Harmony: Better Stroller Handle

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A stroller handle designed to increase comfort and control for caregivers with arthritis

Design by Evan Gasparini
01 PROJECT OVERVIEW
Overview

02 RESEARCH
Cultural Research
Arthritis Research
Market Research

03 PRELIMINARY DEVELOPMENT
Starting Point
Potential Features
Empathy Testing

04 DETAILED DEVELOPMENT
Prototyping
Testing Procedure
Validation

05 FINAL DESIGN
Form
Manufacturing
Marketing

06 DEC CAPSTONE OUTCOMES
Outcomes
HARMONY BETTER STROLLER HANDLE

The Harmony Better Stroller Handle is a stroller handle designed to increase comfort and control for caregivers with arthritis. The family dynamic and economy in China particularly create an opportunity to cater to the needs of a demographic that is both mainstream and completely underrepresented in a growing product segment. A licensable design integrated directly into the manufacturing of full size strollers is ideal for this scenario. This product was developed to improve the child caretaking experience for users with arthritis without sacrificing performance for those who do not.
<table>
<thead>
<tr>
<th>Research Type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural Research</td>
<td>10</td>
</tr>
<tr>
<td>Arthritis Research</td>
<td>16</td>
</tr>
<tr>
<td>Market Research</td>
<td>20</td>
</tr>
</tbody>
</table>
China’s one child policy began in 1979 as a temporary measure to curb population growth. The policy only applies to ethnic Han Chinese living in Urban areas, but is estimated to have prevented as many as 300 million births in its first 20 years. Families who comply with the regulation receive higher wages, better schooling, and increased financial assistance from the government. Families who birth a second child illegally are sanctioned with fines, employment termination, and difficulty obtaining government assistance. Since its implementation, China’s total fertility rate has dropped from 2.91 to 1.55 children per woman, well below the replacement rate of 2.1. This drop has led to several demographic issues and prompted the government to relax its regulations on family planning, however it will be decades before the effects of the one child policy are reversed.
According to a study conducted by the United Nations, the number of Chinese citizens over the age of 65 will increase to 219 million in 2030 and will continue growing to make up a quarter of the total population by the year 2050. This is due to the combination of relatively high birthrate prior to the one child policy and dramatically lower birthrate during. This means a significant portion of residents will age out of the workforce and will not be replaced by the younger generation, putting a huge strain on social securities and other entitlement programs. In what is being called the 4-2-1 Problem, singleton children are often responsible for solely supporting both parents and often all four grandparents in their old age. It is becoming increasingly necessary for seniors to minimize their economic burden in retirement and for all working age citizens to be as productive as possible.
Because of the growing necessity for all working age residents to have careers on top of the increasing number of women pursuing professional careers, modern families are relying on the traditional dynamic of depending on grandparents to act as primary caregivers to their grandchildren. In Shanghai, 90% of children under the age of six are being cared for by at least one grandparent. This allows both parents to pursue career advancement and support grandparents financially. They are responsible for caring for their grandchildren often for well over 10 hours a day and for doing typical things such as feeding, playing with and talking to them. It is also becoming increasingly important for this generation of singleton children to leave the house and interact with other children in order to develop proper social skills. “Grandparent Schools” have popped up all over China to help the older generation raise small children.
Arthritis is an umbrella term referring to joint pain and disease. People of any age, sex and race can and do suffer from arthritis, although it occurs more frequently in women and with advanced age. It is the leading cause of disability in America where it affects 50 million adults. Common symptoms of arthritis include swelling, pain, stiffness and decreased range of motion. Symptoms can come and go, range from moderate to severe and can stay the same for years or progress steadily. Severe arthritis can cause enough pain to prevent daily activity such as climbing stairs or grasping small objects and can cause permanent changes in joints that may be visible. Osteoarthritis is the most common form of arthritis and brought about when between bones wears away and those bones rub together directly. Inflammatory arthritis is another form of arthritis where the body’s immune system mistakenly attacks joints with uncontrolled inflammation.
Steven Martin is an occupational therapist with 25 years of experience, practicing in upstate New York. Occupational therapists are health and rehabilitation professionals who work with clients in need of specialized assistance to lead independent, satisfying lives due to physical, developmental or social problems. As it relates to this product, Steve’s expertise in using assistive devices to overcome physical limitations was vital to development.

