WPI

Design and Analysis of Cognitive Focus Devices

Major Qualifying Project Submitted to the Faculty of

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Abstract

The objective of this project was to design and manufacture a cognitive focus device, develop a business plan for the product, and determine if fidgets can relieve individuals of the modern, evolving world's anxieties. The rationale of this project was to produce a product for adults in the academic and professional world and to understand how fidgets are used in developing and industrialized countries. The methods used were surveys, fidget testing and manufacturing, interviews with professionals and individuals who fidget, market and financial analysis, and academic research of the professional literature on this subject. The results were the creation of the Fidget Egg, the product commercialization of the Fidget Egg, and a discussion about how some people center themselves through the use of sacred or secularized objects to relieve oneself of the world's anxieties. The conclusion reached by the team is that the Fidget Egg is a viable product that can empower consumers to direct their focus, and there is no ideal fidget for everyone. Additionally, there may be a correlation with the use of fidgets and the pressures of industrialization.

Abbreviations

ADD: Attention Deficit Disorder

ADHD: Attention Deficit Hyperactivity Disorder

ASD: Autism Spectrum Disorder

DSM: Diagnostic and Statistical Manual of Mental Disorders

LLC: Limited Liability Company

MQP: Major Qualifying Project

ODS: Office of Disability Services

ROI: Return on Investment

WPI: Worcester Polytechnic Institute

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Executive Summary

The interdisciplinary nature of this project was made possible by students from different academic backgrounds who worked together to share different knowledge and perspectives on an entrepreneurial and humanitarian interest throughout the globalized economy. One of the authors, who is diagnosed with Attention Deficit Hyperactive Disorder (ADHD), convinced four other WPI students that there is a need for fidget devices specifically made for adults. Additionally, the extent of knowledge about ADHD and related psychological and learning disorders is not well known. This team set out to address that issue and designed a discreet, affordable, and effective cognitive focus device that can be marketed and sold to an international market.

For the purpose of better understanding customer needs, the team researched ADHD as well as current studies completed on the use of fidgeting devices and their effectiveness. Studies show that people with executive functioning disorders have shown strong correlations to ADHD, and individuals with ADHD are often inattentive and fidgety (The National Institute of Mental Health, 2016). There have also been studies conducted to try to determine whether fidgeting can help with the attentiveness of those with ADHD and others (Pedersen, 2015; Kofler, 2015). Through research, it became clear that almost no studies have been done on calming devices in the developing world and to the extent that such devices exist that do not fall under the term "fidgets." To resolve this cross-cultural dilemma, research had to be directed toward equivalent psychologically calming aspects of everyday life in undeveloped societies, which seem to have traditional religious dimensions.

The design team, which consisted of three mechanical engineers, focused mostly on designing and manufacturing a helpful, usable fidget by preliminary surveying, using the axiomatic design decomposition, prototyping, testing, and creating the final product. Each

member of the design team brainstormed three possible product ideas, rated each design based on the axiomatic design decomposition, and choose the best design to manufacture and refine. The team created a decision matrix from a previous axiomatic design decomposition that had possible functional requirements for the design. These functional requirements and rankings were determined by results from previous surveys (Appendix B). Once a design was chosen, the design team began prototyping. The manufacturing process began with finding suppliers or manufacturing methods for all the parts that would be needed to assemble the prototype. The parts to be gathered were the body of the prototype, the side buttons, the large button, the slider, and the gear. The body, slider, and gear were 3-D printed on a MakerBot Replicator 2X at WPI. The first prototype was created to get the proper size that would fit in a person's hand and to test the feasibility of the gear resistance mechanism.

The distinct features of the Fidget Egg are a rounded, beveled gear, a double spring-loaded slider on the opposite end, a safety button on one of the flat surfaces, and two silent buttons on the side of the device. 3D printing creates a semi-rough surface, and the device sits naturally and discreetly in the user's hand. The thin design also allows for easy storage in a user's pocket. Additionally, consumers can choose between three sizes to get the best ergonomic fit in the palm of their hands.

This project team also included two business students who developed a business plan for the Fidget Egg. The mission of Fidget Egg as a business is to introduce an affordable, discrete, and versatile fidgeting device to consumers. The product was designed for anybody, to be bought in any budget, and for any purpose. Often fidgets are kept in close proximity to the buyers such as in pockets, backpacks, purses, keychains, or left on desks that the person frequents. One of the

goals in producing the Fidget Egg was to ensure that the device is beneficial to the needs and wants of consumers.

Fidget Egg aims to create a company image that has a balance between professionalism and fun. Target consumers are primarily college students and young professionals who fidget or are looking for ways to concentrate better on work. Additionally, the Fidget Egg will be marketed toward consumers with disabilities, such as those with ADHD. In order to create clear communication between Fidget Egg and its consumers, a professional website is highly recommended.

Clearly, the Fidget Egg will only succeed in the market if the business can financially support itself and eventually make a profit. It is important to consider all aspects of the financial feasibility of turning the Fidget Egg into a business, including the costs of production, other operational costs, and pricing strategy. Additionally, long-term and short-term forecasting should be done to predict when the Fidget Egg could hit the break-even point and begin earning profits.

In addition to analyzing potential costs of creating Fidget Eggs, the business team considered how to price the product in order to maximize profits. According to survey data (See Appendix B), almost 90% of respondents were willing to spend at least $5 on a fidget device such as the one they tested out, while over 47% were willing to spend up to $10. Assuming that the Fidget Egg sells for $5 each, the total revenue for a batch of six Fidget Eggs would be $30, which results in a profit margin of 27.4%. If the Fidget Egg sold for $10, the total revenue would be $60, which brings the profit margin to 63.7%. Furthermore, the return on investment, or ROI, can be calculated using the figures above. At a price of $5, the Fidget Egg would have a ROI of 37.7%. At a price of $10, the Fidget Egg yields a ROI of 175.5%.

At the conclusion of this project, the team is confident that the Fidget Egg is a worthwhile product and could be very successful in today's market. Several team members are considering registering as a business, particularly as a limited liability company, or LLC. In order to protect the intellectual property of the design of the Fidget Egg, the design team filed a provisional patent (See Appendix H), which was submitted to the U.S. Patent and Trademark Office on February 16, 2017. The title of invention is "Cognitive Focus Enhancement Device."

The third aspect of this project is an international component that investigated the use of objects that are handled physically by an individual and serve as calming devices in countries and cultures around the world. The well-known thesis of Max Weber, the 19th century sociologist, argues that tribal people live in a sanctified world where there may be pressures and anxieties about invasion, death, and starvation, but which are addressed psychologically by their overarching spiritual worldview (Becker, 1973). Weber argued that tribal peoples had a firmer grasp about their purpose in life and if they died, whether or not their culture posited an afterlife, their beliefs in animism gave meaning to their life and death and every worldly event (Probe Ministries, 2015). Nowadays in the modern world, our everyday lives are much more secularized and focused on material goals (Bruce, 2016).

The ever presence of sacred references in what was seen around tribal peoples in nature or in conversation about the mystical dimensions of life and death perhaps, some anthropologists speculate, put minds at ease and calmed existential worries. However, in modern times, the frantic pace of modern production sometimes requires a person to have a physical distraction so that they can concentrate on the task at hand, such as fiddling with stress ball, silly putty, or elastic bands. People with ADHD, autism, and other brain disorders also benefit from the use of fidget toys where these fidgets help relieve stress and promote concentrations on tasks. Weber's

thesis raises the question as to whether a sanctified universe might have fewer incidents of these well-known modern anxieties and psychological disorders.

Religious objects such as rosaries or prayer beads were used to help remember the true spiritual and sacred message of scripture and doctrine. Those objects might have taken on secondary psychological functions and worried and anxious believers turned to religions such as Christianity, Roman Catholicism, Islam, Hinduism, and Buddhism to ease fears about worldly pressures. Religious individuals in the process of worship used these varying tools to help them memorize prayers, meditate, and for some the tools provided a type of spiritual, emotional, and mental healing qualities (Greer & Vaughn, 2007). Increasingly in modern industrial society psychological neuroses and behavioral problems could be addressed by non-sacred playthings such as silly putty, finger springs, stress balls, or spinners. Whether modern-industrial society creates neurosis, psychological behavioral problems and the need for playing objects requires further investigation.

In the current developed society, fidgets have been clinically identified as a tool to treat ADHD in the developed world, but we do not know if doctors recommend the use of fidgets in the developing world to people with neurodevelopmental disorder. ADHD and Autism Spectrum Disorders (ASD) are widely misunderstood and children are misdiagnosed and do not receive appropriate recognition and treatment for their disabilities throughout the world. In the developing world, neurodevelopmental disorders are identified in regions that have little to no resources and healthcare professionals available (Autism Speaks, 2014).

While the industrial world has commercial disability aids for brain disorders, throughout the developing world such services are tied to traditional religious practices or have become sanctified in their original religious purposes. Prayer beads or rosaries are counted in a repetitive

method that allows the worshiper to keep track of how many prayers have been said, which cultivates more devoted attention to prayers. A string of beads "acts as an anchor with which to focus thoughts and still the mind," which religiously oriented functions that are similar to the uses of fidget devices in the secular world are used as aids in concentration (Henry & Marriott, 2002). Prayer bead users in several major religions in the world shares the sense of calm and well-being that the secularized Greek *komboloi* provides to people. In *Beads of Faith*, we learn about the Catholic Rosary, the Hindu *malas*, the Buddhist *malas*, and the Muslim *tasbih* to name a few, are prayer beads in their associated religions (Henry & Marriott, 2002).

Prayer beads are not a toy like fidgets, but their use shows that many major religions have similar aids "to focus the mind, help solve problems and dispel fear" to help a person remember their task of reciting a mantra, prayers, or names of their deities (Henry & Marriott, 2002). If worshippers are dependent on a direct, devout reflection upon their religious significance then some formerly religious objects are quite far from their original sanctified purposes. Nowadays, something like the Fidget Egg, with no religious connections, can be used to enhance concentration, whether for educational or work-related purposes.

In modern society, people have invented a variety of hand fidgets to serve various needs related to enhancing concentration or stemming anxieties. In the developing world among religious people, some of those needs are met—perhaps indirectly—by prayer beads, prayer wheels, amulets, stones, and because large sections of these societies are less secularized, many people achieve spiritual calmness through reciting prayers, chanting, and repeating mantras. Reciting mantras provides people with the means to heal themselves from life's worries and anxieties. If people can be assisted from sacred objects then there may be a chance that other sacred or secularized objects can also serve these roles throughout the world.

The conclusion reached by this project team is that the Fidget Egg is a viable product that can empower consumers to direct their focus although there is no ideal fidget for everyone. Additionally, there may be a correlation with the use of fidgets and the pressures of industrialization.

1. Introduction and Problem Statement

The initial motivation for this project began with an idea from one of our group members, Daniel Sturman. As someone who experiences ADHD himself, Dan saw that there was a need for more fidget devices that are specifically made for adults. Although he used other fidget devices before, he wanted the opportunity to create his own product that would also allow him to incorporate his Mechanical Engineering degree. Soon after, this Major Qualifying Project (MQP) team was formed, and work began in the fall of 2016. The project evolved to incorporate several aspects: the mechanical engineering design process, the development of a business plan for the fidget device, and research about the connection between other cultures, fidgeting, and fidget devices.

As mentioned above, there is a lack of adult fidget toys in the market today and it is not clear what their role might be in the developing world, among other issues the extent of knowledge about ADHD and related psychological and learning disorders is not well known. This is especially of concern for young adults with ADHD who recently graduated high school and are entering the workforce or continuing their education. Because these young adults were likely given resources in high school to manage their ADHD, they must learn to adapt to their adult lives without as much guidance. This team set out to address that issue and designed a discreet, cognitive focus device.

This paper aims to answer these nine questions in detail about the Fidget Egg: What is it? How was it designed? How is it made? Who uses it? Why would they use it? When would it be used? Where would it be sold? What will it take to make this product happen? What are fidgets role be developing and industrialized countries?

2. Methods

An interdisciplinary team of students pursuing degrees in Mechanical Engineering, Business, and International and Global Studies completed this project. This MQP has a mechanical component—the physical design of the fidget—a business component related to marketing and value proposition of the Fidget Egg, and an international component investigating whether or not objects similar to the Fidget Egg can be found in different cultures and in societies at different levels of economic development. Each component of this project has a separate chapter with a different set of objectives, methods, results, analysis, and discussion.

In order to complete an interdisciplinary, complex project such as this one, strong organization and communication was required of all group members. Throughout the course of this project, all five team members met once or twice a week as necessary, and meetings were set at the beginning of each academic term. Additionally, meetings were held on an ad hoc basis with the project advisors and other helpful resources, such as the WPI Office of Disability Services. The business team typically met about twice a week on average. The design team met daily. Carolina completed the international component by receiving guidance from her advisor usually once every two weeks, but on a weekly basis towards the completion of the thesis.

This project team utilized several communication methods, including email, GroupMe, texts, Google Drive, and OneDrive. For lengthy messages or communication outside the project group, the email alias fidgetwidget@wpi.edu was used often. For shorter messages, the GroupMe mobile app was used, and for messages pertaining to only one other group member, group members typically used text communication. All of the documents pertaining to this project, including meeting minutes, were kept on Google Drive in a folder that contains several subfolders. Toward the completion of the project, the final report was exported to OneDrive in order to adjust formatting and further edit the report content.

2.1 Design Team Approach

The design team focused mostly on designing and manufacturing a helpful, usable fidget by preliminary surveying, using the axiomatic design decomposition, prototyping, testing, and creating the final product. The design team methods are discussed in detail in Section 3.5.

Before beginning the axiomatic design decomposition, the team conducted preliminary surveying, asking about volunteer's current fidgeting habits and aspects of fidgeting that provide the most interesting movement or tactile sensation. The results from this survey helped the design team determine the first iteration of the axiomatic design decomposition.

The axiomatic design decomposition helped the team design a product that satisfied the customer needs and include the most popular fidgeting features. It also ensured the durability and portability of the device through the design constraints the team determined important.

Using the 3D printer in Washburn shops and 3D printers from 3D printer hubs and friends, the design team was able to make many prototypes, a product made for testing, and eventually our final product.

2.2. Business Approach

Evaluating the need of fidgets was done by researching consumer behavior of these products and conducting a market analysis of fidgets and financial analysis of the Fidget Egg. Due to the scope of fidgeting objects and the fidget market, the topics will be thoroughly explored in Market Analysis (4.2).

A design survey was conducted with the mechanical engineering team to get an understanding of which features of the Fidget Egg people would use the most or least during their week trial period. Among the feedback gathered from the trial period, either written or verbal, and the conducted research, helped us identify ways in which to enter the Fidget Egg into the market. The Business Plan consists of three methods.

1. Research
2. Design Survey
3. Interviews

2.2.1 Research

The business description entails research and evaluation of introducing a fidgeting object designed and manufactured by the mechanical engineering team to consumers. Literature studies was also involved consisting of papers on topics of designing fidgets for individuals to use. During the preliminary research, it became clear that almost no research has been done on calming devices in the developing world and to the extent that such devices exist that do not fall under the term “fidgets.” To resolve this cross cultural dilemma research had to be directed toward equivalent psychologically calming aspects of everyday life in undeveloped societies, which seem to have traditional religious dimensions.

2.2.2 Fidget Egg Design Survey Analysis and Evaluation

After the Design Team created the first design, prototype testing was conducted over the course of a week, where 29 members of the Worcester Polytechnic Institute community were given their own fidget device to test and provide feedback to us. Survey respondents were asked to complete a pre-use survey and a post-use survey. Answers were kept confidential by asking the respondent to submit a participant number, rather than his or her name or other identifying information. The results of these surveys can be found in Appendix E, and the Design Team’s analysis of the results can be found in Section 3.6.1. As explored further in Chapter 4, the results of the survey confirm that our product aligns with the objectives set out in our vision and mission statement.

2.2.3 Interviews

We interviewed one of the mechanical engineering authors to learn about this project origins and because he is a regular user of fidgeting objects. Additionally, we gained insight into the use of fidgeting objects in social and academic settings and their respected benefit levels of having fidgets on his person.

Outreach to a local high school in Worcester was conducted to learn more about behavioral disorders that interfere with learning and for a closer look into fidgeting in classrooms. These interviews were also to receive feedback from educators on their views and comments towards students using objects in classrooms and their distractions or restrictions on those objects, if any.

2.3 International and Global Studies Approach

This chapter of the report was completed in three parts: literature studies on topics such as psychological behavioral problems, the need for people to utilize playing devices, and primary research on the use of fidgeting objects used in industrialized and developing countries, and interviews with experts from or knowledgeable about different industrialized and developing countries. The reasoning behind each of these methods are explained below. Literature studies, primary research, and interviews were conducted to further explain the use of fidgeting objects.

2.3.1 Literature Review

Literature reviews were conducted from books, articles, journals, and relevant works to identify the use of stress, anxiety relieving, or calming objects whose purpose were not originally for fidget use but that function in such a manner as to promote concentration. In addition, identifying the types of people who fidget and how their conditions are recognized, diagnosed and treated is crucial in understand the forms of medical or psychological treatment available to people outside of the industrialized world. Furthermore, during the search for cultural that are

used by people for apparent calming functions we sought assistance from a librarian, who guided us to relevant terminology and research.

2.3.2 Primary Research

A wide understanding of different, yet related, subjects was necessary to get comprehensive and analytical insight into a topic with broad but varied cultural differences. We reviewed references and other cited work from papers and articles. Researching literature over fidgeting objects in developed and industrialized countries proved to be difficult due to the language constraints in identifying terms used in other cultures that refer to practices similar to fidgeting. To measure the prevalence of certain brain disorders that contribute to fidgeting, we consulted healthcare websites where professionals provide statistical data of various types of diagnoses.

2.3.3 WPI Faculty, Staff, and Cultural Student Group Outreach

Informal face-to-face interviews were conducted with WPI students and a structured survey with key information about the project was sent to 16 cultural groups (Table 1) and international students on campus to learn about fidgeting objects used in developed and developing countries. Emails with a short project description and questions were sent to WPI faculty and staff in Humanities and Arts department, International House, and the Interdisciplinary and Global Studies Division for expert information of the use of fidgeting objects or customs performed in cultures to relieve persons from stress or anxiety.

Table 1: Organizations Contacted for International and Cultural Use of Fidgets

Organizations contacted for International and Cultural Use of Fidgets
Chinese Student Association (CSA)
Chinese Student and Scholar Association (CSSA)
Albanian Student Association
Brazilian Student Association
Burmese Student Association
French Circle (Cercle francais)
German Club (Deutschklub)
Hellenic Student Association
Hispanic and Caribbean Student Association
International Student Council
Iranian Student Association
Japanese Culture Club
Korean Student Association
Russian-speaking Students and Scholars Association
Turkish Student Association
Vietnamese Student Association

3. Fidget Egg Design

3.1 Design Team Objective

The two objectives of the design team were to create a fidget and to determine what makes something an ideal fidget. We believe an ideal fidget would be non-distracting and help prevent distraction.

The fidget toy designed during this project provides fidgeters with non-distracting physical stimulation and is usable in any social environment. The fidget is engaging, to avoid distracting the user, and discreet, so as not to distract others. Many current fidgeting motions, such as pen clicking, can be a distraction to people around the fidgeter. Avoiding this annoyance is especially important in professional and academic settings. The design team aims to design and manufacture a fidget, which is discreet to avoid unwanted attention.

The fidget will prevent distraction by providing the fidgeter with physical stimulation. This stimulation will help create an outlet for persons with hyperactivity, while engaging their working memories. It will also allow people to be active without moving enough to distract themselves.

3.2 Rationale

11% of children, four to 17, are diagnosed with ADHD (U.S. Department of Health and Human Services, 2017), even more are on the spectrum, and everyone fidgets whether it's with their hair, pencil, jewelry, or cell phone. Fidgeting with these items can sometimes be distracting or even harmful, causing a further indirection of focus. Using fidgets can better direct the user's focus and help them pay attention in class or a work meeting. However, most products sold today are marketed to children with bright colors and loud noises and movements. These products do not allow adults to fidget in a professional or academic setting because they are distracting, and not socially or professionally acceptable. The product of this project will provide adults with a solution to fidgeting in the workplace and classroom that is discreet and effective. Additionally,

there has been to our knowledge no attempt to market fidget objects in areas of the world that are the least developed.

3.3 State of the Art

For the purpose of better understanding the customer's needs, the team researched ADHD symptoms and treatments as well as current studies completed on the use of fidgeting devices and their effectiveness. Then research on different fidgets in the market today was completed to discover what products are available, what features those products provide, and to gain a better understanding of how fidgeting is dealt with in society than academic research could alone.

3.3.1 Executive Functioning and ADHD

Fidgeting has been the topic of several studies throughout the last few years. Most of these studies focus on the K to 12 system with executive function disorders (Biederman, 2004). Executive functions are a set of cognitive processes that help in problem solving and behavior control (Biederman, 2004; Morin, 2017). People with executive functioning disorders have shown strong correlations to Attention Deficit Hyperactive Disorder (ADHD). Though people may use these executive functioning and ADHD interchangeably, ADHD is a subset of executive function disorders. Persons with ADHD are often inattentive and fidgety (The National Institute of Mental Health, 2016). There have been studies that try to find whether fidgeting can help with the attentiveness of those with ADHD and others (Pedersen, 2015; Kofler, 2015).

3.3.2 Existing Studies

Out of the studies found, only two focus on college-aged students without a diagnosis of ADHD (Petersen, 2006; Slater, 2011). Other studies discuss the importance of keeping children with ADHD active and engaged in the classroom (Rotz, 2010; Kofler, 2015). Other potential benefits of fidgeting such as stress and anxiety management are not covered by these studies.

One study called “The Relationship between College Students’ Executive Functioning and Study Strategies” the Journal of College Reading and Learning had 81 community college students complete two self-reports at the beginning of each semester. The LASSI (Learning and Study Strategies Inventory) report was used to measure the student's academic strategies and determine strategic deficits such as time management or anxiety management. The EFRS (Executive Functioning Rating Scale) report was used to assess difficulties in planning, organization, and meeting goals. The study found that time management and concentration strategies are directly correlated to deficits in executive functioning (Petersen, 2006).

The study called “An Innovative Use of Fidget Toys in a University Classroom” from Georgia Southern University had students fidget with construction-hat-shaped stress balls over an academic year. They filled out a survey at the beginning and end of each semester about the fidget’s effectiveness at redirecting their attention towards classroom topics. The study concluded that students were able to keep their focus longer on in-class topics and during the learning process overall when using the fidget toys (Slater, 2011).

3.3.3 Existing Products

In order to determine the current state of the fidget toy market the design team analyzed a variety of existing products (some are shown in Figure 1). Websites such as Marbles the Brain Store, Therapy Shoppe, and Office Playground, to name a few, have compiled numerous fidgets where students and adults can shop to their needs. The following are fidget products that were examined while determining the current state of the market.

Figure 1: Assorted Fidgets

Fidget Cube

One of the most lucrative fidgets that is on the market right now is the Fidget Cube (shown in Figure 2). The Fidget Cube is marketed towards adults as a discreet way to fidget while at home, work, or the classroom. The Fidget Cube is "a desk toy for anyone who likes to fidget." Fidget Cube made almost six and a half million dollars in a Kickstarter campaign during fall 2016 (McLachlan, 2016). This campaign had over 150,000 backers that ordered a Fidget Cube. The tremendous interest in this product shows adult interest in fidgets throughout the United States, Europe and other western countries. The Fidget Cube stands out among its competitors as one of the first fidgets to be marketed towards adults.

Figure 2: Fidget Cube (left) and Fidget Cube Features (right)

Where this cube differs from the other fidgets that are on the market is in the user options. The Fidget Cube has six different sides, each containing a different fidget. In addition, this product gives the user the option to fidget silently, with four sides that are specifically designed for quiet use.

The Fidget Cube met with huge success from the Kickstarter; there are areas that their product can be improved on. Many of the backers to this project expressed interest in an ability to be able to attach it to a keychain, because they believed it would be easily lost (McLachlan, 2016). Additionally, at $25 a piece users felt that would be a costly toy to lose.

Squidget

The Squidget (shown in Figure 3), a fidget on Kickstarter from August 2014, has a similar design to the Fidget Cube which is discussed above (Snee, 2014). A team from Worcester, Massachusetts collaborated to “transform fidgeting into squidgeting and change the world, one very special person at a time.” Though they mention their product specifically working towards persons with ADHD, Autism, and Down syndrome, Squidgets are advertised for classrooms, homes, and offices- similar to the Fidget Cube.

The Squidget has six sides and seven uses including pen-clicker, hair twirling stimulation, button twirler, pencil roller, surface rub, spinner, and deep nail pressure relief. The

variety of different sides allow all types of users to fidget to their preference. The Squidget has a loop for easy keychain attachment and a mechanism for customers to suggest new attachments for future design iterations.

Figure 3: 3D Printed Squidget (left) and Clay Home-made Squidgets (right)

Its Kickstarter page provided viewers with a production plan, future goals, feedback avenues, and even the anticipated risks and challenges. Though it was introduced two years prior to the Fidget Cube, it did not reach its $35,000 Kickstarter goal (Snee, 2014).

Fidgeting Finger Springs

Fidgeting Finger Springs are inch long plastic spring fidget toys. The finger springs are made of two plastic strands fused together on the outside to create one curving, multicolored spring. An image of the finger springs can be seen below in Figure 4.

Figure 4: Fidgeting Finger Springs

Fidget springs encourage physical stimulation in a variety of ways. Because of their coiled shape, fidget springs provide resistance to movement during winding and unwinding. The springs exert pressure, which rises and subsides as the spring is wrapped from one finger to the next. The finger spring's shape and flexibility allow it to be used at the user's discretion.

The fidget spring's size allows it to fit in a user's hand or be stored in a pocket. The nature of having the spring twirled around user's fingers creates a tether that prevents the spring from falling during use. This tether allows for temporary storage of the spring if the user's hands are immediately needed for another task such as writing or typing.

Fidget springs are audibly quiet and visually loud. These springs are silent during most use, but can make clicking sounds when springing back together from extension. The twirling movement created when playing with the springs is large. This can draw attention to the fidgeting when being used during conversation. The bright colors of the product also draw attention.

Compared to other fidget toys, the team has found the Finger Springs to be inexpensive, durable, and clean. Fidget Springs cost about $5 for a pack of 10, $18.50 less than the Fidget

Cube per unit, making them one of the least expensive fidget toys on the market (Therapy Shoppe, 2017).

3.4 Approach

Through this project, the design team developed a discreet, quiet, and professional product that allows users to fidget during a class lecture or during a meeting at the office without bothering those around them. Most of the fidgets being sold today are marketed towards children and use bright colors and toy-like aspects such as blocks of colors, squishy textures, and a variety of sounds. This product not only has neutral colors and silent features, but also is sleek and professional looking.

3.5 Product Design Methods

3.5.1 Axiomatic Design Decomposition

In order to develop the team's fidget design, the axiomatic design process was used. To complete an axiomatic design decomposition, the customer needs, functional requirements, and design constraints must be independent of each other and cover everything the design must have. The overall customer need begins with the customer's fundamental need to fidget with something. The steps after this are called the functional requirements of the product. These include experiencing physical stimulation, using the fidget intermittently for extended periods, and knowing the location of the device. Each of these functional requirements was further divided until a singular and specific solution for each was incorporated into the design. Finally, the design constraints of the fidget were aspects that the customers and the design team wanted, but were not necessary in order to fidget. Some of these include size, weight, and cost.

Identifying Customer Needs

In order to best identify the customer needs for the fidget, a variety of fidget toys were purchased, the WPI community was surveyed about general fidgeting habits and preferred features, and the design team met with the Office of Disability Services weekly to gain their professional perspective.

Bought Toys

In order to understand fidgets and how they work, the design team purchased and studied a variety of existing fidgets. Some of the fidgets examined were putties, ring and chain fidgets, Fidgeting Finger Springs, stress balls, spinners, Greek komboloi, marbles in tubes, bead bracelets, Fiddle Links, Squidgets, and Fidget Cube. Images and product names for each of these toys can be found in Appendix A. By playing with these fidgets, pros and cons for each device were identified. One example of these tradeoffs are spinner fidgets which provide excellent stimulation, but which were also distracting to the user. After using each of the fidgets for a couple of weeks, the design team selected spinners, rubber springs, stress balls, Squidgets, and marbles in tubes for further study because they target a wide variety of fidgeting behaviors and represent the wider range of fidget toys.

Surveying

The primary tests for determining important fidget features were two surveying events. The full survey and collected data can be found in the Appendix B. During these events, the team occupied heavily trafficked public locations with five kinds of fidgets: spinners, springs, Squidgets, stress balls, and marbles in tubes. The survey display can be seen in Figure 5. Passersby played with each kind of fidget and then took a survey to record their opinions on the fidgets they used and fidgeting in general. Passers also recorded which of the five fidgets they most enjoyed by taking a piece of candy from jars associated with each toy. In order to increase

the number of respondents the design team also collaborated with WPI's Office of Disability Services for the first surveying event and the Gamma Iota Chapter of Sigma Pi Fraternity for the second. These events provided the team with a large volume of information about peoples' fidgeting preferences.

Figure 5: Layout of Surveying Table

In the survey, information was collected about people's fidgeting habits and opinions by asking what aspects of the toys people liked most and how they currently fidget while working. Other questions focused on collecting data that would not be acquired through observation (e.g. how much people would be willing to pay for a fidget device). The information collected from this survey influenced the features included in the fidget device.

Meetings with ODS

Regular meetings with WPI's Office of Disability Services (ODS) helped the team in a variety of areas including establishing market interest, focusing research, narrowing the customer scope, and collaborating in data collection. Learning about problems experienced by people with

a variety of disabilities introduced the team to unexplored ways fidgets could benefit their users. The research helped the team to understand challenges for people with disabilities. Encouraging the team to focus on WPI students created a realistic project by reducing the scope to an available audience. Collaborating for data collection connected the project with that target audience and began the independent surveying.

From the ODS, the design team learned that people with ADHD have needs that could be met by a fidget. ODS provided anecdotal evidence about how using fidgets during counseling sessions or meetings has helped WPI students in the past. The desk toys they use such as silicon sand and magnetic balls were some of the first fidgets analyzed in the research. Additionally, the ODS provided research topics, books, and studies which furthered the research and demonstrated the scope of these problems. These resources have shown there are many people who could be assisted by a fidget.

By focusing on WPI students specifically, the need to survey and evaluate people outside of the small and accessible range was eliminated. This saved considerable time and effort conducting research and identifying customer needs. Furthermore, by collaborating with the ODS for their fall de-stress event the team was provided with an excellent surveying opportunity. The ODS's de-stress event provided context and increased participation for the survey. By setting realistic goals and assisting with data collection the ODS hastened the completion of the project.

Functional Requirements

After the initial list of functional requirements (FRs) was completed, the design team needed to go through several revisions in order to have an axiomatic design decomposition that accurately reflects what the customers need. To do this, three main separate pass through were completed.

In the first pass through, all FRs were removed that conflicted with the design constraints (shown in Figure 7) or with each other to ensure that the design parameters would be functionally independent. These FRs include “provide oscillating force”, “gyroscope”, “temperature”, and “manufactures as a solid piece.” As an example, temperature was removed from the axiomatic design decomposition because though warm or cold feelings could give an interesting tactile sensation, it is not easily controlled or maintained and would be difficult to include in the lifetime guarantee fidget.

After the second pass was completed, FRs about fidgeting features and movements were removed that were not popular based on the surveying data or suggestions from the ODS. These FRs include “rough texture”, “squeezing”, “gyroscopic resistance”, “centripetal acceleration”, and “spring.”

In the third pass through FRs, which were wants and not needs, were converted to design constraints. These included “last more than 24 hours of use” and “survive 15ft drop.”

Finally, the language was fixed in the axiomatic design decomposition. The top level FRs switched between being phrased as “what the customer wants” and “what the fidget needs to do.” The design team decided to switch the FRs’ phrasing to the customer’s perspective in order to improve understanding of the customer’s needs. From this meeting the design team also changed the design parameters into statements starting with “device which...” and following with its respective FR; such as “device which fulfills the need to fidget with something.” With these changes completed, the axiomatic design decomposition was finalized (as shown in Figure 6). The decomposition revisions can be seen in the Appendix C.

