edi

the pet that takes
care of you

Integrative Project Thesis Paper

by Rachel Krasnick

introduction

“Did you take your medicine?” I am sure that many people have been asked this question by their parent at some point in their lives, whether due to taking medication on a daily basis or just having a brief stint with antibiotics. Most of the time, if people have not taken their medicine, they will go do it. But sometimes there is no push, or motivation to do so.

In fact, it can be a battle to take medication every day for chronic illnesses when you do not have the habit to do so, or even feel sick at all. Facing complicated feelings about taking medication myself inspired me for this thesis project. I have been taking a daily medication for anxiety for the past 6 years. Like any imperfect human, there are times I forget to take it. But there are also times I feel like I do not need to take it. In fact I feel fine, is this little pill really doing anything for me?

Through trial and error, and as the more matured, self-aware person that I am, I have learned to realize that my medication does help me every day. Even more importantly, I understand that it is unsafe to just skip a dosage of a daily medication one day. The long period of time that has elapsed since first starting my medication has helped me form the habit of taking it every day.

However there is a particular group of individuals, who, if they take a daily medication for chronic or mental illness like anxiety, may not have the same habits and level of understanding – adolescents. Adolescence is a time when many people are diagnosed with a mental illness and begin taking daily medications. These individuals are

just learning how to form habits, and do understand the benefits of long-term medications. Nonetheless, it is crucial that adolescents form healthy habits and consistently take their medication.

So why not just let parents administer daily medication? For one, parents can forget too. But there are larger implications for the child. Complete control by parents does not allow adolescents to form habits, or give them any sense of responsibility. This may be a reason why even most fully independent adults are not good about taking their medication. A common thread among my research and conversations with patients, doctors and researchers is that it is more common not to follow a treatment plan than to follow one. It seems necessary to target individuals at a point in their lives, adolescence, when learning habits and understanding the impact of their medication is crucial, and can therefore affect their thoughts and actions for the rest of their lives. How might parents trust their adolescents to undertake this responsibility? Can a product instill a better understanding of one's illness and medication along with forming habits?

This is where design can come into play. I do not believe that the transition from parental dependency to adolescent's autonomy has been thoroughly explored through the lens of design, so that is what I set out to do. Design is not only for making the world prettier, but, for solving problems, changing behavior, re-scripting experiences and influencing opinions. Every one of these aspects can be applied to the problem of adolescent independence with daily medication for chronic illness.

My research and design process has led me to develop edi. edi is a companion robot that helps adolescents remember to take, as well as manage, their daily

medication. edi works like an interactive pet, but it takes care of the user. Adolescents with mental illness yearn not to be, or feel, different. edi combats this by working to keep users on track with their medication, especially when they feel they do not need it. To do this edi communicates with users to understand their medication and manage side effects. edi also serves parents and doctors because its sensing technology can tell if the child has taken his or her medication and can alert parents for their peace of mind. Meanwhile doctors can review if medication has been taken and continue managing the process. Most importantly, edi is joyful and aims to add delight to the medication-taking experience.

defining non-adherence

"Non-adherent" is the term used to describe individuals who do not properly take their medication. According to the World Health Organization, "'adherence' is the extent to which a person's behavior - taking medications, following a diet and/or executing lifestyle changes, corresponds with the agreed recommendations from a health care provider."[1] From a more measurable standpoint, "patients are considered adherent to medications when they take prescribed agents and doses at times recommended by a health care provider and agreed to by the patient."[2]

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[1] Eduardo Sabaté, *Adherence to Long-Term Therapies – Evidence for Action* (Switzerland: World Health Organization, 2003), 18.

[2] Aurel Iuga, "Adherence and health care costs," *Risk Management and Healthcare Policy* 7, (2014) 35-44, accessed December 3, 2017, doi:10.2147/RMHP.S19801

The cost of non-adherence is high, both financially and physically. These costs impact not only the patient, but the greater society as well. Medication is taken in order to prevent problems and keep symptoms down for chronic illness, but not doing so directly impacts one's health and increases chances of getting sicker. According to the Health Science Journal, specific results of non-adherence include "re-hospitalization, morbidity, mortality, deterioration of patients' general health and increase of expenditure."[3] Improving patient's adherence to their medication would lead to better health outcomes.

Non-adherence also has an impact on the larger economy. According to the Nation Center for Biotechnology Information (NCBI), about 50% of adults in the United States have a chronic illness and, in the past, expenditures for all prescription drugs in the United States has been roughly $259 billion dollars. Medical costs that result from the high percentage of patients not adhering to their medication for chronic illness significantly adds to this number. The NCBI calculates that, "between $100 and $300 billion of avoidable health care costs have been attributed to non-adherence."[4] Of course, that is money that could be spent elsewhere, like being redirected to help cover medical costs for those who cannot afford it. Attempting to positively influence the

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[3] Victoria Alikari, "Conceptual analysis of patient compliance in treatment," *Health Science Journal* 8, no. 2 (2014) 179-186, accessed December 3, 2017, http://web.b.ebscohost.com.proxy.lib.umich.edu/ehost/pdfviewer/pdfviewer?vid=1&sid=f30ead88-fd64-4404-bd96-fb6deec46800%40sessionmgr101

[4] Aurel Iuga, "Adherence and health care costs," *Risk Management and Healthcare Policy* 7, (2014) 35-44, accessed December 3, 2017, doi:10.2147/RMHP.S19801

medication taking experience, in order to promote adherence, could have a greater impact beyond the individual patient.

current products that combat non-adherence

Numerous products have been designed to help improve adherence, seeing as the impact is so widespread. Many of these products tend to be targeted for elderly users and do not actively attempt to empathize with the user. Philips Healthcare develops products that they claim help improve adherence. One is Medido, a smart pill dispenser (Figure 1). Instead of working to help improve users' habits, Medido completely automates the experience of taking medication. While the product does technically work to deliver medication at a proper time, it does not use any inviting elements to bring delight to the experience. In fact, Medido does the opposite and can make users feel like part of an automated process.

