redesigned the apartment in three phases. In the first phase, young couples with their first child live here. In the second phase, they have their second child. In the final phase, this small apartment has returned to the state where two people live because both children have grown up and have their own houses. According to the needs of different characters in different phases, I proposed a renovation plan for this small apartment with the aim to enhance the living experience for all family members, implement small space use strategies, and keep renovation to a minimum in order to reduce costs over the entire period of time. These factors: two child family, an existing 50 square meter apartment, three phases of change in the family dynamics, flexibility and moveability of design elements and implementation of colour and surface treatments set the parameters for this design research project.

5.3 Phase 1 (A couple and a child)

In this phase, the design is suitable for married couple life and extends to after the couple has had a child. In the design, I explored how to improve the utilization of small spaces. I set the occupations and hobbies of the family members (Fig 21). At the same time, I investigated the surrounding facilities of the apartment and found that the facilities around the apartment are varied (Fig 22). The surrounding integrated shopping malls, parks and museums provide family members with daily entertainment and leisure venues. I also set up a schedule of daily activities according to their lifestyle (Fig 23-25). This helped me design from the user's perspective.

Characters	 李华 John	 林月 Lisa	 李霖毅 Jimmy
Occupation	Office worker	University teacher	Kindergarten student
Hobby	Hiking Play basketball Skiing Swimming Play poker	Cooking Play badminton Skiing Swimming Yoga Flower arrangement	Play Legos Play remote control car Play basketball Skiing Swimming Painting Hip-hop Violin Taekwondo

Figure 21. The persona of Phase 1.

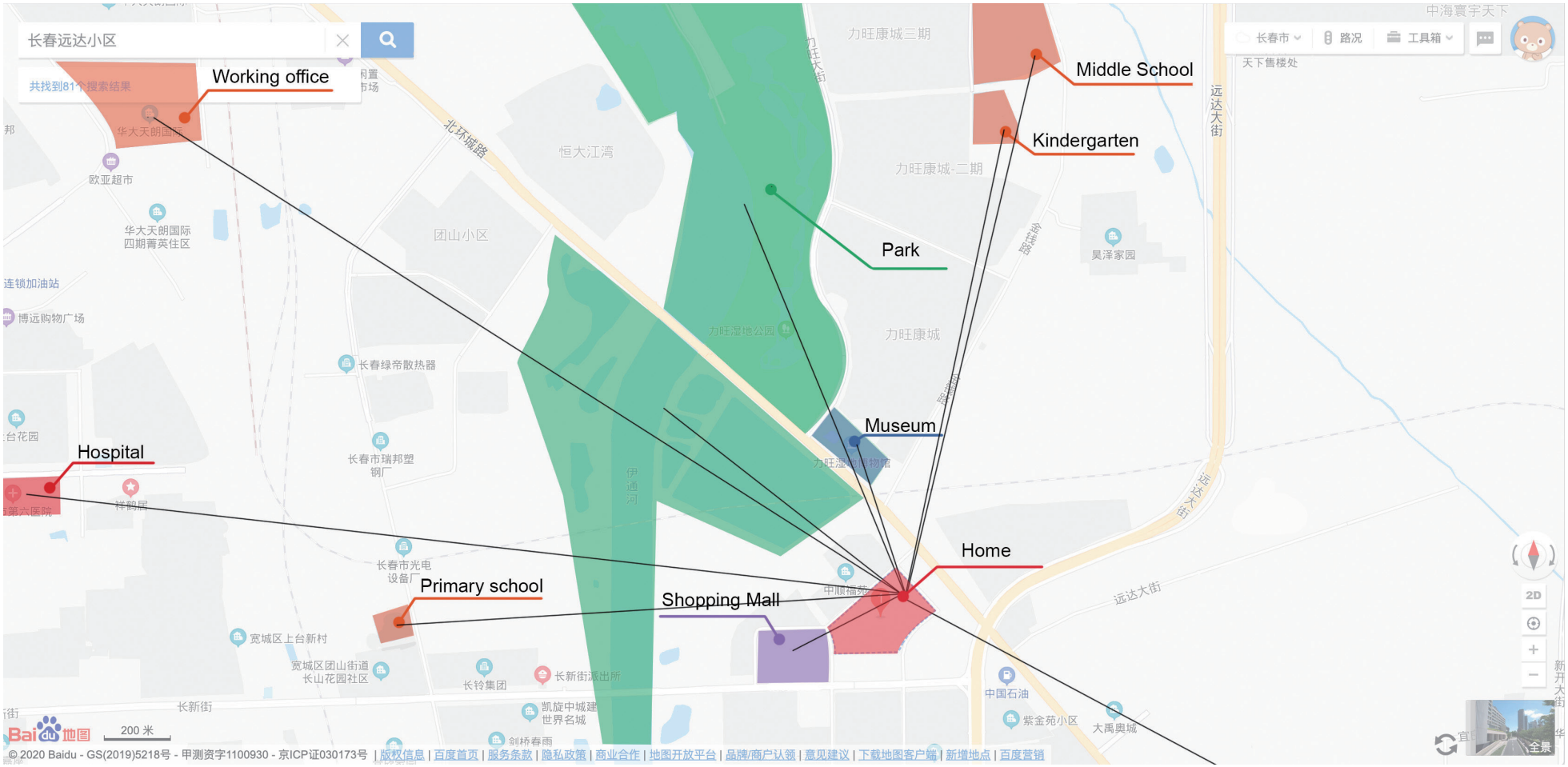


Figure 22. Map of surrounding facilities.