#	[FR] Functional Requirements	[DP] Design Parameters
0	Fidget with a device	Device which fulfils the need to fidget with something
1	Experience physical stimulation	Device features which provide physical stimulation
1.1	Experience tactile stimulation	Device feature which provide tactile stimulation
1.1.1	Experience a bumpy surface	Device featuring a bumpy surface
1.1.2	Experience a smooth surface	Device featuring a smooth surface
1.1.3	Experience a squishy surface	Device featuring a squishy surface
1.2	Experience stimulation through the device exerting a force	Device feature which exert force
1.2.1	Experience an impact force	Device feature which exerts an impact force
1.2.2	Experience a clicking sensation	Device feature which exerts a clicking sensation
1.3	Experience stimulation through exertion of motion	Device feature which move
1.3.1	Cause a spinning motion	Feature which can spin
1.3.2	Cause a sliding motion	Feature which can slide
1.3.3	Cause a stretching motion	Feature wich can stretch
2	Use intermittently for an extended period of time	Method to provide extended intermittent use
3	Know location of device	Method to know location of device

Figure 6: Axiomatic Decomposition Functional Requirements and Design Parameters

Design Constraints

For this axiomatic design decomposition, the design constraints (shown in Figure 7) were defined as aspects of the fidget that were not necessary to its function. All of these constraints were written in the Performance Requirements section of Acclaro®, an axiomatic design organization software. These constraints were chosen based on aspects of other fidgets used from experience, research and from the feedback from the surveys and ODS meetings (e.g. silence).

A few of the design constraints were pulled from the original list of functional requirements (FRs) after realizing they were not necessary for the product, but customers' preferences instead. Some examples of these are water resistance and durability. However, the lifespan of the product is important to the target audience.

[RQMTS_PERFORMANCE] Performance Reqmts	
0	These are functional measures that define the
1	Size
1.1	No bigger than a cell phone/pocket
1.2	No smaller than a quarter
1.3	Stowable in less than 5 seconds
2	Weight
2.1	Less than 125 g
3	Noise
3.1	Should be less than xx decibals at 5 feet
4	Cost
4.1	Cost under $4.00 to manufacture
5	Cannot be visually distracting
5.1	Colors
5.2	Lights
6	Used by at least one hand
7	Durability
7.1	Survive 15 ft drop
7.2	Water Resistant

Figure 7: Axiomatic Decomposition Constraints

3.5.2 Building the Product

Once the axiomatic design decomposition was completed, the design team each brainstormed three possible product ideas, rated each design based on the axiomatic design decomposition, and choose the best design. Many prototypes were created and once the final product was created, a standard manufacturing process was instituted.

Design Ideas

From brainstorming the design, team created the following possible product ideas:

Design Idea 1: Spinnable Poker Chip

This design was roughly the size of a poker chip with an outside edge that could rotate freely and the inner material would be able to be depressed and give a clicking sensation. This design would also be thin enough to be easily manipulated in the hand of the user.

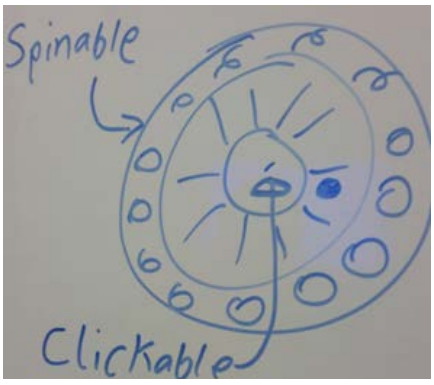

Figure 8: Spinnable Poker Chip

Design Idea 2: Spinnable Pencil Attachment

This idea was a spinnable ring of rubber that would be able to attach to any pen or pencil. This spinnable ring would also be able to be pressed in to give a clicking sensation.

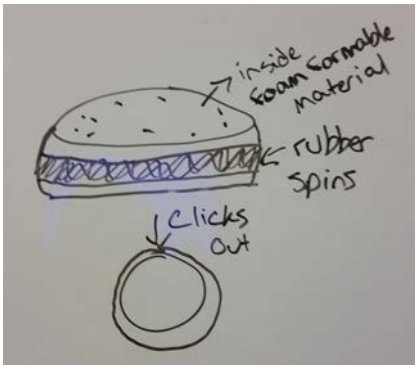

Figure 9: Spinnable Pencil Attachment

Design Idea 3: Gear Spinner

This design idea was to have two linearly connected bearings that would be able to be spun in the user's hand. This device would also have a gear that could spin freely and a button that would give a clicking sensation.

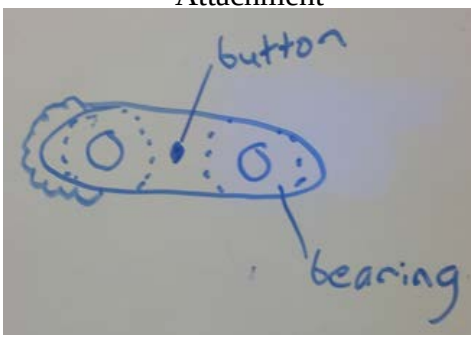

Figure 10: Gear Spinner

Design Idea 4: Fidget Phone Case

This idea had multiple fidget mechanisms that would be on a phone case that would be able to attach over a phone. The mechanisms included interlocking gears, a clickable button, and a formable putty.

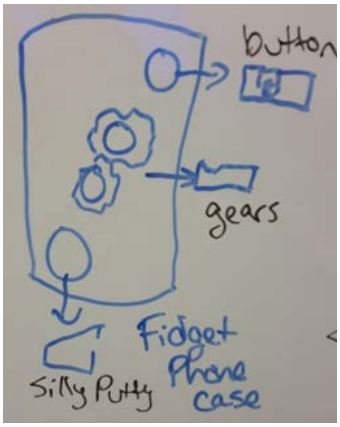

Figure 11: Fidget Phone Case

Design Idea 5: Egg Shaped Fidget

This idea consisted of an egg shape approximately the size of a palm that had a clickable button on one end and a spinning gear on the

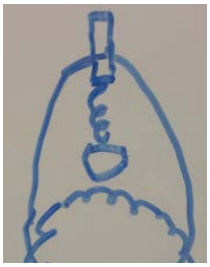

Figure 12: Egg Fidget

other. The button would be able to change to resistance of spinning the gear, when open the gear would spin freely, when depressed the gear would have resistance.

Design Idea 6: Button Bar

This idea consisted of a block approximately the size of your palm that had buttons of varying resistance. These buttons would be able to be both spun and depressed by the user.

Figure 13: Button Bar

Design Idea 7: Ball in Tube

This idea consisted of a small, solid ball that would be able to be pushed up and down a tube. This tube would be able to be formed and attached to different surfaces such as onto a water bottle or a pencil.

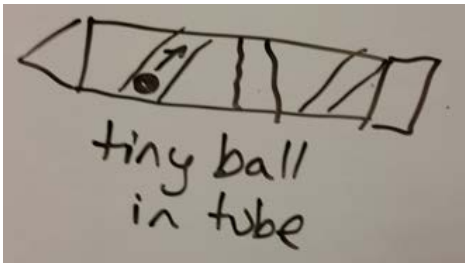

Figure 14: Ball in Tube

Design Idea 8: Inverse Spinnable Poker Chip

This idea is the inverse of the first idea where the middle material will be able to spin and the outer edge will able to be depressed to give a clicking sensation.

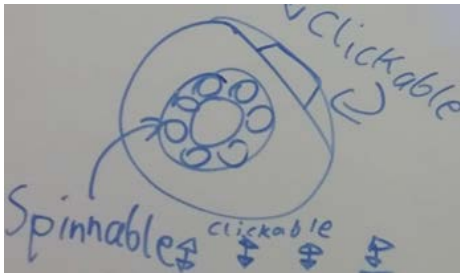

Figure 15: Inverse Spinnable Poker Chip

After developing the individual designs the team came together to discuss the different designs and the way to pick the best design to construct the first prototype. The designs were created using the axiomatic design decomposition as a reference, but the team decided it would not be an appropriate tool to choose the best design. Thus, the design team decided to create a decision matrix from a previous axiomatic design decomposition that had many possible functional requirements for the design. These functional requirements were then ranked to find which were most important. These rankings were determined by results from previous surveys (Appendix B). Each functional requirement was given a scale of from one to five with each number corresponding to how much it was needed in the product (Table 2).

Before the design matrix was pursued, the team had selected two designs that were thought to be best, the poker chip and the egg. These designs were to be looked into further to discuss the feasibility of construction and manufacturability. Before continuing further with the two designs, the team realized that to make the best decision on a design, a decision matrix was needed.

Table 2: Scale for Functional Requirements in Decision Matrix

Scale	
5	Excellent
4	Good
3	Satisfactory
2	Mediocre
1	Unacceptable

The functional requirements that scored fours and fives on the scale were then used in the decision matrix for determining a design (Table 3).

Table 3: Decision Matrix

FRs	Scale	Spinnable Poker chip	Spinnable Pencil Attachment	Gear Spinner	Fidget Phone Case	Egg Fidget	Button Bar	Ball in Tube	Inverse Spinnable Poker Chip
Clicking	5	1	1	0	1	1	1	0	1
Sliding	4	0	0	0	1	0	0	1	0
Spinning	5	1	1	1	1	1	1	0	1
Springy/ Stretchy	4	0	0	0	1	0	0	1	0
Water Resistant	5	1	1	0	0	1	1	1	1
Droppable	5	1	1	1	0	1	1	1	1
Long Lasting	5	1	1	1	1	1	1	1	1
Fits in Pocket	5	1	1	1	1	1	1	0	1
Attachable	4	0	1	1	1	1	1	1	0
Bumpy	4	1	1	1	1	1	1	1	1
Smooth	5	1	1	1	1	1	1	1	1
Totals		39	43	33	41	43	43	36	39

The three designs that had the highest scores, Spinnable Pencil Attachment, Egg Fidget, and Button Bar, were then further considered for the final design. The Egg fidget design was one that had previously been considered and was decided on being the design that would be used to continue the project.

Prototypes

The first steps after deciding on a design were creating prototypes and improving the concept. The product went through three different prototypes before it was given to testers. The first prototype was created to get the proper size that would fit in a person's hand and to test the feasibility of the gear resistance mechanism. CAD was done to create a 3D model of the original design (Figure 16 Left). Research was done into a possible silent clicking mechanism to aid in keeping the device quiet. After research, the silent clicking mechanism was found to be difficult to create and, thus, not used in the prototype. The full device prototype was modeled to

have the proper shape and the size along with the gear. The gear was moved from the wide end to the small end to make it easier to hold. This zero order prototype was more of a 3D model feasibility analysis of the design instead of a physical prototype.

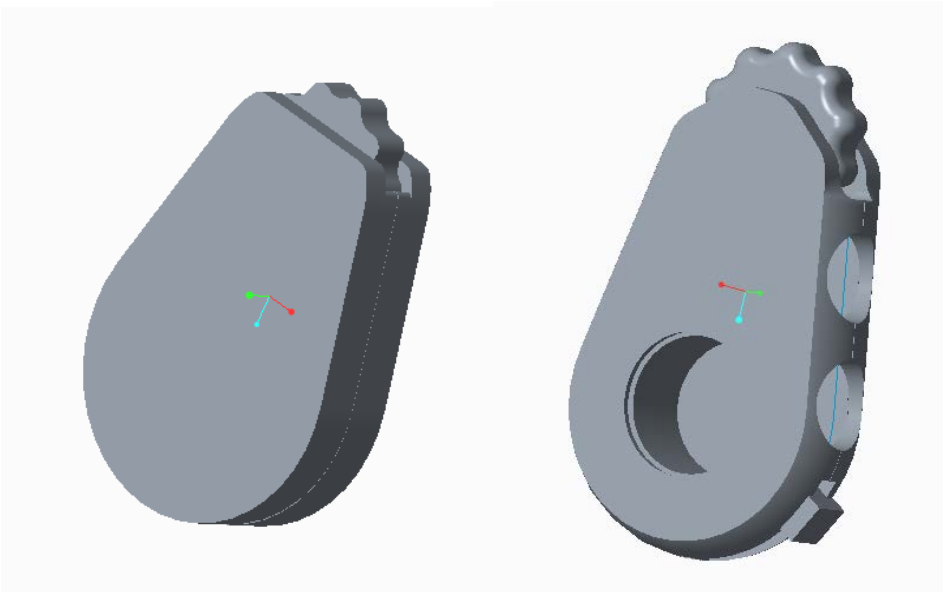

Figure 16: Original CAD Model (left) and CAD Model Used for testing (right)

The next design included two halves that would come together, hold the gear, and allow it to spin. A 3D printer was used to create three different sizes of prototypes to decide which would be the most comfortable size. This prototype was printed using ABS plastic because it was readily available and easy to print. After printing, the two sides were connected by tape. It was then decided the next prototype would need features to hold the sides together. After testing a variety of sizes and finding the most comfortable fit, the team discussed features that could be added in the next prototype.

The axiomatic design decomposition was referenced heavily for deciding what features were needed for the next prototype. The team decided that the original idea of the varied resistance gear would not bring as much consumer satisfaction as other features that could be placed in the product using the same space. Using results of previous surveys and research, more features such as buttons, a slider, and increased ergonomics, were added to the original design.

Each of the features was iterated until a suitable result was found. The first round of changes increased the ergonomics of the device and made it more comfortable to use. After observation, it was found that when the team was holding the product, the edges would cut into the skin making it uncomfortable to hold. A rounded edge was added around the outside of the two halves to remedy this. It was also found that the two buttons were spaced too closely together to be easily used by two separate fingers, so the buttonholes were moved farther apart. The large button on the face of the prototype was iterated until it could be easily manufactured and assembled. The first test of this feature was to test whether this feature could be manufactured in house using thin sheets of metal. These tests resulted in un-clickable metal sheets, which could not function as buttons, so it was decided to purchase buttons wholesale rather than manufacture them. Several sizes of slider were tested to find the one that provides the proper amount of resistance during use. The last problem to be corrected was the inability to rotate the gear through its full range of motion with the thumb. This problem was corrected by removing the upper corners of the egg, allowing the gear to be rotated more easily and farther by the user. The CAD drawing is shown in Figure 16 (right) and various evolutions of our prototype can be seen in Figure 17.

Figure 17: Assorted Evolution of Fidget Devices

Manufacturing Process

The manufacturing process began with finding suppliers or manufacturing methods for all the parts that would be needed to assemble the prototype. The parts to be gathered were the body of the prototype, the side buttons, the large button, the slider, and the gear. The body, slider, and gear were 3-D printed on a MakerBot Replicator 2X at WPI (Figure 18). The body was designed to have two halves that would combine to make the full body. All these parts were designed to be 3D print. The approximate print time was eight hours to produce six bodies, six sliders, and five gears. Research was also done to find suppliers for the different buttons that were needed for the product. An image of a prototype fidget sheet in the MakerBot can be seen below.

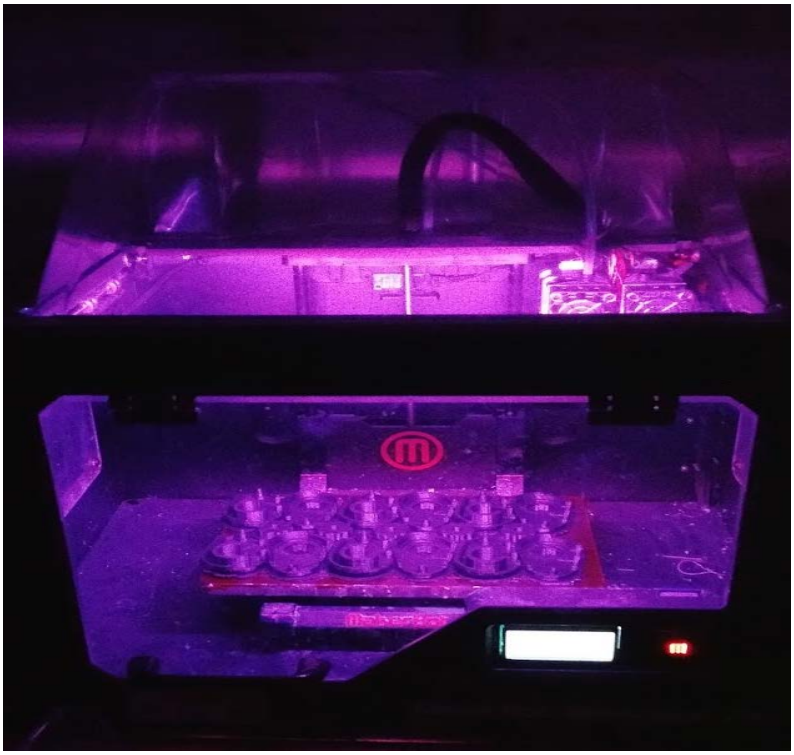

Figure 18: 3D Printer Printing Fidget Devices

The following steps were used to assemble the fidgets:

1. Remove raft material from all fidgets
2. Remove edges from all large buttons

3. Super glue the large buttons into place on the fidget side without protrusions
    a. Hold for two minutes
4. Place super glue drops onto each snap fit
5. Snap fit the halves together with the gear and slider in place
    a. Hold for two minutes
6. Add super glue to the lower button ends
    a. Hold for one minute

3.5.3 Testing the Fidget

Participants were contacted from the survey to test the fidgets and give feedback. The volunteers were asked to fill out a pre-use survey upon receiving their fidget and to complete a post-use survey after a week with the device. At the end of the week the volunteers were able keep their fidgets.

Originally, 51 participants were contacted from the survey who expressed interest in being contacted further about the project (all email communication can be seen in Appendix D). From those participants, 28 people responded and 27 volunteers picked up a fidget and completed the pre-use survey about their first impressions of the features they will use and their basic fidgeting habits. After a week, the post-use survey, with questions about design improvements and overall use, was sent out and 25 volunteers completed it. The pre-use and post-use survey can be seen in Appendix E. This feedback allowed the team to complete design revisions and validated customer needs.

3.6 Design Team Results

3.6.1 Design Changes

The design changes made to the prototype were based on feedback received from the testers. During their post-use survey, testers were asked for specific feedback about each feature on the fidget. This feedback was compiled into categories so the most popular suggestions could be identified.

For the gear component of the fidget, testers most commonly said that they wanted more resistance, to spin more freely, the edges to be more rounded, to emit less noise, and that they generally enjoyed it as a feature. Feedback that was echoed by two or more respondents can be seen in Figure 19.

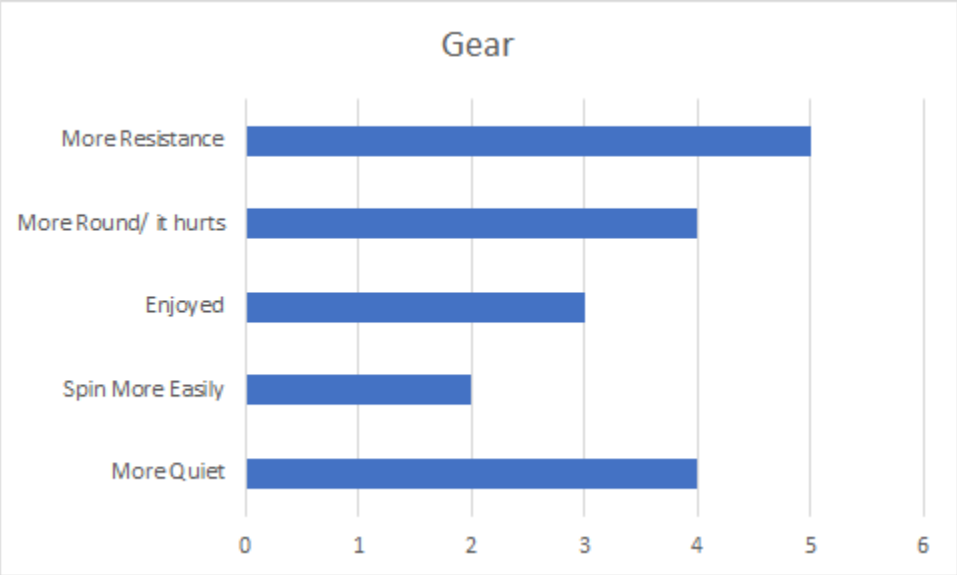

Figure 19: Feedback on Gear Feature

Based on this feedback it was decided to round the edges of the gear, experiment with rubber coating, and leave the rotation force unchanged. Rounding the edges of the gear eliminated the sharpness and discomfort some users felt while the gear engaged their palms. By coating the gear in rubber, or printing with a variety of materials including plastics with more give than ABS or PLA, the design team hoped to reduce the noise emission while also making it

more comfortable and dynamic to hold. The general resistance on the gear will not be changed because the feedback was mixed for both more and less resistance.

For the side buttons of the fidget testers most commonly said that they wanted buttons that were easier to press and had resistance that is more tactile. Feedback that was echoed by two or more respondents can be seen in Figure 20.

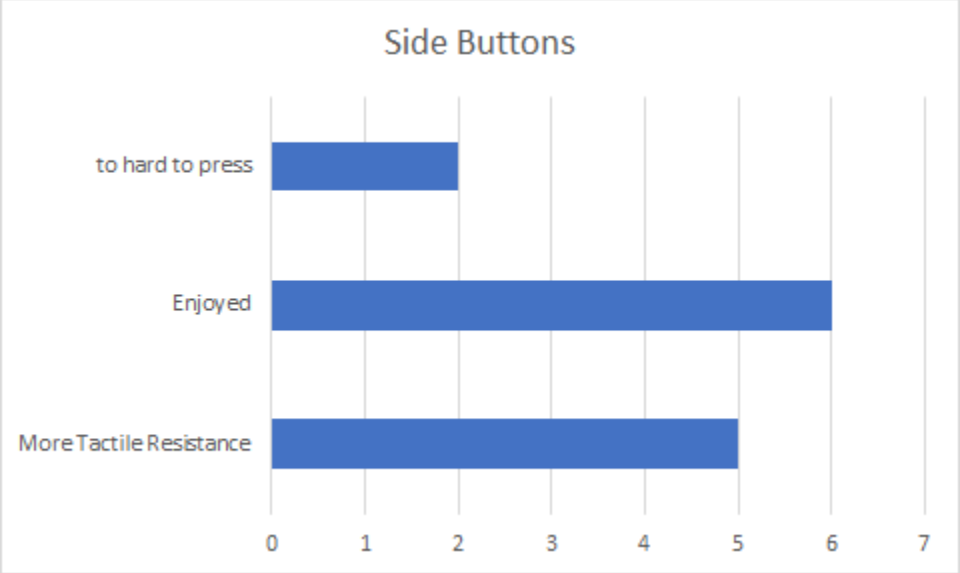

Figure 20: Feedback on Side Button Features

Based on this feedback, possible alternative buttons with more sensory feedback than the current buttons were identified. It was found that keyboard switches are a reasonably inexpensive button alternative, which require a low activation pressure. These switches are designed to emit tactile and satisfying feedback while being pressed.

For the size and shape of the fidget testers most commonly and overwhelmingly said that they enjoyed the current size. Feedback that was echoed by two or more respondents can be seen in Figure 21.

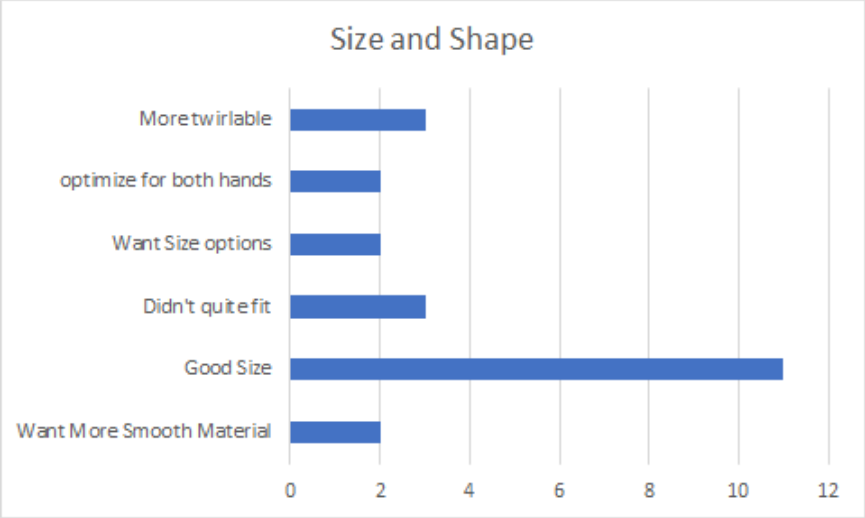

Figure 21: Feedback on Size and Shape of Fidget Device

Because the testers enjoyed the current size, the design team is working to ensure future changes will have a negligible impact on the fidget's envelope. The team is experimenting with rubber coating solutions for the gear that will not change the profile of the fidget. In addition, ways to modify new buttons and features to ensure they can fit within the fidget's current body are being researched.

For the large button feature on the fidget testers most commonly said they want a greater range of depression, that they enjoyed it, and that many of them did not use it. Feedback that was echoed by two or more respondents can be seen in Figure 22.

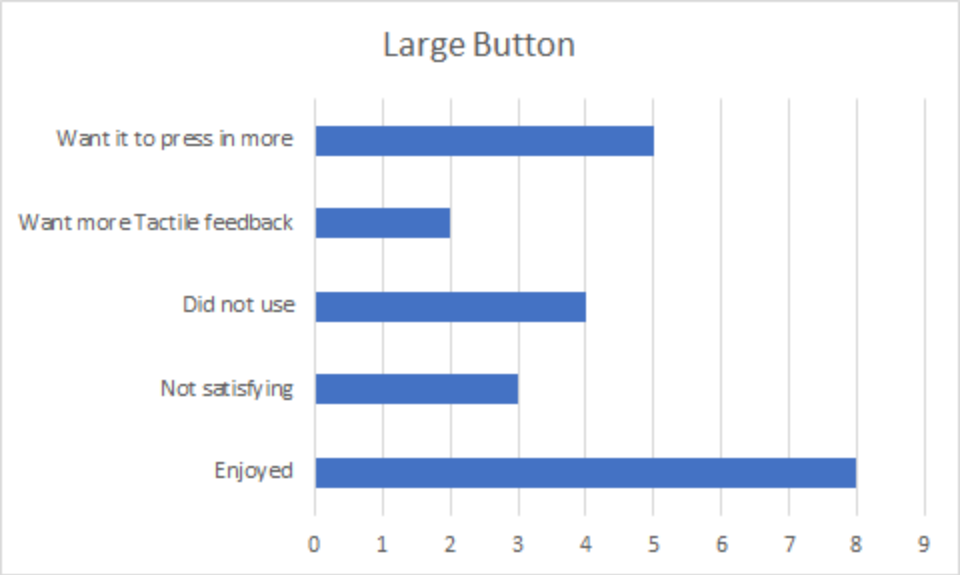

Figure 22: Feedback on Large Button Feature

In order to create a greater range of depression, with a similarly large button like feature and which might appeal to a wider range of people, the large button will be replaced with a joystick. The joysticks ordered for testing should provide a tactile experience and movement options similar to joysticks used in popular video game controllers like PlayStation 2.

For the slider feature on the fidget testers most commonly said that it was too sharp, that they want more tactile feedback, that the track should be longer, and that it needs more resistance to be satisfying. Feedback that was echoed by two or more respondents can be seen in Figure 23.

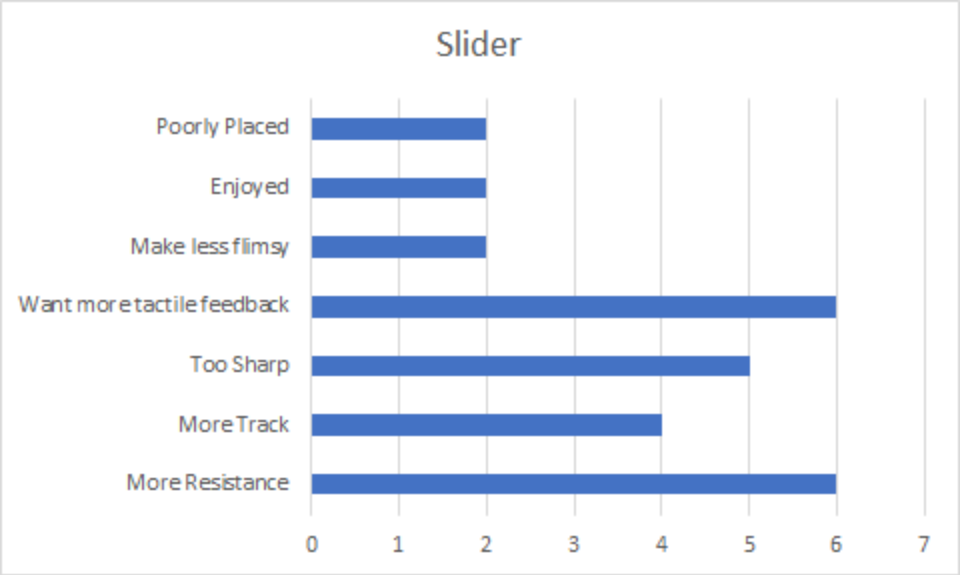

Figure 23: Feedback on Slider Feature

In order to make these improvements the team is changing a variety of the slider's features including its geometry, method of fixturing, and track length. The slider has been redesigned with a mushroom like shape to eliminate the sharp edges. The slider's fixturing in the track will be changed so that it is held in the center of the slot by two springs. These springs will add more resistance than the current design, in which the slider is held only by friction. They will also create a more tactile sensation as the sliding force will vary as the springs stretch. The total length of the slider's track has also been increased.

For the texture of the fidget testers overwhelmingly said that they would like a smoother surface. Feedback that was echoed by two or more respondents can be seen in Figure 24.

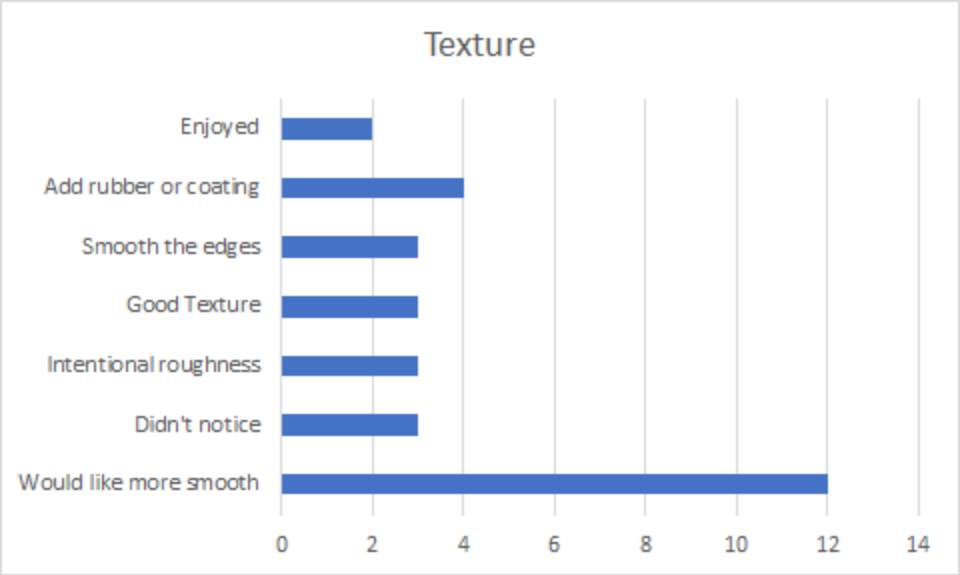

Figure 24: Feedback on Texture of Fidget Device

In order to decrease surface roughness in the fidget, a variety of 3D printing techniques are being researched. The design team has begun printing in PLA instead of ABS for its improved surface characteristics. Unfortunately, a sustainable and defect free manufacturing process with this material has not yet been identified. The team has experimented with printing without a raft onto gaffers tape, but the created surface was too rough. The team will experiment with printing ABS onto kapton tape and making ABS parts smoother with acetone vapor in the future.

3.6.2 Product Usefulness

During the post-use survey, users were also asked some questions relating to the usefulness of the product during the testing period. The first question asked was how satisfied the user was with their product.