Figure 1. Philip's "Medido" dispenses medication by printing out packets of pills. This can make the process of taking medication feel very automated.

Medido Pill Dispenser. Digital Image. Medido.Philips.Nl. Accessed December 4, 2017. http://www.medido.philips.nl/

Other existing adherence-related products work similarly to Medido. These products are considered successful in terms of ensuring that a medication is taken out of its package and, hopefully, swallowed. In a way, the problem of forgetting medication, or keeping it safe, is solved. But do these products have the ability to empathize with the

user, encourage better mindfulness and provide delight? These aspects are needed especially in a product designed for adolescents who face a constant unwanted reminder of being different whenever they take their medication. Encouragement and playfulness can also help adolescent's develop better habits, instead of just forcing them to do something undesirable.

gamification in interaction design

Interaction designers have taken innovative approaches to create products for kids/adolescent's managing chronic illnesses. These include mobile apps, websites, and video games that aim to teach about illness and how it can be managed. Gamification, "which applies game-related elements to non-game contexts,"[5] is a powerful tool integrated into many of these products. Researchers from the University of California, Santa Barbara have studied the effects of interactive video games on motivating behavior change. According to results from their clinical trials, these interactive games led to, "fewer urgent care and emergency visits ... improved knowledge about health...increased

Figure 2. Bronkie the Bronchiasaurus attempts to teach kids how to manage their asthma by navigating an asthmatic dinosaur through triggers and asthma attacks.

Bronkie the Bronchiasaurus. Digital Image. Engadget. Accessed December 4, 2017. https://www.engadget.com/2007/04/26/virtually-overlooked-bronkie-the-bronchiasaurus/.

[5] D. Basten, "Gamification," *IEEE Software*, vol. 34, no. 5, pp. 76-81, 2017. doi: 10.1109/MS.2017.3571581

confidence ... and better daily self care."[6] Empathizing with, and protecting a character allows kids to better understand the importance of taking care of themselves. These gamified apps and educational tools have become popular for educating kids with chronic illnesses such as asthma and diabetes. But what about adolescents? Older kids might find simple story games to be childish. And what about kids with mental illnesses such as anxiety and depression? There are fewer interactive products (both in the world of research and in the broader market) to help young adults deal with the complex nature of managing their chronic illness, including mental illness.

reframing the problem

Just because this type of product does not exist, does not mean that it cannot be done. Instead of framing chronic and mental illness through a problem-driven lens, perhaps we can look at it through a possibility-driven lens. Design professors Pieter Desmet and Marc Hassenzahl explore different approaches to design in the chapter titled "Towards Happiness: Possibility-Driven Design" of the book *Human Computer Interaction: The Agency Perspective*. Desmet and Hassenzahl differentiate possibility-driven design from problem-driven design. The latter is, "primarily about avoiding, solving, or neutralizing the negative...however, avoiding the negative must not necessarily equal a positive experience."[7] This is the type of experience that products like

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[6] Debra A Lieberman, "Management of Chronic Pediatric Diseases with Interactive Health Games: Theory and Research Findings," *Journal of Ambulatory Care Management*, vol. 24, no. 1 (2001): 26-38, accessed March 31, 2017, https://www.ncbi.nlm.nih.gov/pubmed/11189794

[7] Pieter Desmet and Marc Hassenzahl, *Human-Computer Interaction: The Agency Perspective* (Berlin: Springer Berlin Heidelberg, 2012), 3-27.

Medido offer users. Possibility-driven design takes a situation from a neutral state to a positive one by tapping into interactions that bring joy, resulting in designs that make people happy – happiness is the design goal.

How can designers design for happiness? Desmet and Hassenzahl propose designing for "the good life [which] implies the design of products that represent meaningful, but maybe non-obvious goals and help people attaining those goals."[8] This prompted me to think about the goals adolescents with (and without!) chronic illness might have: to feel "normal" or "cool," or gain freedom from their parents. Being constantly monitored by parents does not align with those goals. How can this experience be re-designed into one that is positive?

TinyTask is a project that aims to help people reach goals of improving their happiness. Users carry the key chains with them as gentle reminders to complete tasks that can result in happiness. An important element that contributed to the success of this project is that the participants were motivated to improve certain parts of their lives - they wanted to engage in the process. This same aspect applies to the design of my product. Intended users are not aggressively, intentionally non-adherent, but more likely are

Figure 3. Users receive key chains with different, simple, mindful acts written on them. Each act promotes happiness and well-being.

TinyTask. Digital Image. Delft Institute of Positive Design. Accessed December 4, 2017. http://studiolab.ide.tudelft.nl/diopd/uncategorized/tinytask/

[8] Pieter Desmet and Marc Hassenzahl, *Human-Computer Interaction: The Agency Perspective* (Berlin: Springer Berlin Heidelberg, 2012), 3-27.

forgetful or neutral about the medication, and have not yet developed a strong habit. But if people want to improve their health and happiness, why don't they just do it?

design for behavior change

It is difficult to develop habits, or change our behavior, even if we want to. The reflective mind understands how to improve oneself, but the mind in the moment may not feel the same way. Economist Richard Thaler defines this phenomena as the Planner versus the Doer. Thaler explains that, "the Planner is trying to promote your long-term welfare but must cope with the feelings, mischief, and strong will of the Doer, who is exposed to the temptations that come with arousal."[9] Desmet and Hassenzahl also refer to this in terms of the automatic system and the reflective system. Considerably more time is spent in the automatic, or doer state of mind in adolescents. In my discussion with Dr. Jane Krasnick, an allergist in Warren, Michigan, she noted that, "adolescents live in the moment. They might feel better after taking their medicine for a few days and then they just forget – they do not see how it affects them one day at a time."[10] How do researchers, doctors, and designers combat this? Many turn to what Richard Thaler calls a nudge.