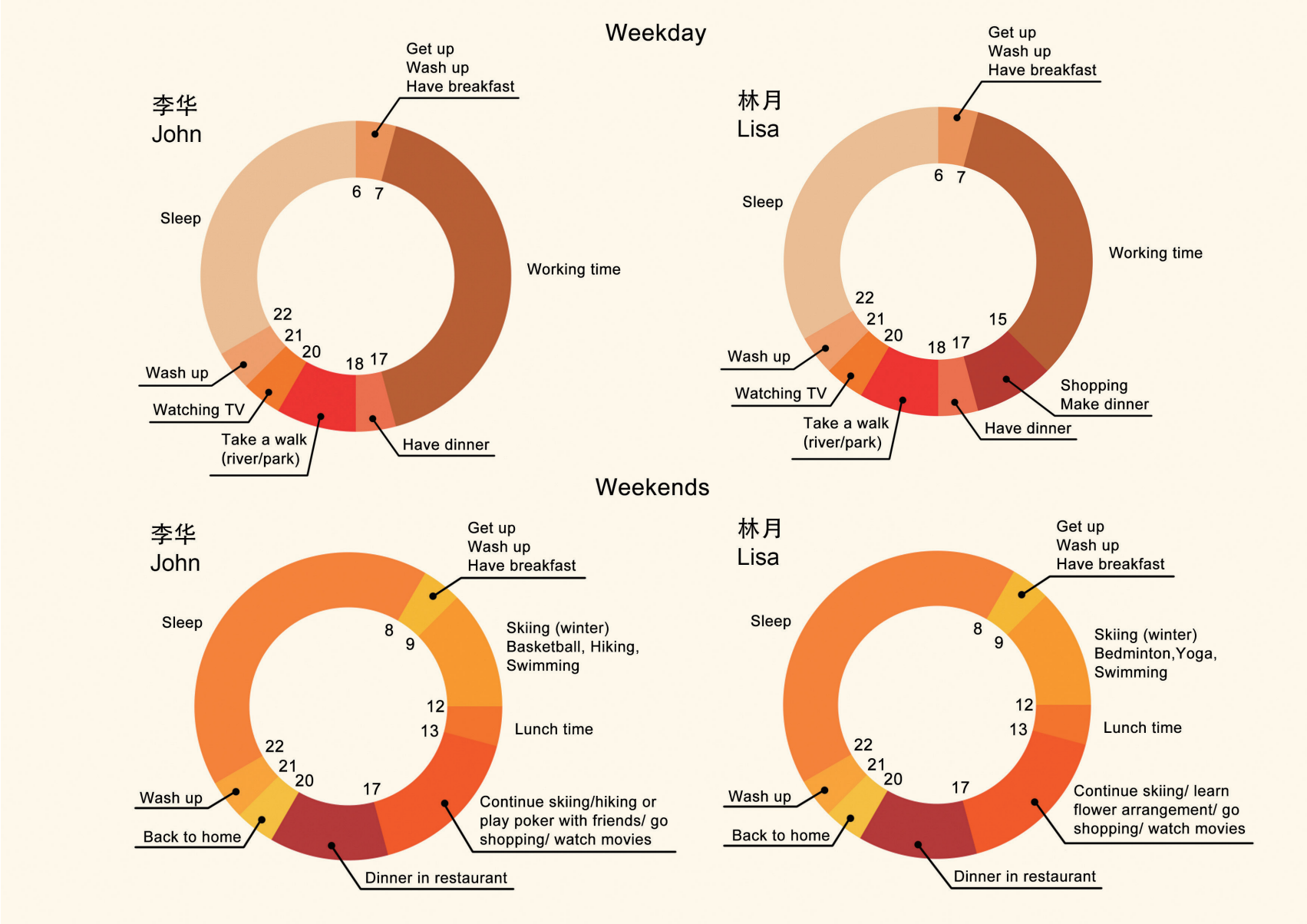


Figure 23. John and Lisa's daily schedule before having a child.

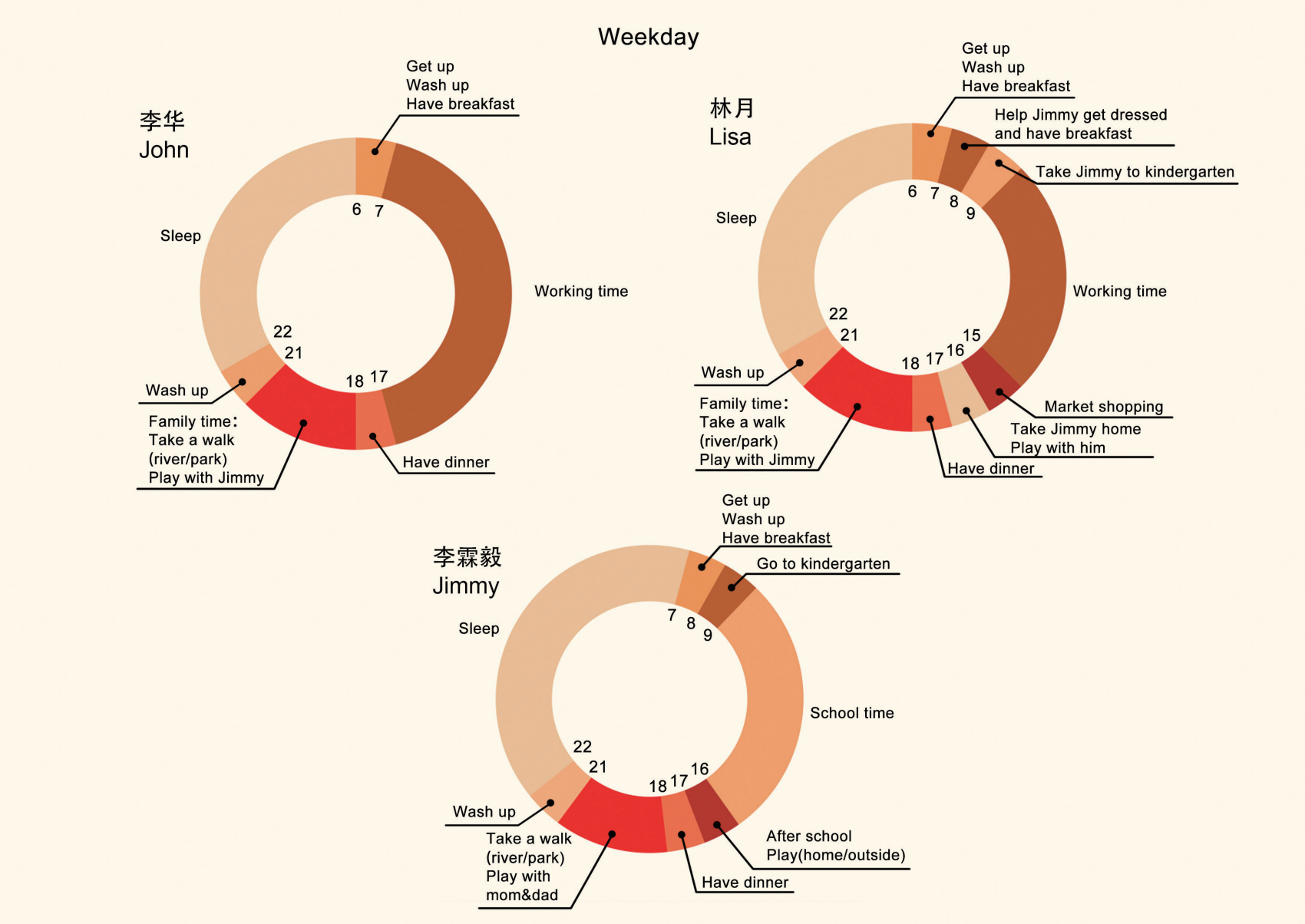


Figure 24. Weekdays schedule for family members of one-child phase.