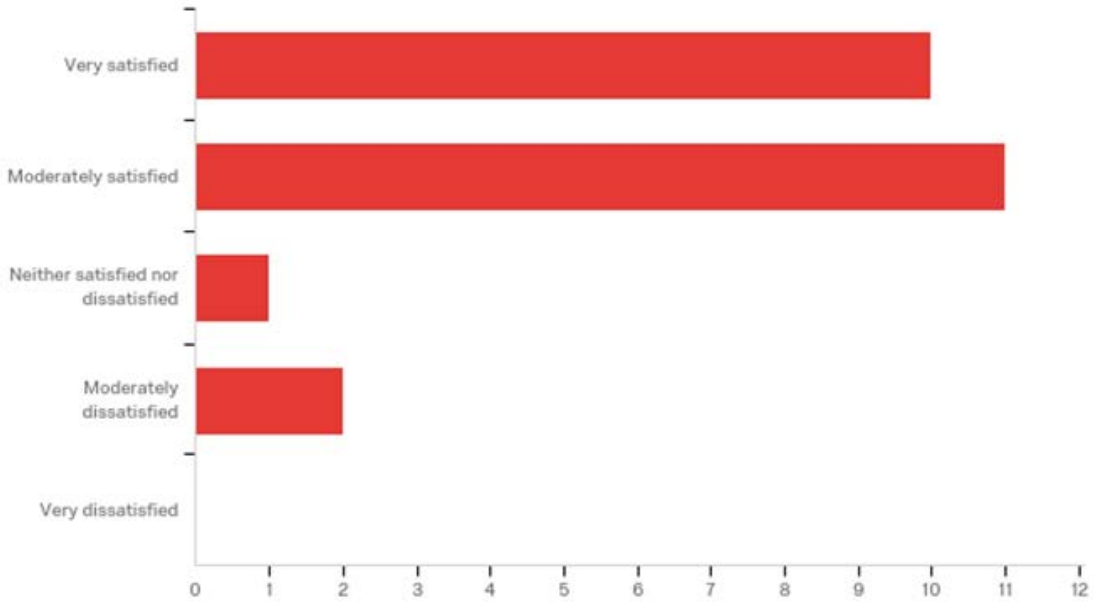

Figure 25: Feedback of Question Asking How Satisfied the User was with the Product

The results (Figure 25) show that over 75% of the users found the device satisfying. Later the survey asked specific questions (Table 4) as to how this device was useful in the user's daily life. Results from these questions showed that the device was able to help the user focus better, receive physical stimulation, and relax.

Table 4: Post-Use Survey Question: How was this device useful in your daily life?

#	Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	This device helped me focus better	4.17%	4.17%	25.00%	58.33%	8.33%
2	This device provided me with physical stimulation	4.17%	4.17%	0.00%	54.17%	37.50%
3	This device helped me relax	4.17%	0.00%	37.50%	50.00%	8.33%
4	This device helped me spend less time on my phone	4.17%	20.83%	20.83%	41.67%	12.50%

3.6.3 Final Product Description

The invention this team created was a 3D printed, handheld device that can be used to prevent distraction and help the user direct their focus (Figure 26). This invention consists of an ergonomically teardrop shaped outer shell, with rounded edges, that has a large circle at one end and tapers off to be thinner at the other end. The device has five intended fidgeting features.

The first of these features is a rounded beveled gear that protrudes from the thinner edge of the device. The user can spin this gear with their fingers or roll it on different surfaces to feel a rumble sensation. While using the gear with their thumb, the user has another option on how to fidget two silent buttons. Unlike a pen that makes an audible clicking noise when pressed, these buttons are far more silent and less likely to distract others around them. The buttons were placed on the side edges of the fidget so that they could be used at the same time as the gear without have to reorient the fidget in the user's hand. They were also spaced enough apart so that two fingers could comfortably fit onto the two buttons.

On the side opposite the gear on the round end is a small slider that the user can slide back and forth through a small channel in the outer casing. This slider can have varying degrees of difficulty to move depending on the wants of the user. There are options in manufacturing to have a loose slider that easily moves back and forth, a tight slider that requires more effort to move, and a self-center slider that uses elastics to cause resistance and center itself when not in use.

On the flat face of the device is a large metallic button that can be satisfying to users that desire an auditory response while fidgeting. This large button is placed on the flat face of the fidget in the center of the circular end of the fidget. When pressed, this button can make an audible pop that many users find satisfying. Though the feature can create an audible noise, it

can also be pressed in such a way that it creates no noise and would not distract others around the user.

The texture of the two flat faces also allows users to fidget. 3D printing creates a semi-rough surface that the user can run their fingers across to receive pleasant tactile stimulation. The smooth, rounded outer edges of the fidget also work as a fidgeting outlet that a user can run their fingers up and down for calming sensory feedback.

What prior devices lack is the ergonomic placement of their fidgeting attachments on their products? The devices out on the market do not fit well in a person's hand and can be very uncomfortable to play with for a long time. In addition, the shape of this device is meant to sit naturally in a person's hand so that an onlooker would not even notice the user had something in their hand. The thin design also allows for easy and discreet storage into a user's pocket whereas other products are difficult to get in and out easily.

Figure 26: The Fidget Egg

3.6.4 Axiomatic Design Check

After completing the fidget's final design, it was checked against the axiomatic design decomposition to ensure the functional requirements were still met. Figure 27 is a chart that shows which FRs were completed and how.

FR#	FR Description	How
0	Fidget with a device	Fidget Egg
1	Experience physical stimulation	Fidget Egg materials
1.1	Experience tactile stimulation	Fidget Egg textures
1.1.1	Experience a bumpy surface	Gear
1.1.2	Experience a smooth surface	Egg body/buttons
1.1.3	Experience a squishy surface	Not fulfilled
1.2	Experience stimulation through the device exerting a force	Buttons/slider
1.2.1	Experience an impact force	Slider
1.2.2	Experience a clicking sensation	Buttons
1.3	Experience stimulation through exertion of motion	Slider/gear
1.3.1	Cause a spinning motion	Gear
1.3.2	Cause a sliding motion	Slider
1.3.3	Cause a stretching motion	Not fulfilled
2	Use intermittently for an extended period of time	Snap fits/glue/strong infill
3	Know location of device	Keyring hole

Figure 27: Functional Requirements and How They Were Completed

The only unfulfilled FRs are FR 1.1.3 and FR 1.3.3. Future design plans include a stretchy/squishy material for the gear, which will fulfill these FRs and complete the axiomatic design decomposition.

3.6.5 Future Design Ideas

Since the final product design was completed, customizable options were created so customers can decide which fidget options will help them the most. This change to fidget customization puts the Fidget Egg ahead of fidgets on the market today, making it the first fidget to provide customers with fidgeting options. This change primarily affects the fidgeting features and not the overall ergonomic shape of the device.

The fidget options for the center of the larger end of the device are a safety button, a bearing, and a joystick. The safety button is the option in the original design as described

previously, but with color options. The bearing is a ball bearing that allows fidgeters to spin the entire device around this center axis. The joystick is a game-controller-styled joystick that allows the fidgeter to spin the joystick in circles and click it down like a button, while having the familiarity of a game controller.

In place of the original red side buttons, buttons that create a clicking sensation, in order to simulate clicking a pen, and buttons with more resistance, for providing a higher force, have been found. Customizable options for the gear feature include a high resistance gear and a more free spinning gear. These two options were explicitly requested by the fidget testers to create a more satisfying sensation for this fidgeting aspect. The slider options include both more and less resistive sliders, providing movement that is more interesting for the fidgeters. Each of these fidgeting components includes color options as well. In the future, it will also be possible to replace these components with entirely different fidgeting stimuli.

Not only can customers choose custom fidget options to provide the most effectiveness, but they can also choose between three overall sizes- small, medium, and large- of the device to get the best ergonomic fit. On the overall shell, customers are able to make their fidget personalized by getting their name engraved and choosing an overall color.

3.7 Design Team Discussion

Since the beginning of this project the two metrics of success were to make and test a new kind of fidget toy and to identify what fidgets are best for the customers. Through the Fidget Egg the team has designed, manufactured, and tested a new product to meet fidgeting needs. Through the testing and analysis, the team has found that no fidget can be ideal for every customer. The combination of these accomplishments established the following conclusions:

- Created a fidget that helps people direct their focus
- There is no ideal fidget for everyone, people have differing fidgeting needs

Creating the Fidget Egg, involved multiple stages of design. The team began with research that helped the team establish the customer needs. These customer needs allowed the team to proceed with the axiomatic design decomposition, which dictated what features the Fidget Egg would eventually have. Once the team determined what product would be created physical prototypes were created and used for testing. The feedback from testing has been incorporated into the final products design. The current Fidget Egg meets the products goals.

Feedback from the testing showed that the Fidget Egg is a good fidget toy, but that it is not perfect for everyone. Through studying the tester's feedback, the team determined that many of the customer's desires, like the device's total size, were incompatible with each other. Because it would be impossible to create a "perfect" fidget, or a fidget that met every need of every customer, the team begun determining ways for people to customize their Fidget Eggs in order for each fidget to best fit its customer's fidgeting preferences. Because no single fidget device can be ideal for every customer, customization will allow the team to make Fidget Eggs the best toy possible for every person. This project has succeeded in its main goals of yielding a new fidget and identifying that the best fidget is the one made especially for each customer.

4. Business Plan

Now that we have discussed about the design and manufacturing, the focus of this chapter is to discuss the future of the Fidget Egg on the business end. This business plan includes a general description of the business.

4.1 Business Description

The need to occupy our hands or feet while thinking occurs every day. This behavior may take the form of spinning a ring on a finger, clicking a pen, squeezing a stress ball, to a foot jumping up and down repeatedly. The literature study, primary research, and experimental design and manufacturing of a fidgeting device called the Fidget Egg, is the framework from which this business plan is based. In this plan, we explored how to bring the Fidget Egg to consumers on the market.

4.1.1. Vision

This major qualifying project team saw a need for people to use fidgeting objects as tools to empower people to direct their levels of focus or for their own varying reason's, on a person's preferred tasks. This project inspiration came to be from an interaction from one of the mechanical engineering author's experiences in his sophomore year by fidgeting with a pen during lecture. The professor leading the lecture saw that the pen used as a fidgeting object was a disruption to lecture and prohibited the use of the pen other than to take notes. From the author's experience in class, he wanted to ensure that other consumers who need an outlet for excess energy or any other reasons, to be empowered by discreetly using fidgeting objects that are not a distraction to the user or to others.

Two business students saw this project as an opportunity to explore the aspects of bringing a fidgeting object to market and investigate the technicalities creating a business or start-up.

Related Work

One on-going study that closely relates to our work is from Michael Karlesky from NYU Tandon School of Engineering and Katherine Isbister from Jack Baskin School of Engineering, University of California Santa Cruz. Karlesky and Isbister developed two products called the Fidget Widget: Infinite Bubble Wrap and Fidget Widget: Rock the Cradle "as a playful secondary interaction to modulate affect and shape cognitive state to support a user's primary task" (Isbister & Karlesky, 2013). Their Fidget Widgets are small, digital, touch screen devices that operate independently or together, that reacts to movement and produces noise feedback.

Another study is by Rebecka Nyqvist from Lund University, Sweden, in which she explains that the four main reasons to fidgeting is to relax for physical release, being active for physical engagement, to be focus for cognitive engagement, and to explore for cognitive release (Nyqvist, 2016). Nyqvist states that for a person to find a suitable object for them is dependent "on personal preference, type of activity and desirable benefits" to which she recommends a website to be developed to help people understand the benefits of fidgeting and how to acquire fidgets appropriate for the office.

A Fidget Device

We are introducing an affordable, discrete, versatile fidgeting device to consumers. As mentioned in Nyqvist's study, fidgeting objects are not a one product fits all to the needs of consumers. Shoppers who are looking for fidgeting objects available online or in-stores all have varying reasons, which allows several fidgeting devices, produced by product developers or mechanical engineering teams, be made readily available to consumers by retailers or vendors.

For Anyone

The Fidget Egg is for consumers that may satisfy a want or a need. The product was designed to be used for anybody, to be bought in any budget, and for any purpose. Originally, the experimental device was to be designed for WPI students however, the Fidget Egg gained

popularity during its testing period by the author's friends, family, and WPI faculty and staff that with this traction allowed the authors to market the product ahead of schedule and inadvertently sell prototypes of the Fidget Egg to students and testers.

For Anywhere

Consumers who are looking for new fidgeting objects to occupy their hands can satisfy those conditions by using the Fidget Egg. The fidgeting device was designed to be small, hand-held devices for easy storage and access. Often fidgets are kept in close proximity to the buyers such as in pockets, backpacks, purses, keychains, or left on desks that the person frequents. The use of the Fidget Egg is for any type of environment that fits best to the consumers' needs or wants. This allows the product to be used discreetly at home, at work, in lecture, in meetings and anywhere else that the consumers wishes.

For Any Reason

Some people think there are negative connotations associated with fidgeting. The inability to keep still may be viewed as disruptive behavior in classrooms, in office settings, and in classrooms. Fidgeting is a behavior that most people exhibit. For some this behavior is portrayed as touching objects near their workspace, to checking notifications on one's cell phone, or looking at their watch for a mental break. Most people fidget when "under-stimulated, bored, sitting still, waiting, uneasy or nervous," meaning that this reduces the stigma of fidgeting as a behavior that should be corrected (Nyqvist, 2016). A goal in producing the Fidget Egg was to ensure that the device is beneficial to the needs and wants of consumers.

Fidget Egg Mission Statement

The purpose of the Fidget Egg is to empower the consumer for any productivity task and to be made available for anyone who would like to use its properties to relieve stress and increase focus.

4.1.2. Value Proposition of Fidget Egg

As discussed in Chapter 3, the Design Team created a fidget device that aligns with our vision for this business plan. The device, which we named the Fidget Egg, is egg-shaped and made of 3D printed plastic. The device frame comes in black with red buttons and has several features on it, including a gear, side buttons, a safety button, and a slider. Designed to fit in one hand, the Fidget Egg is currently being manufactured in three different sizes to fit best the needs of the user with moderately sized hands. As supported by the design survey results, which are included in Appendix E, the Fidget Egg is versatile, discrete, affordable, and effective for consumers.

One of the main benefits of the Fidget Egg is that it is versatile. Due to its multifaceted design, the consumer can use whichever features they want, the most popular of which are the gear and side buttons. Consumers can use their Fidget Eggs in many different locations as well, such as home, work, or school. Nineteen survey respondents, or 70%, used the Fidget Egg in more than one location throughout their testing period. Additionally, the Fidget Egg can be carried around in various ways, such as the person's hand, his or her pocket, on a keychain, or in a backpack or purse.

Another benefit of the Fidget Egg is that it has a discrete design, which many adults prefer. Due to its overall shape and size, it can be concealed in one's hand or pocket. Most survey respondents – almost 80% – reported that they usually kept the Fidget Egg in their pockets. The features on the device are relatively quiet and are not likely to draw attention from others due to noise. In addition, since the colors of the device are neutral, adults can feel comfortable using a Fidget Egg in professional settings, such as at work.

A survey sent to Doherty Memorial High School, a local Worcester public school, asked two educators on their thoughts of students using fidgeting objects in their classrooms. Full

responses of the survey can be found in Appendix F. During their time teaching both instructors have come across students with behavioral disorders, typically students with ADHD and autism. Both teachers stated that they would be fine with students using a fidget toy, as long the object does not pose a distraction to other students. In the responses, they have come across students using cell phones, pens, pencils or water bottles, which can be found in the immediate vicinity of a student's desk as fidgeting objects. Using a cellphone in the classrooms, however, is against school policy thus they would discourage students from using them. The teachers stated that they would permit non-cell phone objects that are both quiet and discreet in their classroom. With the Fidget Egg's small, nearly soundless, and unobtrusive scheme, the product would fall under the educators approved items in the classroom. In addition to adults using the Fidget Egg in a professional setting, the product would also be found in classrooms, lectures, and other workspaces for people to fiddle with in their hands.

Furthermore, the Fidget Egg is a very affordable option for adults who wish to use a fidget device. Of those who answered Question 23, almost 90% of respondents were willing to spend at least $5 on a fidget device such as the one they tested out, while over 47% were willing to spend up to $10. Both of these price points would be sufficient to turn a profit (refer to section 4.4 for more details), and are very affordable compared to other fidget devices on the market, such as the Fidget Cube, which has a retail price of $25 (Fidget Cube, 2017).

Perhaps the most important benefit of using the Fidget Egg is the effect it has for consumers. Based on our current data, consumers are responding positively in regards to the effectiveness of the Fidget Egg. Of those who answered Question 10 over 87% of respondents were at least moderately satisfied with the Fidget Egg, and almost 42% were very satisfied. As shown in Figure 28, of those that answered Question 11 over 65% agreed that the device helped

them focus better, 95.7% agreed that the device provided them with physical stimulation, 69.6% agreed that the device helped them relax, and almost 74% agreed that the device helped them spend less time on their phones.

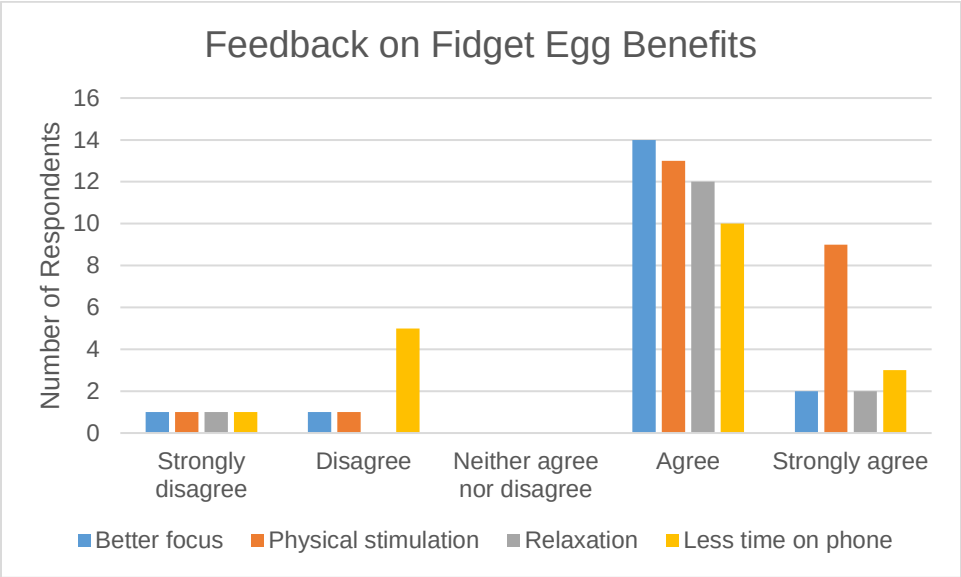

Figure 28: Feedback on Fidget Egg Benefits

When asked to provide general feedback about using the device, one respondent answered:

> I love it! It is fun and useful, it helps me stay off my phone and resist biting my nails. (Student Respondent, 2017)

The above statement means that for some people the Fidget Egg assisted the user in addressing harmful habits in reducing nail biting.

Besides the other benefits already mentioned, the Fidget Egg could also help reduce the stigma of fidgeting and the use of fidget devices among the general population. Of those who fill out both the pre-use and post-use survey, 43% showed an increase in the belief that there is a stigma attached to fidgeting, while 33% showed a decrease in that belief. Of those who answered Question 24, 63.6% of survey respondents believe there is a stigma to fidgeting. Of those who answered Question 25, only 27% of survey respondents believe there is a stigma attached to

fidget devices, while almost 32% thought that might or might not be a stigma attached to fidget devices. Although there are many ways to interpret this data, one interpretation could be that using a fidget device is less stigmatized compared to other fidget habits, such as leg bouncing, nail biting, or pen clicking. With the introduction of the Fidget Egg into the market, this trend could continue and fidget devices such as the Fidget Egg could provide an accessible, common way for individuals to cope with fidgeting habits. When asked to explain his or her feelings about stigmas, once participant responded:

> Fidgeting and being jittery often annoys people so I feel like there is judgment placed when people do that, but I do not feel like the toys detract from anyone's views of people because often people have things on their desk and that does not mean anything bad about them. It seems like it is just for fun but it actually serves a purpose. (Student Respondent, 2017)

Observations of Fidget Egg Users

An exchange that was observed by one of the authors during the Fidget Egg's testing period was that in one occurrence during a student governance meeting, a user was pushing on the safety cap repeatedly in a rhythmic fashion and alternatively pressing on the two side buttons on top of the desk. As these actions persisted a WPI student, (non-user of the Fidget Egg) sitting beside the user remarked in reference to the Fidget Egg:

> You need to stop doing that. It is a distraction to me. If you are going to use it during the meeting then I need you to put it away. (WPI senior, 2016)

In this occurrence, the use of Fidget Eggs to other non-users was shown that the product is a distraction to some who can visibly and audibly hear the product in use. This information was shared to the mechanical engineering team in investigating other button options that do not produce audial feedback when pressed. Although the WPI student who said the above statement could visibly see the Fidget Egg in use, there is no way to control how Fidget Egg users utilize the product for their needs and wants in their own personal time and environment.

In an exchange with one of the author's friend who was testing the Fidget Egg, off-handedly asked them how they liked the device to which they remarked:

> The fidget is a distraction to me. I do not need it to focus or anything. I find myself playing with the fidget than doing my work. (WPI freshman, 2016)

In this occurrence, the Fidget Egg demonstrates that people who do not fidget as frequently as other users do not gain the same benefits and effectiveness in relieving stress or increasing levels of concentration. The user felt unsatisfied with the product in that they would be less likely to purchase a Fidget Egg after the testing period as their own personal choice.

4.1.3. Business Model

In order for this business to succeed when it is fully brought to market, a comprehensive business strategy must be created and implemented. In the following sections, we provide more details about the Fidget Egg marketing strategy, which highlights information about consumer behavior, a market analysis, and an advertising strategy. We also created an operations strategy, which contains details about orders are processed and how the manufacturing process can be improved to be more efficient. Additionally, we conducted a financial analysis, which includes information about costs, pricing strategy, and forecasts the business cycle for this product.

After working on the design and business plan of this fidget device for over six months, we truly believe that this project lays the foundation for high success. As fidget devices are brought to market, more people could benefits from them. The Fidget Egg will help adults focus better, as well as reduce the stigma of those who fidget, especially people who have ADD/ADHD or other disabilities.

4.1.4. Legal Structure and Intellectual Property

The success of any business requires the proper legal framework in place. Legally registering a business provides structure for the owners and legitimizes the company for potential customers. In addition, in order to protect the company's intellectual property, it is recommended that patents, copyrights, and other forms of intellectual property protection be obtained as necessary.

Limited Liability Company

At the conclusion of this project, several team members are considering registering as a business. After some deliberation, the team agreed that registering as a limited liability company, or LLC, is the best option in the immediate future. LLCs are beneficial for several reasons. For example, as the name suggests, there is limited liability for all members of the company. Therefore, members' personal assets are protected in case of debt or litigation. Additionally, there is less paperwork involved with an LLC as opposed to a corporation, and the start-up costs are generally lower (U.S. Small Business Administration, 2017).

In order to register as an LLC in Massachusetts, a business name must be chosen and the Certificate of Organization must be created and filed with the Secretary of the Commonwealth. The Certificate of Organization may be filed online, and the cost of registration is currently $500 (Secretary of the Commonwealth of Massachusetts, 2017). Although not required, it is recommended that an operating agreement be created as well. Due to the nature of this product, no extra permits or licenses are required (U.S. Small Business Administration, 2017).

However, there are some disadvantages to registering as an LLC, such as self-employment taxes. Also, should one of the members decide to leave the LLC, the remaining members may be required to dissolve the company and/or refile (U.S. Small Business Administration, 2017). In the future, as the company grows in size, Fidget Egg, LLC would

likely transition into becoming a corporation. As a corporation, Fidget Egg would file taxes separately from the owners, and the company would have the option to sell stock in order to raise funds. Furthermore, Fidget Egg would be able to offer more benefits to current or potential employees (U.S. Small Business Administration, 2017). Although registering as a corporation would require more time, money, and paperwork, this would be the best option to help Fidget Egg expand in size and capability.

Provisional Patent

In order to protect the intellectual property of the design of the Fidget Egg, the design team filed a provisional patent (See Appendix H: Provisional Patent), which was submitted to the U.S. Patent and Trademark Office on February 16, 2017. The title of invention is "Cognitive Focus Enhancement Device," and applicants assert small entity status under 37 CFR 1.27. This provisional patent will be valid for one year and makes the following claims:

1. A device for providing mechanical outlets to direct cognitive focus comprising: an eccentrically circular shaped body; and a plurality of mechanical attachments disposed on the body, the mechanical attachments responsive to displacement movements by a user, whereby user activation of the mechanical attachments diverts user attention from extraneous distractions to permit enhanced focus on a foreground task.
2. The method of claim 1 wherein the body is substantially egg or teardrop shaped.
3. The method of claim 1 wherein the body is printed on a 3D printer using additive manufacturing techniques. - 2 - COG17-01p
4. The method of claim 1 wherein the 3D printer is responsive to successive print iterations of varying size body and mechanical attachments.

4.2 Market Analysis

To have a successful product and a business, it is imperative to understand the current state of the market before a detailed marketing strategy is developed. For the Fidget Egg, the market is very new; the concept of a fidget device has risen in popularity just over the past few months. As mentioned in section 3.3.3., the Fidget Cube is one of the most popular fidget devices on the market right now, and was originally a Kickstarter project. According to Google Trends, the frequency of the search term "fidget" increased dramatically in the United States in early September, 2016 (Google Trends, 2017) – the same time that the Fidget Cube raised $1,000,000 in funds on Kickstarter (McLachlan & McLachlan, 2016). The term "fidget" also reached a peak popularity on Google in the United States in January 2017 (Google Trends, 2017). Some related search terms such as "fidget toy" and "fidget device" also show similar trends in popularity.

Because the fidget toy market is so new, there is not much information available about how to effectively market to consumers for this type of product. However, research on consumer behavior is still very beneficial for creating a marketing strategy.

4.2.1. Consumer Behavior of Fidget Devices

Today people can buy products with a few simple clicks on their smartphones and have those products arrive to their doorsteps in a matter of minutes, days, or weeks. Consumer behavior is the study of when, where, and how people shop for products, use them, and later disposes of them – repeating the cycle. Jeff Tanner and Mary Raymond explain in their book *Marketing Principles* that the reasons why people purchase products are due to "personal, situational, psychological, and social" circumstances (Tanner & Raymond, 2010). Without much thought, people are able to purchase items and for some the research for the right product may

take days, weeks, or months to consider and make a decision. For market researchers, their goal is to stay ahead of the buyer before they even make a decision to make a purchase.

The Decision-Making Process

Over the years, consumers have constructed their own techniques and methods on which products to purchase and dispose of by unknowingly going through the buying stages processes. These decision making processes are evaluated and typically followed by consumers in the following stages (Tanner & Raymond, 2010):

1. Need recognition
2. Search for product information
3. Product evaluation
4. Product choice and purchase
5. Post purchase use and evaluation of product
6. Disposal of the product

We will use the decision-making process and the personal, situational, psychological, and social reasons in which consumers are influenced by purchasing fidgeting objects. First, consumers need to come to the realization that they need or want a fidget – need recognition. For a number of reasons a consumer wants or need to buy a fidget that are discussed in later sections, let's say that a college student is unable to keep their hands still and are always touching the closest objects around them. They would like to instead of using random objects to purchase a small, palpable object that is easier for them to carry around places, store away as needed, and without the worry of using an object that may cause a distraction to others. This would involve for the student to evaluate which objects they typically use most often or more attracted to touching when in reach to see if they have a preference of fidgeting objects since there is no "one-size-fits-all" fidgeting objects. Additionally, if the student goes through using several

different type of objects or they do not stay with an object for too long, their quest for fidgets will be an ongoing process.

In the second stage, search for product information, is the active search conducted for products that satisfy their needs and requirements. The student has an option of going to a local store and ask a sales representative if they have products specifically for hand-use and is not a distraction towards others. Another option is for them to ask their friends and family if they have any recommendations of fidgeting objects they can purchase or their experiences of using hand-held objects. Online searches and reading product reviews is another method in which the student can research and learn quickly about the different types of tangible objects offered to consumers from different websites. The student would also be exposed to stories of other people who have come across fidgeting objects that have worked best for them and their experiences of using the product in different settings.

For example, by using a web search engine such as Google and then the student types in the search bar “fidget hand toys” the following results shown in Figure 29 generates.

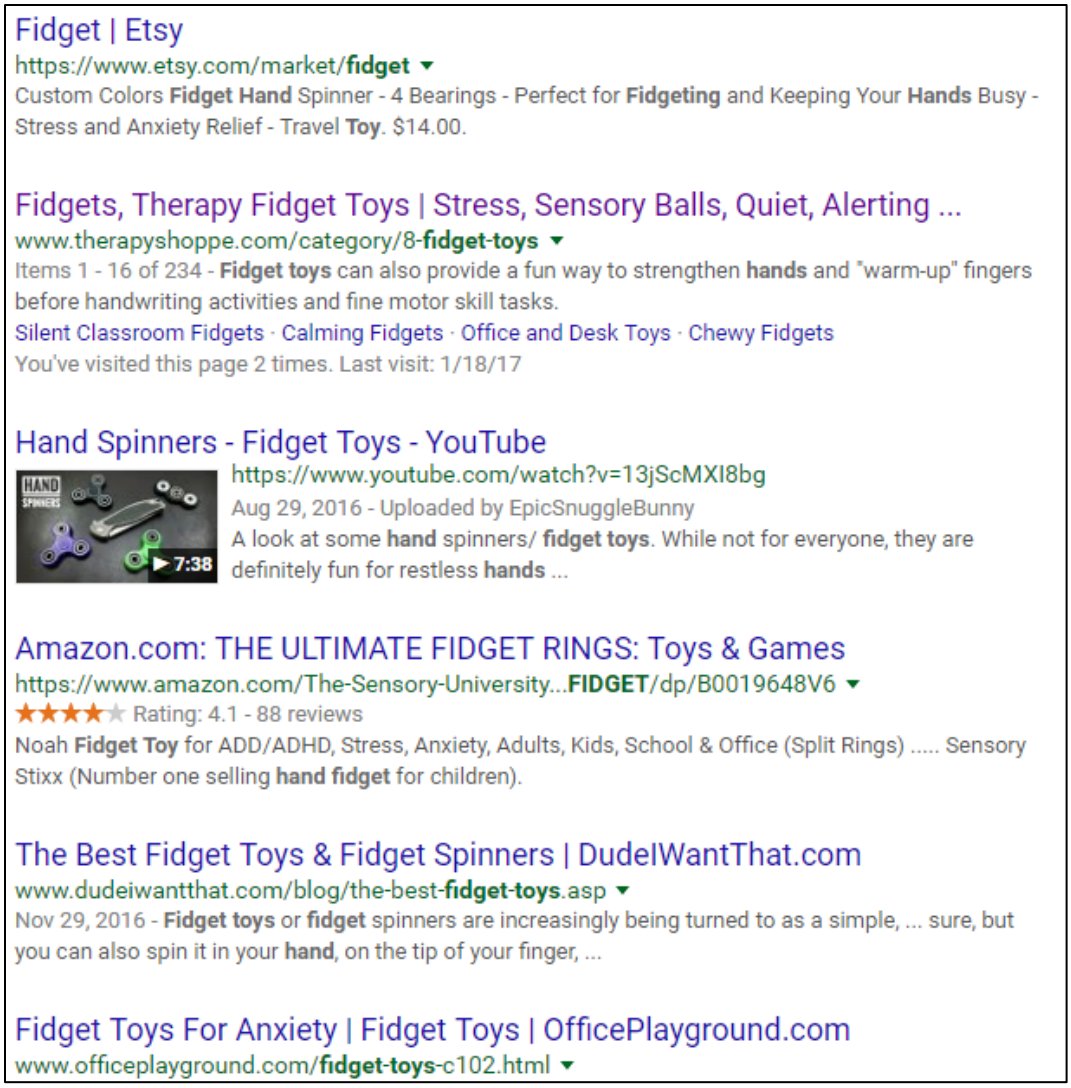

Figure 29: “Fidget Hand Toys” Search

The student, or consumer, is prompted to open several results in new tabs or windows to learn more about the different types of fidgeting objects, or toys, offered to consumers by videos, short product descriptions and corresponding pictures and product reviews. This is when the consumer is made aware that there is a whole consumer market for different types of demographics that consumers may or may not fall under. New terms for fidgeting objects become evident while searching for products online and helps structure newer searches for fidget toys from the words websites use to describe their products. Using a free online word cloud generator that draws the reader to large, key words then to smaller words. The size of the words

depends on how repeated the term was used in text – large font size means the word was used more often, small font size means the word was used less often. Using the terms used in the web engine search result titles and website highlighted sentences or words from the previous figure, a consumer may use the following terms to conduct new fidget toy searches as show in Figure 30.

