

Cat Housing: A Case for Inclusive Cohabitation

by
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Abstract

This major research project (MRP), focused on inclusive industrial design, is a continuation of the "Fumao Jihua" (福猫计划) or the "Cat's Paradise" Project for rescuing stray cats that I was engaged in between 2011 and 2013 in Xi'an, China. The project involved creation of modularized furniture for cats that could be used both at home and in rescue facilities. Primary research conducted in that project informs my MRP. Inspired by the Inclusive Design program, I expanded the idea and the function of the furniture to creating modularized, environment-friendly furniture that provides an inclusive space and environment for both humans and animals to cohabit in crowded city locations. To maximize the design, I created two versions, for use both indoors and outdoors. My designs could also be useful to children with autism, because close habitation with pets is reported to be therapeutic. Future work includes conducting social experiments on the use of the furniture in public places.

Keywords: inclusive design, industrial design, animal rescue, cat, furniture, autism therapy, pet therapy.

Acknowledgment

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I thank my friends in my class, with whom I had a fun time for two years. I am grateful to Kolowood Inc., Toronto, for working on my prototypes.

To my friends in Xi'an, China, who are continuing to run the Momi Forest Postcard and Café and taking care of the "Fumao Jihua" (福猫计划) or "Cat's Paradise" Project after my leaving for Toronto and updating it on the Chinese social media - Weibo.

Last, but not the least, I thank all the cats that participated in my research in China, and the cats that live with me in Toronto.

Dedication

To Cathy He and all the furry friends in our life.

仅此，献给何玥，还有我们生命中路过的那些可爱的毛茸茸的小伙伴们。

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Introduction

The British Standards Institute (2005) defines inclusive design as: “The design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible ... without the need for special adaptation or specialised design.” My project went one step further, and designed furniture that is accessible to, and inclusive of, both animals and humans: a sturdy wooden box with a hole on the side, which enables people to sit on it while their pet cat (or dog) sleeps cozily inside. This was based on my previous research, which showed that cats love to live in a box with a hole on the side (see Figure 1). It all began five years ago in the city of Xi'an in China.

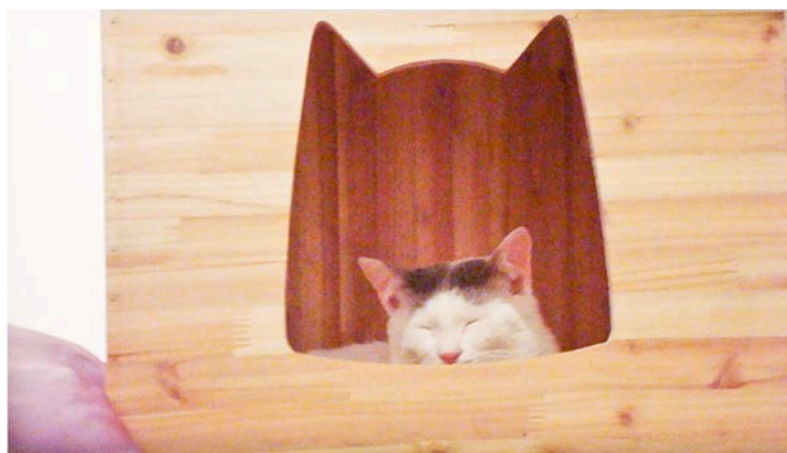


Figure 1: Cats love to live in a box with a hole on the side.

Initial Idea from China

In 2011, when I was doing my undergraduate program in Industrial Design, my friends and I started the "Fumao Jihua" (福猫计划) or the "Cat's Paradise" Project for rescuing stray cats and we co-founded the first cat café in China called the Momi Forest Postcard and Café. Soon we had a substantial number of furry animals purring around the café, wanting a place to curl up so they don't get kicked around.

Cat furniture was expensive, costing at that time anywhere between 200 RMB to 1650 RMB (roughly 40 CAD to 350 CAD). Even for that price one could only purchase single function furniture for the pet alone. I wasn't sure if even the cats loved them. So I decided to design furniture for cats.