I asked Steve about the types of physical disabilities he saw most commonly among clients age 60 - 70. He informed me that roughly half of clients in that age range suffer from some form of arthritis and that nearly 80% suffer from degenerative knees or back. He stressed the importance of avoiding improper use of the related joints and muscles because it will worsen the severity of the condition and possibly lead to debilitating injury that could take weeks or even months to fully recover from.

Next we spoke specifically about strollers, the initial focus of this project, and what the major pain points might be and how to address them from an occupational therapy point of view. I introduced Steve to a particular stroller on the Chinese market, the Teknum High Landscape stroller and discussed with him a list of activities my user would perform on a regular basis. Steve identified the potentially painful actions and suggested the best way to address them in order to avoid injury.

**Grasping** - Moving fingers towards the thumb in order to grasp narrow objects. A spherical profile 2” - 3” inches in diameter will be the easiest to hold.

**Pulling** - Putting stress on the digits in order to pull on a component of the stroller. Users should only be required to push with their palm near the base of their thumb to perform tasks.

**Lifting** - Grasping a weighted load with hand and lifting. The best method of lifting heavy loads is to loop a handle over the users elbow and lift using entire arm.

**Bending** - Bending the knees or back to reach near the ground, especially to lift a heavy item. This action should be avoided all together raising interaction points higher on the stroller.

Steve also informed me that sever arthritis will require custom modifications and to focus on solutions that minimize stress on affected joints that would cause pain and advance the severity of the arthritis.
The middle class in China is undergoing rapid expansion right now, resulting in rising incomes, urban living and changing spending patterns. Per-household disposable income is expected to double between the years 2010 and 2020. In the same time frame, the percentage of households considered mainstream consumers ($16,000 - $34,000 annual disposable income) is expected to grow from 6% of the urban households to 51%. This consumer group of 167 million households will become the standard setters for consumption and will be able to afford products such as family cars and small luxury items. Spending on discretionary items is expected to rise 13.4%, while spending on semi-discretionary items is expected to see a 10.9% growth with health-care related products representing 10% of annual household consumption. The emerging senior market is also recognized as a significant one, especially with surveys suggesting that the next wave of seniors (now age 45 - 55) is more willing to spend on discretionary items than their parents.
Consumer spending on infant care products in China is soaring. This is because of a combination of increased middle class spending power and families with one child being more able and willing to spend on higher quality items. Marketing Research firm Mintel estimated that the Chinese retail market for mother and baby products grew 256% from 2010 to 2015 and will continue to grow 15% annually over the next five years. The stroller market in particular is a $1.5 billion industry in China and is expected to grow consistently with the childcare market. Retail amount for strollers is also growing and exceeded 500 RMB in 2014. While the majority (67%) of strollers are still being purchased in department stores, the online segment (33%) is growing at an alarming rate and is being led by Alibaba Group’s online marketplace Tmall.
Tmall is an online, business to consumer portal for purchasing mother and infant products and is owned by Alibaba Group, a Chinese e-commerce giant. Online sales account for one-third of stroller sales in China but that number is growing quickly and online shopping is quickly becoming the future of consumerism in China. There are three distinct categories of strollers found on Tmall. The first is the low price umbrella strollers, the second is the mid priced full size strollers and the third is the high price premium strollers. At the time of research the Teknum High Landscape Stroller was the best selling mid level stroller in terms of volume, far exceeding its best selling counterparts in the flanking price and quality levels.