Clocky by Nanda Home is an example of a product that keeps the Planner versus Doer mentality in mind. An individual in the Planner state of mind may set their alarm for 7

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[9] Richard Thaler, *Nudge: Improving Decisions about Health, Wealth, and Happiness* (United States of America: Yale University Press, 2008), 42.

[10] Jane Krasnick, interview by Rachel Krasnick, September 23, 2017.

AM, but the tired Doer state of mind might continue to snooze that alarm and miss their opportunity to exercise. With Clocky, the option to snooze is not as simple. In order to turn off the alarm you must physically get out of bed and shut it off.

Figure 4. Using its wheels, Clocky rolls off the nightstand, and all around the floor, essentially running away from the user.

Clocky. Digital Image. boredpanda. Accessed December 4, 2017. https://www.boredpanda.com/clocky-motorized-alarm-clock-runs-away-nanda-home/

Clocky is a combination of a nudge and an incentive. In his book, *Nudge: Improving Decisions about Health, Wealth, and Happiness* Thaler defines a nudge as, "Any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives."[11] Thaler's classic example explains how the layout of food in a cafeteria can affect the food people choose, and possibly steer them in a direction to choose healthier options. Thaler notes that, "by properly deploying both incentives and nudges, we can improve our ability to improve people's lives, and help many of society's major problems."[12] This coincides with the first step of creating a habit forming product, which author Nir Eyal explains in his book *Hooked: How to Build Habit-Forming Products.* The first step of the four step hooked cycle is "trigger." External triggers are common occurrences, like daily notifications that mobile apps send. However, "in the case of

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[11] Richard Thaler, *Nudge: Improving Decisions about Health, Wealth, and Happiness* (United States of America: Yale University Press, 2008), 6.

[12] Richard Thaler, *Nudge: Improving Decisions about Health, Wealth, and Happiness* (United States of America: Yale University Press, 2008), 8.

internal triggers, the information about what to do next is encoded as a learned association in the user's memory."[13] Take for instance, if one is feeling bored, their boredom may trigger him or her to check Facebook.

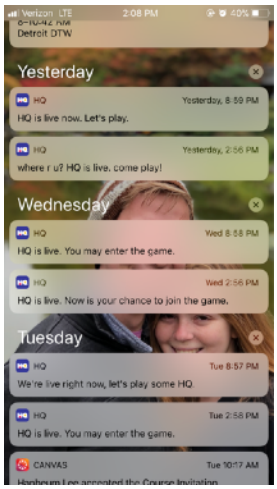

Figure 5. The popular new mobile app game HQ sends questions like, "where r u? it's time to play" to get players to open up the app.

Emotions are the most powerful element of a person's being to tap into when designing a trigger, nudge, or incentive. Emotions, as Don Norman puts it in his book *Emotional Design*, "change the way the human mind solves problems."[14] Tapping into emotions can make behavior change product more successful. The product should aid in the realization or understanding of one's goals, as mentioned by Desmet and Hassenzahl, and affirm actions through an emotionally-charged nudge.

the power of interactive pets

Interactive pets meet a lot of this criteria, making them a strong tool to use for helping adolescents manage chronic illness. An interactive pet depends on its owner for health and happiness, which allows the user to project his/her own feelings/health onto it. Take for instance the popular product Tamagotchi. Tamogatchi is a toy, but it, "appeals to the basic psychological need of relatedness and the associated interest in nurturing,

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[13] Nir Eyal and Ryan Hoover, *Hooked: How to Build Habit-Forming Products* (Toronto, Ontario: Portfolio Penguin, 2014), 51

[14] Donald Norman, *Emotional Design Why we Love or Hate Everyday Things* (New York: Basic Books, 2005), 18.

care, and enjoyment created by taking on responsibility."[15] A sense of responsibility is a goal for adolescents seeking independence. Perhaps if they can manage the health of their pet through the management of his/her own health, they can develop real trust from their parents.

Figure 6. Tamogatchi pets rely on the user to feed them, play with them, and provide general care for them in order to stay alive.

Tamogatchi. Digital Image. Mashable. Accessed December 4, 2017. https://mashable.com/2017/04/11/original-tamagotchi-is-back/#e_ez2JNnGZq4

Aside from developing trust, when a user spends, "a considerable amount of time and energy on the pet, [he or she] becomes invested in its well-being."[16] Investment is the fourth step of Nir Eyal's four-step hooked process, following trigger, action and reward. This sets up a perfect scenario to help adolescents develop a habit. An interactive pet can target a user's emotions, again a powerful element of a person's being, when presenting a trigger or a reward. However, Desmet and Hassenzahl note that, "simply calling an interactive program a pet is not sufficient for people to think of it as one. Not every responsive toy that is marketed as a pet manages to achieve that metaphorical status."[17] One reason Tamagotchi was so successful is that there was a physical artifact to interact with. More modern day online-pets, such as Neopets, can be forgotten about

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[15] Pieter Desmet and Marc Hassenzahl, *Human-Computer Interaction: The Agency Perspective* (Berlin: Springer Berlin Heidelberg, 2012), 3-27.

