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I, Yuxin Meng, hereby submit this original work as part of the requirements for the degree of Master of Design in Design.

It is entitled:
Alleviating Anxiety of Asthmatic Children: Engaging Design into Cognitive Behavior Therapy

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Alleviating Anxiety of Asthmatic Children:
Engaging design into cognitive behavior therapy

A thesis submitted to the Graduate School of the University of Cincinnati in partial fulfillment of the requirements for the degree of

Master of Design

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Abstract

Collaborating design with multiple disciplines provides a second perspective on problem solving. A study has been chosen to explore how could design specifically engage in other fields. Asthma is the most common chronic disease of children (Poole, 2014). Due to the uncertainty and uncontrollability of asthma, anxiety became one of the most crucial triggers of asthma exacerbation. Cognitive behavior therapy has been proved as the efficient psychotherapy method for anxiety. How can design engaging in cognitive behavior therapy to alleviate anxiety? In this study, overall design process applied user-centered design thinking. A design intervention was created in the study and a comparison test was conducted in Cincinnati children’s hospital medical center, 19 children from 9-11 years old involved this study. The result shows a significant increase of the knowledge related to asthma. The decrease of anxiety was not shown. Further research will focus on the variations of anxiety.

Key words:

Design, children, asthma, psychology, cognitive behavior therapy
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Chapter 1: Introduction

1.1 Anxiety in children with asthma.

Asthma is the most common chronic disease of children (Poole, 2014). Over 10 million U.S. children under the age 18 (14%) have been diagnosed with asthma (Bloom, Jones, & Freeman, 2013), which means one in ten children in the United States is suffering or has suffered from this condition. As a chronic disease, living with asthma means constant lifestyle changes, continuous adaptation of behavior due to the unpredictability of the illness, and more than 6 months’ out of the year of unceasing medical care. Children with asthma will frequently face school absenteeism (school absenteeism has been identified as the particular risk factor of causing anxiety), routinely take medicine, frequent hospitalizations and the restriction of activities due to the uncertain conditions of disease (Leblanc, 2003). Living life with those uncertainties and uncontrollability, asthmatic children are at the high risk of psychological problems, especially the symptom of anxiety.

Living with a chronic illness like asthma forces the child and their family to manage various stressors related to uncertainty and uncontrollability of the situation and restriction of freedom of action. Many researchers have already identified the significant relations between anxiety and asthma. The study conducted by Johnsson, R. J. disclosed that children with asthma had double the risk of getting anxiety disorder compared to the children without asthma (2013). Professor
Arlene, M. from Johns Hopkins University says, “anxiety may influence asthma by stimulating airway inflammation and hyper-responsiveness.” (1993) Study shows asthmatic children who have anxiety get more asthma attacks than children without asthma symptoms. From Ten Brinke’s research, anxiety may also increase the use of asthma medications and, in turn, asthma medications may induce anxiety (2001).

1.2 Cognitive behavior therapy

Cognitive behavior therapy (CBT) is a form of psychotherapy, using professional psychological methods to help people with different mental disorders, especially for anxiety disorders (Lee, 2013). Cognitive behavior therapy is a problem-focused intervention; the key theory is what people think [cognition] and what they do [behavior] affect the way they feel. Therefore, to change individual’s feeling, one’s cogitation and behavior need to be changed first. For asthma children with anxiety, anxiety as an emotional distress will cause a series of bodily sensations, which brings the inflammation of airway and make the asthma symptom worse. Breaking the cycle by changing the thoughts and behaviors in a positive way to influence the feeling and decrease the anxiety level.

Figure 1. Cognitive behavior therapy
1.3 Design enhancement approaches

This paper focuses on engaging design into cognitive behavior therapy and related psychological theories to alleviate asthmatic children’s anxiety and stress. Analysis of the audience group revealed restrictions for the use of these psychology solutions. Existing interventions are paper-based, conducted by children’s hospitals, usually in asthma camp. Asthma camp is an activity specialized for children with severe versions of asthma organized by hospitals or social institutions (Holsey, 2008). These interventions are mainly dedicated to informing children and their parents the information related to asthma management, featuring children-friendly illustrations and children’s dialogs. Although education is a validate way for alleviating anxiety, for most of the occasions these interventions is one-time use due to the media of the design that cannot engage children for a long-term use to reach the education goals. Applying design into regular psychological treatment will be an experimental innovation to breed an effective way to alleviate the anxiety of asthmatic children. Utilizing design for enhancing and optimizing these solutions is the method the study will explore. The method of engaging design into psychological field, combining psychological theories and human centered design method to solve the problem would bring a significant influence in future medical care and the diversity of promotion of design.
Chapter 2: Methodology

2.1 Human centered design

*Human centered design method is the core method the study will use.* According to ISO*:

“Human centered design provides requirements and recommendations for human-centered design principles and activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes, and is concerned with ways in which both hardware and software components of interactive systems can enhance human–system interaction” (2010).