After a thorough research process involving 18 cats as participants, which is described under the Section "Previous Research and Design", I discovered that cats love to live in a box with a hole on the side (see Figure 1). Using my industrial design expertise, I constructed boxes and the cats living in the Momi Forest Postcard, and Café and those visiting the

café enjoyed curling up in them. The cat owners parked themselves on the boxes while they sipped tea and chatted with their friends, occasionally petting their cats. And their cats licked their hand in turn, purring with satisfaction. This way, the designer in me could design a product that could connect people and their cats to enhance the interaction between them.

Situation in Canada

Fast-forward four years: I found myself in Toronto, commencing a Masters program in Inclusive Design. Bringing my interest in cats with me, I was naturally curious about the situation of cats in Canada, especially in Toronto. I found that over 37% of families in Canada owned one or more cats. My research also led me to discover some uncomfortable details.

The Canadian Federation of Humane Societies (CFHS) has reported on the overpopulation crisis of cats in Canada. To quote them,

Cats are a domesticated species that need human care to survive and stay healthy — especially during cold Canadian winters. But every year, the population of homeless cats grows, and more and more cats flow into already crowded animal shelters. It is estimated that less than half of cats admitted to shelters are adopted. The majority are

euthanized. Many never make it to a shelter, and die painful deaths outside¹ (CFHS, n.d., n.p.).

In 2012, CFHS published a report of its ground breaking study conducted in collaboration with PetSmart® titled “Cats in Canada: a Comprehensive Report on the Cat Overpopulation Crisis”. It puts into perspective the growing problem as:

In one year, a fertile cat can have up to three litters each with an average 4.3 kittens. Given that females from two of these three litters can become fertile within the 12-months period, a rate of 12.8% mortality prior to weaning, and a gender ratio of 47.5% females in the litter, just one unsprayed female alone can result in 25 kittens born in one year (CFHS, 2014, p.4).

The two reports from CFHS point to plenty of other wild animals living in the city areas as well, such as raccoons, squirrels, pigeons and skunks. Raccoons are a common problem to local residents; they sometimes 'move into the house' to find shelter during the cold Canadian winter and even 'steal' food. These details motivated me to design accommodation that would be usable not just by pets indoor but also by wildlife outdoors.

¹ Canada's Cat Overpopulation Crisis: http://cfhs.ca/athome/cat_overpopulation_crisis/.

A Project to Address the Gap

With such over population of cats, dogs, and other urban wild animals in the city, it is not humanitarian to ignore them. A solution to this problem could be in the form of a new kind of animal shelter that is comfortable to the animals as well as sustainable. Extending the cat housing solution developed in Xi'an, I worked on a design that can provide indoor/outdoor spaces that not only enhance the interaction between humans and animals but also make the whole city and society more inclusive at many levels. I evolved the cat café furniture idea into creating "*a space that enhances the interaction between humans and animals both indoors and outdoors*". The over-crowded city spaces provided a justification to make the furniture modular. The harsh weather conditions in Canada made it a necessity to make them sturdy.

Moving forward, this report presents a glimpse of my previous research, which provided the basic design, and the further work that I did during my MRP course to extend it. The outcome of the project is a series of animal shelter furniture that serve as a model of inclusive design.

Previous Research and Design

In this section, I describe my earlier work in Xi'an, China that forms the basis for my MRP. I detail below the research process through which I discovered that cats love to live in a box with a hole on the side, and the design process leading to the construction of the cat boxes that are being used in the cat café in Xi'an even today, evident from posts on Weibo.

Cat Café

After I got interested in making furniture for the stray cats we collected in the Momi Forest Postcard and Café under the "Fumao Jihua" (福猫计划) or the "Cat's Paradise" Project, I began to do some user-centered design research. The first step was to try out different boxes to discover which design appeals to the cats.