[16] Judith Donath, "Artificial Pets: Simple Behaviors Elicit Complex Attachments," *The Encyclopedia of Animal Behavior (Greenwood Press 2004).*

[17] Judith Donath, "Artificial Pets: Simple Behaviors Elicit Complex Attachments," *The Encyclopedia of Animal Behavior (Greenwood Press 2004).*

quickly because their existence is not tangible. This makes the case for creating a physical pet to work with adolescents. The element of a physical interaction also allows for the implementation of more advanced technology to assure that the "action," taking one's medication, is completed. Lastly, a physical product can act as a representation of the medication that needs to be taken, as medication is often kept hidden.

Figure 7. The Pocket Pikachu relies on a physical interaction to be kept alive, unlike traditional Tamagotchis.

Pocket Pikachu. Digital Image. Accessed December 4, 2017. https://www.pinterest.com/pin/481463016392732879/

As I mentioned, the physical element of an interactive pet can create a much more compelling interaction than an existence only on a computer screen. The Pocket Pikachu is a great example of this. Like a Tamagotchi, the Pocket Pikachu is a handheld, interactive pet that relies on its owner to monitor its health. However the Pocket Pikachu is connected to a pedometer worn by the user, and is only satisfied if the user reaches a certain level of activity each day. This is a strong incentive for the user to keep in shape.

applying emerging technology

How can a physical interaction be implemented in an interactive pet for adolescents managing their medication? One option is near-field communication (NFC) technology. NFC is, "a set of communication protocols that enable two electronic devices, one of which is usually a portable device such as a smartphone, to establish communication."[18] NFC is unique because the technology can be put in something as

[18] Cameron Faulkner, "What is NFC? Everything you need to know," TechRadar.com, May 9, 2017, https://www.techradar.com/news/what-is-nfc

small and flexible as a sticker. This technique could be applied by putting RFID stickers on pill bottles, and having the pet product read these stickers.

At the recent Consumer Electronic Show (CES) in Las Vegas, Aflac presented My Special Aflac Duck, a robot to help kids fight cancer. This robot also responds to NFC tags with different emotions. The robot is meant to mimic what a child with cancer is going through. This is a proof of concept that an empathetic, robotic interaction could help someone feel better and improve healthcare experiences.

Figure 8. My Special Aflac Duck is leading the way in applications of social robotics in healthcare.

My Special Aflac Duck. Digital Image. Boston University News Service. Accessed December 4, 2017. http://bunewsservice.com/special-aflac-duck-wins-tech-better-world-award/

An interactive pet can be a motivator, but not always comforting. My Special Aflac Duck is an inspiration because it plays a role of an empathizer, and less of a reliant pet. Adolescents with chronic illness do not necessarily need another bother or worry to take care of, but rather someone or something to be there for them. These realizations have informed my final concept of an interactive pet that takes care of the user.

methodology

In order to stay on track throughout this year I followed a human-centered design process, which I have learned and practiced in previous classes. These steps include: research, synthesis information to find insights, ideation, realization, and test. The path I have followed this year has not been exactly linear, as is the case with many product development processes. Instead, I found myself on a winding path that led me in

different directions. Overall, the strategies of the human-centered design process helped me stay focused.

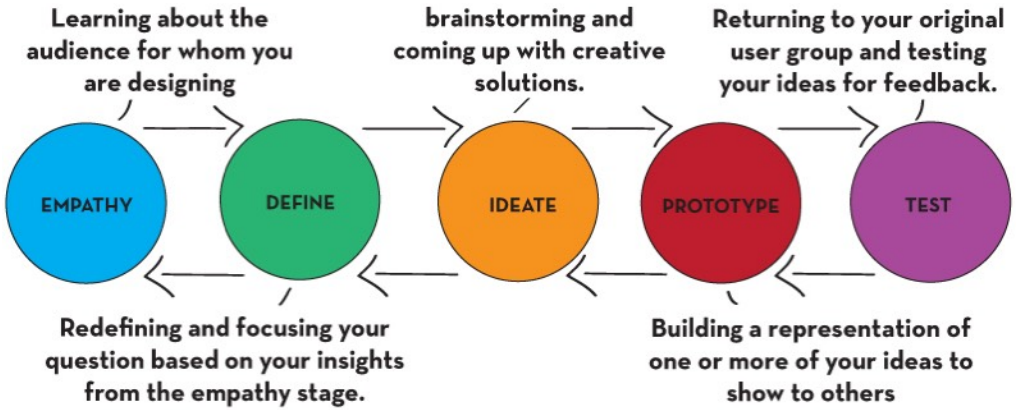

Figure 8. An overview of a human-centered design process. This path, however, is not always linear.

Design Thinking. Digital Image. Create EDU. Accessed April 17, 2018. http://createdu.org/design-thinking/

My first step was to conduct different forms of research in order to inform my understanding of adolescent's habits with taking medication. This initial research included sending out a survey that I created to get an idea about the type of medications people take on a daily basis. I also benchmarked competitor products to see what other products exist in the market. However the most intensive, and revealing, part of my research process came next - conducting interviews with children, parents, and doctors.

Figure 9. I interviewed adolescents, their parents, and doctors. I created an interview protocol (a tool for conducting conversations about a specific topic) to help guide these interviews. Additionally I spent time observing where medication is kept in the home.

These interviews allowed me to understand each of these stakeholder's frustrations, motivations and habits and therefore empathize with them. To keep the interviews consistent I set up an interview protocol, which I learned about through online resources such as IDEO's design toolkit. I prepared questions to ask each set of people (kids, doctors, etc) in the actual interviews. I used the information from these interviews to construct user personas.