Figure 30: Word Cloud of Fidget Toy Searches

Words such as “relief,” “stress,” “quiet,” “sensory, ” “anxiety,” “spinners,” “calming,” “everyone,” “chewing,” “balls,” “school,” “best,” “toy,” “ADD/ADHD,” “travel,” and “strengthen” will prompt consumers to refine their searches and learn more about the types of products that best suit their needs. Shoppers may learn more additional information about the added benefits of using fidget toys have in calming, treating anxiety, or the object’s stress relieving qualities to the users (Carstens, 2016; Fidget Toys, 2017; Fidget Toys, 2017).

The third stage is product evaluation when consumers investigate which products will fit their needs from provided information from sales representatives and marketing professionals

(Tanner & Raymond, 2010). The criteria that the student may be evaluating are price, fit, size, durability, portability, and/or colors of fidget toys (Tanner & Raymond, 2010). The Office Playground and the Therapy Shoppe, in Figure 31 and Figure 32 respectively, are electronic commerce websites that sell many fidget toys.

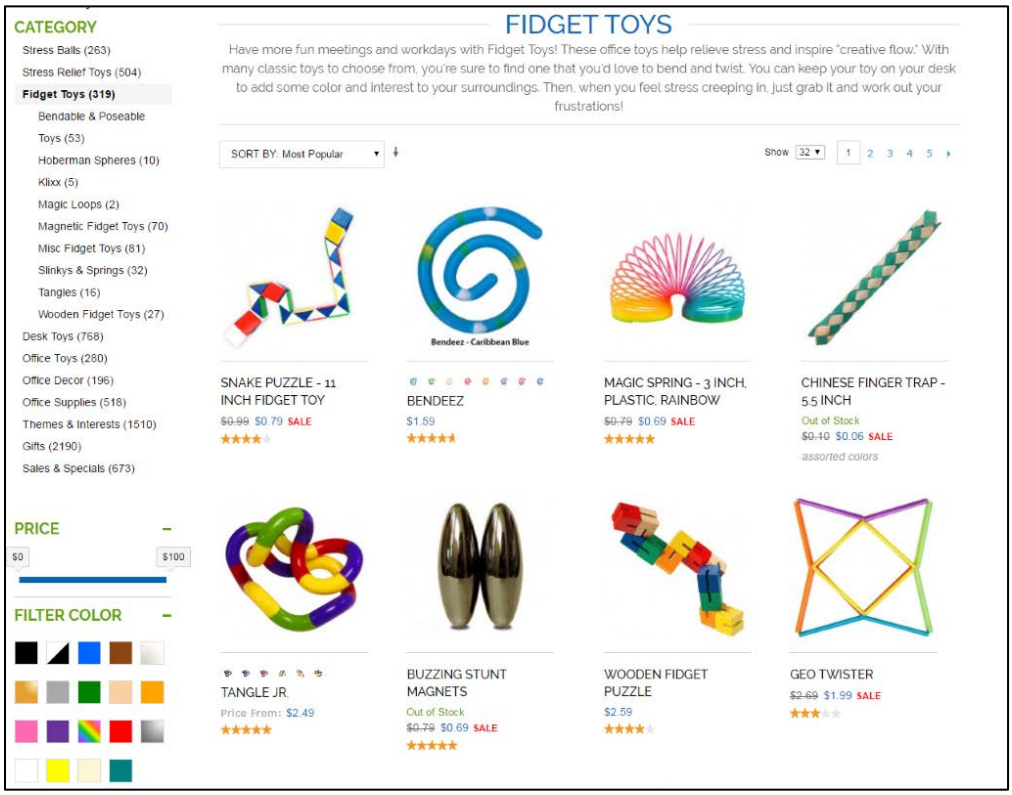

Figure 31: The Office Playground Website

Figure 32: The Therapy Shoppe Website

Then the consumer moves onto the fourth stage, product choice and purchase. At this stage, they have made whichever product to purchase and make the expense at their convenience (Tanner & Raymond, 2010). The consumer may go with the store with better deals that fit within a budget, the quality of the fidgeting toys, the option to purchase bundle packs, or online shopping for the accessibility of delivery (Tanner & Raymond, 2010; Perner, 2008).

After purchasing fidget toys, the fifth stage, post purchase use and evaluation, is when the consumer measures the usefulness of the product from the research that lead up to the purchase to holding the product in their hand (Tanner & Raymond, 2010; Gardial et. al., 1994). If the consumer is satisfied with their fidget toy purchase, they are likely to refer and recommend

online retailers to their friends, family, and coworkers (Zhou et. al., 2007). For companies, these referrals are important for commerce and loyalty from customers are sources of income due to repeated purchases (Zhou et al, 2007; Reichheld & Schefter, 2000). Customer may also leave positive or negative product reviews online, which is the modern "word-of-mouth marketing" that influences consumer's decision making when purchasing a product (Chen & Xie, 2008). If the product was bought at a store, they would most likely return if they had a good experience while shopping (Sherman et al, 1997). For example, a well-spoke salesperson assists a shopper to buy a product that fits their needs and wants, or refers them to a different product, or they informed the consumer of current store deals, sales, or discounts on items – all of these situations influences the buyer's purchase decisions (Oxenfeldt, 1974). Along with leaving negative product reviews online, if the fidget is not up to consumer's standard then people may experience "buyer's remorse" or post-purchase dissonance (Nadeem, 2007). The remorse is when the consumer begins to doubt their purchase for reasons such as waiting "to get a better price, purchased something else, or gathered more information first" (Tanner & Raymond, 2010). With buyer's remorse, the consumer will return fidgets back to the retailers since the product is not up to their standards and negate their purchase (Che, 1996). Some may share with friends and family how terrible the product was and may never buy from the seller again (Tanner & Raymond, 2010). Companies and stores try to avoid buyer's remorse by offering money-back guarantees or providing warranties on certain products (Che, 1996; Tanner & Raymond, 2010). Sellers want to ensure that their product fits all the needs of the consumer to prevent product returns.

The last stage of the decision-making process, disposal of the product, concerns how the purchaser discards the good or how companies make merchandise unusable after some time, e.g.

software updates or technological upgrades (Bulow, 1986; Choi, 1994; Tanner & Raymond, 2010). Fidget toy consumers may purchase similar items until they find a product that satisfies their needs. The manner that consumers dispose of old, unwanted products such as fidget toys and other products are important due to environmental concerns (Porter & Linde, 1995). Sustainability efforts and policies from the Environmental Protection Agency, companies, or activists encourage people to reduce, reuse, and recycle to help their communities "and the environment by saving money, energy, and natural resources" (EPA.gov, 2017).

Additionally, some companies already have methods scheduled to pressure consumers to dispose of their products called planned obsolescence – "a deliberate effort by companies to make their products obsolete, or unusable, after a period of time" (Tanner & Raymond, 2010). Technological companies, for example, release updates that are fashioned to be unsuited with older versions and release newer models because of added features (Pogue, 2015). Software also ages just as any other piece of hardware and computer scientists have to create newer models to function in modern technology (Parnas, 1994). By reducing the time consumers spend to pay for the same product, or between purchases, companies can increase their profits (Anderson & Srinivasan, 2003).

All shoppers do not necessarily follow the stages outlined above. Consumers may jump around in the decision-making process or skipping stages and move forward with purchases without much deliberation or they may never make a purchase from their research. The "level of involvement" with a consumer's interest, or the importance of making the purchase, fall under three categories: (1) low-involvement, (2) high-involvement, and (3) limited involvement (Zaichkowsky, 1986; Tanner & Raymond, 2010).

Low-involvement is a low-risk purchase that is not a financial burden to the consumer because the product is low-priced, therefore, no risk involved if the purchase was made on a whim (Hoyer, 1984). People may develop a habit, or routine, in purchasing a specific type of product because of personal preferences, called the routine response behavior (Hoyer, 1984; Tanner & Raymond, 2010). Consumers do not consider other options after a while – for example, a person purchasing the same sub at a sandwich shop for lunch every day and not taking note of any other meals offered. This is the same for fidget toys as prices vary per item with low prices and many toys can be bought at once for the consumers to review each product. Shown in Figure 33, the Office Playground lets consumers sort fidget toys by prices and as shown in the figure, several fidgets can be purchased under a dollar.

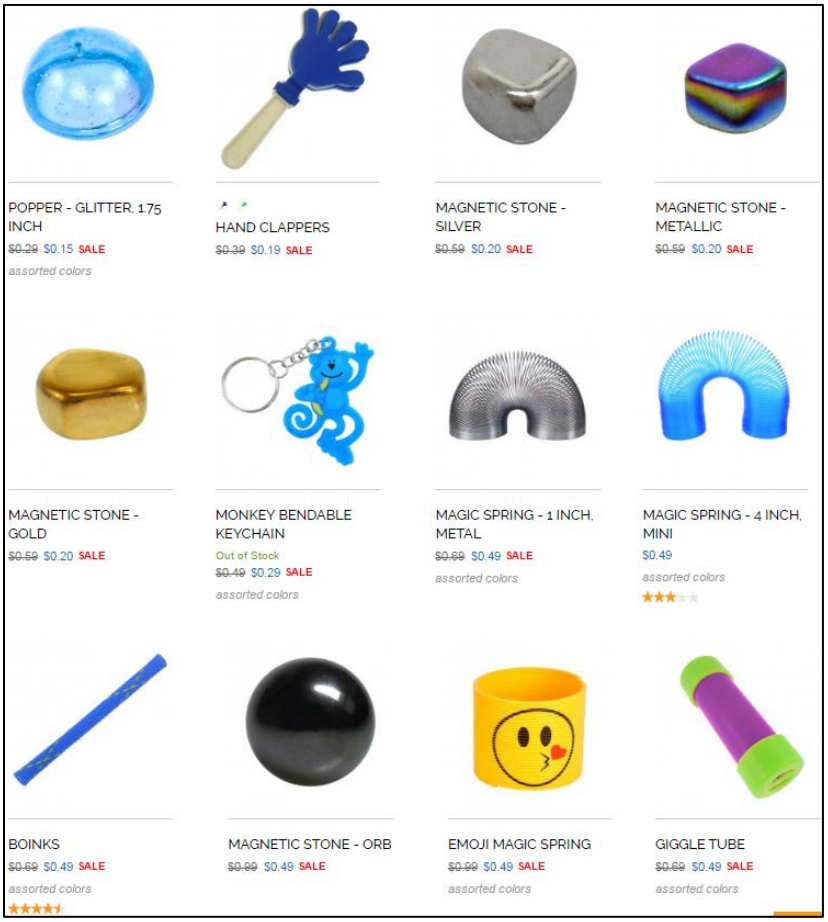

Figure 33: The Office Playground Low Priced Items

Fidget toys are low-risk, low-involvement products that allows consumers to either purchase the same item after the normal use of wear and tear, buy toys as gifts for friends and family, or for the consumer to create a kit for their own personal use. The most expensive fidget toys that the Office Playground sells are in an assortment box illustrated in Figure 34.

Figure 34: The Office Playground High Priced Items

These fidget toy collections are not high-involvement products. A high involvement purchase carries higher risks due to the greater financial burden it places on consumers (Zaichkowsky, 1985) such as purchasing a home, automobiles, buying a specific brand, and more (Laurent & Kapferer, 1985). Consumers want to be sure of their purchases by weighing several options against each other and gaining as much information as possible before coming to a decision (Tanner & Raymond, 2010). Limited-involvement products are in between low-involvement and high-involvement products. When a consumers searches for more information before making a purchase is called limited-problem solving (Saylor.org, 2016).

From the stages in the decision-making process and the level of involvement consumers, engage in before committing themselves to goods or services help market researchers get a better understanding the types of products companies design and create.

4.2.2. Marketing Strategy

Ultimately, this product cannot succeed in the market if consumers are not aware of the Fidget Egg's existence or the benefits of owning a Fidget Egg. The image and reputation of a company depends on each avenue of communication with the customer. Therefore, it is important to define the target consumer as well as each method of communicating with the consumer.

Overall, Fidget Egg aims to create a company image that has a balance between professionalism and fun. Target consumers are primarily college students and young professionals who fidget or are looking for ways to concentrate better on work. Additionally, the Fidget Egg will be marketed toward consumers with disabilities, such as those with ADHD. However, in order to reduce stigmas related to such disabilities, messages to consumers will emphasize how the Fidget Egg can help anyone who fidgets, not just those who have diagnosed disabilities. Messages to consumers will emphasize the benefits of the product, such as those outlined in section 4.1.2: versatility, discreteness, affordability, and effectiveness.

Website

In order to create clear communication between Fidget Egg and its consumers, a professional website is highly recommended. There are several website tools for small businesses available, such as wix.com, weebly.com, or squarespace.com, all of which give the option to sell products online. No matter which website-building tool is chosen, the following sections should be included:

- About Us: This section should include a brief history of Fidget Egg, with information about the leaders of the company, where the company is based, and when the company got started.

- What We Do: This section should explain the motivation behind this project, especially the impact that fidget toys can have on accessibility in society.
- Buy: Ideally, the Fidget Egg website should be easy to navigate and it should be especially easy to place an order. Clear photos and product descriptions will also be beneficial to the consumer and will improve the success of e-commerce.
- Contact: This section should include a customer service email address, a contact form, or both, so that customers can easily reach representatives of the company. As Fidget Egg grows, an address and phone number should be provided on this page.

The cost of maintaining a professional website will be low, estimated at around $10 or less per month. However, the website will likely help increase sales, therefore making the website worth the investment. Something else to consider in regards to a website is hiring a web designer, especially as Fidget Egg builds its customer base and wishes to distinguish itself more. A graphic designer could also help with website and logo design.

Advertisements

As mentioned above, the Fidget Egg can only be successful if consumers know about the product and its benefits. Therefore, creating effective advertisements will be a key factor in the success of this business. One way to influence consumers is to show advertisements that they can relate to (Greenwald, 2014). Since the target consumer is a young adult who fidgets, advertisements should show students or young professionals that use the Fidget Egg in their everyday lives. Furthermore, advertisements for the Fidget Egg should emphasize how the product can help the consumer focus better and perform better in their everyday lives. For example, one advertisement could show a college student who uses the Fidget Egg while working on homework in a group, emphasizing that the Fidget Egg is effective and comfortable to use around others. Another advertisement could feature a young adult who is getting ready for

work and grabs all the necessities for a productive day: phone, wallet, keys, breakfast, and the Fidget Egg.

In addition, it is recommended that Fidget Egg maintains a strong social media presence, since “members of the Millennial Generation are significant users of social media” (Sago, 2010). Fidget Egg can engage more target customers by offering special promotions as well as liking and commenting with individuals on social media.

4.3 Financial Analysis

Clearly, the Fidget Egg will only succeed in the market if the business can financially support itself and eventually make a profit. It is important to consider all aspects of the financial feasibility of turning the Fidget Egg into a business, including the costs of production, other operational costs, and pricing strategy. Additionally, long-term and short-term forecasting should be done to predict when the Fidget Egg could hit the break-even point and begin earning profits. Without an in-depth financial analysis, the owners of Fidget Egg could make a poor investment with no returns.

4.3.1. Costs of Production Using 3D Printer

Currently, the Fidget Egg is being manufactured using a 3D printer on WPI's campus. The MakerBot 3D printer, which is free to use as a WPI student, can produce six Fidget Eggs in roughly 8.75 hours. After printing, it takes about 20 to 30 minutes to remove the Fidget Eggs from the raft and assemble them with buttons and glue. Setting up the printer takes roughly 10 minutes, but could take up to an hour if the printer is broken and needs to be repaired. Table 5 shows the estimated costs of producing one batch of six Fidget Eggs. However, it should be noted that the costs could vary depending on the cost of raw materials. For example, it is cheaper to buy the safety buttons in bulk. If one were to buy a case of 3,700 safety buttons, the cost per unit would drop from $0.13 to just over $0.07 (Fillmore Container, 2017). It should also be noted

that the labor costs were estimated based on a one-hour shift for a manufacturing worker to remove the old batch of Fidget Eggs and start a new batch on the printer. Labor costs were based on the Massachusetts minimum wage, which is $11 as of January 2017 (Massachusetts Law about Minimum Wage, 2017).

Table 5: Estimated Costs of Materials and Labor for 3D Printed Fidget Egg

Item	Cost per Unit	Batch of 6 Fidget Eggs
Plastic for 3D Printer (Including Raft)	$0.33	$2.00
Side buttons	$1.33	$8.00
Safety button	$0.13	$0.78
Labor	$1.83	$11.00
Total	~$3.62	$21.78

Assuming that the Fidget Egg sells for $5 each, the total revenue for a batch of six Fidget Eggs would be $30, which results in a profit margin of $\frac{\text{profit}}{\text{revenue}} = \frac{30-21.78}{30} = 27.4\%$. If the Fidget Egg sold for $10, the total revenue would be $60, which brings the profit margin to 63.7%. Additionally, the return on investment, or ROI, can be calculated using the figures above. At a price of $5, the Fidget Egg would have a ROI of $\frac{30-21.78}{21.78} = 37.7\%$. At a price of $10, the Fidget Egg yields a ROI of 175.5%.

It should be noted that the above cost estimates are rough calculations. These figures represent the ideal cost of producing a Fidget Egg and do not take into account other miscellaneous costs. For example, the 3D printer currently in use is prone to breaking, and fixing printer can be costly and time consuming, especially, depending on which part of the printer broke. Not only could this business incur costs related to buying new printer parts, but the costs of installing the parts must also be considered. The above figures assume that setting up the printer for a new batch takes about ten minutes. However, if the printer is broken, it could take

up to an hour for repairs. Additionally, the cost of glue – which is not included in the table above – is small, but must be considered on a larger scale.

Although the Fidget Egg has the potential to make profits even at a price of $5, the startup costs of manufacturing should also be considered. As a student, the 3D printer at WPI, the MakerBot, is available for use at no cost but must be reserved ahead of time and shared with other WPI students. Additionally, one MakerBot can only print six Fidget Eggs at a time and must be repaired often. When the MakerBot needs to be repaired, it can take over a week to order and receive new parts, which could significantly affect the production schedule. Evidently, there are some major disadvantages to using the MakerBot for all manufacturing.

In order to increase efficiency and keep up with market demands, it is recommended that more 3D printers of higher quality be purchased. A custom 3D printer kit, such as one from Blueprint, can cost upwards of $500. Since the printing process takes roughly nine hours per batch, having between eight and ten printers would be beneficial. Assuming that ten printers are bought, there would be $5,000 worth of startup costs. However, ten printers would drastically help improve the efficiency of the manufacturing process. The manufacturing worker could then spend much less time waiting for the machine to finish printing. He or she could spend more time during the shift removing the raft, assembling the Fidget Eggs, setting up the next batch, and repairing the printer if necessary.

Although the startup costs of purchasing more printers is significant, up to 60 Fidget Eggs could be printed each day, resulting in roughly 300 per week. If retailers were interested in ordering 1,000 Fidget Eggs, for example, the order could be completed in just over three weeks. With only one printer, assuming that it never breaks over the course of production and the printer does not have to be shared, that same order of 1,000 could take over 33 weeks. As stated above,

purchasing more printers is the best option to increase efficiency and keep up with market demands.

4.3.2. Costs of Production Using Injection Molds

Using a 3D printer for manufacturing is a viable option for the start of this company. However, as the company grows and more orders come in, 3D printing will not be able to meet the demands of the market. For example, if retailers requested 1,000 or more units per week, the 3D printers would be incapable of making Fidget Eggs fast enough. Consequently, other production methods should be explored. Injection molds are commonly used in companies because they are extremely efficient, and it is recommended that Fidget Eggs be produced using injection molds in the future.

The use of injections molds should be put off to a later date due to the high costs of the injection mold itself and the injection-molding machine. Both the mold and the machine would likely cost several thousand dollars each, depending on the exact specifications of the mold and the vendor who provides them. For example, Rex Plastics, a company that specializes in making injection molds, states that the average mold costs around $12,000 (Rex Plastics, 2013).

4.3.3. Other Business Costs

In addition to the costs of production, there are costs associated with operating a business. For example, as mentioned in section 4.1.4, simply registering Fidget Egg as a business with the state of Massachusetts would cost $500. Furthermore, many other costs that would add up quickly, such as the cost of salaries to staff, insurance and legal fees, taxes, and employee training, accounting software, shipping and distribution, website maintenance, and advertising. Determining the exact figures for these costs is beyond the scope of this project, but they must be considered when evaluating the financial feasibility of creating this company.

4.3.4. Pricing Strategy

One of the most important decisions to make regarding the creation of Fidget Egg as a business is the price at which to sell it for. Based on what our current research indicates (See Appendix E), the Fidget Egg would likely be sold at a price between $5 and $10, since many respondents were willing to pay between these two price points. Furthermore, both a $5 and a $10 price point would yield profits according to the analysis done in section 4.4.1. However, as mentioned in section 4.4.4, there are many other costs of operating this business, and from a risk management perspective, the Fidget Egg should be priced closer to $10 to cover those costs.

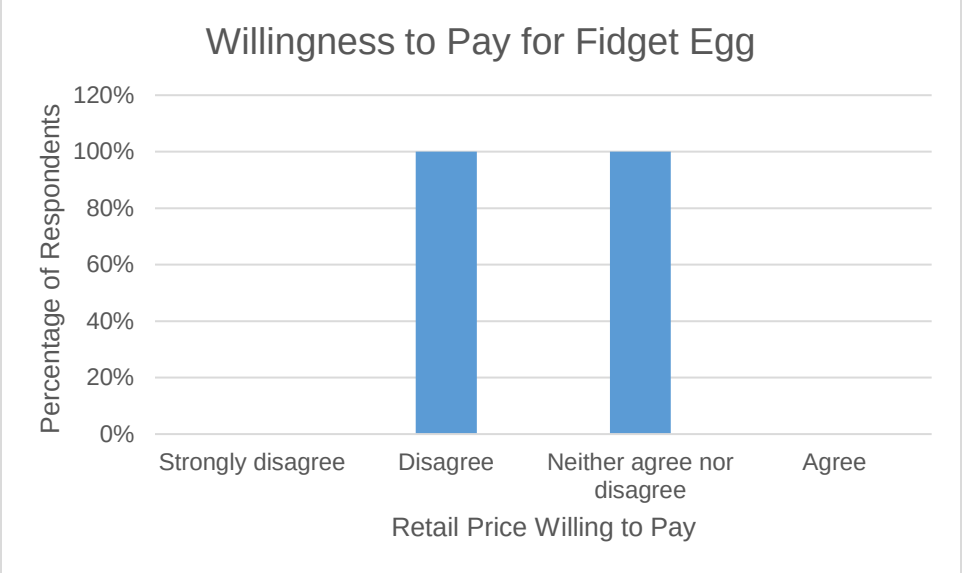

Figure 35: Willingness to Pay for Fidget Egg

Another benefit of pricing the Fidget Egg at $10 retail value is the ability to run sales promotions or coupons. Running promotions periodically could increase customer engagement and allow Fidget Egg to build its customer base. Thus, those who were initially unwilling to buy the Fidget Egg at $10 could now become a part of the customer base at the temporary $5 price.

4.3.5. Forecasting and Business Life Cycle

The previous sections of this paper largely focus on the short-term plans and goals for the Fidget Egg. However, a more sustainable approach to growing the business is to also consider the company's long-term plans and goals. By considering the more distant future, this company can make better decisions in the present. Therefore, it is recommended that the owners of Fidget Egg conduct thorough forecasting and refer to the business life cycle model often.

Forecasting is a powerful tool used by numerous companies worldwide, and there are several methods available for creating forecasts. Fundamentally, forecasting allows companies to make educated guesses about the future so they can make decisions in the present that set them up for success. Ideally, businesses should create forecasts of varying lengths. For example, a company is likely better off conducting a one-month forecast, a six-month forecast, a two-year forecast, and a five-year forecast than only conducting a six-month forecast. Essentially, forecasting is a way to "zoom out" and look at the big picture of where the company is headed.

Although there are many forecasting methods available to use, it is recommended that Fidget Egg utilizes a weighted moving average as the primary forecasting method. A moving average basically takes in data about previous periods of time (days, weeks, years, etc.) and projects future results by taking an average of the last several periods. A weighted moving average also puts more importance on the most recent periods. Although a weighted moving average can be very useful, the business should also keep in mind seasonal peaks – such as back to school season – and other economic factors. For example, if the economy begins to decline, the demand for the Fidget Egg may also drop since a fidget device is a luxury than a necessity.

The owners of Fidget Egg should also consider the big picture by referring often to the business life cycle model. As shown in Figure 36, there are five major stages of small business growth: existence, survival, success, take-off, and resource maturity. As a business becomes

more mature, it expands in size, dispersion, and complexity. This process is slow to start, but expansion happens quickly in stages II, III, and IV. At stage V, growth begins to level off and the company is able to sustain success. Furthermore, once a business grows to stage III, it becomes profitable for all stakeholders.

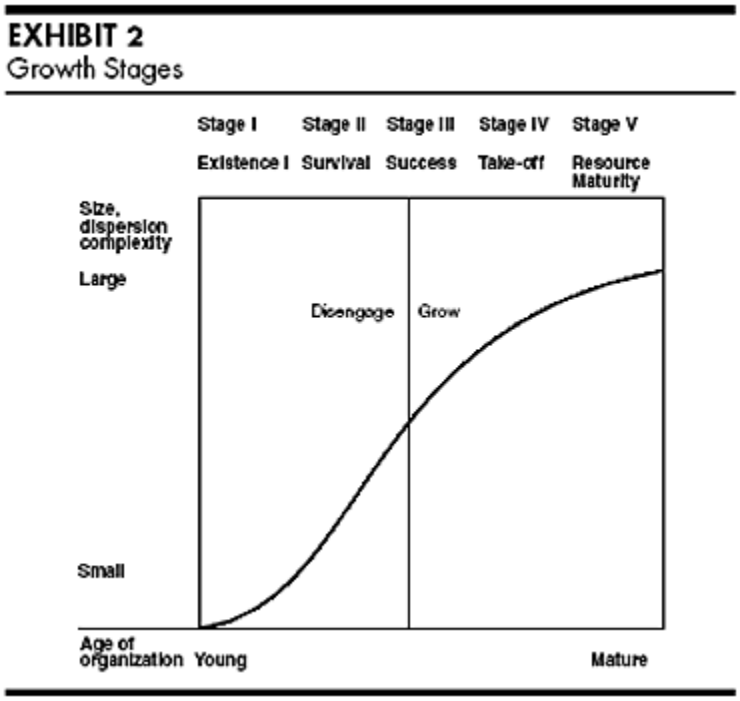

Figure 36: Growth Stages of Small Businesses

At this point, since there are so many unknown factors, it is difficult to estimate at what point in time the Fidget Egg could be profitable. However, based on current cost estimates – assuming that Fidget Egg invested in ten 3D printers – and current pricing strategy, the company would need to sell approximately 800 units in order to reach a break-even point. See Table 6 for details.

Table 6: Break Even Point of Fidget Egg Sales

Item	Number of Units	Unit Cost/Price	Total Cost/Revenue
3D Printer	10	($500)	($5,000)
Fidget Egg Manufacturing	800	($3.62)	($2,896)
Fidget Egg Sales	800	$10	$8,000
Total			$104

The question follows: Is it possible to make this business profitable? Of course, the owners of Fidget Egg must work hard to make the daily operations work and must be proactive about marketing the product to the public. Based on current interest in the product, the team is confident that the goal to become profitable is achievable.

With a small business such as the Fidget Egg, it is important to monitor progress closely. Although the primary goal is to become profitable, sometimes, the best business decision is to shut down the business and cut losses. Referring to forecasts and the business life cycle model can be instrumental in making responsible business decisions.

4.5 Discussion

From the beginning of this interdisciplinary project whenever we informed friends, family, fellow WPI students about our MQP – we learned that, word of mouth in spreading information about our product has social entrepreneurship aspects to it. We are all ambassadors of the Fidget Egg with any interactions we may with the WPI community. This created better accessibility for young adults, which were our main target audience at WPI then expanding the product availability to the general populace.

As with any business start-up, there are many trial and errors that we experienced when contacting retailers about the fidgeting devices that they sell in their stores as one example. Whenever the design team would use newer material, expensive or cheap, we were adaptable in

updating the financial analysis of the Fidget Egg. This adaptability and flexibility taught us that at all times we need to prepare for the unexpected.

During the Fidget Egg trial period, we noticed that the device was posing a distraction to other people, particularly the clicking noises of the side buttons. The aim in designing this product was to ensure that it would not pose a distraction to other people nearby, but evidently, this is not the case for some people or users as well. There is no fine line in determining where the rights of the Fidget Egg users begin and end when it is being used around others.

Furthermore, if the Fidget Egg business wants to keep growing as a start-up, reaching out to the following fidget toy retailers: the Therapy Shoppe, Marbles: The Brain Store, Fun and Function, and the Office Playground. These retailers mainly sell fidget toys targeted for children or people with neurodevelopmental disorders. However with the Fidget Egg, these retailers would have more sales due to an increase of adults purchasing our product. There are only a few adult fidgets that are not too popular or have gained as much traction as the Fidget Cube, there is evidence in Google trends that the rise of popularity of adult targeted products such as the Fidget Egg have chances of being highly profitable.

5. The Evolution of Sacred and Secular Dimensions of Fidgets into Modern Stress Relievers

This major qualifying project is an interdisciplinary work focused in three disciplines: mechanical engineering, business, and international and global studies. The technical and financial aspect of the Fidget Egg are a substantial part of the MQP. The following chapter introduces international dimensions of the use of objects that by being handled physically by an individual serve as a calming device in countries and cultures around the world.

5.1 Introduction

The well-known thesis of Max Weber, the 19th century sociologist, is that tribal people live in a sanctified world where there may be pressures and anxieties about invasion, death, and starvation, but which are addressed psychologically by their overarching spiritual worldview (Becker, 1973). Weber states that disenchantment of the world is due to "the rise of scientific knowledge" where "science contributes to the technology of controlling life by calculating external objects as well as man's activities" – meaning that there is no clandestine forces in the world (Michel, 1997). Another Weber study describes disenchantment as

> the historical process by which the natural world and all areas of human experience become experienced and understood as less mysterious; defined, at least in principle, as knowable, predictable and manipulable by humans; conquered by and incorporated into the interpretive schema of science and rational government. In a disenchanted world everything becomes understandable and tameable, even if not, for the moment, understood and tamed. Increasingly the world becomes human-centered and the universe—only apparently paradoxically—more impersonal. Disenchantment has two distinct aspects, each utterly implicated in the other. On the one hand, there is secularization and the decline of magic; on the other hand, there is the increasing scale, scope, and power of the formal means-ends rationalities of science, bureaucracy, the law, and policy-making. (Jenkins, 2000)

Weber argued that tribal peoples had a firmer grasp about their purpose in life and if they died, whether or not their culture posited an afterlife, their beliefs in animism gave meaning to their life and death and every worldly event (Probe Ministries, 2015). Wrapped up in the

sacrality of the world people perhaps felt psychologically that they were playing a role in the universe, and this understanding of life and destiny – it has often been speculated (Tribhuwan, 2003). Within this animist worldview, all of nature was sacred and served religious purposes. At some point around the neo-lithic age, institutionalized religions emerged with special sacerdotal authority such shamans, witch doctors, holy men, and eventually rabbis and priests (Torrey, 1972). Institutionalization gave sacerdotal authority to certain spiritual leaders who then separated themselves from tribal seers, medicine men, woman healers, who had traditionally helped people problems by what was now labeled superstition or black magic. Sacred religious icons such as amulets, charms, or prayer beads replaced magical talismans and charms. Weber argued that religious establishments assumed the role of re-assuring the faithful of their significance in existence. However, with modern industrialization came secularization, materialism, and eventually the loss of faith, creating new everyday pressures and eroding existential significance.