I put four different types of boxes in the playroom inside my café, Two of them were top-open boxes of different sizes, one was a cylinder-

shaped box and the fourth, a regular card board box with a hole of 30 cm diameter on one side, And I let all my resident cats into the room to observe the reaction of the cats. There were 18 cats of mixed age and breed. The test began at 9 am and ended at 2 pm. Results are shown in Table 1.

Table 1: Results of cats and boxes experiment

Object	Multiple cats occupation (Y/N)	Single cat occupation (Y/N)	Interaction (bite, scratches) Y/N
Open top (20cmx30cm)	N	Y	Y
Open top (40cmx60 cm)	Y	Y	N
Cylinder-shaped	N	Y	N
Box with hole on the side	Y	Y	Y

Cat Boxes

As can be seen from the table, the only design that was used for both single and multiple occupancy and also encouraged interaction,

was the box with a hole on the side. Which is how I initially discovered that cats love to live in a box with a hole on the side. I tried this out several times with different cats, and every time I found that cats loved to sit in this type of a box. This discovery made both the cats and myself happy. I had found the 'purrfect' design for cat housing. I made a few models and they worked well.

A stress test was run from March 2012 to July 2013 with 18 cats using 16 boxes on a daily basis. Barring scratch marks on the surface, the boxes remained intact. Observations of cat behaviours recorded during the test helped me improve the design to make them more suitable for daily use by cats. From the perspective of the human user, keeping the height of the box at 450mm proved to be suitable for a majority of Chinese adults to sit down and interact with the cats with comfort.

I made three boxes and donated to the local rescue facilities in Xi'an. Although I did not attempt to obtain official data or documentary photos from them, I received emails telling me how well the boxes were working in the facility and also how much the animal there loved the boxes.

To make this project sustainable and eco-friendly, a principle of zero material waste was adopted. After the laser engraving process, the piece that was cut off from the board became the menu of the shop.



Figure 2: Piece cut off from box becomes Menu for the shop.

Figure 3 shows a picture of all the participants in my research. They purred in consent when I asked if their pictures could be published!



Figure 3: Hard-working volunteers of the Fumao Jihan project.

Methodology

Design Requirements

The design of prototypes was based on ergonomic design processes and observational data of cats' behaviour from previous research. The current prototypes would, however, be both for domestic animals and for urban wild life. As well, the ergonomic data had to be recast to accommodate North American adults and individuals of non-typical height (the range of human and animal dimensions). Use indoors and outdoors would require different materials. Use of the box in animal rescue facilities for rehabilitating rescued animals re-establish trust with humans had to be kept in mind too, from the perspective of making the cost affordable to non-profit organizations. Also, the design should be eco-friendly and sustainable for both individual user and the rescue organizations. The material needs to be recyclable and the manufacturing and other costs must be affordable.

Size Matters

Statistics of ergonomic design indicate the ideal sitting heights of the Asian male and female to be 400 mm to 470 mm; this can fit most of the Asians. For North Americans, the ideal sitting heights are slightly different, ranging from 375 mm to 475 mm. Therefore, from the perspective of ergonomic design, a sitting height of 450 mm should fit most of the people in the world. However, the modular nature of the design and the do-it-yourself affordances of the design facilitate the opportunity to stretch the design to the dimensions of pets and their human friends that are not typical or average.