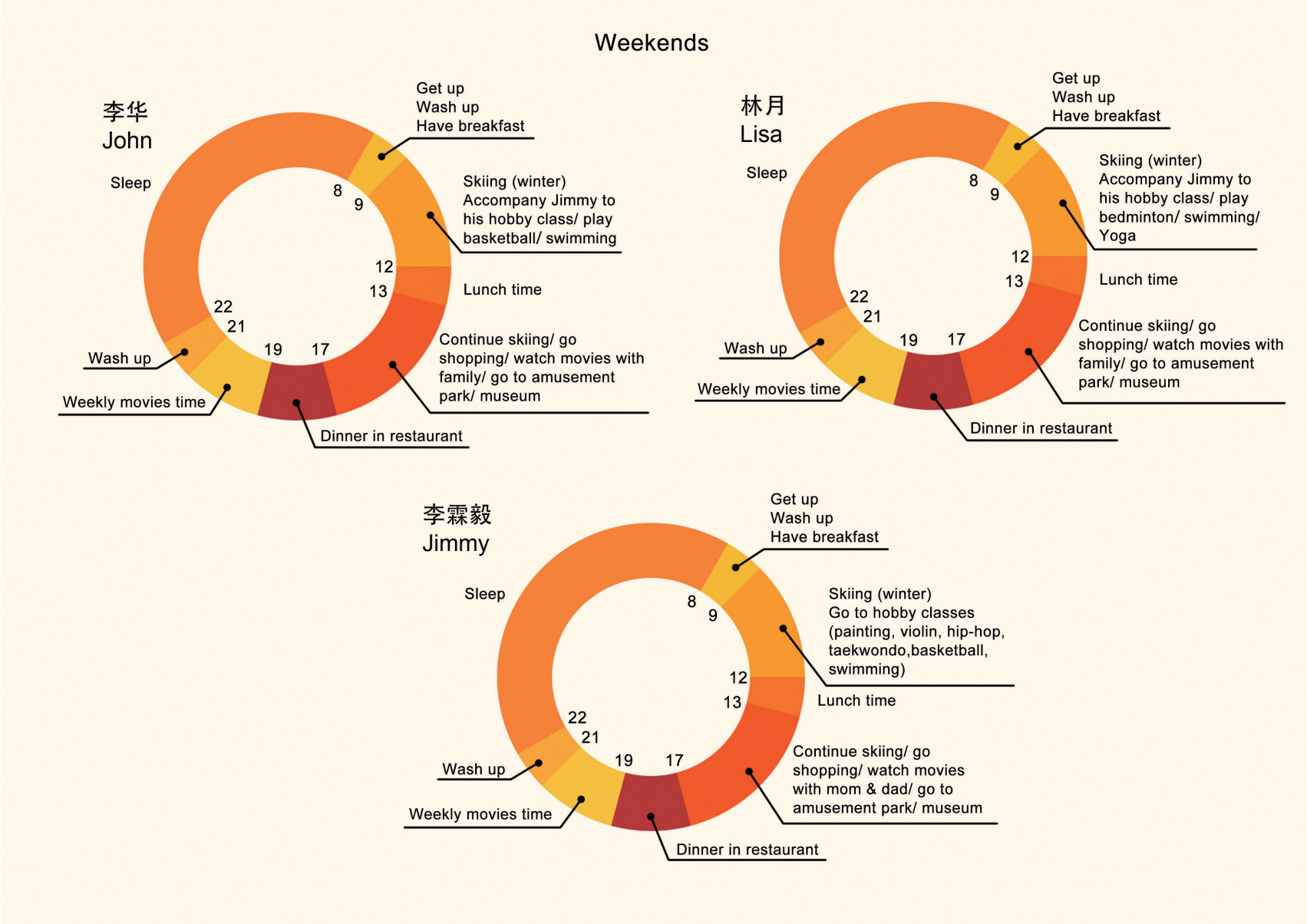


Figure 25. Weekends schedule for family members of one-child phase.

Changes

Before John and Lisa had children, their basic activities at home were eating, sleeping, watching TV, etc. The rest of their activities occurred outside the apartment in the surrounding neighbourhood and city. After having a child, more activities will occur at home, and most of John's and Lisa's time at home will revolve around Jimmy. As a boy, Jimmy would run around the apartment, which required fewer obstacles in the apartment. I tried to make the space as spacious as possible.

Design process

In the design phase, I mainly considered the spaciousness of the space, how to increase the functionality of the space within the limited area and how to make the space joyful. I chose multifunctional furniture, so that in the same space, it can increase the functionality of the space by changing its shape and avoid the waste of space. At the same time, I used the movable wall to create an activity space for the apartment that can be used as a living room. I also used yellow and orange furniture and warm lighting to enhance the warmth and joy of the apartment.