Nowadays in the modern world, our everyday lives are much more secularized and focused on material goals (Bruce, 2016). Except for the very few, quotidian activities are not taken up with thoughts about the sanctity or spirituality of nature; life is about getting the work and job done. The secularized industrial world also brings many workday pressures, often arising from workplace discipline, and without the re-assurance of some cosmic purpose in our secular lives. Today no matter what our job, most of us live on an assembly line here people have to meet stringent deadlines to get things accomplished. At some distant time prior to organized human labor and life, human experience was sanctified because in everyday life tribal peoples were always close to sacred objects and activities that in the spiritual natural world they accepted as reality (Tribhuwan, 2003). There is not much recorded on the nature of leisure in primitive

societies from anthropologists, but information on ancient civilizations such as Ancient Egypt, Ancient Assyria and Babylonia, Ancient Israel and Greece, to name a few, marked the origins of several pastime activities. Without the constant pressures of highly structured and time-dependent work, ancient civilizations and tribal peoples would naturally have times of repose, whereby simply reflecting on old tales and legends or the water rushing over stones, they would enter into spiritual types of reflection that would be re-enacted in sacred gathering and ceremonies. They had also managed work-life balances because to them, they did not separate labor and relaxation. Work was completed as necessary and was permeated together with sacraments that make the work diverse and pleasant. Repose and reflection were done by singing, dancing, drawing, sports, games, storytelling, or by partaking in spiritual gatherings and ceremonies (McLean & Hurd, 2011).

The ever presence of sacred references in what was seen around them in nature or in conversation about the mystical dimensions of life and death perhaps, some anthropologists speculate, put minds at ease and calmed existential worries. However, in modern times, the frantic pace of modern production sometimes requires a person to have a physical distraction so that they can concentrate on the task at hand, such as fiddling with stress ball, silly putty, or elastic bands. People with ADHD, autism, and other brain disorders also benefit from the use of fidget toys where these fidgets help relieve stress and promote concentrations on tasks. Weber's thesis raises the question as to whether a sanctified universe might have fewer incidents of these well-known modern anxieties and psychological disorders.

The idealized type of tribal society that Weber was theorizing about no longer exists because we live in a world where there are almost no completely "undeveloped" societies. Everyone has been effected to some degree by modernization and industrialization. It is no

longer, nor was it at the time of Weber, simply the sanctified universe of tribal peoples and the opposing modern alienated world of industrial non-believers. Everything is overlapped and would suggest that we are headed in the alienated direction. At the same time religious institutionalization of magical and spiritual practices of tribal peoples is also a global phenomenon. The secularized modern world overlays societies in which there are still strong religious practices of rituals, places of worship, a priesthood as opposed to the animist understanding of nature as one huge church.

Religious objects such as rosaries or prayer beads were used to help remember the true spiritual and sacred message of scripture and doctrine. Those objects might have taken on secondary psychological functions and worried and anxious believers turned to prayer to the Virgin Mary or to Allah or other religions such as Hinduism, and Buddhism to ease fears about worldly pressures. Religious individuals in the process of worship used these varying tools help them memorize prayers, meditate, and for some the tools provided a type of spiritual, emotional, and mental healing qualities (Greer & Vaughn, 2007). The question remains if fidgeting devices were developed in the modern secularized world, would people be able to find their place in the evolving world to relieve oneself of the world's anxieties.

Over generations, the culture of a society is de-sanctified and people within it turn away from spiritual notions of psychological wellbeing and toward secular goals and values. In tribal society, faced with anxieties, people turned to sacred icons which they would manipulate physically, but increasingly in modern industrial society psychological neuroses and behavioral problems that produced agitated movements were addressed by non-sacred play things, fidgets like silly putty, finger springs, stress balls, or spinners. Whether modern-industrial society

creates neurosis, psychological behavioral problems and the need for playing objects required further investigation.

Modern literature by third world peoples, for instance Frantz Fanon's *The Wretched of the Earth* and Chinua Achebe's *Things Fall Apart*, describe the alienating effects of European colonization and the forced marched process of industrial modernization (Fanon & Sartre, 1963; 1958). Indigenous peoples suffered psychologically by being dispossessed of their identity under imperial conquest (Australia, 1986). This notion is reaffirmed by a clinical study of Native Americans who faced multigenerational trauma under American hegemonic authority, which is "an intense fear, helplessness, or horror through viewing another's experience of trauma" (K. M. Coll et al, 2012). Children and adolescents were raised in their tribal communities hearing stories of how their ancestors were uprooted from their homes and territories all throughout North America and the trauma felt in one generation transcended into the next generation. Some Native Americans were able to overcome and treat their trauma by "infusing their traditional spirituality, language, teachings, and ceremonies" to heighten their psychological and emotional well-being and academic performance, a point in which is affirmed in other studies (K. M. Coll et al, 2012). American Indian communities seek a spiritual element in treating trauma in order for them to be in touch with their native heritage. Perhaps a fiddling device would be appropriate to some extent in this healing however; the spiritual object would have to have a spiritual dimension given to it. This raises the question as to how fidgeting items and therapy might be introduced into communities where traditional spiritual values are strongly felt.

5.2 Function of Fidgets

A way in which people have taken upon themselves to direct their focus or concentrations on tasks has been by the use of fidget devices. As mentioned in the State of the Art (3.3.), fidgets have been made available for situations where an individual needs a calming or focusing influence. They are productivity tools for mindless interactions that one may have with everyday objects or specifically purchased fidget devices found online or in stores.

People throughout the industrial world work in several different types of environments that might require “breathers” while thinking, analyzing, or problem solving. In the industrial world, busy individuals twirl rings on fingers, listen to music, and squeeze silly putty to enhance their creativity and productivity. We click on pens, pause to check the beep produced from our electronics, or absentmindedly gaze at a nearby picture or gadget to take a step back from work and center ourselves to continue labor afterwards. This physical stimulation provides an outlet for people who need to keep their hands occupied. Some studies have shown that doodling increases attention and fidgeting improves focus (Karlesky & Isbister, 2013).

Fidgets are objects that can be fiddled, which empowers people to direct their focus, and fidgeting is any bodily movement performed by a person’s hands or feet (Nyqvist, 2016). Fidgets are material items for providing a mindless interaction in our hands while doing another task. “Fidget toys are often recommended to parents of children with ADHD as a means to aid focus and attention management” (Karlesky & Isbister, 2013) or to anyone who fiddles in their daily lives that do not have a specific diagnosis that denotes why a person fidgets. In ADHD literature, it has been “hypothesized that fidgeting is a natural coping mechanism the body employs to promote natural stimulant release, enabling the mind to focus on particular tasks” (Karlesky & Isbister, 2013).

Developing and Industrial World Classifications

In this study, we explore the differences of calming devices of pre-industrialized and industrialized societies. The United Nations Development Program classifies countries based on their Human Development Index comprised of life expectancy, education, and income (Human Development Reports, 2015). To be considered a developed country, a high-income state must have a per capita income over $12,000 and most have an average of $38,000 per capita income (Cunningham, 2017). Developing countries are further divided into upper-middle and lower-middle income countries. Upper-middle income countries have a per capita income between $4,000 and $12,000 and lower-middle income countries have between $1,000 and $4,000 per capita. Low-income countries have less than $1,000 per capita (United Nations, 2012).

A country ranked as a least developed country by the United Nations Economic and Social Council is Ethiopia and a high-income country based on their gross national income is Spain (United Nations, 2012). A statistical comparison between the two countries is provided in Table 7: Ethiopia vs Spain Education Statistics Compared to illustrate the differences between a developing and industrialized country.

Table 7: Ethiopia vs Spain Education Statistics Compared
Data retrieved from NationMaster.com

	Ethiopia	**Spain**
Life Expectancy	56.19 years	81.17 years
Education (Adult literacy rate)	35.9	97.63
Income (Per capita)	$1,057.44	$33,647.98

Healthcare, education, public transportation and infrastructure are, however, in a state of expansion and improvement in Ethiopia. Ethiopian's access to doctors and hospitals have become easier with more healthcare centers and hospitals opening around the nation (Living in Ethiopia, 2017). Transportation to these locations have improved because of government spending on refining the quality of paved and gravel roads making the journey easier and shorter

(Living in Ethiopia, 2017). The Ethiopian government is improving the standards of education in rural areas by increasing the amount of educators, schools, and organizations around the country (Ethiopia, 2017).

An example of a developed country is Spain where Spaniards have a higher standard of living in housing, personal security, health, and other life statistics (Spain, 2017). Spain does also rank "below average in income and wealth, civic engagement, environmental quality, education and skills, and jobs and earnings" compared to other nations in the Organization for Economic Co-operation and Development (OECD) (2017). Fifty-seven percent of Spaniards, aged 15 to 64 years old have a paid job where the typical household net adjusted disposable income per capita is $22,007 a year. From five to 39 years of age, some Spaniards go through an average of 17.9 years in formal education and fifty-seven percent of adults have completed upper secondary education (Spain, 2017).

Both Ethiopia and Spain are in the process of undergoing improvements to economic growth that may lead to better access to health care professionals, to quality education, and advances in household living accommodations (Ashcroft & Rayner, 2011; Ethiopia Economic Outlook, 2016; Spain, 2017). The differences and statistics noted between Ethiopia and Spain as a developing and industrialized countries illustrate some of the differences between unindustrialized and industrial nations.

In the world today, Max Weber's thesis about a sanctified universe calming the human spirit may no longer hold true in its psychological effects. Psychologist Ronald D. Laing speculated the high-pressures of modern society that come with industrialization, eroding traditional family and social connections, contribute to mental illnesses such as schizophrenia (Jrank Article, 2017). Laing theorized that psychosis like schizophrenia was in fact a person's

method of avoiding insufferable situations created by modernity (Berger, 2005). Others have speculated that brain disorders such as ADHD, dyslexia, hyperactivity, and autism are responses to the craziness of life under industrialization. The prevalence of such brain disorders are not well identified, diagnosed, or treated in developing countries due to the lack of research and resources (Ngui et al, 2010). By identifying the prevalence of ADHD and autism – illnesses that commonly use fidgeting devices as a means to treat neurodevelopmental disorder symptoms – in developing countries is a means to identify if there may be a correlation with the use of fidgets and the high-pressures of industrialization.

5.3 Identifying Learning Disabilities that Contribute to Fidgeting

While modern society fiddling is a common process for many people, fidgeting is frequently associated with ADHD, autism and other know brain disorders. In the modern industrial society, fidgets have been clinically identified as a tool to treat ADHD in the developed world, but we do not know if doctors recommend the use of fidgets in the developing world to people with neurodevelopmental disorder. In order to get a clear understanding of what defines a fidgeting device, we must look further into the type of culture and industrial development surrounding people who fidget.

5.3.1. ADHD Prevalence

In the research report of Faraone et al, "*The worldwide prevalence of ADHD: is it an American condition*," they researched the prevalence of ADHD in the United States was compared to other more economically developed countries. ADHD has been studied in the United States for over five decades and this research has allowed doctors, parents, guardians, friends, and family to gain a better understanding of the behavioral characteristics associated with the disorder (Faraone et al, 2003). The Diagnostic and Statistical Manual of Mental Disorders (DSM), published by the American Psychiatric Association, has changed the

diagnostic criteria for the classification of ADHD and similar mental disorders over years of research (Faraone et al, 2003). From the collected research of experts all around the world on mental disorders, DSM "defines and classifies mental disorders in order to improve diagnoses, treatment, and research" (DSM-5, 2017).

Faraone et al researched ADHD because at that time, researchers believed that ADHD was an American mental health disorder due to its prevalence in the United States compared to the apparent lower number of ADHD diagnoses in other industrialized countries (Faraone et al, 2003). A study of children from the United States and the United Kingdom noted that children in the 1970s were more likely to be diagnosed with ADHD by a "20-fold difference" in the United States while children with "hyperactive behavior may be more likely to be diagnosed as having conduct disorder in the United Kingdom" (Faraone et al, 2003). Thus the difference in incidents of diagnosis could be attributed the different definition of ADHD in the countries studied and not differences in the characteristics of ADHD (Faraone et al, 2003).

The study concludes that ADHD is the most shared neurodevelopmental disorder of childhood in developing and advanced countries because "there is no convincing difference between the prevalence of this disorder in the USA and most other countries or cultures" (Faraone et al, 2003; Rowland et al, 2002). The diagnostic criteria of ADHD changes over the years and there has not been a standard definition of ADHD whereas scholars do not think ADHD is culturally defined because diagnostics are not the same for different countries. In several studies, diagnostic criteria varies by age, gender, ethnicity, the signs and symptoms of ADHD, socioeconomic status, and the comorbidities present in an individual (ADHD Educational Institute, 2017; Rowland et al, 2002; Gingerich et al, 1998).

There is no consensus about the worldwide prevalence of ADHD because of the lack of statistical information from each nation and not enough racial diversity amongst other factors mentioned above in the researched populations in existing studies (Rodhe et al, 2005). However, the *ADHD Institute* notes in a meta-regression analyses – data from multiple studies – approximates the worldwide prevalence of ADHD, based on 102 studies, "at between 5.29% and 7.1% in children and adolescents, and at 3.4% (range 1.2–7.3%) in adults" (2017). Studies from Africa, the Middle East, Oceania, and South America were used in the meta-regression analyses, which are 11 times fewer than the number of studies reviewed when compared to North America and Europe (ADHD Institute, 2017). The differences in the studies reviewed may be due to the lack of resources and efforts in nations around the world to monitor and record the prevalence of ADHD.

Furthermore, the root cause of ADHD depending on conditions such as genetic, neurobiological, and environmental risk factors that presents present themselves in different ways (ADHD Institute, 2017). The diagnosis of ADHD in children and adolescents are primarily dependent on the information received from parent and teacher reports. The frequency of ADHD from country-to-country is reliant on how the questions are asked to parents and the signs and symptoms existent in children (Rowland et al, 2002). These complications have resulted in several different ADHD classifications over the years to diagnose disorders: Connor's 1969 Teacher Rating Scale, DSM-III, DSM-IV, DSM-V, and International Classification of Mental and Behavioral Disorders-10 (ADHD Institute, 2017; Gingerich et al, 1998; Farah et al; 2009). Continual improvements in assessing ADHD have led to better management and treatment, and a study suggests that with a "population-based epidemiologic studies may shed important new light on how we understand ADHD, its natural history, its treatment and its consequences"

(Rowland et al, 2002). The implication is that advances to psychiatric care of children will lead to better identification and treatment of ADHD and other related brain disorders.

The United States and England are both highly industrialized societies where religious practices are declining (Wormald, 2015; Sherwood, 2016). In England, where secularization is increasing, the religious connotations people once had with spiritual or religious items also decreases. Objects that once served spiritually or existential calming needs have been replaced with non-religious devices that fulfil an individual's needs to focus or concentrate by fidgeting. Using online search engines for England and the United States reveals that similar toys can be purchased (Figure 37 and Figure 38). These websites, among others, illustrate that fidgeting is common to England and the United States, shows similar characteristics between the objects and employs similar devices for focusing attention. As stated above, there is not enough evidence that ADHD is more prevalent in one industrialized culture versus another.

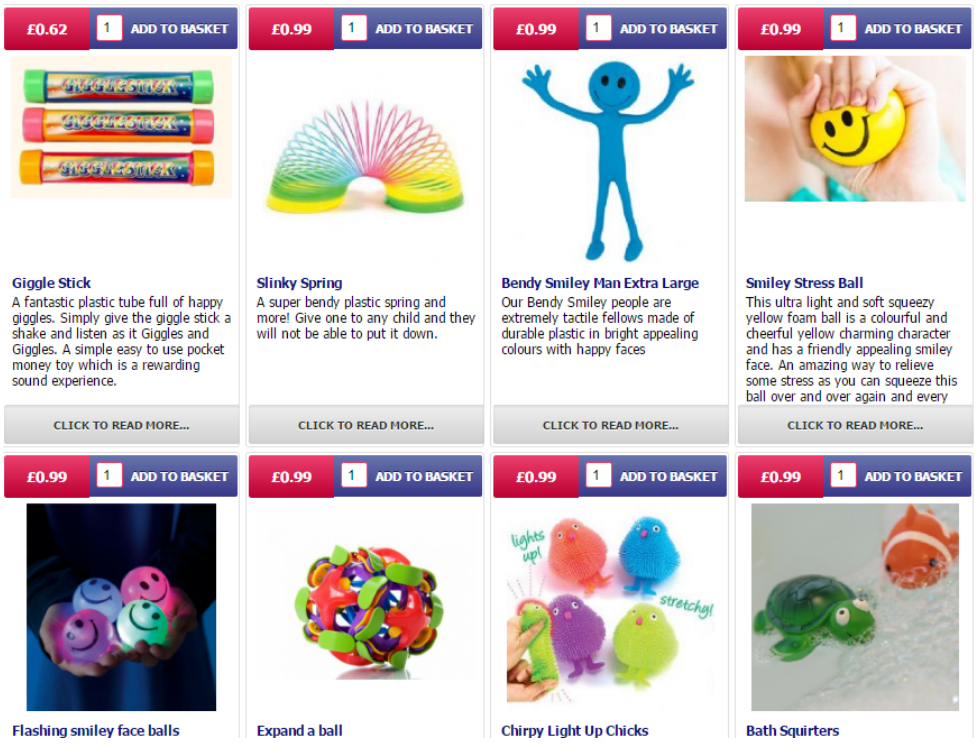

Figure 37: Low-priced fidget toys available in the United Kingdom

Figure 38: Low-priced fidget toys available in the United States.

5.3.2 Autism Spectrum Disorders

Autism Spectrum Disorder (ASD) is a "range of conditions characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication" (Autism Speaks, 2012). Similar to ADHD, ASD is a disorder that is widely misunderstood and children are misdiagnosed and do not receive appropriate recognition and treatment for their disabilities. In the United States the prevalence of autism is estimated at 1 in 68 children or "about 4.5 times more common among boys (1 in 42) than among girls (1 in 189)" (CDC, 2016). Many youth with autism have difficulty sitting still and have sensory-motor challenges, which are both symptoms that may present as ADHD due to the parallel "fidgety" behavior (Vigo, 2015).

A characteristic of ASD is Sensory Integration Disorder or it can be a neurological disorder in its own right (Austim-Help.org, 2017). This sensory disorder is also mistaken with ADHD and both disorders can be present in a person together with other comorbid conditions such as Asperger's syndrome, pervasive developmental disorders, fetal alcohol syndrome, Tourette syndrome, acute anxiety, and other disorders (McIntyre & Van Vorst, 2017). As with

autism and ADHD, children with this disorder exhibit symptoms that pose a distraction to other students for example, “fidgeting in the seat,” “frequent touching of nearby objects,” “playing with items that are unrelated to the lesson” to name a few (McIntyre & Van Vorst, 2017).

Sensory integration disorder affects a child’s one or more senses, e.g. hearing, sight, taste, smell, touch, proprioceptive, balance and movement (McIntyre & Van Vorst, 2017). The hypersensitivity to any one of these senses can be addressed by various management activities in classrooms. Children who have touch sensitivity are recommended to hold stress balls or “fidget with any of the following: straws, paper clips, pencils/pens, stress balls or putty,” and other bodily movements and activities allow them to be productive and undisruptive to classmates in the classrooms (McIntyre & Van Vorst, 2017).

In the developing world, test screening for neurodevelopmental disorders can be identified in regions that have little to no resources and healthcare professionals available (Autism Speaks, 2014). Autism is widespread around the world but there are failures in diagnosing autism and parents struggle to seek help in treating autistic children. In an industrialized country, South Korea, some families avoid having their child diagnosed with autism because “they think of it as a genetic mark of shame on the entire family, and a major obstacle to all of their children’s chances of finding suitable spouses” (Hughes, 2011). Mothers would insist doctors to have their child misdiagnosed with reactive detachment disorder rather than autism or ADHD and other disorders to protect the integrity of their family (Hughes, 2011).

Autism studies outside of the United States, Canada, and the United Kingdom are few and often non-existent, predominantly in the developing world because of the lack of mental health awareness and poor healthcare institutions (Hughes, 2011). Screening and awareness for autism has increased in Mexico, India, South Africa, Brazil, Oman, and Western Australia over

the past ten years, allowing the prevalence rates of autism to be reported in medicinal journals (Hughes, 2011). With increased awareness and screening in these countries, they have received more attention than in other developing nations (Maguire, 2013). Cultural attitudes that put stigmas upon such childhood learning disorders, such as in South Korea, along with the severely limited number of psychiatrists available in the developing world make mental health facilities and identification difficult for any nation (Maguire, 2013). In South East Asia, there can be one psychiatrist per 100,000 people (Maguire, 2013).

While the industrial world has commercial disability aids for brain disorders, throughout the developing world such services are tied to traditional religious practices or have become sanctified in their original religious purposes. In tribal and modern cultures faced with anxieties and other worldly concerns may use sanctified calming tools such as prayer beads, rosaries, prayer wheels and other sacred commodities while reciting prayers or mantras. Examples of such tools that have calming qualities, memory assistance, and meditation functions for the user can be found in the following section.

5.4 The Sanctified or Secularized Prayer Beads in Religions

Sacred objects that serve similar functions as fidget toys can be found in many different countries and religions. Peoples in less secularized cultures do not explicitly call them “fidget toys” or “fidgets” but those objects appear to serve similar functions. Some items serve sanctifying purposes in an individual’s life while similar calming objects have become secularized and are nowadays unrelated to any religious purposes. Prayer beads or rosaries traditionally guide believers “towards the path of self-realization and virtue” by aiding them to recite and count prayers or mantras (Henry & Marriott, 2002; Anthromuseum, 2017). Usually such prayer aids are beads on a string with a tassel that signifies the start of a prayer. The word “bead” has religious connotations in its own right since it is “from the Anglo-Saxon world

bidden ‘to pray’ and *bede* ‘prayer’” (Anthromuseum, 2017). The use of beads were adopted in other religions or their use was retained when branches of a major religion were separated (Athromuseum, 2017). All prayer beads are counted in a repetitive method that allows the worshiper to keep track of how many prayers have been said, which cultivates more devoted attention to prayers. The antiquity and importance of prayer beads in their respected religions continues among many people throughout the world today but in some cases, prayer beads have become secularized and have lost their original spiritual association.

5.4.1 The Secularized Greek *Komboloi*

In Greece, they have worry beads called *komboloi*. People swing back and forth the string of beads in their hands and playing with the komboloi is a cultural practice that no one labels specifically as an anxiety treatment. What psychological effect the komboloi has on those who use them has not been studied, but one might presume at least some of the usage has a calming effect. Greeks do not find twirling the komboloi as threatening or an obstruction to other people, but in the United States, the komboloi may be viewed as an invasion of space when being twirled within a group of people. In the United States, people may have concerns that someone can let the worry breads fling away from their hands and hit another person.

In an informal interview with a WPI Greek senior, we learned the historical context for the rise in popularity of komboloi started as a lower class Greeks used it for non-religious purposes on social occasions. People then started to make more decorative komboloi and the wealthy followed suit in using them. The student gave an analogy of how Blues Music in the United States started as a lower class type of music genre and the music eventually became popularized among all social classes. This trend in Blues Music, called *Rebetiko* in Greece, occurred when Greeks gathered to listen to the music while “smoking cigarettes and playing with their komboloi” (WPI Greek senior, 2017). Similar to how Rebetiko became popular throughout

Greece, komboloi also followed the same progression from lower to upper classes in popularity. The komboloi increasingly became more fashionable, primarily among Greek men.

The komboloi does not have anything to do with the Greek Orthodox Church; although they resemble rosary beads, they are non-sacred objects. To be exact, the beads are not twirled or counted in people's hands while prayers are recited. Older men are the primary users of the worry beads and younger adolescents may adopt them after observing others. From the student's observations in Greece, women are not commonly seen using komboloi as often as men.

Greeks normally acquire komboloi in shops and some are handed down between the men in families. He noted that the overall use of worry beads in people's hands has recently started to die out and has been taken up by more decorative object in people's homes and automobiles. When the komboloi are used as decorative items, they can be found hanging in cars as talisman to protect from evil as denoted by the blue color and the eye style shown in Figure 39. The senior compares the komboloi being twirled in people's hands to people swinging their car keys on a lanyard in the same manner. This suggests that both objects are handled with a certain awareness of fashion and style where people learn the maneuvers from others.

Figure 39: Greek Komboloi

What we found insightful in the use of beads in another country, Sri Lanka, which were used for religious purposes. After the student's return from project work in Greece, he said a Sri Lankan friend told him about the prayer beads that Muslims in his native-country use in their prayers. While the country is predominantly Buddhist, Muslims make up a significant minority of around 10 percent. The prayers beads in Islam are longer than Christian rosaries with more beads to signify the 99 names of Allah. Holy beads are used around the world for religious purposes. This usage may also have a calming effect and in some cases, as in Greece, are clearly used with no apparent religious purpose.

Gray Henry and Susannah Marriott's *Beads of Faith* (2002) relates the history of religions using prayer beads and the meaning behind the words mentioned in the prayers. Through counting, the varied number of beads keep track of prayers or sacred names in different religions. A string of beads "acts as an anchor with which to focus thoughts and still the mind," which religiously oriented functions that are similar to the uses of fidget devices in the secular world are used as aids in concentration (Henry & Marriott, 2002). All of the beads used in prayer are sanctified objects whose powers are strengthen when spoken "in sacred and ancient languages" such as "Sanskrit, Chinese, [and] Arabic or in Greek or Latin" (Henry & Marriott, 2002). The authors also include the history of the komboloi in Greece where the worry beads were introduced into the country in the mid-15th century (Henry & Marriott, 2002). Although the student we interviewed may believe that the use of beads is a trend that is starting to fall from popularity, the fact remains that beads have been in Greece for centuries with no religious affiliation to the Greek Orthodox Church. The worry beads will most likely continue to be counted and looped around in people's hands "as they go about their daily business, not for

prayer, but as a form of secular mental focus by occupying the body with rhythm, sound and texture" (Henry & Marriott, 2002).

Prayer bead users in several major religions in the world shares the sense of calm and well-being that the secularized Greek komboloi provides to people. In *Beads of Faith*, we learn about the Catholic Rosary, the Hindu *malas*, the Buddhist *malas*, and the Muslim *tasbih* to name a few, are prayer beads in their associated religions (Henry & Marriott, 2002).

5.4.2 The Hindu and Buddhist Prayer Beads

The world's oldest religion, Hinduism, uses prayer beads, or *malas*, to recite divine names or *mantras* (mystic chants) (Henry & Marriott, 2002). Hinduism is predominantly practiced in India and has two major branches of religious worship, Shaivism and Vishnuism, each with their own number of beads (Anthromuseum, 2017). In Shaivism followers, use 32 to 108 prayer beads, grouped into five sections and in Vishnu malas 108 beads are strung together (Anthromuseum, 2017). By repeating the sacred names in Hindu, sin is removed within the worshipper and "worldly distractions are minimized" (Henry & Marriott, 2002). The malas's purposes are similar to those of secular fidgeting objects because they create "a devotional focus and a concentration of attention," which enables the user to direct their soul toward the religious task of worship. Figure 40 is an example of a Hindu mala used in prayer.

Figure 40: Hindu Mala

In Buddhism, chanting and meditation are centuries-old practices completed also with malas in countries such as Tibet, China, Japan, Sri Lanka, Korea, and Burma. Buddhism has, of course, a connection with Hinduism because the founder of Buddhism, Siddhartha Gautama, or Buddha, was born a Hindu. Both religions believe in reincarnation and seek freedom from the cycle of rebirths (The Buddha Garden, 2017). Furthermore, they believe in developing mindfulness and spiritual absorption in the transcendent journey. There are other teachings of the Buddha that are assimilated to Hindu practices (The Buddha Garden, 2017).

Parallel to the Vishnu mala, a Buddhist mala consists of 108 beads or 27 beads that are counted in four intervals (Figure 41) (Henry & Marriott, 2002; Anthromuseum, 2017). Buddhists are known to repeat mantras for tens of thousands of times because the "immense numbers of repetitions [transports] the mind beyond the physical act of counting to an original pure and empty state," thus calming the mind to the world's distractions. A monk's aim in Buddhism is to reach enlightenment, or *nirvana*, by overcoming worldly illusions by chanting with the aid of the

mala. Several different types of material can be utilized to make malas such as seeds, bones, and stones (Henry & Marriott, 2002).

Figure 41: Buddhist prayer beads.

5.4.3 The Muslim Prayer Beads

The second of the five pillars that sustains Islam and the teachings of the Prophet Muhammad is to pray five times a day at dawn, at noon, mid-afternoon, sunset, and nightfall. To recite the earthly names of Allah, Muslims use prayer beads, or *tasbih*, which hold 99 beads together in a string (Henry & Marriott, 2002). A shorter set of prayer beads are made with 33 beads that can be counted three times during worship (Henry & Marriott, 2002; Anthromuseum, 2017). Each bead also represents the traits and various names of God, such as The Exceedingly Merciful, The King, The Holy, and The Peace, which bring people closer to the divine from the invocations revealed to man through the Prophet Muhammad (Henry & Marriott, 2002). Praying with the tasbih "may be used at will after canonical prayers, regardless of place: inside a mosque, a private house, a park or a street corner," and the materials used for the beads are made from any type of stone or wood (Henry & Marriott, 2002). Figure 42 displays the Islamic tasbih.

Figure 42: Islamic Tasbih

Within Islam, Sufism is filled with seekers who strive to hasten the spiritual process of becoming closer to Allah. Disciples eventually become masters, or *sheikhs*, and it is expected of them to use tasbih "two or three times" a day with "the aim of attaining in the heart a permanent state of remembrance of God" (Henry & Marriott, 2002). Sufis have the same manner of reciting all the names of Allah, as in Hinduism, in order that a worshipper might enter a trance that allows them to achieve tranquil transcendence of worldly distractions. Reciting Allah's 99 names and the *ayat* of the Qur'an are sacred, devotional methods in Islam to reach the blessed afterlife.

5.4.4. The Catholic Rosary

The use of rosary beads in the Roman Catholic Church began in the late middle Ages as a method of "counting and remembering complex cycles of devotional prayers" (Henry & Marriott, 2002). Roman Catholicism was the last major religion to adopt rosaries and the use of such sacred objects was—surprising to most Christians—adopted from the Arabs during the Holy Crusades (Henry & Marriott, 2002). The word rosary is from the Latin word *rosarium* that means a "wreath of roses" or "garland of roses" (Anthromuseum, 2017; Henry & Marriott, 2002). Comparable to reciting prayers to God as in the previously mentioned religions, the rosary

also respects the Virgin Mary and the goodness of each person's soul. Roman Catholics are also able to engage in prayer in solitary if they are unable to attend a Mass service because rosaries provide a direct link wherever one is located to the commendation of God (Henry & Marriott, 2002). Catholic rosaries have 150 Hail Mary beads, 15 Our Father beads as well as five-lead Glory Be beads as a start to the prayers (Henry & Marriott, 2002). Instead of a tassel to signify the start and end of prayers, the rosaries include the crucifix, a reminder to Catholics of Jesus Christ's crucifixion as shown in Figure 43. The crosses were originally white because the color was more related with the Virgin Mary and then eventually became silver, demonstrating "purity and chastity" (Henry & Marriott, 2002).

Figure 43: Rosaries

To sanctify the beads further, priests blessed the rosaries with prayer or holy water (Henry & Marriott, 2002). Other holy objects used for rosary beads were olive pits, roses, coral beads, pearls, amethyst, topaz, sapphire, and bloodstone – each with their own meanings according to the size, color, and texture (Henry & Marriott, 2002). Just as the malas and tasbih were created to recite mantras, or the holy names of God, rosaries were created for believers to memorize the Hail Mary, Glory Be, and Our Father prayers.