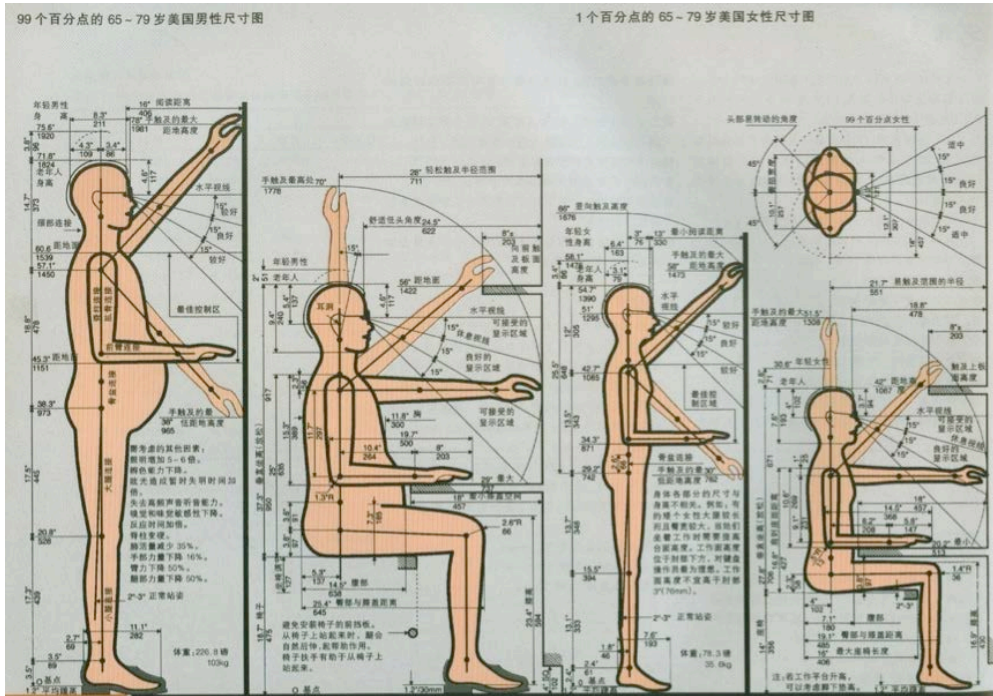


Figure 4: Ergonomic significance of 450 mm sitting height²

Figures 4 and 5 illustrate the ergonomic principles underlying the two size choices of 45 cm and 60 cm.

² Image source: Tilley, A. R., & Zhu, T. (1998). *Ren ti gong cheng xue tu jie: She ji zhong de ren ti yin su*. Beijing: Zhongguo jian zhu gong ye chu ban she.

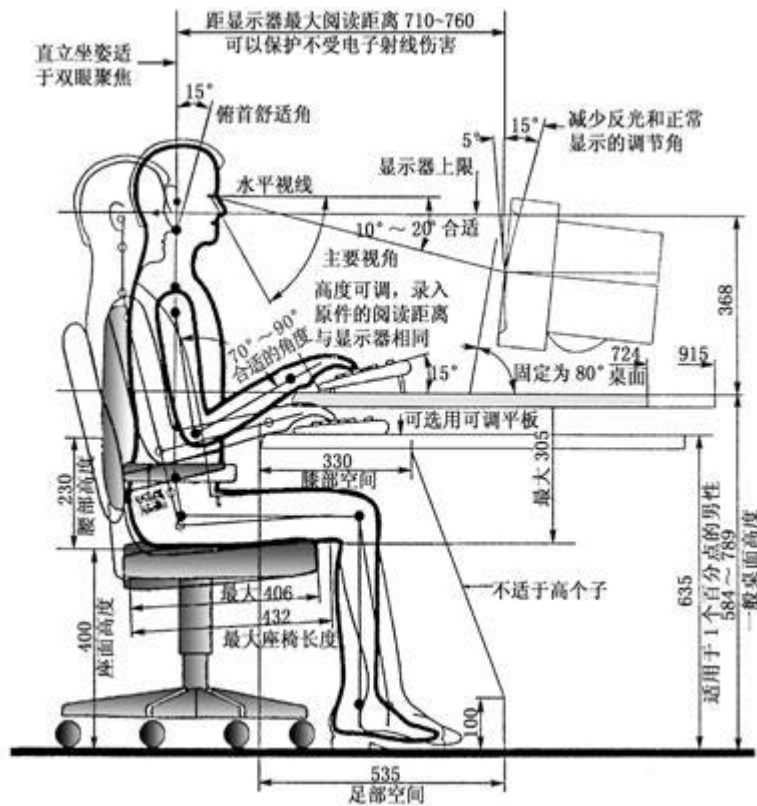


Figure 5: Ergonomic significance of 600 mm sitting height³

A 600 mm box would be ideal for hip support, where the user can lean on the box and, at the same time, they can interact with their pet. Also, the average shoulder height of a medium-sized dog is 340 mm +/- 40 mm, and that of a large dog is 460 mm +/-40 mm, Dogs of any of these sizes could fits in the 600 mm box. With the box height at 600 mm, users can inter act with their pets with comfort in a relaxed position.