Marketing strollers in China is very flashy and usually focuses on high fashion themes. Tall women, usually western, wearing dresses and heels and pushing strollers often without children in them dominate the online sales pages for these strollers on Tmall and other similar e-tailers. Of well over 100 of the best selling strollers, not a single one was marketed specifically towards users with arthritis or more surprisingly towards grandparents. As grandparents represent such a significant part of the care giving demographic, an opportunity to market products with them in mind is being missed here completely.
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Point</td>
<td>28</td>
</tr>
<tr>
<td>Potential Features</td>
<td>30</td>
</tr>
<tr>
<td>Empathy Testing</td>
<td>38</td>
</tr>
</tbody>
</table>
The user group that the Harmony better stroller handle is designed for are families in urban China who rely on the active participation of a grandparent to raise their child, particularly when that grandparent suffers from arthritis or other degenerative joint conditions that limit their ability effectively fulfill this role. In such situations it is the economic success of the family that is at stake, and as such makes investing in products that enable the grandparent worthwhile. Because both mom and dad often work far beyond 40 hours a week in these situations, the grandparents continued health and ability to perform as a caregiver during those hours is critical. This often means leaving the house with child often either to provide peer to peer social interactions for the child or to fulfill other housekeeping responsibilities such as purchasing food and other supplies. This family has to take into heavy consideration the needs of not only the parents but the grandparents as well when making decisions about how the child will be raised and with what tools.

Based on the needs of the consumer profile, my solution had to meet the following goals in order for it to succeed:

- Enable grandparent caregivers to consistently and independently utilize a stroller as a tool to fulfill their role within the family.

- Provide increased comfort with specific consideration to users’ arthritis and other degenerative joint conditions.

- Minimize possibility of injury or worsening of condition that would prevent grandparent from acting as a caregiver.

- Meet the above three criteria WITHOUT compromising the experience for non arthritic members of the family who will still use this stroller regularly.

A solution to this market gap would succeed if it met these points.
The handle of the stroller is a straightforward candidate for improvement. It is the most frequently interacted with interface between a caregiver and the stroller and changes very little from stroller to stroller making it ripe for improvement. Although arthritis can strike joints throughout the entire body, the joints in one’s hands are particularly susceptible to damage because of their relatively small size and frequent use. Listening to the experiences of arthritic parents here in the US, as well as my conversation with occupational therapist Steven Martin highlighted the need for an improved handle that would provide both increased comfort and control over the stroller especially on longer walks and rougher terrain. The ergonomics or wrist angle, grip profile, and application of pressure would all need to be considered in order to make a meaningful improvement.
The next major pain point identified was the frequent need to travel up and down steps with the stroller, especially in urban settings. Even the most thoughtfully designed solutions to this problem on the market today are inadequate for users who suffer from arthritis in their hands, shoulders, back or knees. Systems that allow for one handed fold and lift still put all of the weight of the stroller on the fingers, and require the user to bend their knees and back and engage their shoulder to reach and lift the stroller. After discussing this action with occupational therapist Steven Martin, I determined there was a need to design a method of transporting the stroller up and down steps without carrying its full weight, bending over or placing intense strain on the joints in the users fingers, instead lifting or lowering the stroller using the larger, less damage prone joint in the elbow.

TRAVERSING STAIRS
The third major pain point identified on our typical strollers was the harness. Most strollers come equipped with a five-point harness to keep your child safe and secure while out and about. The harness also serves the purpose though of keeping your child from getting up and wandering off on the user. As such, the harness needs to strike a balance of easy to use yet not so easy that a child can free themselves. This release almost always takes the form of a single button in the center the when depressed releases itself from the side and shoulder straps. These systems however require considerable finger strength and dexterity both to secure and release. They also require the user to perform a pinching action that is very painful and damaging to arthritis stricken joints in a users fingers. The opportunity here was to develop a harness system that eliminated the need for strength and dexterity but still kept a child secure in the stroller.
Of these three potential features, the handle had the most room to innovate and would make the most meaningful difference to my target user.