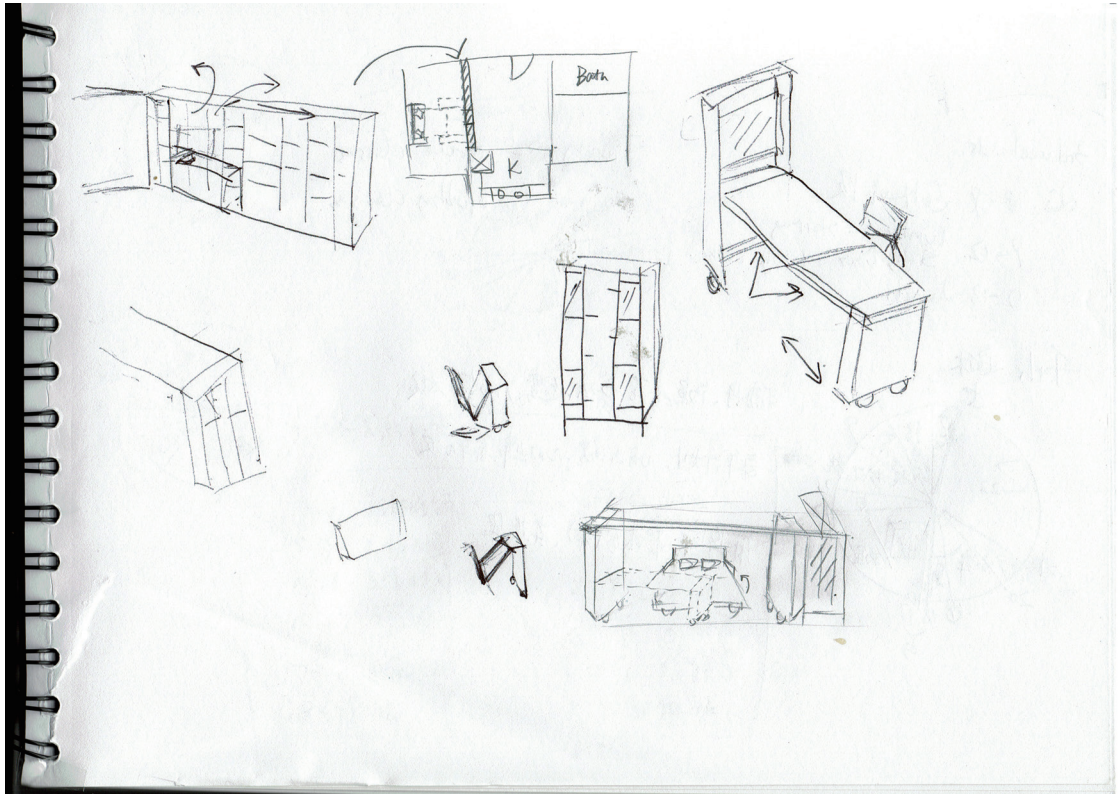


Figure 26. Hand-drawing of the moveable wall.

In order to make the apartment more spacious, I replaced fixed walls with movable cabinets to form a "movable wall" with storage function (Fig 27). The feature of this movable wall is that it can change the state of opening and closing according to people's needs, and it also replaces the bedroom door. When it is closed, it blocks the corridor and the bedroom to form two completely enclosed and independent spaces (Fig 28), and when it is opened, the bedroom and corridor are combined into the living room of the apartment (Fig 29). In addition, I put the dining table and TV in the "moving wall", which can be pulled out and retracted as needed to save space (Fig 30). Besides, this wall is also a display cabinet. The owner's collection, potted plants, piggy bank or children's favourite toys can be placed on this wall, which gives the apartment a sense of joy.

Figure 27. The movable wall.

Figure 28. The corridor.

Figure 29. The corridor when open the movable wall.

Figure 30. Dining table.

Multifunctional beds are used in two bedrooms to save space. The bed can be transformed into a sofa to provide a place for reading, watching TV or chatting during the day. In this way, the main bedroom can be used as a living room (Fig 31). When the bed is opened at night and the moving wall is closed, it becomes a completely enclosed bedroom to provide sleeping function (Fig 32). The children's bedroom also uses the same functional bed, which can be used as a bedroom at night and a recreation room during the day (Fig 33 & 34). This allows children to have more space to play at home, and parents also have more space to interact with their children.

Figure 31. Living room.

Figure 32. Living room change to Lisa and John's bedroom.

Figure 33. Child's bedroom.

Figure 34. Child's bedroom change to entertainment room.

In the design of the kitchen, in order to solve the problem of insufficient storage space in the original kitchen, I set up height-adjustable cabinets on both sides of the range hood. It provides space for tableware, seasonings and microwave oven, and the cabinet below is used to store pots, foods and kitchen cleaning supplies. The height of the cabinet above can be adjusted so that people can easily take items that are at a higher position, and also so as not to block sunlight. In addition, there are two blackboards on the kitchen wall to make the kitchen more joyful (Fig 35). Children can write or draw on the lower position blackboard and parents can write daily recipes or draw favorite pictures on another blackboard to interact with their children.

Figure 35. Kitchen.

Figure 36. Kitchen.

In the bathroom, I use translucent glass sliding door to separate the shower from other facilities. In this way, even if someone is bathing, it will not affect the use of other facilities. This also improves the potential safety hazards of bathroom appliances when encountering water. In addition, there is a step at the bottom of the sink that can be pulled out for easy use by children (Fig 38).

Figure 37. Shower room.

Figure 38. The step under the sink.

Figure 39. Bathroom.

5.4 Phase 2 (A couple and two children)

In the design at this phase, I explored how to transform this apartment into one suitable for a family with two children. An increase in the number of people in a limited space will lead to a decrease in the area used per capita. In this apartment, I tried to increase personal privacy while preserving the existing functions. In the design process, I also used persona (Fig 40) and personal schedule as the design guide (Fig 41 & 42) to analyse the lifestyle of a two-child family and designed a space that meets their needs at this phase.

Characters	 李华 John	 林月 Lisa	 李霖毅 Jimmy	 李霖希 Doris
Occupation	Office worker	University teacher	Primary school students	Kindergarten student
Hobby	Hiking Play basketball Skiing Swimming Play poker	Cooking Play badminton Skiing Swimming Yoga Flower arrangement	Play Legos Play remote control car Play basketball Skiing Swimming Painting Hip-hop Violin Taekwondo	Play with dolls Painting Dancing Piano Skiing Swimming

Figure 40. The persona of Phase 2.