Prayer beads are not a toy like fidgets, but their use shows that many major religions have similar aids "to focus the mind, help solve problems and dispel fear" to help a person remember their task of reciting a mantra, prayers, or names of their deities (Henry & Marriott, 2002). Different religions use the physical manipulation to aid devotional concentration. Furthermore, people who have anxieties or nervousness turns to God for relief and handling the holy beads in one's hands absentmindedly assists in calming their soul and grounding their thoughts. Prayer and worry beads have a universal quality in aiding people to achieve peace and meditation in the modern world. If worshippers are dependent on a direct, devout reflection upon their religious significance then some formerly religious objects, such as prayer beads, amulets, pendants, rosaries, and other blessed objects, are quite far from their original sanctified purposes. Nowadays, something like the Fidget Egg, with no religious connections, can be used to enhance concentration, whether for educational or work-related purposes.

People seek objects that they can draw power from, receive good fortunes, and provide healing properties (Henry & Marriott, 2002). Power beads for example are worn around the wrist similar to Buddhist monks who carry around *malas* (Henry & Marriott, 2002). Different types of worry, power, or prayer beads can be crafted to best suit the physical stimulation needs of the user. In *Pagan Prayer Beads: Magic and Meditation with Pagan Rosaries* written by John Michael Greer and Clare Vaughn, the authors provide information on the different types of materials people can use to construct their own prayer beads. For some who create their own prayer beads "it can provide a psychological or emotional anchor as you go through a difficult period in your life" (Greer & Vaughn, 2007). The need to touch things with one's hands creates peace that allows the handlers achieve a greater level of sophistication.

5.5 Primary Research

The developing world certainly has no actual fidgeting devices manufactured in their countries, but their religious and traditional practices often have elements that serve similar purposes. These elements are not necessarily recognized as performing a calming function but are instead associated with ritualistic sanctified religious practices. Identifying such objects in scholarly literature is hard to do because anthropologists do not focus, of course, on fidgets in the developing world and on the other hand, scholars of religion would not necessarily identify such implements out as serving calming functions. With little original research on the object of this study in the developing world, we turned to WPI students, several faculty and staff about their travels and observations abroad to learn about the possible use of fidgets. The following is an analysis of their responses (see Appendix G for the transcript of the request for information and of responses).

5.5.1 Objects that Serves Same Functions as Fidgeting Devices

WPI faculty and staff in the Humanities and Arts department, International House, and the Interdisciplinary and Global Studies Division were contacted about their experiences and observations in developing and non-western industrialized nations. The responses were helpful in identifying the types of objects people use that serve similar functions as fidgeting devices found in the United States.

Several respondents noted objects or practices that could be associated with sacred customs or rituals. Professor Peet writes about communal baths, meditation, yoga, massages, which are both calming and are practiced as rituals to cleanse the body and soul. Some people go to a temple with hot springs and meditate about the beneficence of their god in alleviating their anxieties. Massages and yoga, for instance, are things some people do to escape the stresses of

industrialized society, but perhaps such leisure actions are considered in industrial society as disrupting the productive processes.

> What I do know is that meditation, yoga, massages, sitting in hot mineral springs or a sauna or steam bath, and putting oneself in isolation to think about life without the distractions of others are definitely things people in other cultures do to deal with life's stresses. So I think there are many ways to deal with stress, and a 'toy' isn't necessarily the way many (most?) people [in the world] deal with it. (Peet, 2017)

Professor Robertson also recognizes that prayer beads, discussed in scholar literature, might be considered as similar to fidgeting implements inasmuch as they aid in concentration for Buddhist prayers. Figure 44 shows a prayer wheel used in conjunction with prayer beads. A prayer wheel is made of a metal cylinder that is "mounted on a rod handle and containing a tightly wound scroll printed with a mantra" (Religion Facts, 2016). These hand-held devices serve similar functions to prayer beads in helping a follower recite mantras during sacred rituals (Religion Facts, 2016).

> I am afraid nothing jumps to mind except prayer beads and small hand-held prayer wheels—both for Tibetan Buddhists. They are both common, especially the beads. They are often used in rituals and pilgrimages but also probably as fidget toys. (Robertson, 2017)

Figure 44: Buddhist Prayer Wheel

Likewise, some respondents noted well-known religious implements such as prayer beads, wheels, and rosaries, but at the same time pointed out objects that have no apparent connections with religion. A response from a German studies professor mentioned stones that some people use to rub their thumbs and fingers on. Sensory stones are also options in the industrial world as fidget toys because of their small size and ease of portability (Therapy Shoppe, 2017). Though this commercialized product does not have to be purchased to produce the same benefits of an ordinary stone picked up from the ground.

> I know people have sometimes used smooth round stones the size of an egg as a fidget. And some Catholics use rosaries, but I could not tell you how common it is in Germany. I do not know if people consider those stones as fidgets, they seem to fulfill that function though. (Brisson, 2017)

The director of WPI's Center for Project-Based Learning responded with his observances about the Zhigao-spinning pens he saw during travels in China (Figure 45). The Zhigao-spinning pen is weighted by metal balls on either side of the pen for balance and stability when being spun around in the hand. The Zhigao-spinning pen is a popular youth hobby in China. Spinning a pen or pencil in a person's hand requires some level of concentration to prevent it from falling on the floor. However, using the Zhigao-spinning pen requires a higher level of focus and centration to manipulate in a person's hand or other body parts to improve their handling expertise. The director provided a link to a video that demonstrates young Chinese adults handling the pens. Pen or pencil spinning is a common phenomenon in any workplace environment. The wide practice of spinning pens may be influenced from observing others doing it and perhaps can be compared to how religions adopted from each other the use of religious tools.

> The only example that comes to mind is China, where people often spin pencils/pens in interesting ways like this. (Vaz, 2017)

Figure 45: Zhigao-Spinning Pen

In a professor's travels to New Zealand and India, Professor Shockey has never observed the use of manufactured fidgets in either countries. She mentions that fidgeting may be only part of a person's own particular physical characteristics and that New Zealanders keep to themselves about any outward display of disruptions to other people. The only memorable experience of seeing someone occupy their hands in gatherings was bringing yarn and a needle to knit. Knitting involves, in fact, a repetitive action of looping yarn that is akin to the repetitive threading and counting of prayer beads in a person's hands.

> I have never seen anything like this in New Zealand or in India. I believe that people fidget on their own as part of their personality, sometimes with a pen or something. Maybe the U.S. is high stress? In general, people in New Zealand are quite private about things like this – and it would not be visible. I have similarly never noticed anyone that fidgets in India. The only fidgeter that I know in the United States brings her knitting to meetings (Shockey, 2017).

Professor Saeed also mentioned rosary and worry beads; however, the use of short canes used by military officers had not come across in our research until his response. The short canes are also called "swagger sticks," a symbol of rank in the armed forces and a part of their uniforms shown in Figure 46 (The Marine Shop, 2017). Mostly likely, from the handling of

swagger sticks in the military the professor drew comparisons to other held objects in the East. Furthermore, some may view smartphones and other electronics as the modern day fidgets.

When mentioning this MQP project to a social science and policy studies professor he remarked that a previous student constantly used and repeatedly handled their cellphone in lecture. Several occurrences the professor asked the student to put the electronic away because the professor saw the use of the cellphone as a distraction from the student's attention on the lecture. The student later revealed to the professor that he needed to be touching his electronic device in class in order to concentrate better on the material covered in the lecture. When we informed the professor about the Fidget Egg and its discreet and small stature would not pose as much as a distraction in class as a cellphone. The professor said that he would not mind the use of the Fidget Egg and was more concerned on the unapproved use of electronics in classrooms, which is stated in the courses' syllabus. A quiet object like the Fidget Egg would be an approved device in courses.

> Many fidget gadgets/processes around: rosaries and worry beads, canes - these are short canes, in particular carried by military officials, hand exercise balls and even chants are the traditional ones in the East. Smart phones, iPods might be the modern ones. (Saeed, 2017)

Figure 46: Short canes, shown in hands, used by military officials.

Two professors and another staff member did not have anything that came to mind as fidgeting objects. Probably because fidgeting is not usually consciously observed unless it is annoying and perhaps our inquiry was the first time they had been asked about fidgeting objects. As Professor Peet said most people do not focus on the fidgeting or calming aspects in a culture.

The following response suggests that the popular use of fidgets in Western nations may eventually spread through globalization to different parts of the world in urban populations. The spreading international popularity and fashion for such items might be compared to the spread in usage of the komboloi among different classes in Greece.

> I do not have any recollection of people playing with fidgeting-like objects in South Africa.
> But I would guess that, given that Cape Town is a very cosmopolitan city with lots of young professional types, I suspect ideas like this may have spread there, if it's common elsewhere. (Jiusto, 2017)

A WPI staff member who has traveled extensively in Europe was also not familiar with the concept of fidgeting objects but referenced that pen twirling is a common habit performed by people, similar to professor Vaz's comments about Chinese people fiddling with Zhigao pens. Doodling and fiddling with objects within arm's reach in a person's workstation have also been mentioned in previous studies because they "help users increase productivity, enhance creativity, and lessen stress by affecting specific areas of the brain" (NYU Engineering, 2014).

> It is very common to play with a pen or pencil in your hand, or maybe do a little doodle or rearrange things on the desk. (Clarkson, 2017)

A Latin American studies professor posed our investigation on her Facebook page and surveyed her friends of their experiences in handling fidgeting objects or stress. For some, people are relieved of stress by alcohol consumption. An interracial couple sees fidgeting as a "first world" activity where people need fidgeting aids to treat themselves or use cellphone to occupy their hands. One comment referred to "*pelotitas antiestrés*" (Figure 47), which is Spanish for

stress balls and the literal translation is “small balls for anti-stress.” The professor commented that stress balls are widely used in Argentina, but she did not think their use is prominent in the United States, based on her observations. Two separate comments from Americans said that the use of fidgeting objects are common in high school and in occupational therapy for hand exercises.

A Guatemalan suggested the cup-and-ball, or *capirucho*, as a possible fidget toy (Figure 48). The toy requires intense focus to capture the ball in the cup. This toy, like the Chinese Zhigao-spinning pen, requires individual attention from the handler, which allows the user to hone their skills in successfully setting the ball on top of the wood handle. Nevertheless, unlike fidgets, it is unlikely a person would use the cup-and-ball while actually completing work although it may serve to limit stress due to the concentration the object demands.

> An Argentine said, “We just drink mate!” A Venezuelan/Paraguayan said, “From my experience it is strictly an American ‘first world’ thing. Nowadays everyone seems to fidget with their phones. Josh [her gringo partner] has a small collection of fidgeting aids.” Another Argentine said that she has seen “*Pelotitas antiestrés*” [in Argentina], but they are nowhere near as prevalent as here. And two Americans responded to say that they're really common even at the high-school level these days, but also in Occupational Therapy. A Guatemalan friend just replied with ‘*Capirucho*.’” (Madan, 2017).

Figure 47: Pelotitas Antiestres

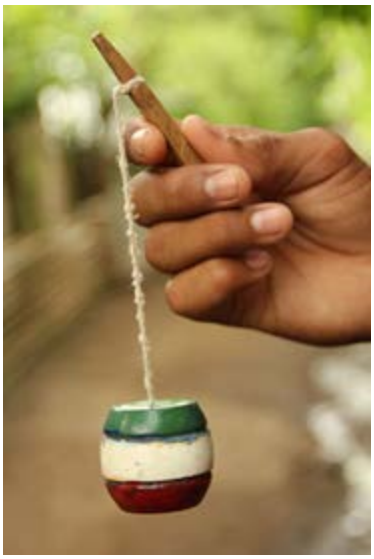

Figure 48: Capirucho

South Americans may not see everyday objects as fidget toys like the stress ball mentioned. The use of such items may be considered by others as an American invention to commercialize products that serve calming qualities and enhance productivity. An author's observation from the responses gathered from WPI faculty and staff was that none of them mentioned that they themselves users for purposes of concentration or stress relief, or any other psychological-mental qualities one may fiddle with objects for. Therefore, the replies gathered from professors and staff are from people who do not appear to fidget on a regular basis.

Another outreach by a survey emailed to international students and 16 cultural groups on the WPI campus was conducted but unfortunately received only one response (see Appendix I). The one answer however, provided cultural insight to a small part of China. The action performed by a Chinese WPI student is thumb twiddling. This action is common for men, women, and children of all ages to perform every day. Some Chinese do not rely on the use of objects to assist them to improve their level of concentration on tasks. She stated that thumb twiddling is an ancient Chinese custom that influences each generation of youth who observe older family members thus carrying on the tradition. Lastly, the student was concerned about

performing this bodily movement publically in the United States because she recognized gestures had different meanings in different cultures.

From using a person's own thumbs to military swagger-sticks, people have many different interpretations of what they would consider fidgeting devices. Some implements that respondents mentioned already had religious connections. Other objects, without sacred qualities, were made to serve the function of a fidget but did not necessarily have the same enhancement of concentration qualities. People have their own item preference that they prefer to occupy their hands with so there is no one-size-fits-all that a person comes to choosing fidgets.

5.6 Final Remarks

The research is not clear, but the question remains if fidgets need to have a religious dimension or remain as a secularized object. In modern society, people have invented a variety of hand fidgets to serve various needs related to enhancing concentration or stemming anxieties. In the developing world among religious people, some of those needs are met—perhaps indirectly—by prayer beads, prayer wheels, amulets, stones, and because large sections of these societies are less secularized, many people achieve spiritual calmness through reciting prayers, chanting, and repeating mantras. Almost all major religions of the world have ways to memorize sequences of prayers or sacred references that are aided by counting beads with each recitation. The Greek kolomboi is an object that has no religious purpose in its usage and probably is the most striking example of de-sanctification of a religious object.

In 2009, a therapist used prayer beads to treat clients on combating negative thoughts with positive thoughts when the beads were handled in conjunction with reciting positive mantras that were appropriate for the client (Wernik). Wernik had observed that major religions used prayer beads to keep track of prayers, chants, and mantras and saw the opportunity to bring the psychological effect of these practices into treating his patients (2009). All three clients

improved when they engaged in the ritual of reciting positive mantras when negative thoughts clouded their minds. The simple act of reciting positive mantras gives people the means to heal themselves from life's worries and anxieties. The individualized use of prayer beads in Wernik's study imitated the repetition function of reciting sacred verses that is common in many religions.

Not many people are attuned to the identification, diagnoses, and treatment of brain disorders in the developing world. The governments and nonprofit organizations that spread awareness to citizens and governmental healthcare divisions need to take measures in recognizing, treating, and accommodating people with these disabilities. These actions will enable people to receive the proper help that one requires. In modern times, people can find a place to center themselves through the use of sacred or secularized objects to relieve oneself of the world's anxieties. Rosaries, prayer wheels, amulets, worry stones, like the prayer beads, can all be used for therapeutic resources parallel to the modern day commercialized fidget toys. We do not know how beneficial those objects would be. We only have one piece of evidence of the prayer beads being used for medicinal purposes to treat illnesses, but if people can be assisted from secularized objects then there may be a chance that other objects can also serve these roles throughout the world.

6. Conclusion

The careful planning and engineering created the Fidget Egg to be a helpful, hands-on fidget, from the initial surveying and the axiomatic design decomposition – all of these factors made this product come into fruition. We learned that every person has their unique fidgeting habits that can be fulfilled by certain fidgeting possessions. Particularly with the product's small build, customizable sizing options allows the team to make Fidget Eggs the best toy possible for every person. Additionally, we identified that some people center themselves with sacred or secularized objects to relieve oneself of the world's anxieties. The conclusions are: the Fidget Egg is a viable product to empower consumers to direct their focus, there is no ideal fidget for everyone, and there may be a correlation with the use of fidgets and the pressures of industrialization.

Interdisciplinary Nature of MQP

With three different majors incorporated into this MQP, there were many opportunities to think about this project from an interdisciplinary perspective. From the beginning of this project, our team intentionally thought about how different disciplines would need to come together to make this project successful. Although mechanical engineering, business, and international studies were the primary disciplines, our team recognized that other areas of expertise, such as psychology, social sciences, and economics are integral to the success of the Fidget Egg. Other specialists and experts could be beneficial to the team as well, such as lawyers, higher education professionals, industrial engineers, and therapists.

During the course of this project, methodologies and frameworks from different disciplines were combined to create the Fidget Egg. From the mechanical engineering side, the primary methods used were axiomatic design and manufacturing. The business team took the approach of creating a business proposal for the Fidget Egg, including a detailed market analysis

and financial analysis. The international aspect of this project includes research about how people from other cultures use and benefit from fidget devices. Some elements of this project overlapped disciplines, such as the pre- and post-design surveys (shown in Appendix E). For example, the questions on the survey that asked respondents what they liked or disliked about the fidget device were useful to both the design team and the business team. For the design team, the answers to these questions were useful in making improvements to the design. For the business team, the answers to these questions were useful in identifying the products' strengths and weaknesses, therefore shaping the value proposition of the Fidget Egg.

Working as an interdisciplinary team sometimes presented an extra set of challenges. One of the primary challenges was trying to understand the other team members' goals and methods. For example, having never worked with a 3D printer, the business team needed more information about how the 3D printing process worked, including the time needed to print, the costs of the plastic used, and what the purpose of a raft is. Another challenge with working on an interdisciplinary team is clearly defining what the roles of each team member was. Some information, like current fidget devices on the market, is beneficial to every team member, so it was sometimes difficult to decide who should gather that information or where it should be placed in the final paper.

Overall, working with an interdisciplinary team was a positive experience that helped each team member expand their thoughts about a problem. The specific problem that we set out to solve – a lack of adult fidgets in the market – was best approached from different angles. Each team member, while primarily focusing on his or her own discipline, benefitted from others' knowledge or point of view, and these different viewpoints came together to create a successful final project.

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Appendices

Appendix A: Fidgets Bought

Putty: http://choices4children.blogspot.com/2012/07/silly-putty.html

Ring and Chain: https://www.therapyshoppe.com/category/P3376-showa-noa-noah-fidget-toys-tools-calming-alerting-fidgets-office-desk-stress-toys

Prayer Beads:

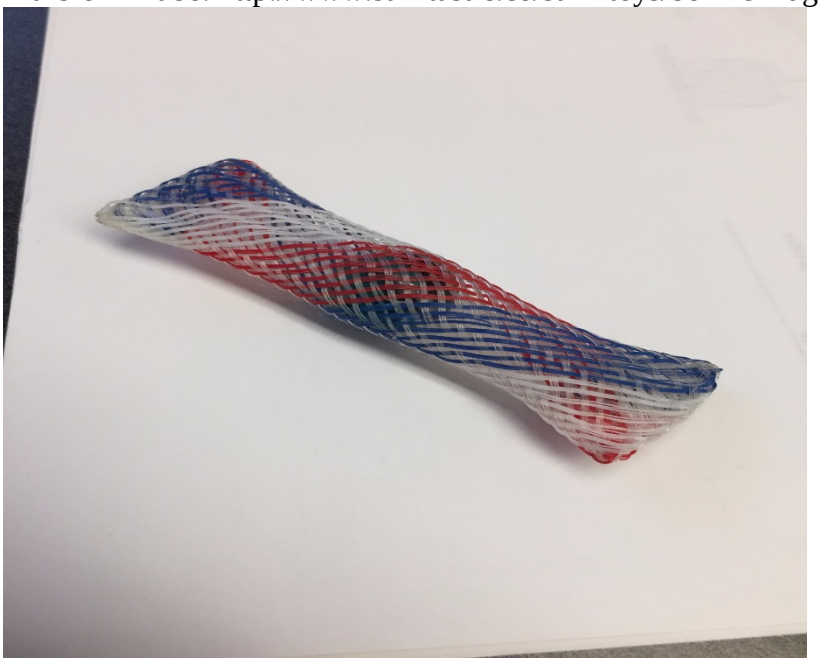
Fidgeting Finger Springs: https://www.therapyshoppe.com/category/P366-fidgeting-finger-springs-most-popular-focus-fidget-toy

Stress Ball: http://www.childrenstherapystore.com/funfidgets_dna_sensory_balls.html

Spinner- 3D printed

Greek Komboloi: http://www.culturetaste.com/Worry-Beads-Greek-Komboloi-Black-Onyx-Gemstone-Round-Shape-p259.html

Marble in Tube: http://www.stimtastic.co/stim-toys/boinks-fidgets

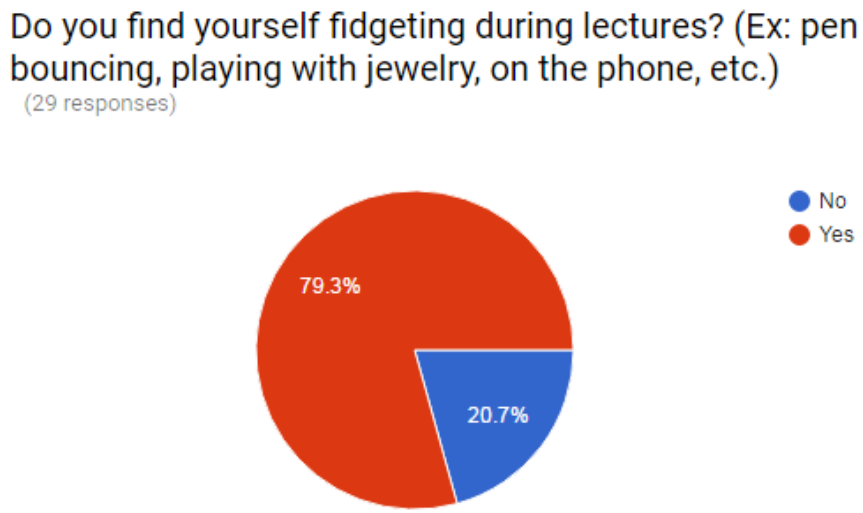


Squidget: https://www.facebook.com/GetSquidget/

Fidget Cube: https://www.antsylabs.com/products/fidget-cube?gclid=Cj0KEQiAlsrFBRCAxcCB54XElLEBEiQA_ei0DBEKFQaVNjQUcT3zoE0JmFITax5gNwkGFWnrxxUfI7AaAusp8P8HAQ

Appendix B: Surveys

Fidget Toy Survey 1:

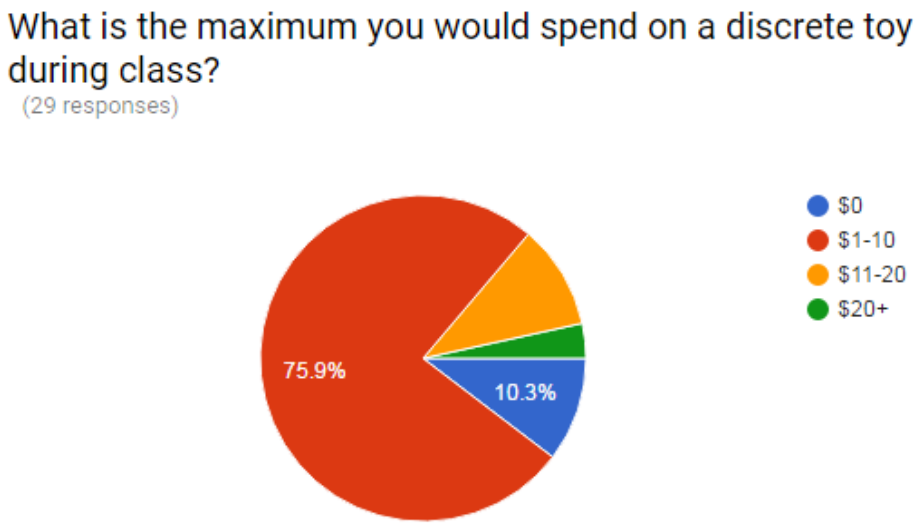


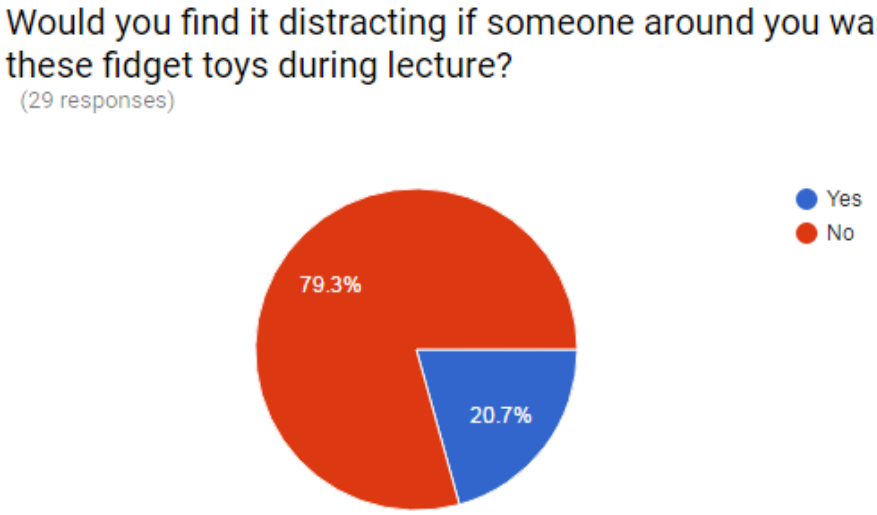
If Yes, what do you use to fidget?
pen
Pen
pen
phone
my fingers or my pen
Taking apart my pen, spinning something (pen)
pencil
my body
pencil or tap fingers
Necklace
my hair
Hearthstone
Pen spinning/drawing
Pens, Rubber Bands, Watch
toothpicks, pens, phone, clicker, really anything
Pen cap, fingers
Everything
My phone
Pen

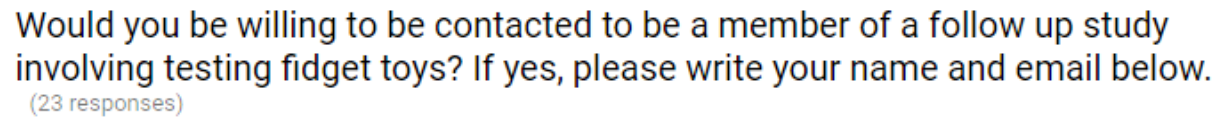
pen
My ring
I have a stimming ring and toy I usually carry with me.
My phone or playing with my hair
pen/hair
Engraving Tool

What did you like best about each toy? What drew you to each toy?
the colors
The springy fidget was cool to wrap around my fingers. The long tube bally fidget felt good when moving the ball back and forth along the tube. The little hard plastic contraption fidget had a roller thing that is fun to roll your finger on. The squishy ball of balls was my personal favorite because it's squishy and bally and super cool and fun to play with!
stability. The plastic cubes felt like I was going to break them
movalbiliy
Feel, movement
The fidgets help me focus and not move around as much.
I liked being able to spin the thing in my hand momentum. I wish there was one that involved taking apart.
I liked the stress ball the best, because I like the way it feels. It also helps take anger or frustration off.
I like the marble in the finger catcher
I liked the ones that I could press and easily use with one hand. I like pressing or squeezing the toy
I liked the spinning toy the most.
The spinner one that had only 3 circles in it was nice because you can bend it and spin it.
color, texture, and shine
Moving parts are always best, I liked things with multiple ways you can use them.
The hypnotic rhythm of each object.
I enjoyed things with dynamic movement. Also objects that had a nice weight to them were especially appealing. Having the "fidget" portion of it being an easy movement was a plus.
they are discreet and aren't as distracting as other things i fidget with
Toys that took two hands instead of one
ball
The squishiness of the ball and the repetitive motion of the fidget
yes
one handed motion
Something I can fidget with one hand so I can use the other hand to take notes
Each toy had a different movement and feel to it. The chinese finger trap was really fun because it had the most unique movements. The cube was close second, but the parts weren't loose enough.
I liked that the toys are really small and portable, so I could use them without drawing too much attention to them.
I like the ball and the rectangular net thing with the ball in it.
I liked the repetitive nature of the bearings however i liked the complexity of the swidget

they were all different and fun to hold
Simplicity







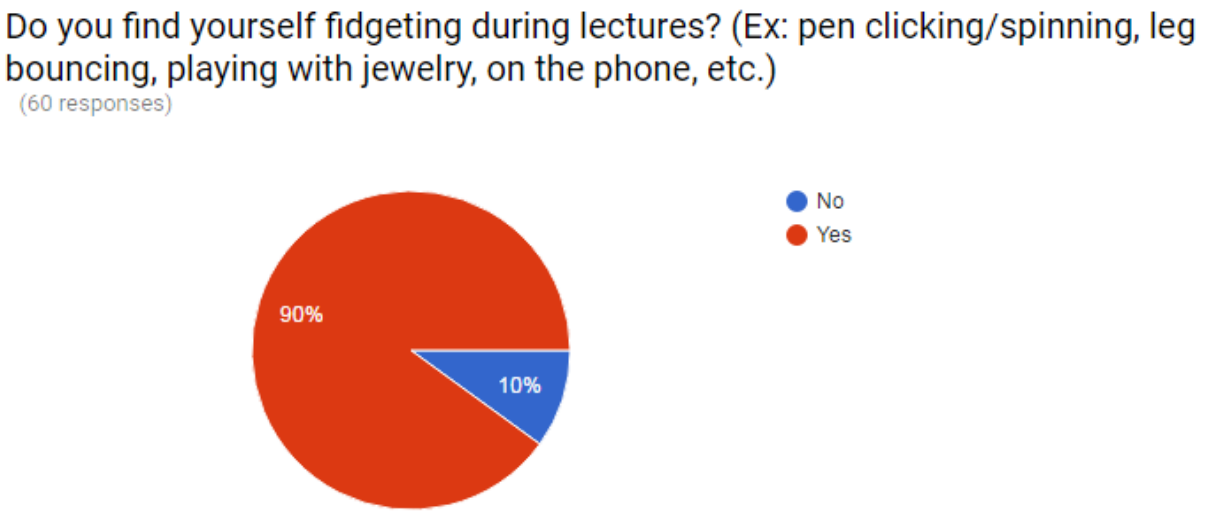
[Responses not shown]

Table 8: Favorite Fidget Voting Results from Surveying Data 1

Toy	**Number of Votes**

Fidgeting Finger Spring	1
Marble in Tube	11
Squidget	3
Squishy Stress Ball	8
Ball Bearing Spinner	10

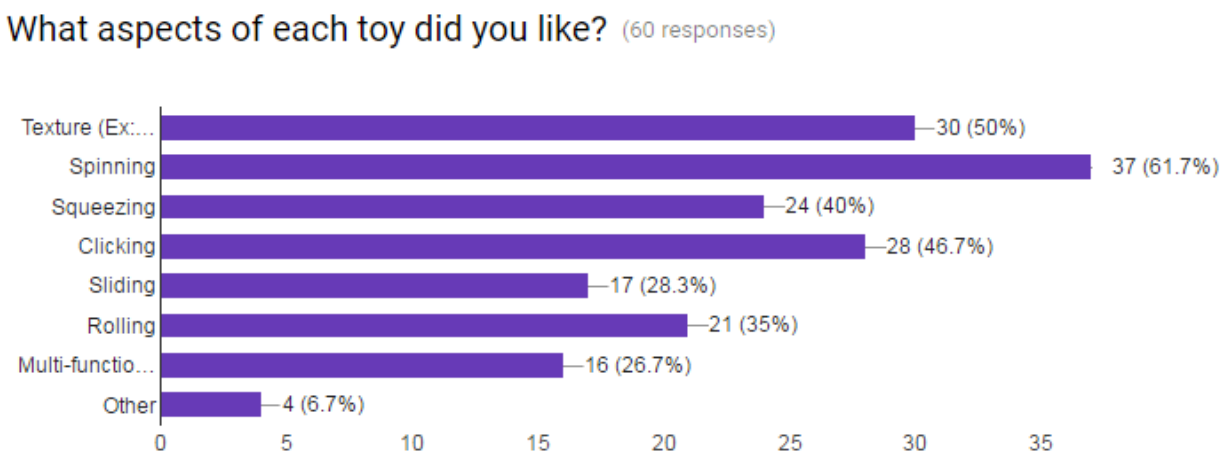
Fidget Toy Survey 2:

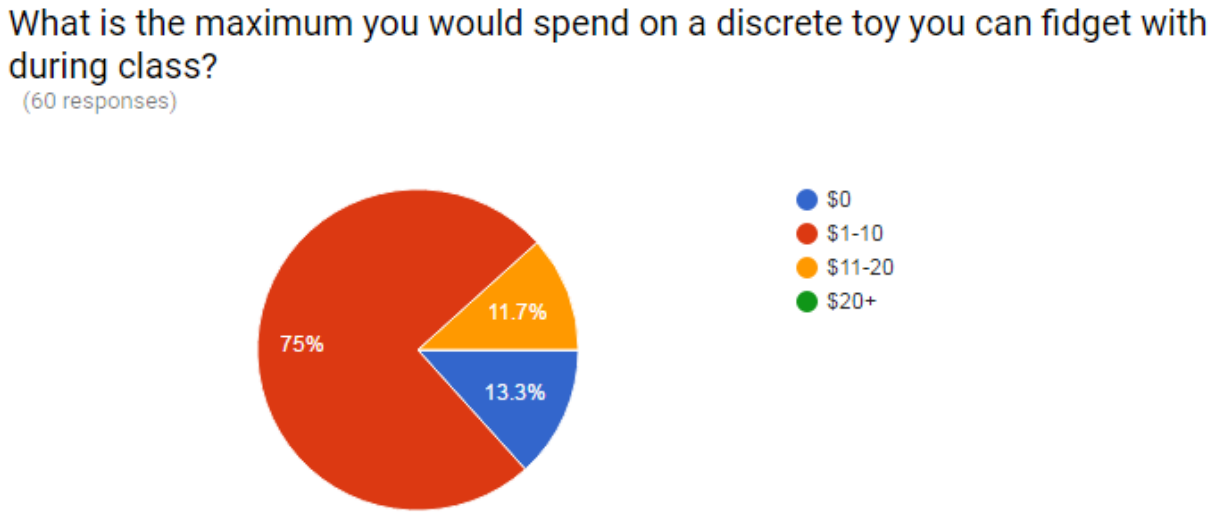


If Yes, what do you use to fidget?
Clicking pen, tapping pen, flicking pen clip, using phone
my hands and phone
pen clicking
pen
Spin my pen
Pen and or fingers
Pen
pen
pens and my phone case
Leg bouncing
Pens. I have a spinner ring.
metal parts
Mechanical pencil(spinning)

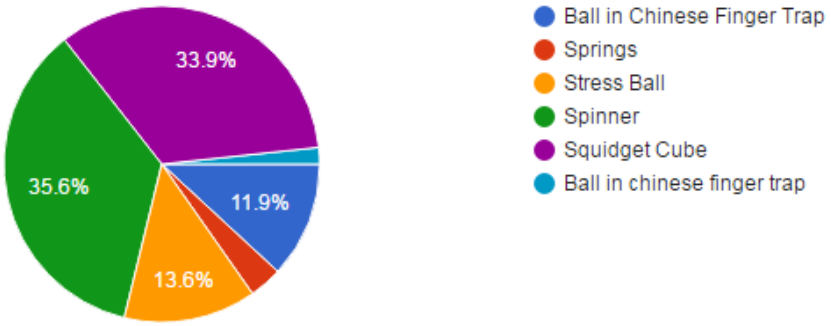
Phone or pen
Play on phone
Pen
pencil
Pens, my legs, paper, really whatever is in front of me
Pens, pencils, Brianna's hair, phone, jewlery
scribbling
Pen
Paper, My hair, My phone, Jewlery, A pen
Pencil
Pen, just my hands
bouncing a pen and or playing with hair
Pen
clicking pens, tapping leg
pen
Pen, bracelet
bounce leg, play with pen, i actually carry a bearing with me too
Pen
Pen clicking or similar
Sometimes
pencil
pen/pencil
Pen, phone
leg bouncing, pen spinning
Napkin/PaperTowel or pen
no
PEN
clicking pen
Pens, Paper, Tape, back pack, everything
My Pencil
pen or phone case
Pens
pencil
Pen, Leg, Phone
braid my hair, pen, pencil, jewelery
Shake legs
zipper on clothes
rotate the pen between my fingers.

my pen
pencil
fliipping/clicking pen
Pencil





What toy would you find most distracting if used in a classroom? (59 responses)



Why?
Too much going on
have to think about it
Too many facets to use and explore.
I focused more on it while fidgeting
Most noticeable action
There is too much movement
Because its so interesting!
It is simple and easy.
too many things
Multi-functionality would be distracting (if I were watching someone else play with it, I'd be thinking about how I'd be playing with it)
The movement required to spin it is a larger one, which draws people gaze.
I stare at it while it spins
I could but it on a pencil
It requires a more focus on the fidget than on the lecture.
most notable motion
I HATE THE STRESSBALL IT AGGRAVATES ME
You have to look down to play with it to see it
high speedness is distracting
Looks weird
It is very colorful and feels like it needs focus.
It just works
It was just the most comfortable to play with
I would be distracted by the colors and the squishyness because I am a sensing person
Fun to play with

It requires two hands
I had to focus to get it to spin
most discrete
It is the most bizarre
It moves most and requires most movement to fidget with
you have to concentrate on playing with it
not discrete, easily noticed, could be very distracting to others
Too much noise and too large
i have popped a stress ball
I would be fascinated by all the things on it so i couldnt look away
It was simple and not too bothering
IT's weird and non elegenat, no good
Squisy
noise
snapping sound
Focus more on that than the class, defeating the purpose of the toy
weird spinning
the clicker could bother others
larger
It distracts me because I want to look at it spin. :v
There's just a lot going on
to much effort to fidget with
so much going on
Too much going on in the toy - had to look at it.

Would you be willing to be contacted to be a member of a follow up study involving testing fidget toys? If yes, please write your name and email below.
(39 responses)

[Responses not shown]

Table 9: Favorite Fidget Voting Results from Surveying Data 2

Toy	**Number of Votes**
Fidgeting Finger Spring	10
Marble in Tube	22
Squidget	3
Squishy Stress Ball	17
Ball Bearing Spinner	23

Survey Results

The data we collected was remarkably favorable toward fidgeting and a number of biases are reflected within it. The short term exposure which volunteers were given to each of the toys may have made it harder for them to identify which kinds of fidgets and features they would have preferred during longer term use. The environment in which our volunteers tested the fidgets was noisy, crowded, and generally unfocused. Additionally, as they were participating in a fidget related survey, it may have been harder for them to identify if any given feature would be distracting in a more serious environment. Because we were table sitting around our campus many of the volunteers were our friends. This may have caused them to give biased feedback on the fidgets. While using our data for design and marketing purposes it was important to consider these biasing factors.

Appendix C: Axiomatic Chart Revisions

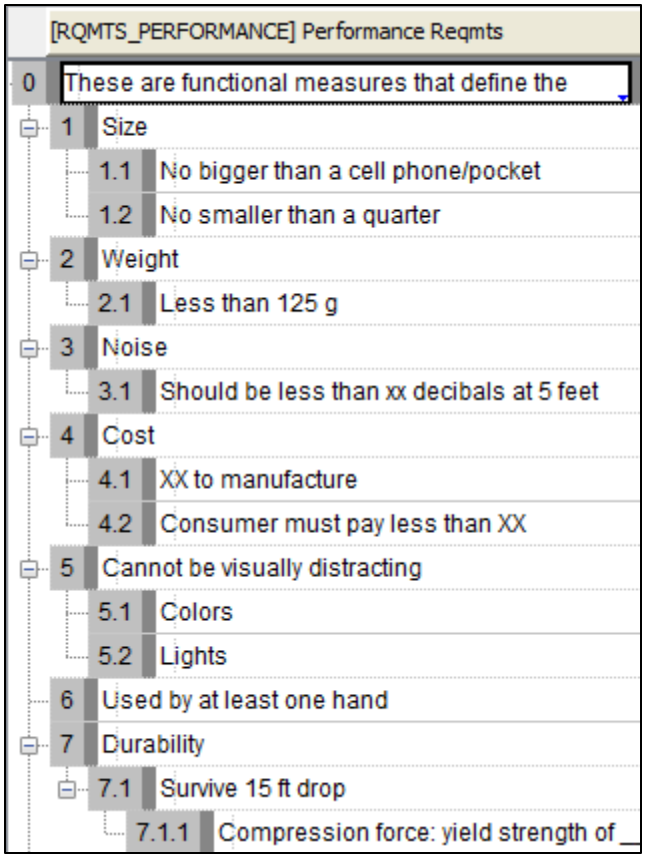
10/26/16

	[FR] Functional Requirements	[DP] Design Parameters	FR Measureme
0	I need to fidget with something	Fidget Widget	
1	To apply physical stimulation		
1.1	Be different textures	Have different materials	
1.1.1	Has surface protrusions of 1/4 inch every 1/4 in with 45	Stone	
1.1.2	Has surface protrusions of 1/4 every 1/4 with a ramp	Cactus	
1.1.3	Yields readily to touch or pressure (Soft)	Fleece	
1.1.4	Has surface roughness of less than XXX (Smooth)	Silk	
1.1.5	Has surface roughness of more than XXX (Rough)	Fine Sand Paper	
1.1.6	Experiences elastic deformation with normal contact	Gelatin	
1.1.7	Has frictional coefficient of less than XXX (Slippery)	Silk	
1.2	Exert a Force		
1.2.1	Exerts a constricting force of XXX (Squeezing)	Clamp, Compression Sleeves, Little Springs	
1.2.2	Clicking	Pen Cap, Buttons on Game Controller	
1.2.3	Flipping a switch	Light Switch	
1.2.4	Centripetal acceleration	Ball on a String, Ball Bearings, Spinning Wheel	
1.2.5	Falling	Rain Stick, Yoyo, Slide Noise Maker, Ball on a String, Gravity	
1.2.6	Magnetism (How do they work?)	Permanent Magnet, Electromagnet	
1.3	Inspire Movement		
1.3.1	Slinky	Slinky	
1.3.2	Rotation	Ball Bearing, Gears, Concentric Cylinders	
1.3.3	Slider	Concentric Cylinders, something on tracks	
1.3.4	Gyroscope	Flywheel Spinners, Gyroscope	
1.3.5	Stretchy	Rubber Bands, Elastics, Little Springs, High Viscosity Material, Silly P	
1.3.6	Spring	Sping	
1.4	Temperature		
1.4.1	Warm	Friction, Body Heat, Mood Rings, Color changing pens	
1.4.2	Cold	Stone	
2	Be durable		
2.1	Last more than 24 hours of use	Material with fatigue life of ___, Matieral of thickness greater than ___	
2.2	Last 15 foot drop	Compression force: yield strength of ___, hardness of ___	
2.3	Water resistant	Solid piece of material, corrosion resistant	
3	Easily stowable	Size: pocket, thin; Protrusions at ___ length, smooth material	
3.1	Attachable	clip, velcro, magnets, etc	

[RQMTS_PERFORMANCE] Performance Reqmts	
0	These are functional measures that define the
1	Size
1.1	No bigger than a cell phone/pocket
1.2	No smaller than a quarter
2	Weight
2.1	Less than 125 g
3	Noise
3.1	Should be less than xx decibals at 5 feet
4	Cost
4.1	XX to manufacture
4.2	Consumer must pay less than XX
5	Cannot be visually distracting
5.1	Colors
5.2	Lights
6	Used by at least one hand

11/14/16

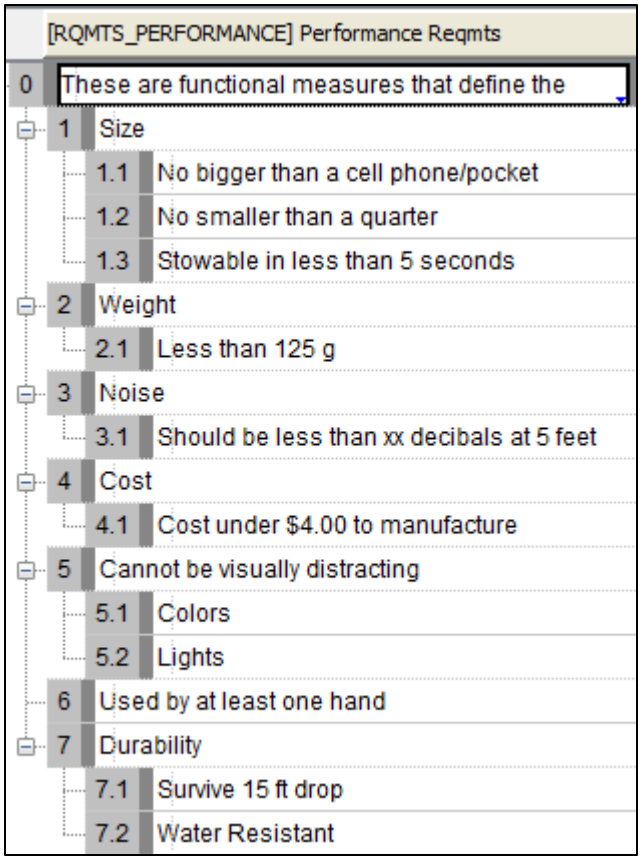
[FR] Functional Requirements		[DP] Design Parameters	FR Measureme
0	I need to fidget with something	Fidget Widget	
1	To apply physical stimulation		
1.1	Be different textures	Have different materials	
1.1.1	Has surface protrusions of 1/4 inch every 1/4 in with 45 degree ramp angles (Bumpy)	Stone	
1.1.2	Has surface roughness of less than XXX (Smooth)	Silk	
1.1.3	Experiences elastic deformation with normal contact (Squishy)	Gelatin	
1.2	Exert a Force		
1.2.1	Impact force	Ball on a String, marble in tube, slinky	
1.2.2	applies resistive force for XXX and then stops (clicks)	Flipping a switch, clicking a pen, buttons, switches, rachets,	
1.3	Provide Motion Options		
1.3.1	Spins about a center axis	Ball Bearing, Gears, Concentric Cylinders	
1.3.2	Provides limited xy motion	Concentric Cylinders, something on tracks	
1.3.3	Low modulous of elasticity	Rubber Bands, Elastics, Little Springs, High Viscosity Material, Silly P	
2	Be durable		
2.1	Last more than 24 hours of use		
2.1.1	Critical features have fatigue life of ___.	rubber or plastic joints	
2.2	Water resistant	Solid piece of material, corrosion resistant	
3	Stowable in less than 5 seconds	Size: pocket, thin; Protrusions at ___ length, smooth material	
3.1	Attachability	clip, keychain, ring	



[RQMTS_PERFORMANCE] Performance Reqmts	
0	These are functional measures that define the
1	Size
1.1	No bigger than a cell phone/pocket
1.2	No smaller than a quarter
2	Weight
2.1	Less than 125 g
3	Noise
3.1	Should be less than xx decibals at 5 feet
4	Cost
4.1	XX to manufacture
4.2	Consumer must pay less than XX
5	Cannot be visually distracting
5.1	Colors
5.2	Lights
6	Used by at least one hand
7	Durability
7.1	Survive 15 ft drop
7.1.1	Compression force: yield strength of __

12/7/16

[FR] Functional Requirements		[DP] Design Parameters
0	Fidget with a device	Device which fulfils the need to fidget with something
1	Experience physical stimulation	Device features which provide physical stimulation
1.1	Experience tactile stimulation	Device feature which provide tactile stimulation
1.1.1	Experience a bumpy surface	Device featuring a bumpy surface
1.1.2	Experience a smooth surface	Device featuring a smooth surface
1.1.3	Experience a squishy surface	Device featuring a squishy surface
1.2	Experience stimulation through the device exerting a force	Device feature which exert force
1.2.1	Experience an impact force	Device feature which exerts an impact force
1.2.2	Experience a clicking sensation	Device feature which exerts a clicking sensation
1.3	Experience stimulation through exertion of motion	Device feature which move
1.3.1	Cause a spinning motion	Feature which can spin
1.3.2	Cause a sliding motion	Feature which can slide
1.3.3	Cause a stretching motion	Feature wich can stretch
2	Use intermittently for an extended period of time	Method to provide extended intermittent use
3	Know location of device	Method to know location of device


[RQMTS_PERFORMANCE] Performance Reqmts
0 These are functional measures that define the
1 Size
1.1 No bigger than a cell phone/pocket
1.2 No smaller than a quarter
1.3 Stowable in less than 5 seconds
2 Weight
2.1 Less than 125 g
3 Noise
3.1 Should be less than xx decibals at 5 feet
4 Cost
4.1 Cost under $4.00 to manufacture
5 Cannot be visually distracting
5.1 Colors
5.2 Lights
6 Used by at least one hand
7 Durability
7.1 Survive 15 ft drop
7.2 Water Resistant

Appendix D: Emails to Participants

Testers Interest Email:

Hello,
Thank you for volunteering to continue helping with our fidget MQP when you took our survey a few weeks ago.
We are working to develop the ultimate fidget toy, a non-distracting toy to use wherever you are to help you focus.
At this point in our project we are looking for testers to use our product during the week of December 5th to December 12th and give us feedback in an initial and concluding survey. We will use your feedback to improve our design.
Please respond to this email by this Friday at 5:00 pm if you are interested in continuing our study. We will send you more information if you respond.
Thank you for your time.
Best Wishes,
The Fidget Team
Brianna Fogal
Connor McGrath
Carolina Ramos
Ashley Stanley
Daniel Sturman

Pre-Use Survey Email:

Hello tester,
Your participant ID number is: XX.
Here's the pre-use survey:
http://wpi.qualtrics.com/SE/?SID=SV_3rbEqy1dOAmPe8l
Please fill this out before you start fidgeting.
Let us know if you have any questions. We will be sending out the Post-Use survey in one week. Thank you for your help!
Best,
Fidget Team

Post-Use Survey Email:

Hello Testers,
Thank you so much for helping us with our MQP!
Please fill out the following Post-Use Survey. Your feedback and suggestions will help shape the next model of our fidget. We appreciate your honesty and thoughtfulness with your responses. This survey could take about 10-15 minutes.
Your participant ID # is the same from before which can be found in the original Pre-Survey email we sent to you.
http://wpi.qualtrics.com/SE/?SID=SV_0GN7i43JPIA13qR
Let us know if you have any questions! Thank you so much again!
Best wishes,
Fidget Team

Brianna Fogal
Connor McGrath
Carolina Ramos
Ashley Stanley
Daniel Sturman

Appendix E: Design Surveys

Pre-Use Survey:

Q1 - Please enter your participant ID number.

Please enter your participant ID number.
0
12
4
29
8
7
11
21
16
17
14
10
2
23
26
28
3
15
20
22
24
27

9
13
19
18
5
25

Q2 - What are your general expectations about using this fidget device?

What are your general expectations about using this fidget device?
Something to keep my hands occupied while listening or engaging in another task.
Non-distracting gadget with which to occupy my hands while in class or doing something
I expect a discrete method of figuring that won't bother those around me. I expect an easy to use device that will both look nice and not break
That it will help me focus more during class and studying without being distracting to those around me
I hope to cut down on my fidgeting that may be distracting to others and myself, such as playing with my phone or clicking pens.
I expect to focus more in class and to stop biting my nails
It will entertain my restless hands
That it will distract my fidgetness enough that I will be able to concentrate better
I hope, and think, this device will replace my pen and other fidgets I use in class. I'm unsure which aspect of the fidget I'll use most.
I expect this to keep my hands contained and occupied while I can focus my other senses towards lectures.
Help me to fiddle around with something in class in order to absorb my extra energy. Having something to occupy my hands will allow me to keep my mind engaged in lecture during times that are speaking heavy and don't require me to take notes. I also think this will satisfy my urge to tap pens, bounce legs, and whatever other fidgeting I already do in a less distracting method. Fidgeting helps me focus and with this being a less intrusive method, I hope those I interact with will recognize me as being more attentive.

Not getting distracted with using it. It is comfortable to hold. It's small enough that it won't be too noticeable. It has a few different ways to use it.
Ergonomic and comfortable in my hand Mentally relaxing and focussing
Something that will be subtle and will help me channel my distractions into something that won't take away from the conversation or subject at hand.
that it will help me focus since I will always have something to fidget with.
That it won't help and will distract me.
Something I can mindlessly fiddle with while otherwise occupied. Not distracting, just there.
Hopefully to get rid of excess energy, that can result in distracting behavior. Also, I want it to not break, and remain as useful and able to be played with as it is currently.
Discrete, easy to use
I'm excited to use it because I always am fidgeting with stuff and it helps me concentrate
I expect to learn something new about myself. I've never really paid attention to my fidgeting before I heard about this project, so I'll be intrigued if this ends up helping me focus. I expect to misplace it at least several times because I am a struggle bus, but besides that I don't really have any expectation besides having fun with it.
Not much other than having something to do to keep myself from getting bored.
I am hoping it will help me stay off my phone in class and stop biting my nails when I'm bored. It looks like it has several different components to keep things interesting.
Something small enough to carry around but that still has little things that are amusing to fuss with.
I expect it to keep me focused better than my pens, doodling, or twitching my leg. I want it to be have a satisfying user experience and not distract me.
I'm not expecting much as I don't tend to fidget except with my pen. But it could be fun.
To be less distracted in class

Q3 - On average, how often do you fidget (examples: leg bouncing, pen clicking, biting nails) during class, work, meetings, or at home?

#	Answer	%	Count
1	Never	0.00%	0
2	Sometimes	7.14%	2
3	About half the time	21.43%	6
4	Most of the time	53.57%	15
5	Always	17.86%	5
	Total	100%	28

Q4 - How often do you notice yourself looking at electronic devices for no real purpose (i.e. to keep yourself occupied)?

#	Answer	%	Count
1	Never	0.00%	0
2	Rarely	7.14%	2
3	A few times a day	32.14%	9
4	Many times a day	60.71%	17
	Total	100%	28

Q5 - Have you used a fidget device before?

#	Answer	%	Count
1	Yes	21.43%	6
2	No	67.86%	19
3	I don't know	10.71%	3
	Total	100%	28

Q6 - What devices have you used? What did you like or dislike about them?

What devices have you used? What did you like or dislike about them?
Bearing Spinner, I really do enjoy it however it can be distracting for people around me.
I used fidget bracelet
I love spinners. Not really sure why...
I have the spring from your earlier survey. I like how simple it is.
They were pretty basic which was nice to just mindlessly something to play with.

Q7 - Where did you typically use your fidget device?

#	Answer	%	Count
1	Home	0.00%	0
2	Work	0.00%	0
3	School	50.00%	3
4	Other	16.67%	1
5	All of the Above	33.33%	2
	Total	100%	6

Other

Other
All

Q8 - How often do you think you'll use the fidget device?

#	Answer	%	Count
1	Once or twice this week	3.70%	1
2	Several times this week	18.52%	5
3	Every day	33.33%	9
4	Multiple times every day	44.44%	12
	Total	100%	27

Q9 - Where do you think you will use the fidget device? Choose all that apply.

#	Answer	%	Count
1	Home	77.78%	21
2	Work	40.74%	11
3	School	96.30%	26
4	Other	7.41%	2
	Total	100%	27

Other

Other
Walking around
While doing homework

Q10 - Where do you think you will most use the fidget device?

#	Answer	%	Count
1	Home	11.11%	3
2	Work	0.00%	0
3	School	88.89%	24
4	Other	0.00%	0
	Total	100%	27

Other
Other

Q11 - Please respond to the following statements about your expected benefits of using this fidget device.

#	Question	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Total
1	This device will help me focus better	0.00%	0.00%	18.52%	59.26%	22.22%	27
2	This device will provide me with physical stimulation	0.00%	7.41%	7.41%	59.26%	25.93%	27
3	This device will help me relax	0.00%	7.41%	40.74%	40.74%	11.11%	27
4	This device will help me spend less time on my phone	0.00%	14.81%	14.81%	55.56%	14.81%	27
5	This device will not help me focus better	18.52%	51.85%	18.52%	11.11%	0.00%	27
6	This device will not provide me with physical stimulation	25.93%	51.85%	14.81%	7.41%	0.00%	27
7	This device will not help me relax	11.11%	51.85%	25.93%	7.41%	3.70%	27
8	This device will not help me spend less time on my phone	11.11%	51.85%	18.52%	14.81%	3.70%	27

Q12 - Rank what qualities of this fidget device are most important to you right now. (Drag and drop)

#	Question	1	2	3	4	5	6	7	8	Total
1	Color	0.00 %	0.00 %	0.00 %	7.41 %	7.41 %	18.52 %	51.85 %	14.81 %	27
2	Ergonomics (comfortable to hold)	40.74 %	25.93 %	18.52 %	7.41 %	7.41 %	0.00 %	0.00 %	0.00 %	27
3	Size	0.00 %	13.04 %	21.74 %	17.39 %	21.74 %	17.39 %	8.70 %	0.00 %	23
4	Portability	37.04 %	14.81 %	18.52 %	18.52 %	7.41 %	0.00 %	3.70 %	0.00 %	27
5	Texture	0.00 %	11.11 %	14.81 %	7.41 %	22.22 %	33.33 %	11.11 %	0.00 %	27
6	Multifaceted/versatility	7.41 %	7.41 %	14.81 %	25.93 %	22.22 %	14.81 %	7.41 %	0.00 %	27
7	Physical features (buttons, gears, etc.)	14.81 %	29.63 %	14.81 %	18.52 %	11.11 %	11.11 %	0.00 %	0.00 %	27
8	Other	0.00 %	0.00 %	0.00 %	0.00 %	3.70 %	7.41 %	18.52 %	70.37 %	27

Other

Other
Resistance
Quiet/Not distracting to others
Clicking in or out, you can feel when something clicks into place

Q13 - What feature of the fidget device do you think you will use most often?

#	Answer	%	Count
1	Gear	22.22%	6
2	Large button	25.93%	7
3	Side buttons	40.74%	11
4	Slider	11.11%	3
	Total	100%	27

Q14 - What feature of the fidget device do you think you will use least often?

#	Answer	%	Count
1	Gear	7.41%	2
2	Large button	22.22%	6
3	Side buttons	11.11%	3
4	Slider	59.26%	16
	Total	100%	27

Q15 - Overall, how satisfied do you think you will be with this product at the end of the trial period?

#	Answer	%	Count
1	Very satisfied	25.93%	7
2	Moderately satisfied	59.26%	16
3	Neither satisfied nor dissatisfied	11.11%	3
4	Moderately dissatisfied	3.70%	1
5	Very dissatisfied	0.00%	0
	Total	100%	27

Q16 - Do you think there is a stigma attached to fidgeting?

#	Answer	%	Count
1	Definitely yes	22.22%	6
2	Probably yes	62.96%	17
3	Might or might not	7.41%	2
4	Probably not	3.70%	1
5	Definitely not	3.70%	1
	Total	100%	27

Post-Use Survey:

Q1 - Please enter your participant ID number. Your participant ID number can be found in the email where you received the pre-survey.

Please enter your participant ID number. Your participant ID number can be...
26
2
11
26
14
28
18
27
5
22
7
15
25
17
24
19
29
12
23
4
16
3

20
21
13
9

Q2 - What general feedback do you have about using this fidget device? What were your first impressions and how did they change or not change over time?

What general feedback do you have about using this fidget device? What were...
It helped a lot because I always am fidgeting and need something in my hand. I wasn't sure how much I would use it but it really was useful to always have around.
Its wonderful
A softer material that will feel more comfortable in the hand, a wheel that spins without sound, more resistance in the part that moves back and forth
There is so much. It has some good features, in particular the side buttons, and some bad features, like the slider in the initial implementation. The more I used it the more enjoyed using the side buttons and just kind of spinning it. I also noticed that the wheel as well as the slider hurt my palm in certain holding positions.
I really like the spinny wheel and the snapple button thing. I used it pretty frequently in the beginning, but then my interest petered off a bit at the end. I found that it was kind of difficult to hold in my hand and I was focusing so hard on how to hold it that it actually distracted me a little more.
In general, the device was fairly entertaining. I thought I would use the slider more, but I ended up pressing the red buttons the most. Also, I have some recommendations. First, I would like the devices to be larger, or at least have different size options. Second, I want the slider to be longer since the motion didn't feel like it was enough. Third, possibly adding another part known as a clicker. The sound isn't important but movement similar to that of a pen is quite satisfying.
The texture is a little rough and edges are kinda sharp (but that is understandable given that it was 3D printed). Otherwise I've been satisfied with it for the duration of testing. By the end however I noticed that the gear was a little too noisy for my liking.
The edges of the gear sometimes can feel a bit sharp at times, same with the corners of the slide. Something else I might consider would be putting a side button on both sides
Over the last week it went from something I thought I might use a couple times to something I had in my hand almost all the time. Usually absent mindedly I would play with it in class, at

home, at meetings. I also used all the little bits even though I thought I'd only use the buttons. I used the whole thing to fidget
I liked the fidget device. I liked that it fit well in my hand and I liked the shape of it.
There is some noise associated with the little fidget that I wasn't expecting. I had fun with my fidget though!
First impression was an appreciation of the overall design. The shape isn't what I expected, and I really grew to like it. The form factor makes it easy to hold and use
Wasn't nearly satisfying as I was hoping it would be. My first impressions were that the device has a myriad of things to play with but I realized that they just weren't up to snuff. Also the build quality offered by 3D-Printing was a major turnoff. The weight as well was too light.
At first, I was very interested in using it. I carried it around all the time and used it more to pass the time than as a focusing tool. About half way through the week I left it in my room on accident, but did not feel the desire to use it. Isn't a necessity in my life.
The tactile feedback is excellent. I ended up using all of the features quite a bit. However, I felt that more resistance on both the slider and the wheel would be better. For example, a mouse scroll wheel type thing to provide a different feel.
Love the ergonomic design. Still use it constantly. By the end though I wish there was another aspect to it on one of the sides, maybe a sphere you could rotate
It isn't something I find my self using easily. I have to force my self to use it which makes me concentrate less in class. My first impression was that it looked cool and fun but as soon as I started using it, it made me concentrate less in class and it hasn't changed since.
I really liked it. It was mostly comfortable to fit into my hand, and had a variety of things that allowed me to fidget in different ways. The only things I would add would be something that uses both hands, and to make the switch on top more interesting, like have a spring or a click or something. It would also be awesome to make it more able to twirl between fingers. These are just suggestions, and if they are impractical or detrimental to the design feel free to ignore them.
I think this is an excellent first attempt. I found myself using almost all of the features. Also, although I originally would have preferred flashier colors, I appreciate the discreteness of the scheme as it exists.
I love it! It's fun and useful, it helps me stay off my phone and resist biting my nails.
My impressions on the Fidget Device did not change much, it was a toy that I could use to be doing something.

Q3 - How often did you end up using this fidget device?

#	Answer	%	Count
1	Once or twice this week	12.50%	3
2	Several times this week	29.17%	7
3	Every day	37.50%	9
4	Multiple times every day	20.83%	5
	Total	100%	24

Q4 - Where did you use the fidget device this week? Choose all that apply.

#	Answer	%	Count
1	Home	70.83%	17
2	Work	58.33%	14
3	School	91.67%	22
4	Other	12.50%	3
	Total	100%	24

Other

Other
Club
When walking
Car rides

Q5 - Where did you most often use the fidget device this week?

#	Answer	%	Count
1	Home	16.67%	4
2	Work	12.50%	3
3	School	62.50%	15
4	Other	8.33%	2
	Total	100%	24

Other

Other
Club event
Outside/at a play

Q6 - Did you lose the fidget device at any point this week?

#	Answer	%	Count
1	Yes	41.67%	10
2	No	58.33%	14
	Total	100%	24

Q7 - Did the fidget device break at any point this week?

#	Answer	%	Count
1	Yes	0.00%	0
2	No	100.00%	24
	Total	100%	24

Q8 - How did it break?

How did it break?

[No Responses.]

Q9 - How did you typically carry this fidget device?

#	Answer	%	Count
1	In my hand	16.67%	4
2	In my pocket	79.17%	19
3	In my backpack/purse/bag	4.17%	1
4	Other	0.00%	0
	Total	100%	24

Other
Other

Q10 - Overall how satisfied are you with this product?

#	Answer	%	Count
1	Very satisfied	41.67%	10
2	Moderately satisfied	45.83%	11
3	Neither satisfied nor dissatisfied	4.17%	1
4	Moderately dissatisfied	8.33%	2
5	Very dissatisfied	0.00%	0
	Total	100%	24

Q11 - Please respond to the following statements about the benefits of using this fidget device.