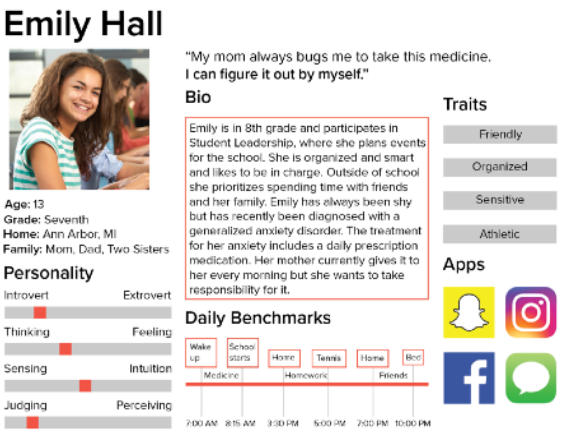

Figure 10. One of the user personas I created. These personas helped frame who my design was for.

Next came synthesis. I parsed through all of the information I collected in order to identify important themes and insights. To do so, I made all of the information physical (aka, I made plenty of sticky notes) so I could immerse myself in it. I used the process known as Affinity Diagramming to find common themes and relationships in my research. Key paradoxes arose in this process, especially between doctor's opinions and adolescent's actions. For example, many kids felt that they were in charge of taking their medication every day, when parents, on the other hand, said it was they who handed it to their child every day. Or, parents said that they wanted their children to be independent in taking their medication, but commonly do not act on it until it is too late (therefore good habits are not formed in time for college). Lastly doctors expressed that often times there is no clear distinction of who is in charge of the medication within households. Identifying these paradoxes/issues helped shape the problems I set out to solve.

Figure 11. In order to understand all of the information and research I gathered, I used a process known as Affinity Diagramming. This consists of clustering data into groups based on common themes or relationships.

In the ideation phase I sketched out ideas that could solve the problems I uncovered. This included making issues that are usually hidden more visible such as making the display of medication more accessible. In addition, defining who is in charge of medication, and transforming the idea of taking medication into something that one does not have to be ashamed of. To do so, taking medication should be made more fun and intriguing. After sketching I had many divergent ideas, but I was drawn to some specific themes which were: alerting about and dispensing medication in a playful form, and designing a connected device to work in pairing with the medication. I solidified these themes and ideated on the corresponding designs. At this point I had three different concepts that I visualized and prototyped.

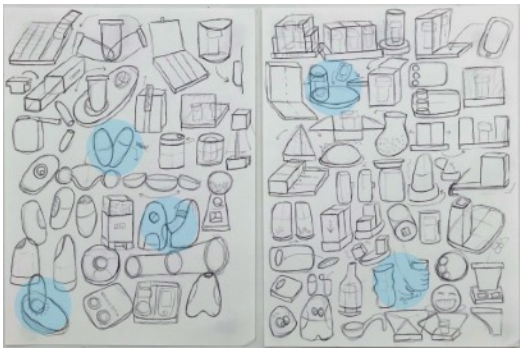

Figure 12. Exploring ideas through sketches.

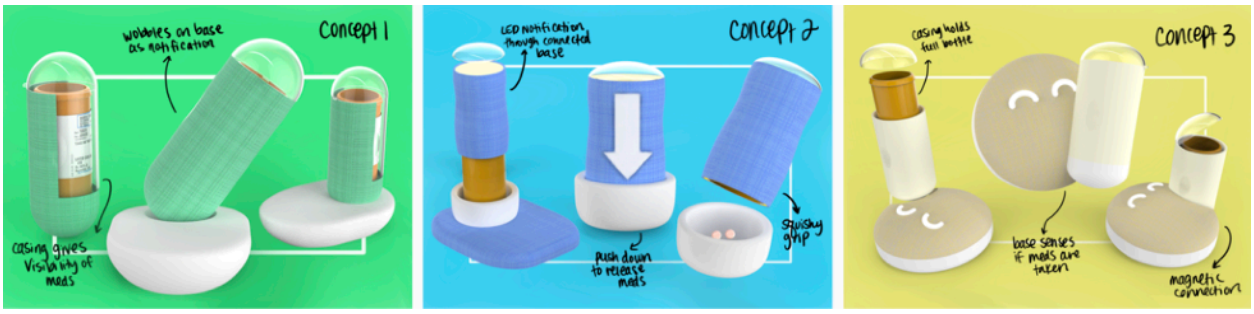

Figure 13. Three concepts that I defined and presented to my peers for feedback on my project trajectory.

I then transitioned to low-fidelity prototyping. During this time I ideated with scrap materials, which allowed me to get a quick understanding of sizing and functionality. This fast prototyping exercise informed my sketches and vice versa, which lead to further concept development.

Figure 14. I prototyped forms with scrap materials and foam. I also prototyped interactions using Arduino and neopixels.

Up until this point I had been working on my own, and felt caught up in my own ideas. Therefore I sought out feedback from my peers and potential users. The feedback I received helped me to me realize I was not pushing myself enough conceptually. My intention was to improve the medication taking experience, but really I was coming up with unexciting vessels, those of which could not even accommodate a range of

medications. My classmates agreed that one idea, labeled concept 3 in figure 13, had potential, as it was less of a vessel and more of an interactive experience for users.

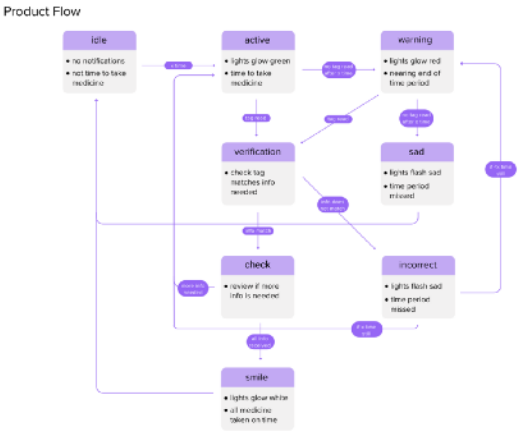

Figure 15. A state-chart diagram I created. These diagrams are used to model the flow of a complex system.