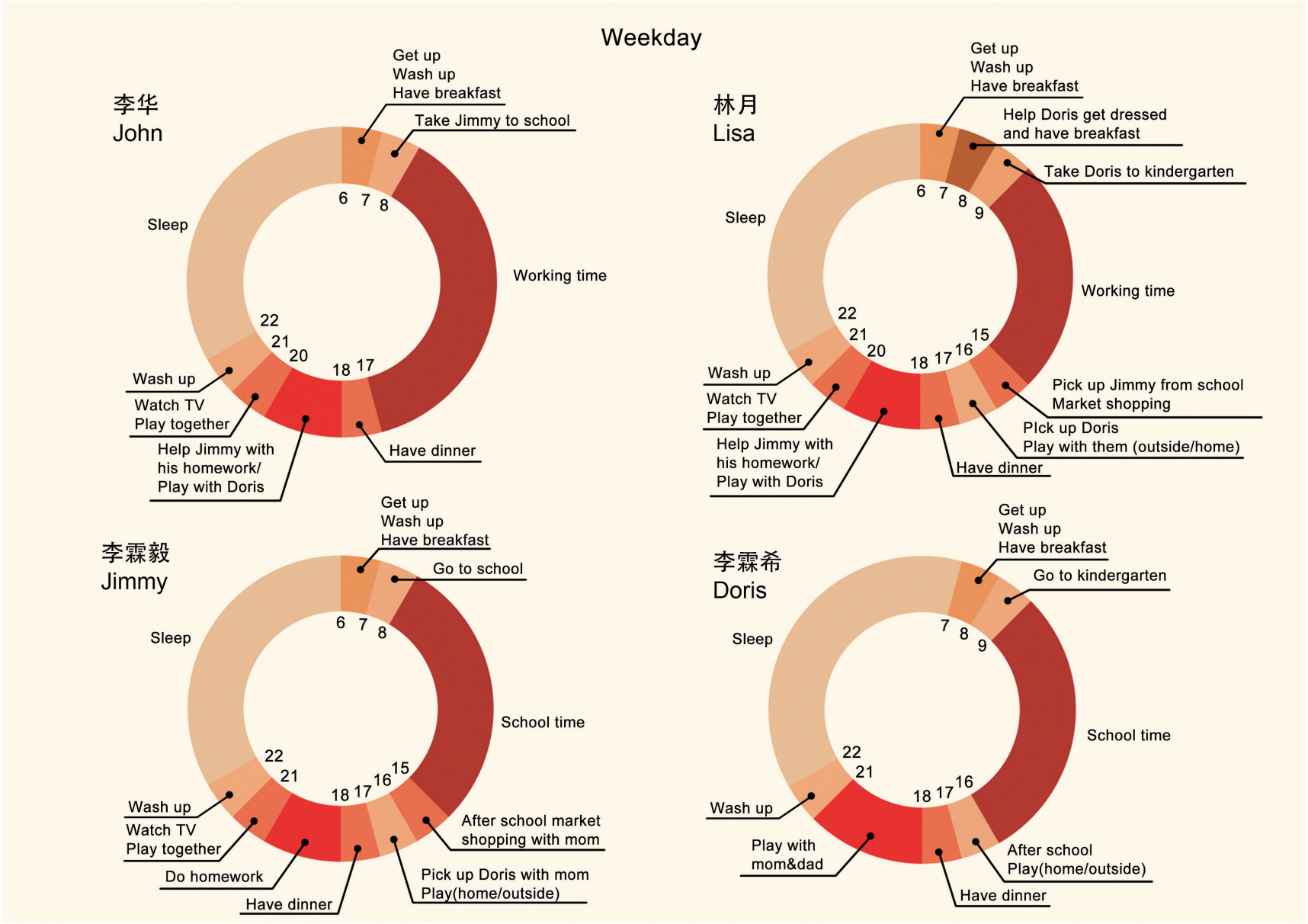


Figure 41. Weekday schedule for family members of the two-child phase.