³ Image source: Ding, (2000). Ren ji gong cheng xue. Bei jing: Bei jing li gong da xue chu ban she. ISBN:9787810134217

Modular Design

During the design process, inspired by Lego. I decide to use modular design. This helped in fitting the boxes into variable situations and different spaces as needed. One of the features of modularization was the use of pins between the units to limit movement between units. After the build of the first batch of prototypes, I modified the design of pins into a match-shaped-corner design and indicated this design aspect on the face panel (or the front panel) as illustrated in Figure 6.

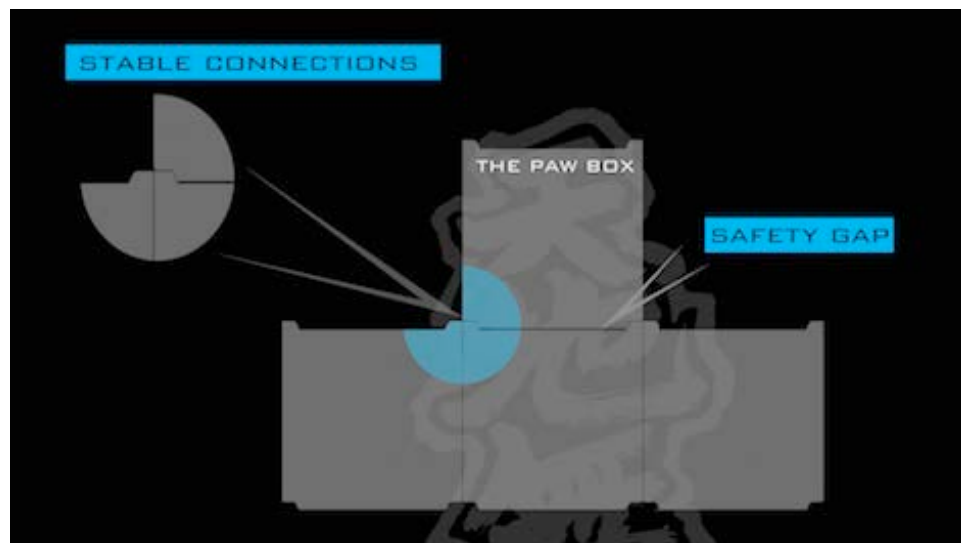


Figure 6: Engineering the box – corners for stable connection

The size of each box is 450mm x 450mm x 450mm, it can be occupied by 2 adult cats with enough space or 4 adult cats squeeze together. The manufacturing process used a flat CNC milling machine to cut the wooden board. The material used is called puzzled board, which is made from natural wood to fit without any glue or chemical, Wooden boards 12mm thick were placed in a well-ventilated room for a week to let them dry. This is also a necessary step to avoid the board from bending after the final assembly. After cutting, the panels' edges were polished to make them safe.