Moving forward I began development of a stroller handle that was designed to increase comfort and control for caregivers with arthritis.
I began by creating prototypes to test against a traditional handle. The prototypes used were not intended necessarily to evolve into the final form, but rather to let me test and observe how users with arthritis interact with this object differently than users without this condition. I cut PVC pipe to 10” lengths and secured it to my test stroller in a variety of configurations. Because my research had informed me that my user needed to, above all else, minimize damaging strain on their fingers and instead apply pressure with the palms of their hands near the base of their thumbs I configured the different handle options at varying angle angles so that pressure would have to be applied by testers differently in order to turn and maneuver the stroller.
In order to observe how a user with arthritis would interact with this stroller, I used my research on the symptoms of arthritis in one’s hands and simulated the net effects of arthritis. My system used rubberized gardening gloves, tape and pieces of styrene to achieve its affect. The tape was wrapped tightly around users joints in order to decrease range of motion and grip strength, styrene was positioned over the users fingers to inflict localized pain on joints when the user gripped or otherwise tried to close their hand and the glove was put on the user upside down to reduce grip, articulation and dexterity. Using these gloves while performing most common actions that we take for granted proved to be awkward and uncomfortable.
In order to gain meaningful insights, I created a repeatable testing procedure that allowed me to observe testers and then survey them consistently from tester to tester and from prototype to prototype. I set up predetermined paths for testers to follow using tape. They were asked to wear the arthritis simulation gloves and to follow the taped path. This way, I was able to observe how users would perform actions like accelerating, stopping, reversing, turning, and pivoting while naturally compensating for their arthritis. The stroller itself also carried some precious cargo in the form of a five-gallon bucket with 35 lbs of water in it. This created a more lifelike need for strength when maneuvering the stroller. Each tester was given NO instruction on how to best grip the handles or to imagine they were coping with arthritis.
I learned that no one of my handle prototypes was appropriate for every scenario because pressure had to be applied from different directions at different times. I also observed testers intuitively compensating for the arthritis by widening their grip when they rounded corners.

From this I learned that my solution would have to let users apply multi-directional pressure on the handle only by pressing with their palms, and that it had to provide as wide a grip as possible for better leverage.
## 04 DETAILED DEVELOPMENT

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototyping</td>
<td>48</td>
</tr>
<tr>
<td>Testing Procedure</td>
<td>52</td>
</tr>
<tr>
<td>Validation</td>
<td>54</td>
</tr>
</tbody>
</table>
Based on research into the needs of caretakers who suffer from arthritis in their hands, including insights directly from this user group as well as an in-depth interview with an occupational therapist, and also from observations and feedback garnered from empathy testing, a list of design characteristics was created to inform further development. A spherical grasp 2.75” in diameter, as opposed to the narrower cylindrical grasps found on traditional handles, would be the most comfortable profile for users to securely grip. Wider spaced points of contact would give users more leverage when turning and pivoting and therefore reduce the grip strength necessary to perform those actions. Because pulling on the handle creates unnecessary strain on the joints in the user’s hand, the ability to maneuver the stroller exclusively by pushing with the palm was a must. Finally, the flat angle of most stroller handles puts increased strain on the users wrists over longer walks, this design needed to allow for a neutral wrist position.