#	Question	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Total
1	This device helped me focus better	4.17%	4.17%	25.00%	58.33%	8.33%	24
2	This device provided me with physical stimulation	4.17%	4.17%	0.00%	54.17%	37.50%	24
3	This device helped me relax	4.17%	0.00%	37.50%	50.00%	8.33%	24
4	This device helped me spend less time on my phone	4.17%	20.83%	20.83%	41.67%	12.50%	24

Q12 - Rank what qualities of this fidget device are most important to you now. (Drag and drop)

#	Question	1	2	3	4	5	6	7	8	Total
1	Color	4.17%	0.00%	0.00%	0.00%	8.33%	25.00%	54.17%	8.33%	24
2	Ergonomics (how it fits in your hand)	45.83%	16.67%	16.67%	12.50%	8.33%	0.00%	0.00%	0.00%	24
3	Size	4.17%	12.50%	8.33%	20.83%	25.00%	25.00%	4.17%	0.00%	24
4	Portability	8.33%	20.83%	16.67%	25.00%	16.67%	4.17%	8.33%	0.00%	24
5	Texture	4.17%	12.50%	16.67%	16.67%	20.83%	25.00%	4.17%	0.00%	24
6	Multifaceted/versatility	4.17%	16.67%	16.67%	16.67%	12.50%	16.67%	16.67%	0.00%	24
7	Physical features (buttons, gears, etc.)	29.17%	20.83%	25.00%	8.33%	8.33%	4.17%	4.17%	0.00%	24
8	Other	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.33%	91.67%	24

Q13 - What feature of the fidget device did you use the most often?

#	Answer	%	Count
1	Gear	39.13%	9
2	Large button	8.70%	2
3	Side buttons	43.48%	10
4	Slider	4.35%	1
5	Other	4.35%	1
	Total	100%	23

Q13 - Other

Other
I liked to twirl it, or roll the gear across things.

Q14 - What feature of the fidget device did you use the least often?

#	Answer	%	Count
1	Gear	20.83%	5
2	Large button	41.67%	10
3	Side buttons	8.33%	2
4	Slider	25.00%	6
5	Other	4.17%	1
	Total	100%	24

Other

Other
I rotated through them all fairly evenly

Q15 - What did you like/dislike about the gear? How could it be improved?

What did you like/dislike about the gear? How could it be improved?
It could spin more easily and be more quieter, but I really liked being able to move it
I though I would use it the most but how the fidget naturally sat in my hand was with the slider close to my thumb. If I held it the other way it didn't feel right. but I did enjoy using it!
It hurts when you hold it in the way where it points towards your palm. I think if it was round or softer or something that might be better.
The gear was perfect. Mad dope.
Since the slider wasn't as long as I would have liked, I used the gear because it continuously turned. It could be bigger and spin more smoothly.
Disliked how loud it was
The edges sometimes felt that they were cutting into my pinkies
There were times I wished it didn't have teeth so I could roll it along a desk. I also might prefer some resistance to turning it
More resistance
I like the spinning aspect. Pretty much anything that spins is good with me. However actually pushing the gear was somewhat unsatisfying. If it were to rumble, or have some other kind of tactile resistance, then it would be perfect.
I liked really liked the size and the way it fit in my hand. I think it could have been improved by having a smoother texture and more rounded edges.
I liked how it spins freely. If it doesn't spin freely then it isn't particularly useful.
The gear is by far the noisiest feature, finding a way to quiet it down would be great
Feels light and cheap, I would also like to see more resistance from it or let is spin more freely.
.
Whoops, I guess I answered this already. I loved having the gear, but I feel that more resistance would be better.
There was a rough patch which impeded its rotation
That it is free flowing but I think it is too free flowing and should be more stiff but not too stiff.

The gear kind of makes it hard to hold in your hand, because it bites in to your palm when you try to hold it to play with the buttons. The gear is very fun to run across things though.
I think the texture got bland after a while, adding rubber covers to buttons or a joystick type cover to the slider would have provided more variety of stimulation
It can be noisy which makes me less likely to use it when in class or a meeting.
The gear was fine the way it was.

Q16 - What did you like/dislike about the side buttons? How could it be improved?

What did you like/dislike about the side buttons? How could it be improved?
Have them click in (but in a silent way if that's possible) I like when you can click in and out (like the end of a pen)
It was very pleasing to touch and i liked the fact that there were two of them. Maybe try three of them?
They were amazing. Great physical feedback, fun to use, love them.
It was kind of difficult to utilize them just based off of their location on the fidget. Maybe put them on the front where the snapple button is or do just one big button like that instead of the snapple button.
I liked the buttons. No complaints.
I liked them! Maybe place them a little lower.
Maybe adding a snap detent (clicky thing)
I found myself wishing they clicked, but that would get very obnoxious to others. This is another part I wish had more resistance
These were kinda loud and just not really fun to play with. Would be more fun if they clicked, but that would be hard to make quite.
I think they could have been a little easier to press. (less friction). It was fine at first but when my fingers got tired from pressing the buttons.
I liked to hold the fidget like a little controller and play with the buttons that way. If you clicked the buttons to much, like clicked down the side you could launch the buttons. The buttons are good, just they could be improved to be more secure.
These surprised me, I didn't think I'd use them much, but I could hold the device in a way they'd press when I squeezed my hand, acting like a stress ball
Did not click well and were not satisfying.
.
The side buttons were great, I think they were perfect as is.
maybe a clicking noise them
They were fun to push, then can have a click when it's pushed all the way down.

I liked them, but they are not how I usually fidel. They were a bit to long and stiff for me, but I heard that other people really liked them.
I would consider adjusting the resistance on one so using each button is a different sensation
I loved how there were 2 of them. I like how they were quiet, but you could flick them so they made a nice clicking sound. It would be nice if they were a bit less squeaky.
The side buttons were the best part of the fidget device. They provided just basic stimulus of being able to press something. There were also two of them so it was fun figuring out which fingers I could use to press them.

What did you like/dislike about the side buttons? How could it be improved?
Have them click in (but in a silent way if that's possible) I like when you can click in and out (like the end of a pen)
It was very pleasing to touch and i liked the fact that there were two of them. Maybe try three of them?
They were amazing. Great physical feedback, fun to use, love them.
It was kind of difficult to utilize them just based off of their location on the fidget. Maybe put them on the front where the snapple button is or do just one big button like that instead of the snapple button.
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These surprised me, I didn't think I'd use them much, but I could hold the device in a way they'd press when I squeezed my hand, acting like a stress ball

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.
The side buttons were great, I think they were perfect as is.
maybe a clicking noise them
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I liked them, but they are not how I usually fidel. They were a bit to long and stiff for me, but I heard that other people really liked them.
I would consider adjusting the resistance on one so using each button is a different sensation
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The side buttons were the best part of the fidget device. They provided just basic stimulus of being able to press something. There were also two of them so it was fun figuring out which fingers I could use to press them.

Q17 - What did you like/dislike about the size/shape? How could it be improved?

What did you like/dislike about the size/shape? How could it be improved?
I wish that it felt better as a material, more smooth, but the overall size fit well in my hand
Good size!
The only thing I can think off is that it'd be better if it was more easy to spin as a whole between my fingers.
It was awkward to hold for me. I don't know if it was too small or too big, but it didn't quite fit in my hand. Maybe having different size options so that people of all hand sizes can get the same satisfaction.
Shape is fine, I would recommend making it larger, or at least giving the option.
Make it a tad smaller? Great shape, though.
Making it better shaped for use in both hands
I wish it was smaller in my pocket, but it felt great in my hands
It fit well in my pocket. That's mostly what matters
Overall size and shape is great. Something that I was looking for was a way to easily twirl it through my fingers.
I liked the size. The shape could have been more rounded at the corners.
I liked the size and shape, it can comfortable fit in the palm of my hand and I have relatively small hands. It was very well sized for its purpose to be a little portable device to fuss with.
Fantastic on both parts
Decent size and shape, awful material
?
The size was almost perfect for my hand, but I don't think it should be changed. My hand is not necessarily the average hand, and it should be sized to conform to that so the most people feel comfortable using it.
N/A
It fit well in my hand. Be more smooth.
The size was good as was the shape. If it was possible to make it skinnier that would be cool, so you could twirl it more.

The size was good. It fit in my hand well.
It was the perfect size. However, it seemed to be designed to fit in the right hand, it would be nice if it were just as comfortable in the left hand.
The size was fine, but the shape of the device (I guess mainly the layout of the parts) made it hard to use each part at the same time, and I ignored the big button for the most part.

Q18 - What did you like/dislike about the large button? How could it be improved?

What did you like/dislike about the large button? How could it be improved?
I liked the size and placement, I don't know how I would improve it
It just never seemed that satisfying. Also when I would unconsciously use the fidget device the large button never got used.
It gives some feedback, but by far not enough. The feedback also wore down fairly fast.
I had no problems with it. It didn't stimulate me that much so I didn't really use it, but I thought it was fine.
I liked the large button the least. Possibly making it press in more, but I don't see it improving much.
Never used it - awkwardly placed
Perhaps there could be one on both sides
I like it. It's in a good spot on the widget and it's fun to play with.
This one was my favorite at first, but it wasn't has satisfying when repeatedly pushed
It's perfect in my honest opinion.
I didn't like how it is not deep enough.
I liked the feel of it, but sometimes it could be loud which felt weird in class.
The large button is pretty nice, but becomes the only feature you can use if you use it based on how the device holds in your hand
I would love something with more give
Too hard to push
The large button was the best! I absolutely loved the bottle cap feel. And I'm 90% convinced that it was actually a bottle cap in there. 10/10

maybe that it would be decompressed more
You could barely push it and was useless. It can have more of a snap effect like from bottle caps.
I liked the large button alot, but did not actually use it that often. I noticed that on some of htem it did not click as well.
NA
The feel and sound of it were very satisfying/relaxing, but it was quiet enough that it was not disruptive to other people.

Q19 - What did you like/dislike about the slider? How could it be improved?

What did you like/dislike about the slider? How could it be improved?
More resistance, It didn't feel that useful to me it kinda just flew around
the slide distance could be doubled. The edges were relatively sharp if they were smoother I feel I would have used it more.
Undoubtedly the worst of all features. It is placed in an awkward position (hits the palm when holding it to use the buttons). It has no feedback, which is very annoying, i wish it would snap back or something. The head hurts and should be round or at least not hurt me.
I think it would be better if it had a little more resistance or a longer track to slide along.
Increase the length of it and make the piece less flimbsy.
Didn't really use it - feel neutral about it
The corners were a bit sharp
I kept unconsciously trying to click it into place on either side. It'd be cool if it actually clicked into place. I think the cap could be a bit bigger
Could have a varying resistance
I was looking for some pressure in the slider, such as a spring. The slider, like the gear, was kinda disappointing to push. However I did play with it extensively.
Needed more friction ;) ;)
My slider was really loose which I actually enjoyed. I could just shake it back and forth which was fun.
I loved the slider

Feels cheap with uneven resistance
.
The slider, as mentioned, was too free moving. I personally would enjoy more resistance. In addition, its positioning felt off, somehow. I'm not sure where to move it, but it felt like it wasn't in the best place.
the range of sliding motion was a tad small
It was fun too move and it can be made more stiff to move.
the slider was a bit sharp on the edges and had no added bonus. Mine clicked, which made me happy, but many others did not. It seemed a bit bland.
The slider was difficult to use the full range of motion in almost every position I held in my hand. Also the sharp square top made it less comfortable to use. Also, the lack of resistance made the sensation provide little entertainment.
It is a simple piece, but it I used it quite a bit. The only problem is after being used, it loosened up and would make move/make noise when the fidget was shaken.

Q20 - What did you like/dislike about the texture? How could it be improved?

What did you like/dislike about the texture? How could it be improved?
It was rough, which is understandable because it was 3D printed, but if there was a way it could be coated in something smoother that would be better for mw
I didn't really notice the texture.
I wish it was smooth and the whole product was heavier.
I thought the texture was a little too rough. It wasn't bad but I would either make something purposely rough (ie little ridges or something to improve grip) or make it smoother.
The texture was good.
Make it smoother and the edges less sharp/rough!
Maybe a smoother or slightly more rubbery texture would feel nicer, but I'd have to use both to decide. Sometimes the hard surface is good.
I like it how it is. I'd like it if the edges were rounded though
The whole thing was sharp in some places. Also I'd like a smooth texture everywhere.
Smoother would have been better.

I actually liked the texture of the fidget, it was nice to have it not be completely smooth.
Smooth texture with a matte finish would be better for me
Just not good texture at all. would much rather see a smooth finish
.
Nothing to say here. It was fine, but nothing special that I really noticed.
weird texture, maybe try for smoother next time
The texture didn't feel nice and maybe if it was more smooth it would be better.
I neither liked nor disliked the texture. It allowed me to grip it, but I did not run my fingers over it.
The texture, while fine, was mostly plastic and did not vary much. I think changing the texture of 1-2 features would do a lot for the product.
I liked that it wasn't smooth, it gave a grip and nice feel to it.

Q21 - Do you have any other concerns about this product or things you would like to improve?

Do you have any other concerns about this product or things you would like...
Nope, but let me know if you need more help!
make it so it is ergonomic both ways so that the slider and gear both sit comfortably for the thumb to use. As in don't make it tear drop shape because I believe it creates a bias with how its held and then the gear becomes useless.
Nothing that comes to mind
Nope!
I loved it! Good job guys!
Nah
Eh
.
I lost it because I'm an idiot which made me really sad. Maybe a keychain?
It is very good.

The weight of the product made it feel like a cheap hollow plastic tow at times. I think increasing the weight a small amount would make it feel sturdier and provide a better experience.
Maybe add a keyring or something to make it easier to carry

Q22 - Would you be interested in buying a fidget device like this one?

#	Answer	%	Count
1	Yes	45.45%	10
2	Maybe	40.91%	9
3	No	13.64%	3
	Total	100%	22

Q23 - How much would you be willing to pay for a fidget device like this one?

#	Answer	%	Count
1	Up to $5	42.11%	8
2	Up to $10	47.37%	9
3	Up to $15	10.53%	2
4	Up to $20	0.00%	0
5	Over $20	0.00%	0
	Total	100%	19

Q24 - Do you think there is a stigma attached to fidgeting?

#	Answer	%	Count
1	Definitely yes	36.36%	8
2	Probably yes	27.27%	6
3	Might or might not	13.64%	3
4	Probably not	22.73%	5
5	Definitely not	0.00%	0
	Total	100%	22

Q25 - Do you think there is a stigma attached to fidget devices?

#	Answer	%	Count
1	Definitely yes	9.09%	2
2	Probably yes	18.18%	4
3	Might or might not	31.82%	7
4	Probably not	40.91%	9
5	Definitely not	0.00%	0
	Total	100%	22

Q26 - Please explain your answers from the questions above.

Please explain your answers from the questions above.
Fidgetting and being jittery often annoys people so I feel like there is judgement placed when people do that, but I don't feel like the toys detract from anyone's views of people because often people have things on their desk and that doesn't mean anything bad about them. It seems like it's just for fun but it actually serves a purpose
I know from personal experience people usually find my fidgeting annoying and will tell me to stop, but it is hard because it helps me think and just happens unconsciously.
Fidgeting definitely seems to be associated with impatience.
People think fidgeting is juvenile and denotes a lack of focus. Fidget devices can be seen as toys which can also be seen as juvenile.
Personally, I don't not have I seen negative reactions towards someone with a similar device. However, I suppose it is possible.
I can't think of ever seeing anyone have a problem with it. Everyone who saw me using this one thought it was neat and wanted to try it
This is something people talk about, so it would be strange to acknowledge it with a device.
I'm not really sure if I can. I just feel like its the case...
I think when it is really obvious that someone is nervous and fidgeting it is kind of a stigma.
I don't think there is a stigma, I think to some extent everyone fidgets. Sometimes the moving around irritates people but I don't feel like there is a stigma.

"Stop figiting" is a common phrase at home, but these devices seem well received so far
Really depends on the person and their understanding of the uses.
.
More and more people are being diagnosed (or self diagnosed) with ADD or other attention disorders. I feel that most people are understanding of the need to fidget and move.
I don't know enough information to make a definite guess but it looks like people like playing with things while doing something.
Fidgeting is attached to a lack of focus and inability to pay attention, both of which are highly valued aspects of interaction and education. Fidget toys are often loud or distracting to others around the fidgeter, which can cause more people to loose focus and not pay attention.
I don't think fidget devices have been around long enough to develop a stigma about them. However I can attest that the stigma for fidgeting is definitely real, having been scolded for doing so many times.
People associate it with not paying attention, not caring, or as having a disability/condition.

Q27 - Do you have a diagnosed disability?

#	Answer	%	Count
1	Yes	31.82%	7
2	No	68.18%	15
	Total	100%	22

Q28 - Do you have any feedback or comments about this study and/or the topic of this study?

Do you have any feedback or comments about this study and/or the topic of t...
I am very interested in the results!
Great job guys!
I think this is a super cool project and I'm excited to see what you guys come up with for the final design!
You go guys!
I think the way it was handled, from originally picking the design by vote in the wedge, all the way through to beta testing and surveys was very easy for the survey participants and very professional as well. Good work

Excited for the outcome!
Good job :) I wanna do this for my MQP!
No, I just feel like $10 is a lot to pay for this little device.
Nope
-
<3 you Connor and Dan
Keep up the good work!
This is an awesome project!! Great job :)

Appendix F: Fidget Toy Use in Classrooms - Educator Survey

Fidget Toy Use in Classrooms response from Doherty Memorial High School's Science, Technology & Engineering Department Chair:

Date: 1/17/2017

1. Please provide background information about you, your education, and the time you have spent teaching:

I have been a teacher at Doherty Memorial High in Worcester since 1999. I have a BA in Mathematics from the College of the Holy Cross, and two Master's degrees from WSU (Education/Biology and Administration).

2. As an educator, do you often come across students with behavioral disorders that interfere with learning?

Yes, I have students with diagnosed disorders. Often ADD or ADHD are the norm. Over the years, I have had students with sensory disorders, often stemming from environmental issues. (E.g., light sensitivity, noise sensitivity, overcrowding/personal contact issues)

   a. If so, what type of behaviors do you typically comes across?

The students with sensory issues tend to be more withdrawn.
Students with ADD/ADHD demonstrate difficulty remaining in their seat, or remaining focused on the task for 'long' periods. They often will try to use their phone, or talk to another student.

3. Do you have students who fidget in class (hands, feet, or squirming in their seat)?

Absolutely. But this is a common trait throughout the population. Attributable to stress, confusion, diagnosed (or not) disorder, boredom or fatigue, etc.

4. In your classrooms, have you noticed students fidgeting with an item with their hands?

Yes. I see many pencils, attempts to use phones, and now the water bottle flipping phenomenon.

5. What is your reaction from students using fidget toys in class?

Anything that poses a distraction to another student (e.g. bottle flipping) or that is not allowed per school policy (e.g. cell phone) is not permitted in my class.
If it is not bothering anyone (e.g. someone using a pencil or something else on the 'fidget-toy' idea), then I have no issues with its use.

6. Do students bring fidget toys to class or use everyday objects as a fidget? Provide examples.

I have not seen examples in the classroom of actual, marketed 'toys.' Usually students will fidget with what they have available. Pencils/pens are the most common. Phones (the software really) provide a constant source of distraction.

7. Are fidget toys disruptive to other students, or to you, in the classroom?

Non-phone manipulatives are, in my opinion, generally not disruptive. Most things in the class are quiet, which provides no major distractions if used unobtrusively.

8. Have you noticed a significant difference in a student's behavior when they are using a fidget toy?

I know some teachers who, for classes with students with severe behavioral issues, provide materials like clay for the students to manipulate. In my opinion, a material or toy like this is tacitly allowing the student to be excused from the class expectations, and therefore I do not use such materials.

9. Have you noticed a change of academic performance with students who use a fidget toy?

I have not used marketed fidget toys, so I am not sure how to answer this. As stated earlier, most students, if they are manipulating an object for stress or focus reasons, tend to use what is available in the classroom environment anyway. As long as they are not distracting others, then I tend to not make a big deal about it.

My opinion is that it would likely benefit some students, but those who fidget subconsciously. This manipulation, in my unscientific or unfounded opinion, would abate their symptoms and would allow better focus in the class. But for others, the novelty of the toy becomes a distraction in itself.

10. Do you have any physical or mechanical objects that you share with your students to help them direct their focus in class?

    a. When do you typically give a student a fidget toy? For how long? What are the rules around it?

Whatever they use cannot violate school policy or create a distraction for themselves or other students. Other than that, I try to treat the students as adults.

    b. How old are the students who typically use them?

I teach a range of ages (often grades 10-12) and there are consistent needs in all grades.

    c. Do they benefit from having this object?

---

    d. Where do you hear about such items?

I have seen marketed toys on my social media feeds (I subscribe to several education-based sources). But no one has, to my knowledge, used the actual products in the school.

    e. Where and how much can the items be purchased for?

Not currently in use at Doherty, to my knowledge.

11. Are there any other types of therapy (music, art, etc.) that you have used or are using in the classroom to help students direct their focus or concentration on tasks?

I, at times, will play music in the background…often-low volume. Too high and students talk louder to overcome it. If low enough, it tends to make the students talk quieter with each other.

12. Please provide any additional comments that would help with our research:

Fidget Toy Use in Classrooms response from Doherty Memorial High School's Mathematics Department Chair:

1. Please provide background information about you, your education, and the time you have spent teaching:

I have a Bachelor's of Science in Mathematics and a Masters of Education in Secondary Leadership from Worcester State. This is my 15th year as a Mathematics Teacher and my sixth as department head.

2. As an educator, do you often come across students with behavioral disorders that interfere with learning?

Quite frequently.

   a. If so, what type of behaviors do you typically comes across?

Students who have difficulty focusing. They daydream or try to distract themselves by distracting others. Other students do not take any sort of correction lightly. They take it as a personal assault and become defensive and at times belligerent.

3. Do you have students who fidget in class (hands, feet, or squirming in their seat)?

I have had students who fidget in the past.

4. In your classrooms, have you noticed students fidgeting with an item with their hands?

Usually they try to play with their cellphones to soothe themselves.

5. What is your reaction from students using fidget toys in class?

I do not mind toys, if it is quiet and is not disruptive.

6. Do students bring fidget toys to class or use everyday objects as a fidget? Provide examples.

Mostly their cellphones.

7. Are fidget toys disruptive to other students, or to you, in the classroom?

No, if they are like stress balls, I would not have a problem with it.

8. Have you noticed a significant difference in a student's behavior when they are using a fidget toy?

I cannot speak to this, as I have not seen a student use fidget toys.

9. Have you noticed a change of academic performance with students who use a fidget toy?

I cannot speak to this, as I have not seen a student use fidget toys.

10. Do you have any physical or mechanical objects that you share with your students to help them direct their focus in class?

No.

    a. When do you typically give a student a fidget toy? For how long? What are the rules around it?

    b. How old are the students who typically use them?

    c. Do they benefit from having this object?

    d. Where do you hear about such items?

    e. Where and how much can the items be purchased for?

11. Are there any other types of therapy (music, art, etc.) that you have used or are using in the classroom to help students direct their focus or concentration on tasks?

12. Please provide any additional comments that would help with our research:

Appendix G: Outreach to WPI Faculty and Staff about Fidgets

Sample of an email sent to WPI faculty and staff to learn about fidgeting objects in developing or other industrialized countries:

My adviser, Bland Addison, recommended to reach out and ask you about your knowledge of German culture. In America, the high rate of industrial society creates anxieties which some are dealt with the use of fidget widgets such a squishy balls that can be played with your hands and still think and concentrate on tasks. I would like to know if Germany, another highly developed industrial society, with high work discipline, have anything similar that people fidget with their hands to keep on task, think, or relieve stress?

Responses of WPI Faculty and Staff:

Your fidget egg looks great!
When I first received your email about the survey, though I had to google fidgets, as I did not know what they were.
That gives you an idea how much or little I know about their use, even less in Germany.
However, I know, people have sometimes used smooth round stones the size of an egg as a fidget. And some Catholics use rosaries,
but I could not tell you how common it is in Germany.
I'm very sorry of not being able to be more helpful.
I do not know if people consider those stones as fidgets, they seem to fulfill that function though.

UB

I cannot think of any examples of these types of toys used in other countries. The only example that comes to mind is China, where people often spin pencils/pens in interesting ways like this.

This is in interesting topic and question. I have never seen anything like this in NZ or in India. I believe that people fidget on their own as part of their personality, sometimes with a pen or something, but I've never seen a device for that. I also just don't run across that many fidgeters, haha. Maybe the U.S. is high stress? In general, people in NZ are quite private about things like this – and it would not be visible. I've similarly never noticed anyone that fidgets in India. The only fidgeter that I know in the US brings her knitting to meetings.

Many fidget gadgets/processes around: rosaries and worry beads, canes, hand exercise balls and even chants are the traditional ones in the east. Smart phones, ipods might be the modern ones.

these are short canes, in particular carried by military officials.

I have not seen anything in my travels that people fidget with their hands to keep on task, think, or relieve stress.

Sorry. Nothing comes to mind....

That's a great question! Stress balls and fidgeting objects specifically aren't' quite as common to my knowledge (at least in Europe, where I lived), but it is very common to play with a pen or pencil in your hand, or maybe do a little doodle or rearrange things on the desk. I hope that helps!

Hi Carolina! What a cool project. I put my feelers out through an informal FB survey, and my Latin American friends got a good laugh. I asked, "Calling all those w/knowledge of Latin America: a WPI student team is doing a senior project on "fidget widgets," e.g. those squishy balls you can play with to relieve anxiety or to think and concentrate on tasks. They would like to know if people in Latin America have anything similar to fidget with to keep on task, think, or relieve stress?"

An Argentine said, "We just drink mate!!!!" and that got 4 likes and lots of comments w/big smiles, tongues out, etc. A Venezuelan/Paraguayan said, "From my experience it is strictly an American "first world" thing. Nowadays everyone seems to fidget with their phones. Josh [her gringo partner] has a small collection of fidgeting aids." Another Argentine said that she's seem "Pelotitas antiestrés" there, but there nowhere near as prevalent as here. And two Americans responded to say that they're really common even at the high-school level these days, but also in Occupational Therapy.

No problem! A Guatemalan friend just replied w/ "Capirucho"

I don't have any recollection of people playing with fidgeting-like objects in South Africa, but I also can't say I've really noticed many people anywhere, including right here at home, playing with such things. So – I'm not too observant!

But I would guess that, given that Cape Town is a very cosmopolitan city with lots of young professional types, I suspect ideas like this may have spread there, if it's common elsewhere.

Appendix H: Provisional Patent

Doc Code: **TR.PROV**
Document Description: Provisional Cover Sheet (SB16)

PTO/SB/16 (11-08)
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Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

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All Inventors Must Be Listed – Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. — Add

Title of Invention	COGNITIVE FOCUS ENHANCEMENT DEVICE
Attorney Docket Number (if applicable)	COG17-01p

Correspondence Address

Direct all correspondence to (select one):

(•) The address corresponding to Customer Number	( ) Firm or Individual Name
Customer Number	58406

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

(•) No.

( ) Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:

( ) Yes, the invention was under a contract with an agency of the United States Government. The name of the U.S. Government agency and Government contract number are:

EFS - Web 1.0.1

Doc Code: **TR.PROV**
Document Description: Provisional Cover Sheet (SB16)

PTO/SB/16 (11-08)
Approved for use through 05/31/2015. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Entity Status
Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29

- (●) Applicant asserts small entity status under 37 CFR 1.27
- ( ) Applicant certifies micro entity status under 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
- ( ) No

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Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Christopher J. Lutz/			Date (YYYY-MM-DD)	2017-02-16
First Name	Christopher J.	Last Name	Lutz	Registration Number (If appropriate)	44883

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **This form can only be used when in conjunction with EFS-Web. If this form is mailed to the USPTO, it may cause delays in handling the provisional application.**

PATENT APPLICATION
CJL

Inventors: Brianna R. Fogal, Connor J. McGrath and
Daniel A. Sturman
Attorney Docket No.: COG17-01p

COGNITIVE FOCUS ENHANCEMENT DEVICE

BACKGROUND

Repetitive, low-magnitude movements, or "fidgeting" has been the topic of recent studies in executive function disorders, particularly of school-age children. Executive functions are a set of cognitive processes that help in problem solving and behavior control. Patients with executive functioning disorders have shown strong correlations to ADHD (Attention Deficit Hyperactive Disorder), for example. Though people may use these executive functioning and ADHD interchangeably, ADHD is a subset of executive function disorders. Persons with ADHD are often inattentive and "fidgety." There have been studies that try to find whether fidgeting can help with the attentiveness of those with ADHD and others.

SUMMARY

A device for providing mechanical outlets or distractions for a user assists in directing cognitive focus by providing an eccentrically circular shaped body having a plurality of mechanical attachments disposed on the body. The mechanical attachments are responsive to displacement movements by a user, whereby user activation of the mechanical attachments diverts user attention from extraneous distractions to permit enhanced focus on a foreground task. In particular configurations, the body is substantially egg or teardrop shaped, and may be printed on a 3d printer using additive manufacturing techniques. The 3d printer is responsive to successive print iterations of varying size body and mechanical attachments, thus providing scalability for production of devices sized to user specific dimensions.

A particular configuration takes the form of a 3D printed, handheld device

that prevents distraction and help the user direct their focus. The preferred device includes an ergonomically teardrop shaped outer shell, with rounded edges, that has a large circle at one end and tapers off to be thinner at an opposed end. The device has a plurality of intended manipulation or "fidgeting" features. The resulting egg shaped device provides ergonomics and discreteness in size and operation. Conventional approaches do not exhibit a design that could comfortably fit in the user's hand. Further, conventional devices do not allow the user to manipulate the mechanical attachments (or "fidget") without being obtrusive to others around them. In contrast, configurations herein permit users to comfortably fidget while not bothering those around them.

While the system and methods defined herein have been particularly shown and described with references to embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention encompassed by the appended claims.

CLAIMS

What is claimed is:

1. A device for providing mechanical outlets to direct cognitive focus comprising:

an eccentrically circular shaped body; and

a plurality of mechanical attachments disposed on the body, the mechanical attachments responsive to displacement movements by a user, whereby user activation of the mechanical attachments diverts user attention from extraneous distractions to permit enhanced focus on a foreground task.

2. The method of claim 1 wherein the body is substantially egg or teardrop shaped.

3. The method of claim 1 wherein the body is printed on a 3d printer using additive manufacturing techniques.

4. The method of claim 1 wherein the 3d printer is responsive to successive print iterations of varying size body and mechanical attachments.

5 DETAILED DESCRIPTION

Various configurations depicting the above features and benefits as disclosed herein are shown and described further below.

Appendix I: International Fidget Survey

Survey sent to 16 cultural and international groups at WPI.

We are interested in learning examples of items or actions people do while at work in other countries and cultures.

If you would like to share a picture or video of the fidget or action done in your culture or country send it to this email: ceramos@wpi.edu

Q1. What is it that you have in your culture or country of origin that people fiddle with or an action people perform to direct their focus or concentration on tasks?

People like fiddle with their hands to help them get concentrated on tasks. A particular movement is thumb twiddling.

Q2.
What is the history of this object, movement, or custom?

People love twiddling since thousands of years ago in ancient china. I saw my grandfather did it and my father did it.

Q3. How do the object(s) or action make them feel?

It helps the people feel they are thinking and concentrating

Q4. Who are the people that are primarily using this object or doing the action (children, adolescents, adults, men, women, etc.)?

- [ ] Children
- [ ] Adolescents
- [x] Adults
- [x] Men
- [x] Women
- [ ] Other

Q5.
When and where do people use the object or do the action (certain time of day, during work, socializing, etc.)?

When people are suffering from difficult tasks

Q6.
How do people get the fidget or learn to do the action (family, teachers, doctors, priests, street vendor, grocery store, etc.)?

People learn it naturally from other people

Q7. How much does an object or learning to do the action typically cost?

$0

Q8. Do you have any concerns of fiddling with an object and/or performing an action that helps direct your focus in the United States versus in your country or culture?

I do have concems about thumb twiddling, because I know different places have different meanings of gestures.

Q9. Gender:

Female

Q10. Age:

20

Q11. Primary nationality:

Asia

Q12. Ethnicity (cultural background):

Asian including Chinese, Japanese, and others

Q13. Country of origin:

China

Q14. Please add any additional comments that you would like to provide for this research.

No additional comment