Structural Stress Testing

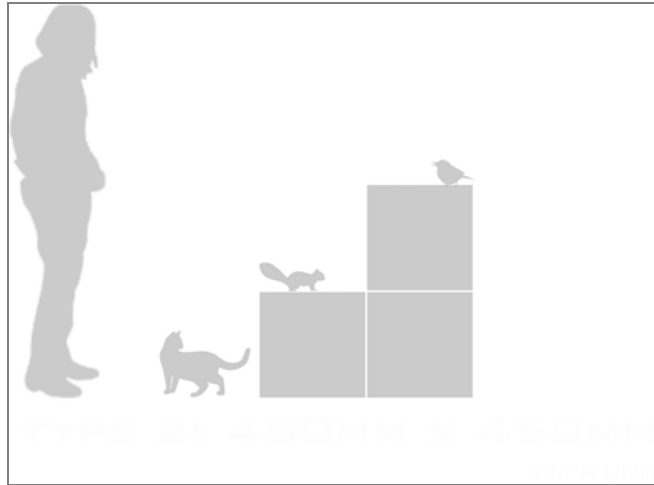
The prototypes were also tested for structural stability. It was found that the 450mm cube box could hold up to 100kg of evenly distributed weight on its top; which means an adult of average weight can sit on the cat box without any concern.

Previously the box(s) were designed to only deal with 1 or 2 cats in a regular Chinese family under normal situations,. But According to the City of Toronto Municipal Code, Chapter 349 states that "no person can keep more that six of any combination of dogs, cats, ferrets and rabbits at any

given time in their home," the design might have to deal with more than two pets. To make sure the design can achieve this, I had my friend at the Xi'an cat café try out further stress tests with similar prototypes in my cat café, which has 18 residential cats and a high visitor flow rate of around 100 per week.

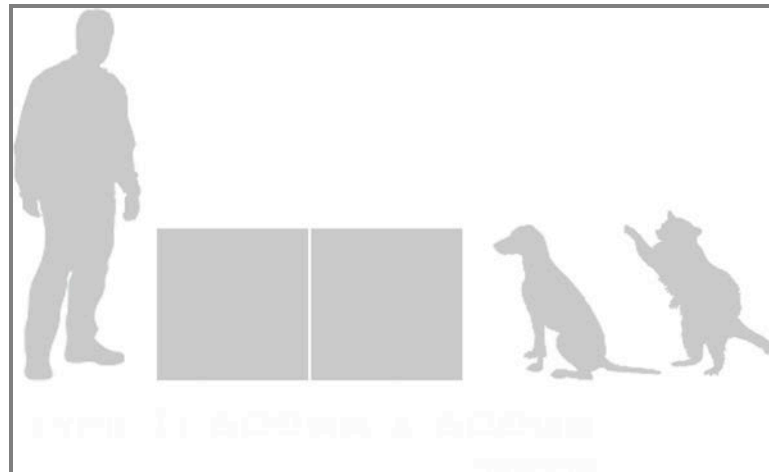
Design Prototypes

After the research above, the design was infused with new criteria that can allow occupation by other animals such as raccoons and skunks. Also the new design contained boxes in two categories: the 45-series (as shown in Figure 7) for small animals like cats, skunks and ferrets and the 60-series (as shown in Figure 8) for bigger animals such as dogs and raccoons. Each unit can be deploy individually and also they could be joint to form a combination set to fulfill the needs of varying space demands in small urban residences.



The 45 series- Size= 450mm x 450mm x 450mm

Figure 7: 45 cm cubed series boxes



60 series- Size= 600mm x 600mm x 600mm

Figure 8: 60 cm cubed series boxes

Figure 9 shows a typical cat box. This prototype box is not as well finished as the final product.



Figure 9: Initial prototype

Figures 10 and 11 show how the resulting boxes accommodate themselves in small urban residential spaces. Modular design makes the boxes stackable one on top of the other or sideways. The way three boxes are stacked in the figure could serve to house several cats and, at the same time, enable human beings to seat themselves and have table space at their side for a cup of tea too.



Figure 10: Boxes stacked vertically

The boxes can seat humans without any discomfort. Further, when the boxes are stacked as a combination, it also provides a close space for the pets and the owner to communicate with each other.



Figure 11: Stackable, wall-mountable cat boxes.



Figure 12: Positioning a cat box in the corner

As can be seen from Figure 12, the box can be placed anywhere as convenient to the layout of each home. To meet the personal needs of indoor pet owners, the only thing that needs to be changed in the design is the material. In the outdoor situation, the material must be environmentally friendly and also low cost. But in the indoor environment, it needs to fit within the style and taste of the house. The manufacturer could provide several styles and grades of panel material to enable personalized meeting of market needs.