I worked to refocus my thoughts by exploring how an interactive base could work. To start I created state-chart diagrams (Figure 15) which allowed me to design the flow of information, and revealed potential connections between a base and an app. I also created a storyboard of the user journey which helped to define the steps of the product experience.

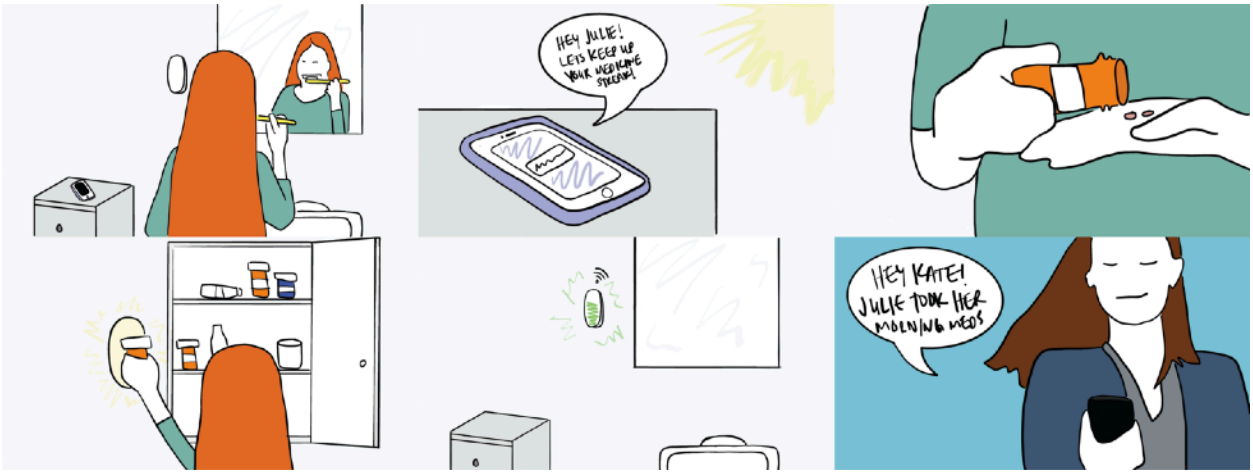

Figure 16. In this storyboard, the user starts off getting ready for her day. She gets an alert from the product, as well as her phone, that it is time to take the medication. She takes her medication and taps it to the product as a confirmation. The product sends a message to the user's mother letting her know the medication was taken.

During this period of exploration, my professors and classmates pushed me to think more conceptually about how design could affect behavior. I felt it was important to be able to show users how their daily decision to take their medicine positively impacts

them in the long run. This raised the question, how could I create a device that could express how actions add up over time, in order to show the importance of taking medication every day?

However at this point, I got ahead of myself. Instead of continuing to formalize a concept, I dove into prototyping ideas with Arduino. I worked to develop generative images on an LED matrix that would be triggered every time medication was taken. I got distracted from my overall goals and caught up in making something work – this matrix of LEDS – because the work was challenging and fun.

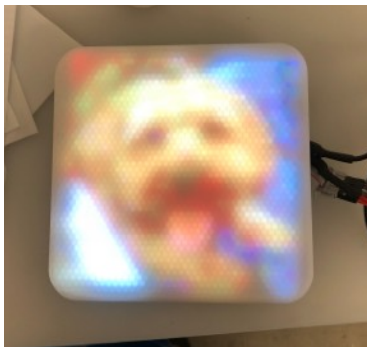

Figure 17. An image generated on an LED matrix. A 3D printed cover is placed on top to help make the image visible.

I came back from winter break with a clear head and strong feedback from my December review. Some advice I got included: get back to the user – define who the user is; research behavior change; research nudge theory and tamagotchi; and do not get caught up in how it will work. At this point I went back in the human-centered design process to research and synthesis — as I said before, this process was not linear. I read about nudge theory, possibility-driven design, and the effectiveness of interactive pets. Synthesizing this new information helped me find new direction.

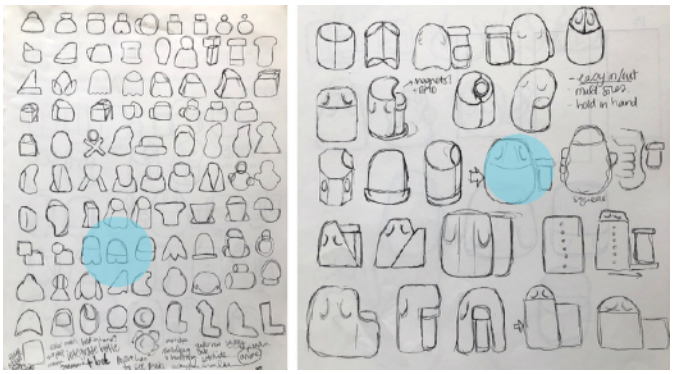

Figure 18. I went back to the drawing board to come up with new forms.

After months of work, feedback and revision I landed on my concept: a companion device that takes care of the user by helping the user manage his/her medication. I explored this idea

through sketching. Feedback from users helped inform a visual direction that is playful and cute, but minimal and appealing to a wide audience.