**DESIGN CHARACTERISTICS**

- **Spherical Grasps**
- **Wider Grip**
- **Multi-Directional Push**
- **Neutral Wrist Angle**
With these design characteristics in mind, a testing model was created that would fulfill those four objectives. The most important physical components of this design are the knobs on each end. Using PVC pipe, slotted tennis balls and hose clamps let me quickly and easily figure out what the most secure and usable configuration for the knobs and their supports would be. Creating this model allowed me to test a fully functional form and observe whether or not it met my design characteristics and whether or not those characteristics would improve the experience for child caregivers with arthritis.
Testing this model meant starting by returning to the previous testing procedure to confirm that this iteration was in fact an improvement. It was tested indoors, on a taped out course by users wearing the arthritis simulation gloves. Unanimous preference to the new model confirmed its initial success. Next it was tested against the traditional handle in a more intense situation. This meant that setting moved from flat, tiled floor to steep, rough pavement. Testers were asked to perform actions such as stopping and turning on this surface and were barely able to complete the task with the traditional handle but made it look easy with the new model. They were able to confirm that this model was more comfortable and made the task of maneuvering the stroller significantly easier.
Despite the positive results from user testing while simulating the effects of arthritis, validation was still needed from users who actually suffer from arthritis themselves. This is one of those testers. Her name is Bonnie and she has a particular form of arthritis in her hands known as Raynaud’s Phenomenon. The symptoms of this condition are a particular sensitivity to cold and lack of strength in her hands. Bonnie told me that she has always loved to garden but her newly acquired condition makes it difficult and painful to dig into the earth with her tools. Her experience was directly relatable to my target user and her feedback on my design was crucial.
We walked around the block, over bumpy sidewalks and steep hills, and she compared the experiences of pushing the stroller first without and then with my prototype. I purposely gave Bonnie no instruction on how to hold the prototype handle and was able to observe her intuitively place her hands in the position that gave her the most control. In the end, Bonnie happily told me that the handle I had created was more comfortable for her to hold and easier to push.
<table>
<thead>
<tr>
<th>Department</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>62</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>68</td>
</tr>
<tr>
<td>Marketing</td>
<td>70</td>
</tr>
</tbody>
</table>
SPHERICAL GRASPS

MULTI-DIRECTIONAL PUSH
The Harmony better stroller handle is designed to be fully integrated into the manufacturing process of the stroller it will supplement. The ABS plastic body is a two part construction sandwiched over the bent aluminum extruded handle bar. The grips are then over molded with EPDM foam before the entire assembly is riveted onto the main body of the stroller. This process deviates from standard stroller handle manufacturing as little as possible in order to minimize the cost of adopting this design.
In order to bring this innovation to the market, it made the most sense to patent the design of the Harmony better stroller handle and license it to existing stroller manufacturers. The addition of this handle to the design of any stroller will add value for a largely ignored consumer group and help that stroller stand out from the rest of the pack.
Outcomes
DEC CAPSTONE OUTCOMES

01 INTEGRATION & SKILLS
Integrate the skills and knowledge acquired through the DEC Core curriculum to propose solutions to real-world problems, through:

A- Strategy Identification
   Pages 6-7

B- Formulation of value propositions
   Pages 6-7, 28-29

C- Identification and explanation of systems
   Pages 62-73

D- Formulation of research questions
   Pages 10-25

02 SYNTHESIZE INTERDISCIPLINARY WORK
Synthesize interdisciplinary work (both collaboratively and independently) through:

A- Proposal of solutions/hypotheses
   Page 6-7, 36-37, 44-45, 48-49, 62-73

B- Interdisciplinary collaboration
   Pages 18-19

03 COMMUNICATE FINDINGS
Communicate capstone experience findings effectively using multiple modes
   Pages 1-73

04 PROFESSIONAL RELEVANCE
Evaluate the relevant professional, ethical and social responsibilities associated with the capstone experience
   Page 6-7, 36-37, 54-55, 68-73

05 GLOBAL CONTEXT
Explain the global context of the capstone experience
   Pages 6-7, 10-25, 28-29

06 APPLICATIONS | TRENDS | TECHNOLOGIES
Interpret emerging applications/practices/trends/technologies as they apply to the capstone experience
   Pages 10-25, 68-73

07 CAPSTONE EXPERIENCE
Relate the capstone experience to relevant contemporary issues
   Pages 6-7, 10-25
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