*Figure 2. Human-centered design process*
Figure 3. Design process based on human-center design thinking
From my perspective, human centered design is a systemic thinking method; the only measure of whether the intervention is success or not is to see how much the design instrument satisfied user’s requirements. Human centered design methods fill in the gap between users and designers, which can let designers get better understanding of what the users need. Sometime users do not even know what they need or what is the problem based their situation.

2.2 How the problem be solved in psychology field

How a person deals with a stressful situation is called coping. The better asthmatic children can cope with anxiety, the more likely they can get rid of the distress and enjoy a better quality of life. “One’s perceptions or cognitive appraisals are an important element in regulating distress or managing the problem causing distress.” (Last et al., 2007) Generally there are three types of coping strategies: appraisal-focused strategies, problem-focused strategies and emotion-focused strategies (Weiten, 2008). Cognitive behavior therapy is a professional psychotherapy that belongs to problem-focused coping strategy.

2.3 How design enhance the psychology solutions

“Cognition is the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses” (Eckardt, 1996). Child’s thought process and understanding is not just a miniature version of adult thought and comprehension (Wyman, 1998). To get better learning performance, multiple learning media have been explored. Based on Montessori education theory. Children like images, colors and shapes, which bring an incredible opportunity for design using visualization techniques to address this issue.
2.4 User test

A three-step qualitative research was mainly used to prove this hypothesis. There are several reasons for choosing this method. Qualitative research operates based on a conversation, which is better operated with the special target audiences, in this case the asthmatic children. According to the primary research, a child’s thought process and understanding is not just a miniature version of an adult’s thought process and comprehension. It is vital to be aware of the motivations and the thinking patterns behind the data to get a better understanding of their reactions and emotions. Besides that, the focus group [children from 6-11 years old] has the limitation of reading and writing; a conversation-based research is a more feasible way to communicate with these children and get insights from them.

2.4.1 Participants

Children from 6-11 years old with asthma in the Cincinnati area participated in the research. The specific age group was decided by the following reasons:

**Children’s cognition development.** Cognition is the way people think and process outside information. Children’s cognitive development brings out different performances in different ages. Several literature reviews have been done to explore the cognition development of children from age 3-16. It disclosed that children from 6-11 years old developed the ability of manipulating things in their minds through symbols and logical patterns, which make the children in this age group understand the content and the stakes related to themselves better rather than the children in younger age groups. For children older than 11 years old, their cognition pattern is dramatically different from children in 6-11 age group; this study will focus
on younger age group to improve asthmatic children’s life as young as possible.

**The altering of children’s social environment.** Children who are 5 or 6 years old are facing elementary school education, which will bring a higher risk of getting asthma attacks and anxiety because they are separated from their parents. This poses potential difficulties for sports at school.

**Asthma clinic manifestation.** Asthma is generally diagnosed from very early on, and asthma is a chronic disease that cannot be cured. Therefore, managing asthma from early on is really crucial for these children to live healthy lifestyles and have more success in their futures.

Both asthmatic children, and their parents were filling the Spence Children’s Anxiety Scale (SCAS) questionnaire.

2.4.2 Data collection Procedures

**Preparation.** A design instrument focusing on asthma education has been produced to introduce the knowledge of asthma self-management for children. According to behavior changing theories, the effectiveness of education influencing an individual’s behavior and emotions has been demonstrated; combining this with the design model is the way to practice and prove the hypothesis. The design instrument will introduce the asthma knowledge related to children’s daily lives including asthma definition, triggers, the use of inhalers and societal care, and using an interactive way to let children play with the design model to enhance the learning process.
Figure 4-2. Function callouts (example: identify asthma triggers)
3-Step research. To conduct the research, firstly the children were asked to play with the design instrument and an observation during the same time recorded how the children interacted with the application, especially the children’s reactions and emotional changes; then, a qualitative research addressing an interview started, and several questions was asked related to the content of the application to understand how the design instrument works with asthmatic children. Finally, a following questionnaire, SCAS were sent out to these asthmatic children’s parents, and let them finish with their children to further address these children’s anxiety level.

Figure 5. Intervention
2.5 Data Analysis Procedures

The data from the qualitative research and the previous observation research identified how the design instrument works with asthmatic children by directly showing their learning performance of using this application. All of the interviews were recorded and were transmitted into a document, and were coded by specific keywords; the frequency of these key words was calculated as the result of the research.