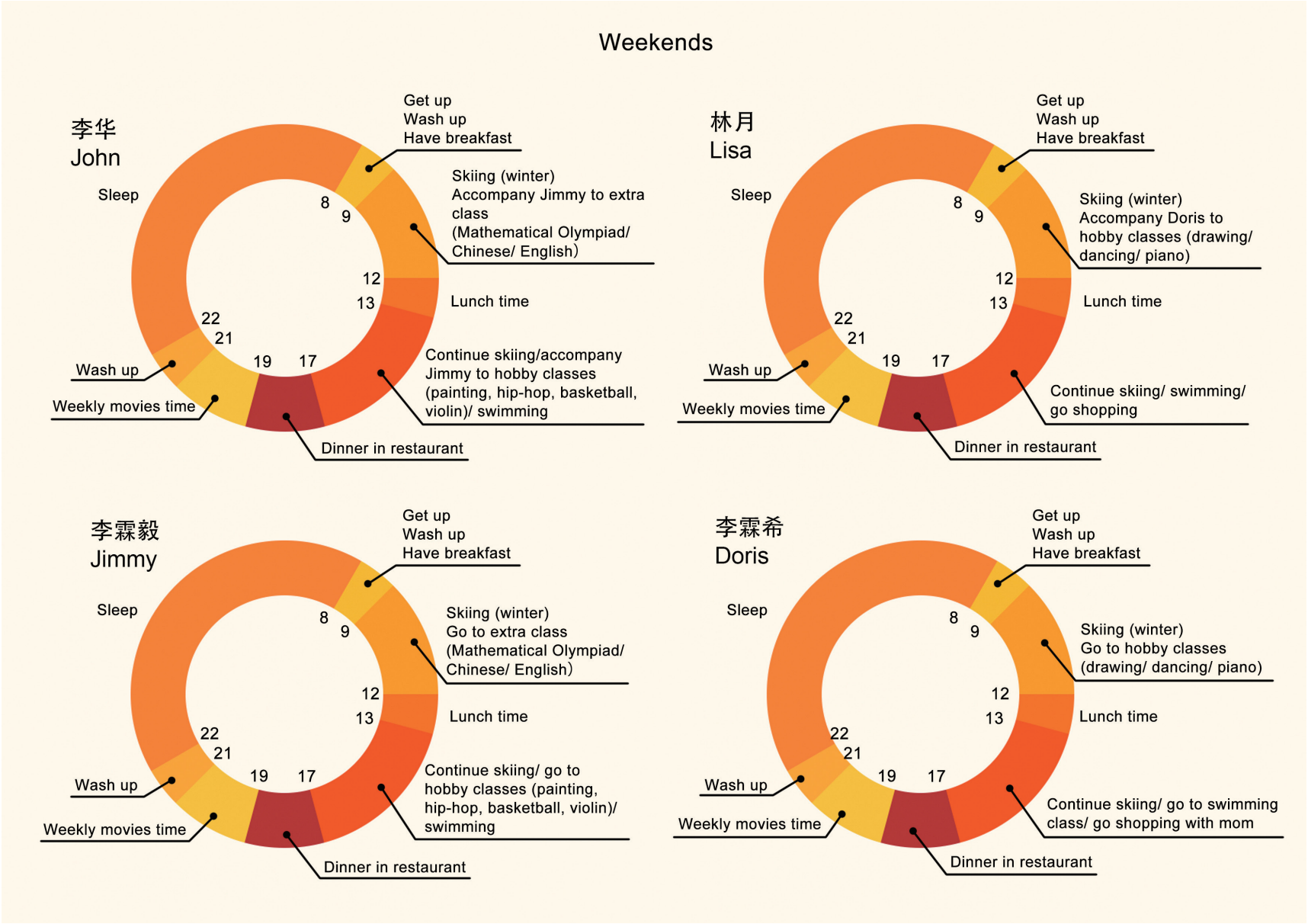


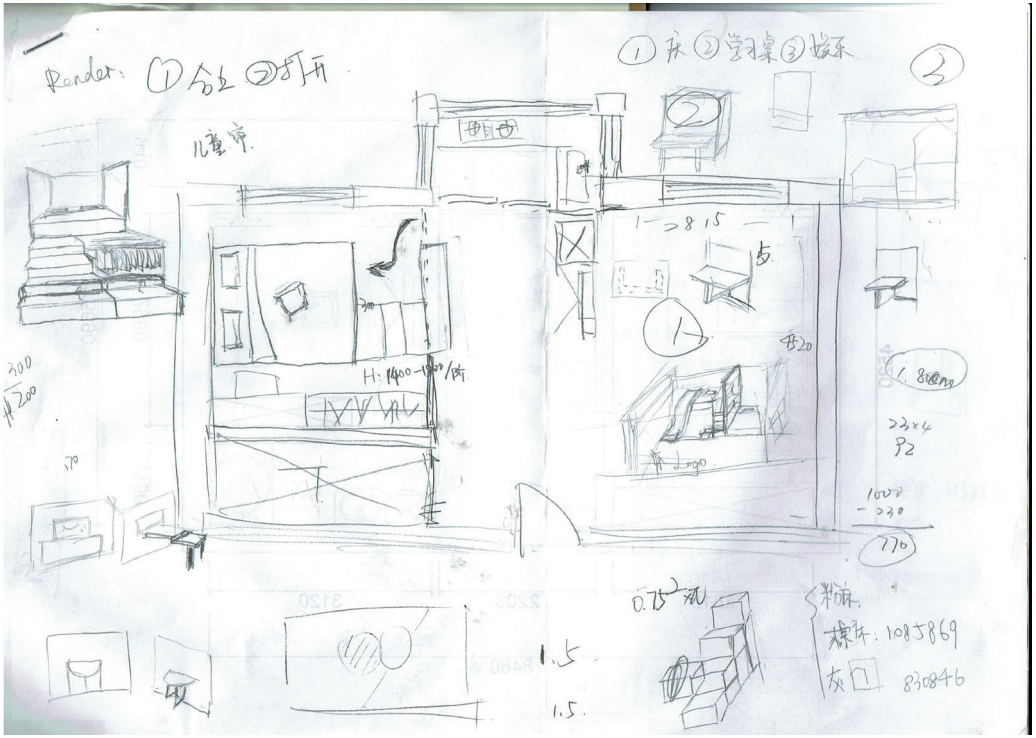
Figure 42. Weekend schedule for family members of the two-child phase.

Changes

The gender difference of the two children leads to their different personalities and preferences. Due to the size of the apartment, it is inevitable for them to share one bedroom. Considering the influence of private space on children's psychology, I tried to increase privacy in the design to meet their psychological needs. In addition, as children grow up, their homework increases, so I also considered the learning space in the design.

Design process

In this phase of the design, I kept the kitchen, bathroom and movable wall in the previous design, and only changed the design of two bedrooms to save costs. Considering that the gender and age of the two children are different, the children's room needs a larger area to realize that they have independent space and reserve more space for activities, so I changed the larger bedroom into the children's room. In addition, as in the first phase, the moving wall effectively saves the space of the apartment and makes the apartment spacious.



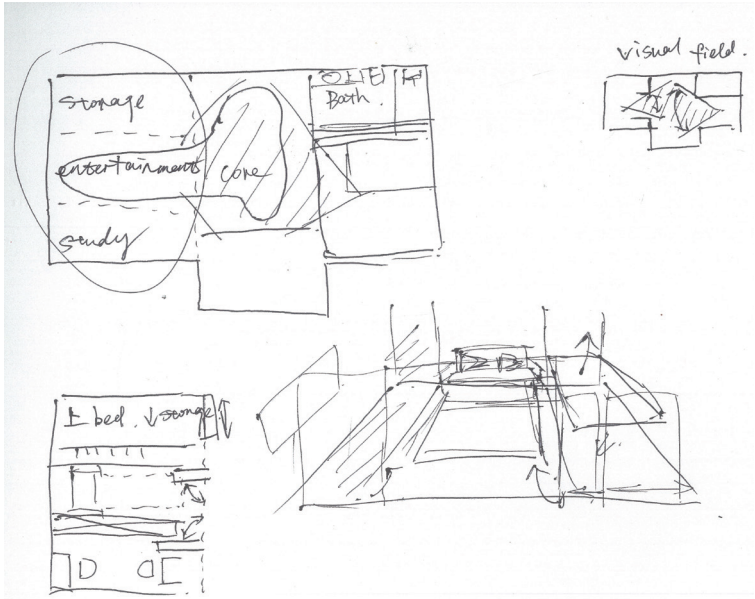


Figure 43. Hand-drawing draft.

Figure 44. The corridor .

Figure 45. The corridor when open the movable wall.

In the design of the children's room, in order to increase the utilization rate of the space, I used movable wall and a multifunctional sofa bed to divide the space into three parts. At night, when the moving wall is closed, the room is a bedroom for children (Fig 46), when the wall is opened, the room is divided into the study area, entertainment area and storage area (Fig 47). At the same time, I staggered the two beds, separated by plasterboard inlaid with stained glass (Fig 49). This method limits children's sight in the non-enclosed space so as to increase the privacy of each child. When the sunlight passes through the stained glass, there will be projections of different colours, which adds to the fun of the room. The lower part of the raised bed is used as a storage space, and the steps used to go to the bed are also drawers for storage. This increases the utilization of space in the vertical space. In addition, Lego was used as the background wall of the children's room to increase the fun of the room and also enrich the colours (Fig 50). The night is also considered in the design of the children's room. Some small night lights in the shape of clouds and stars on the wall are used to increase the warm atmosphere of the night (Fig 53 & 54). This design is intended to allow children to study and play in the room during the day, and to fall asleep in a warm environment at night.

Figure 46. Children's room with movable wall closed.

Figure 47. Children's room with movable wall opened.

Figure 48. Dining table.

Figure 49. Children's room's plasterboard inlaid with stained glass.

Figure 50. Children's room.

Figure 51. Children's room.

Figure 52. Children's room study area.

Figure 53. Night view of children's room.

Figure 54. Night view of children's room.