I spent the majority of second semester prototyping and bringing this concept to life in all forms. I continually iterated on the design through 3D models and renders. I worked mainly in Rhino as it gave me the most control over a more organic form. These

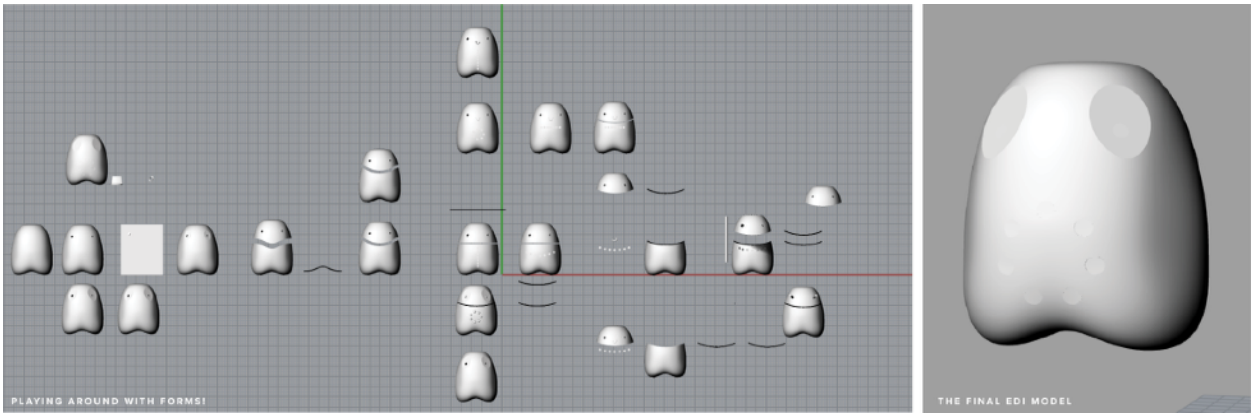

Figure 19. A screenshot of my work in Rhino, the 3D modeling software.

3D models were informed by physical models I 3D printed. Printing the forms allowed me to better understand size and shape. I repeated this process many times, each iteration added to the final form. I experimented with many different colors and materials as well.

Figure 20. Some of the many edi models I created. They multiplied quickly thanks to 3D printing.

Aside from the physical form, the hardware and software were necessary components to develop. I tested different electronic parts to decide how I wanted to demonstrate the product's interactions. I soldered together a strand of 25 neopixels which serves as the product's main form of feedback (light). Additionally I tested out different ways of communicating with the product, including RFID, hall sensors and touch sensors. Once I had a configuration that accurately represented the interaction I designed, I worked with my friends in computer science to develop the code. I wrote out the sequences and states that needed to occur, and they created it in code.

Figure 21. The diagram on the far right represents the connections between all of the electronic components. The middle image is a snippet of the Arduino code. I worked with my engineer friends to bridge the hardware and software

By March, I had a functioning looks-like and works-like prototype of the product.

Figure 22. A layout of the app wireframes in the program Sketch.

My next step was to design the accompanying mobile app for the product. I followed a similar design process to creating the physical form but in a much shorter amount of time. My goal was to create an app that serves as the voice of the product, in order to have communication with the

user. To design the app, I started off by sketching out the pages I needed to include, such as a home page, a calendar, a messaging page, and a settings page. I transformed these sketches into digital wireframes of the app. I quickly moved on to creating the visual design. I created the interactions of the app in the platform Invision in order to ensure a seamless working prototype.

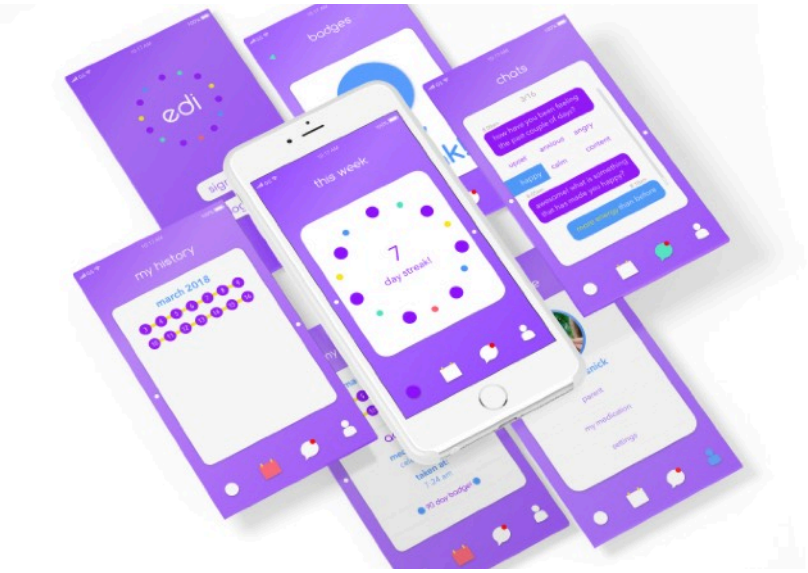

Figure 23. The visual design of the app is playful and simple, just like the product edi itself.

Still, my work did not stop here. I designed and created the messaging around the product. This included a logo and a video to explain how the product works. All of these elements came together on display at the final exhibition.

creative work

edi's purpose is to help adolescents with chronic illness remember to take, and manage, their medication. edi is a personal support system meant for individual users and their needs. However edi is not like other adherence-related products. It is delightful

Figure 24. edi responding to a pill bottle being tapped on its head.

and customizable — in an attempt to bring joy to the experience of taking medication.

Currently edi has a few different states that are clear to the user. The first is blink mode (edi just blinks its eyes). This means that a message has been communicated to the user through the app and it has not yet been read. The next mode happens when it is time for the user to take their medication. edi blinks its eyes, as well as the top of its head, and the current day of the week. At the same time it sings a song. From this point two different states can happen. If medicine is taken, (which is done by tapping the pill bottle on top of his head), edi will celebrate. All of its lights will turn into a rainbow and edi will congratulate the user. If the medicine is not taken by a specific time, edi goes into urgent mode. In this state, everything blinks faster and the music intensifies. Users can still take their medicine and continue their streak, but if they miss, then edi fades back into sleep mode. In each state, edi communicates through the app to let the user, or the user's parent know what needs to — or has been — completed.

Figure 25. This graphic explains the different states edi can be in.