Figure 6. Measures

Chapter 3: Result

19 asthmatic children who are receiving asthma treatment in asthma center in Cincinnati children’s hospital participated in the test of the educational intervention. Their parents also participated to fill in the Spence anxiety scale report. 53% of the children who participant in the test are under 8 years old; 42% of children are from 9 to 11 years old. Average age is eight. Amount 19 individuals, 58% children are girls; 14 children have had asthma attack, 5 of them had attack in previous 2 months, 9 of them had attack in the previous 12 months.
Figure 7. Demographic information of participants of the educational intervention test

According to figure 7, children in all age range, the post-test score is more than 5 times higher than the pre-test score. 94% of children can tell three or more asthma triggers after they interacted with the intervention; 53% of children can tell 70% of the asthma triggers the intervention conveys. The standard deviation for pre-test score and post-test score is close, less than 0.5 difference, which represent the consistent of the cognition of children. In pre-test, the standard deviation of children from 6-8 years old is higher than the children from 9-11 years old; In the post-test, The SD of 9-11 years old group is higher than 6-8 years old group. For both test, children in 9-11 age group got higher mean test score than children in 6-8 age group; specifically, in pre-test the difference of the mean score of the is 0.7, but in the post-test, the difference is 2.77. The higher difference score in post-test reflect Jean Piaget’s children’s cognition development theory, children in 6-8 and children in 9-11 fall in two different stages of mental development which lead to a divergence of performance for learning. To further verify this interference, regression analyses were done in figure 9.
Figure 8. Pre-test and post-test data for the educational intervention

<table>
<thead>
<tr>
<th>Patients 6-8</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>1.58</td>
<td>10.1</td>
</tr>
<tr>
<td>SD</td>
<td>1.52</td>
<td>1.16</td>
</tr>
<tr>
<td>Patients 9-11</td>
<td>2.28</td>
<td>12.87</td>
</tr>
<tr>
<td>M</td>
<td>1.07</td>
<td>1.5</td>
</tr>
<tr>
<td>SD</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>SD</td>
<td>1.35</td>
<td>1.81</td>
</tr>
</tbody>
</table>

Figure 9. Regression analysis (pre-test & post-test)

The Post-test shows a higher $R^2$ value than the pre-test, the $R^2$ value is close to 1 proves the high correlation between children’s age and the test score in the post-test. The graph revealed a liner regression for the age and the test score, which means with the children getting older, they will get better understanding of the intervention.

A graph combining the demographic information with pre and post-test score was made to further explore the connections between each variable. (Figure 10) The result shows children
who have experienced more times of asthma attack got higher pre-test score than the children with fewer times of attacks. According to the interview conducted before the test, 60% of children who had the experience of asthma attack can tell more than one asthma trigger related to their previous asthma attack. The intervention increased knowledge dramatically. Do not know if intervention decreased anxiety. According to (Last et al., 2007), increase knowledge can reduce anxiety. We hope to confirm this outcome in future testing.
Figure 10. Combination graph of the demographic information and Spence anxiety scale
Chapter 4: Discussion and conclusion

Cooperating design with health care creates a new way to improve medical service. This study is a good example. Firstly, designers can look beyond the initial medical service and build empathy with stakeholders. Designers are not medical professionals. Bringing a fresh eye to existing issues guarantees a creative and efficient way to solve the problem. Secondly, human-centered design thinking provides a validate method for both designers and non-designers to reach out patients’ needs. Thirdly, design skills like visualization skill improve the communication between patients and professionals. Since the specialty and severity of medical, communication becoming one of the big issues of medical service. Visualizing abstract medical information to a graphic form that non-professionals can understand make the medical care process smooth and satisfying.

For designers, the study provides a tentative exploration of applying design into other fields and solving complicated problems. For the further study, I suggest designer or researcher pay more attention to children's cognition. From the test and observation, children reacted in a different way in each age steps. For example, when a seven-year-old girl saw a broom with dust causes coughing symptom, she would only say "the broom makes me cough." However for a 10-year-old child, the child can make the connection between broom and coughing, and have the conclusion: "the dust make me cough." Specify the needs of users in detail will make the design more successful.

Design could be collaborative and versatile. Integrating multi-discipline of design makes a
better performance of problem solving. In this study, the research demonstrates a couple of opportunities of collaborating industrial design and interaction design to further improve the medical service. For instance, detecting asthma symptom, which can utilize the knowledge of industrial design attaching a wearable device on the patients’ body. Jumping out of the restrictions of the major and collaborating another techniques make the project more success.

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