The parents' bedroom continues to use the furniture from the previous phase to save costs, and raise the bed in the same way as the child's room, with sleeping space above and storage space below. I use this way of overlapping space to increase space utilization to achieve the effect of large use of small space (Fig 55). The steps used to go to bed are used for storage drawers to store some small objects (Fig 56). They can be pulled open to become a bed step, or can be retracted without affecting the closing of the room. It can also be used as a seat, family members can sit on different steps to watch TV or play games. In addition, the storage space at the bottom of the bed is divided into three parts: a small storage box, a large storage box and a hanger. In this way, their small accessories such as ties, brooches and underwear can be stored in the small storage box, infrequently used clothes or clothes that are not suitable for the season can be stored in the large storage box, and the frequently changed clothes can be hung on the hangers that can be pushed and pulled for easy picking (Fig 57).

Figure 55. Parent's bedroom raised bed.

Figure 56. The steps as drawers.

Figure 57. Storage space.

5.5 Phase 3 (An elderly couple after adult children leave home)

The design at this phase is suitable for the couple's life after retirement. In the design, I still followed the principle of reducing costs, so I tried to keep most of the previous designs. On this basis, the apartment will be slightly modified according to user needs at this phase. Therefore, I chose to keep the original design of the kitchen and bathroom, and only changed the design of the two bedrooms. Employing the design method of the first two phases, I designed the interior space by setting the persona and analysing the timetable of each character to infer their activities at home.

Characters	 李华 John	 林月 Lisa
Occupation	Retirement	Retirement
Hobby	Tai Chi Calligraphy Play Mahjong Fishing	Cooking Flower arrangement Tai Chi Knitting Play Mahjong Dancing

Figure 58. The persona of Phase 3.

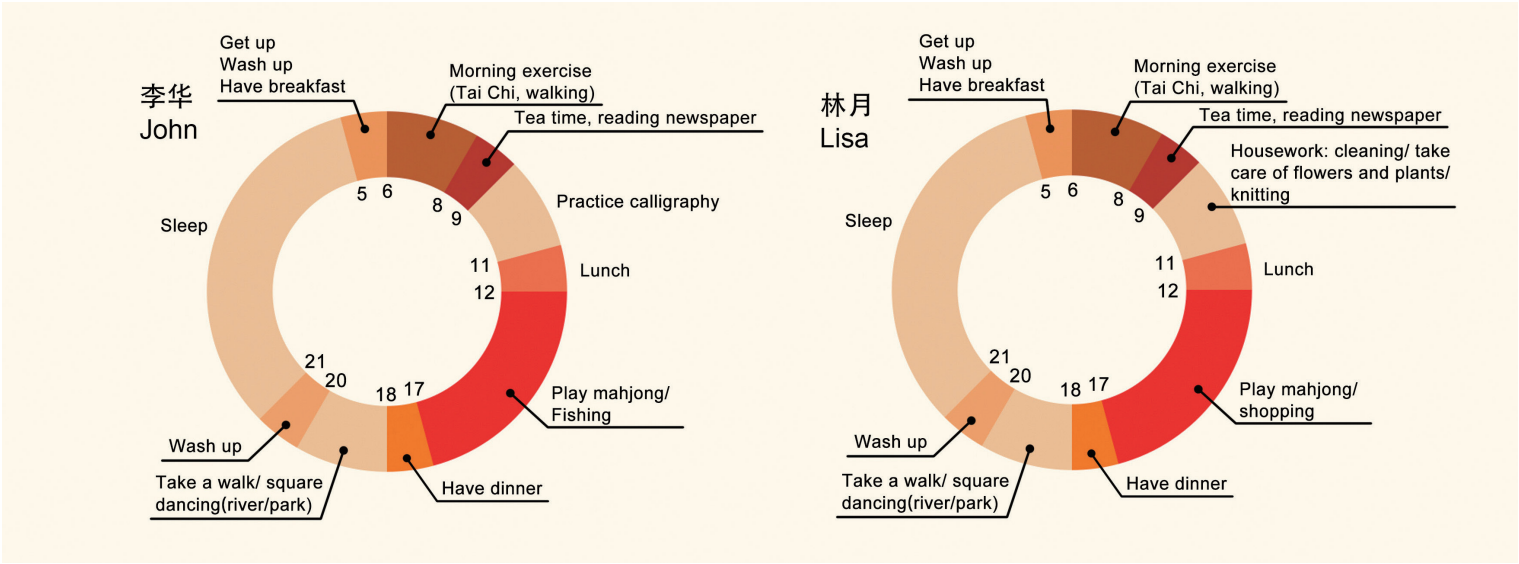


Figure 59. John and Lisa's daily schedule after retirement.

Changes

At this phase, John and Lisa will spend more time at home because they have retired. Their hobbies have gradually changed from being very active to being relatively quiet, and the activities carried out at home are the same. Except for playing mah-jong to gather three or two friends, the rest of the time is quiet activities, such as calligraphy, reading, planting flowers, knitting, etc.

Design process

At this phase, the number of people using the apartment has decreased, and the elderly will not perform various activities associated with children, so I changed the original children's room into an entertainment room (Fig 60). This room can satisfy John and Lisa's various hobbies such as calligraphy, playing mah-jong, planting flowers and dancing. Multifunctional furniture is also suitable for this phase of design. I merged the furniture needed for activities that cannot be performed at the same time to avoid too much furniture that might make the home look crowded and obstruct the passage. Play Mah-jong is a group social activity while calligraphy is a quiet activity. It can't be done at the same time, so a table will be used for both activities (Fig 61 & 62). In addition, I placed the plant stand in a sunny place on the side of the window in this room, so that the plants can better absorb the light and play the role of decorating the space (Fig 63).

Figure 60. Entertainment room.

Figure 61. Mah-jong and calligraphy area.

Figure 62. Change to calligraphy table.

Figure 63. Plant stand.

For the bedroom design, I deleted the design of the bed that must go up the stairs to make it more convenient. But the storage space has also been reduced, so I added a wardrobe around the windows in the bedroom (Fig 64). The cabinet under the window has a storage function and a tea table above it that can be raised and lowered. This tea table is also a chessboard. John and Lisa can read books, read newspapers, drink tea and play chess here in their leisure time. This brings a comfortable atmosphere to the room (Fig 65).

Figure 64. Bedroom.

Figure 65. Wardrobe and tea table.