Building the Boxes

Figures 13 to 16 show the box building process.



Figure 13: Work in progress – 1



Figure 14: Work in progress – 2



Figure 15: Work in progress – 3



Figure 16: Finished product

Design Modularity

To make the design more inclusive, I have put the design into a modularized function that facilitates customization for different purposes.

Business perspective

Indoor furniture for both humans and pets

To make this design a mature product in the market, the material of the panels can be changed to the major cabinet panel material with a variety of colors and surfaces to fit most of the home decoration styles and personal tastes. For the families that have children, each unit features a childproof design to prevent any hazards to the child from the product. A set of reinforced connection parts will also be included in the package.

Charity perspective

Outdoors shelter for stray animals or urban wild life

To fulfill the demand for rescue of street animals, the product needs to be low cost and also environment friendly; at the same time it

should be durable enough to survive extreme seasons such as rain, snow and low temperatures. The material of the panel can be changed to a less expensive, light weighted and eco-friendly material. With lower cost, we can provide more shelters to charity organizations within a limited budget.

General perspective

General use at home or therapeutic facilities

As mentioned in the previous sections, this product may be used in home and also facilities that need therapeutic animal services. In this case, the box could be customized to fit hospital environments, etc. by using appropriate material for the panels. The staff of the facility or the homeowner can also flexibly arrange the combination of units. The panel material will be different in each case depends on the varying condition of the home or the facility such as color and the number of the boxes.

Customization Perspective

The modularized design could give this product a unique feature, which is to engage the user in making their own furniture combinations,

providing them a chance to exercise self-determination of their needs and a sense of ownership and agency in the building process. Also the combination can fit different sizes of living space, from a small condo in downtown core to a large house in a satellite or suburban area. This design can fit them all in a one-size-fits-one manner, which is another expression of the spirit of inclusive design.

Inclusive Design Perspective

Modularization Design Perspective

During the design process, to achieve the goal of inclusive design, I use modular design to make the box fits various space and environment limitations. By using different number of units, the combination of the units could have different functions within the variety of space limits, especially in urban living conditions. The corner design of each unit could limit the movement between units when they are attached, the additional connection parts are also provided in the package for extra connection usages.

In the inclusive design methods, one-size-fits-one is the key. Another principle is to enable an adjustable fit through a minimum number of changes or adjustments. In my MRP, combined with the modular design, I call this "one-size-fits-one-for-all" to design the product as an extensible system instead of a fixed single product and choose the units to fulfill the demands under certain circumstances. This design can fit a variety of conditions in the real world without changing the original design. After the design of the foundation units is done, the system will be ready for further improvements that fit the connected profile.

Conclusion

Contribution to Animal Welfare

We are expanding the city boundaries by appropriating more land from Mother Nature to build houses and commercial spaces. At the same time, we are rendering so many animals that lived in that land homeless. We have cozy houses and comfortable yards, but what about our furry neighbours?

My project designed shelters in the form of wooden boxes to cater as much as possible to the housing needs of the animals that live in the city/urban environment. These boxes can blend with the environment and are recyclable, affordable and sustainable. Being further inclusive, the boxes have been built to serve as a seat or bench for humans in the daytime or to encourage cohabitation by humans and animals to build trust, love and humaneness.

Contribution to Inclusive Design

My design extends the definition of inclusive design given by the Inclusive Design Research Centre as, "*design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference*" to include design that considers animals and the coexistence of humans and animals.

My design provides a space that enables human beings to interact with animals, no matter whether they are urban wildlife or pets. From an inclusive design perspective, this design has a broader impact in that it can be used in facilities that require animals to communicate with human beings for therapeutic reasons.