Figure 26. Features of the entire edi product experience.

Each of edi's features aims to combat key problems I uncovered about the medication taking experience. These features include:

Reminders: edi reminds the user to take their medication through lights and sound. This simply combats the act of forgetting to take one's medication.

Progress bar: edi keeps track of the user's actions with the days of the week on its stomach. This encourages users to keep up their streak of taking medication, and the accompanying app shows how their progress over time adds up.

RFID: An RFID sticker can be put on any type of medication. An RFID reader inside edi ensures that a medication is physically swiped over the product, which equates to taking the medication.

Personalization: edi's base colors, lights, and music are all customizable. Having control in the decisions behind taking medication makes an adolescent feel included, and therefore more likely to participate.

Visual design: edi is cute, happy and inviting. edi is not an object one would feel embarrassed to have, and can match a variety of personalities. Most importantly, it makes people feel happy.

Emotions: edi attempts to empathize with the user through its feedback physically and in the app. The goal is to create a sense of comfort, instead of a negative association, with taking medication.

Privacy: edi is meant to be kept in an adolescent's own space, rather than hidden in a bathroom cabinet. This gives the user ownership and a sense of responsibility that he/she may lack otherwise.

Targeted for adolescents: edi is designed for this younger audience in order to help initiate a transition from parental dependency to adolescent autonomy with medication.

App check-ins: edi sends messages to the user through the app. These conversations work through issues and feelings about missing medication, or side effects, which can be shared with doctors and parents.

Parent-facing app: Notifications and updates are sent to the parent's phone as well as the user's. This gives parents the ability to trust their kids to take medications on their own.

edi is displayed in context in order to allow users to interact with the device and understand how it works. edi is situated on a nightstand, along with a phone and medication, which mimics where it would be located in a real user's space. Additionally, a video plays overhead which shows how users interact with edi. This video is meant to inform gallery visitors about how the product works.

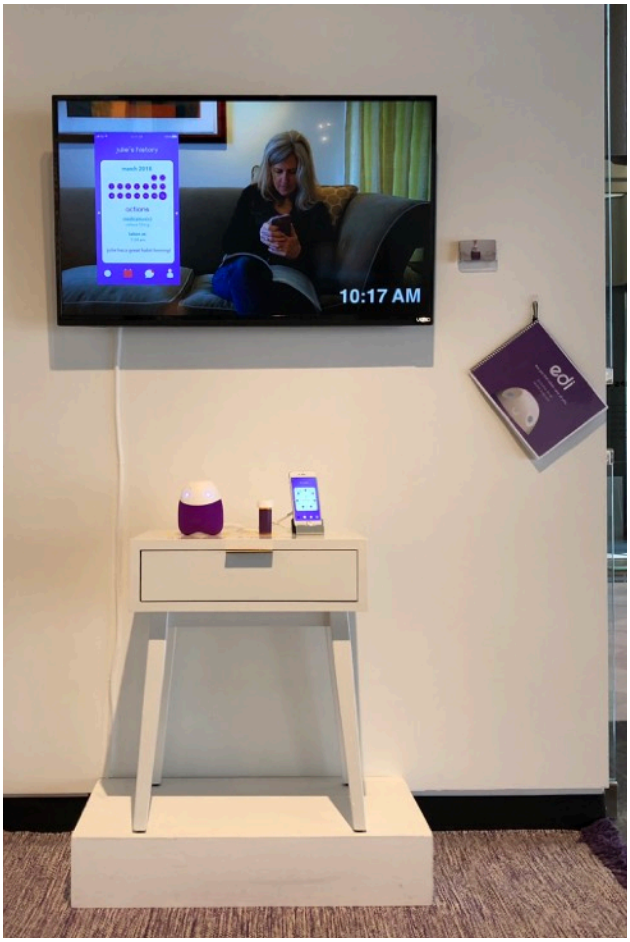

Figure 27. The exhibition display in the Stamps Gallery in downtown Ann Arbor, MI.

Figure 28. Visitors of all ages loved edi.

The opening of the thesis exhibition was the perfect opportunity to observe how people interacted with, and responded to edi. Every time someone tapped the pill bottle

on edi's head, a huge smile appeared on their face. All of those smiles were wonderful to see.

conclusion

While most medication-related products on the market attempt to force adherence, edi takes a different approach. edi attempts to associate happiness with the medication-taking experience, and therefore, encourage better adherence habits. While edi was developed through following a human-centered design process, like many other existing products, it is different because the guiding question was framed by possibility, instead of by problem. "How might we make the medication-taking experience more positive?" instead of, "how might we make patients be more adherent?" By framing the project in this way, I attempted to find a way to impact long-term behavior. Human-centered design, behavior change, and interaction design methods came together to result in edi. At the heart edi has always been about the user's experience, and been guided by the traditional steps of human-centered design. And while triggers, actions, and rewards can help teach behavior to people of all ages, it is important to develop habits at a young age. edi starts behavior change at an impressionable age, which can build healthy habits in the long run.

Unlike products like Medido, edi brings joy to a not-so-joyful situation. And while adherence-related games such as "Bronchie the Bronchiasaurus" are effective and powerful, edi is targeted for a slightly older user base who have the possibility of

responsibility. In use, edi is really able to transcend age. edi has the potential to change how adolescents, and everyone else experience their medication.

edi will continue to live on in a few ways after the Integrative Project is over as I plan to pursue development. Working on this project has allowed me to see that I am interested in healthcare and improving patient experiences through design and social robotics. From creating state-chart diagrams to writing out the different states of the code, I learned I have what it takes to be not just an industrial designer, but a user experience designer and project manager as well. While there is still much to be done, I strongly think there is a place for products that aim to make our world brighter by making people happier.