5.6 Changes of the floor plan across the 3 phases

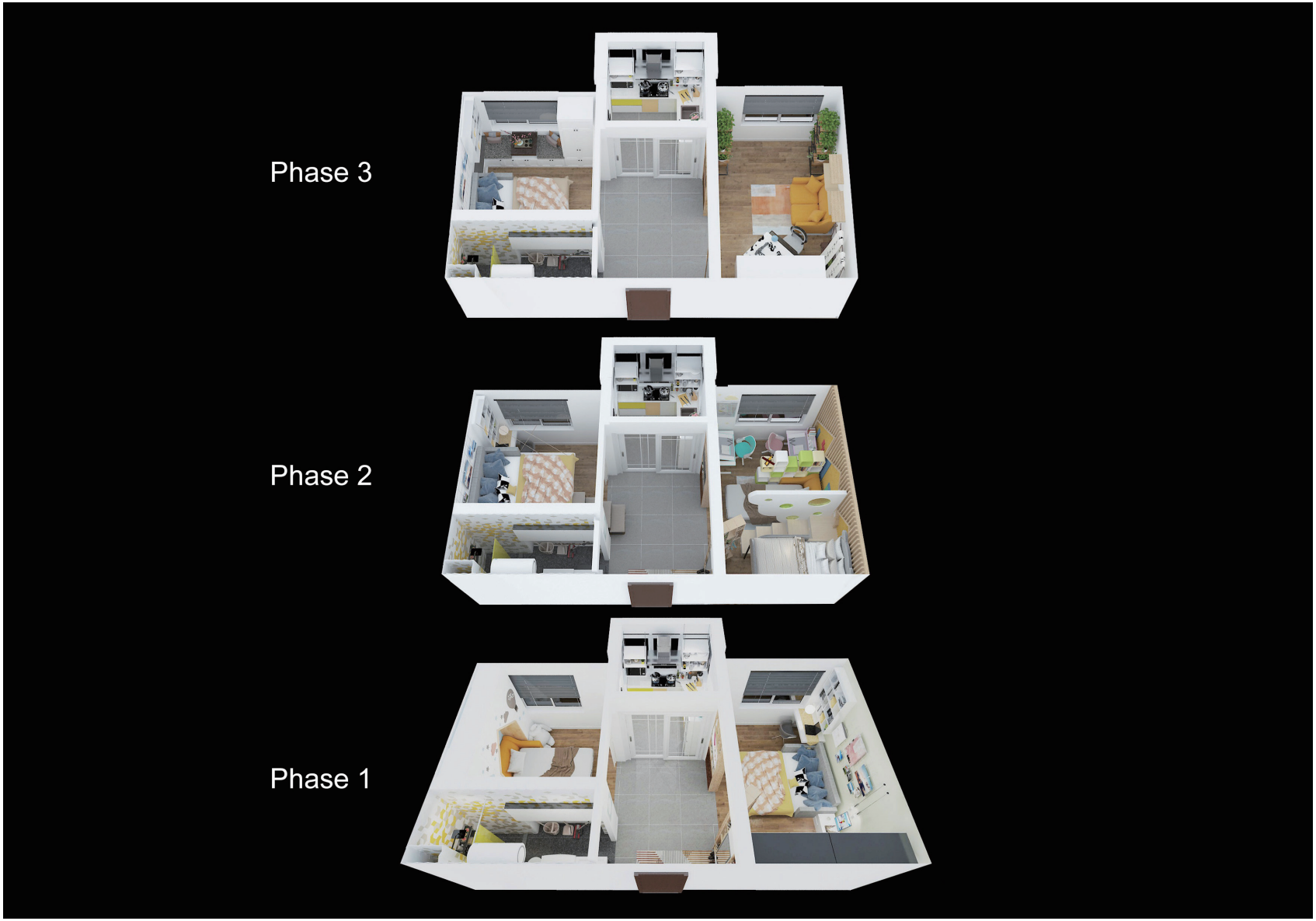


Figure 66. Changes of the floor plan across the 3 phases.

6. Conclusion

The starting point of this study was to provide Chinese two-child families living in small apartments design comfortable living spaces that meet their needs. Based on this starting point, I further explored how the apartment can meet the needs of people at all phases of life. In order to achieve this goal, I redesigned an existing small apartment, and used the method of persona to simulate the user's indoor and outdoor activities. That let me to design from the user's perspective, which allows me to avoid making a subjective design that is not generally accepted by people.

I designed three phases living plan for people living in this apartment, which are applicable to different family patterns for different ages of users. In these three phases, I tried to keep the furniture and design of the previous phase, add furniture and change the design appropriately through the analysis of the needs of the family at each phase on the original basis. The continued use of furniture can complete the change of space without much expense. This was used to answer a question I was exploring, how to design the small apartment to meet the low- and middle-income families' needs in Changchun in each phase of life?

In the process of exploring and transforming the living space of a small apartment to be suitable for two-child families, I learned about the psychological and physical needs of children for living space through literature reading. While considering the privacy of the children, I did not set up a completely closed personal area but an area that is relatively closed but still communicates with others, so as to avoid some psychological problems that the children may have. At the same time, I also paid attention to family members sharing time and space. I created a harmonious atmosphere in the family by designing an open family centre core area. And I used multiple colours and multiple shapes in the children's space to increase entertainment. It also adds a joyful atmosphere to the home.

Through the design, I found that the use of multifunctional furniture and raising the level of the bed can achieve the purpose of increasing space utilization. The variability of multifunctional furniture allows the same space to have multiple functions. I used movable wall to transform the space between the living room, corridor, bedroom, and dining room; and use the transformable bed to transform the space between the living room and the bedroom. In addition, I raised the height of the bed, and the space below is used for storage. This method also uses the overlapping area in the vertical direction of the space to increase the functionality of the space. Therefore, the use of multifunctional furniture and vertical space in the space can improve the space utilization rate of small living spaces to meet the needs of more family members. This led me to the conclusion that a small area does not mean less functions.

Through research, I attempted to help families who live in small apartments facing insufficient living space or families who will face such problems in the future. This continuous design can not only save the cost of decoration, but also avoid the waste of resources. Let people see the possibility of renovation of small apartments and increase the acceptance of small apartments.

In the future, the problem of insufficient housing space will be a serious problem faced by society and more and more two-child families. According to Ning (the Director of the Chinese Bureau of Statistics, 2020), the number of births in China in 2019 was 14.65 million, of which the proportion of children with two or

more children reached 59.5%. The birth of the second child affects society in many ways, such as economy, wellbeing, and resources. This project provides a solution to this significant social problem in terms of housing, which can be used as a reference for similar family models and apartment types. This continuous design can not only save decoration costs and relieve family pressure economically, but also avoid waste of resources. Let people see the possibility of renovation of small apartments and increase the acceptance of small apartments.

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