This design may be a solution for both pets in the house and stray animals: to enhance bonding and interaction between family members and pets on the one hand, and to improve the relationship between humans and urban animals (include cats and dogs that live on the street) by giving a chance for both parties to establish/regain mutual trust. From a life educational perspective, children could learn to be nice to animals, no matter if they are pets or furry animals who live in the community park.

A Therapy Aid for Autism

French researchers published a study in PLOS One in 2012 which focus on the possibility of pets could help people with autism. The researcher interviewing the parents in 260 families with an autistic family member and they found that there is a certain number of families that own a pet at home can benefit the improvement of pro-social behaviours.

The author of the study also wrote "The new arrival of a pet potentially elicits more attention in individuals with autism, thus leading to a greater chance of bonding with the pet." To be specific, the researcher found that the autistic children who had a pet had more social activities such as offering to share or comfort to others after the age of five.

A live example will deliver more than theory (Cara, July 19, 2015). Iris Grace, a 5-year-old girl who is a child with autism living in UK is well known as the girl with autism who has the wonderful ability of painting. She has a special friend called Thula, who is a one-year old Maine Coon (a cat-breed, known as the most intelligent and gentle in all cat breeds). Thula has the special connection with Iris, which is to help her fight with autism.

As a therapeutic cat, Thula shows great patience and compassion towards Iris. For Iris, Thula is more of a friend than a pet. She lowers Iris' daily anxiety level and keeps her calm. At some points, Thula has encouraged Iris to have more social activities with other family members.

According to Iris' mother, Arabella Carter-Johnson, "Iris has been through a stage over the last year of hating baths and having her hair wetted. Thula has been getting in the bath tub with Iris and even letting me shampoo her as well to help Iris." Cats usually don't like water especially wetting their fur with water. But, in this case, Thula intentionally got into the bathtub and encouraged Iris to overcome the inner barrier, which is great for child a child with autism.

The results of the research are obvious: cats can help people with autism by encouraging them to engage in social activities with them as well as with other human beings. After Iris' case, there are more and more therapeutic cats working with people who needed help from them.

Parting Thoughts

When I spoke about my MRP to my friends, they were sceptical about my choice because they wondered how I thought a simple box could solve so many problems. During my life in Xi'an, we accepted plenty of rescued cats into the cat Café, which served as their foster home, I have experienced how the box gave those cats a feeling of security and also provided them a chance to meet humans that came to the café without step out their own comfort zone. Cat in my café already living in boxes helped newly rescued cats get familiar with the new environment in about 2-4 hours. After that the new cats begin to trust us. Further, they slowly accepted other people touching and interact with them. Thus trust with humans was built up again for those cats.

After arriving in Toronto, I often heard news about how raccoons destroyed people's houses, spread diseases, etc. Every time I happened to see dead bodies of stray animals on the highway, I shuddered. They want to survive in the urban environment; they didn't choose to live in the city area, they have no choice but to adapt to situations and find a way

to live. I saw a conflict here between urban humans and urban wildlife. Hitting them and running away does not solve the problem. Finding a way for humans and animals to coexist and share the meagre urban resources is the essence of urban life.

While my MRP might not completely solve the problem of stray animals, I hope it marks the beginning of a new awareness and a novel way to combat precarious living by furry wild animals and enhance trust between human and animals. A case in point is that one of my friends took some prototype boxes from the factory to his house in Markham and put them in his backyard. Within two weeks, he found that a family of raccoons had moved in. He said to me that he doesn't have to worry about the raccoon problem any more, because the raccoons have their own place now. It is only competition that breeds animosity. Collaborative sharing of resources leads to peaceful coexistence.

The third iteration of prototyping improved the linking design to secure the connection between different units. It also added the baby-proofing aspects such as rounded edges to make the furniture safe to use in families with children.

It is interesting that I followed the same strategy of modular building that I used with the research process for writing this report as well. I broke the whole report into small parts connected to a skeletal structure, wrote the small parts individually, and assembled all the parts with the skeleton once they were completed. Just like I build my own design by manufacturing it piece by piece as per the blue print, and assembling the pieces together in the end.

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