Implementing Abbreviated Personas into Engineering Education

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Implementing Abbreviated Personas into Engineering Education

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Jonathan graduated from USMA in 2009 with a BS in Mechanical Engineering. After serving in the 82nd Airborne Division as a Combat Engineer for several years he was selected to join the Special Forces. As a Green Beret, he has worked with several partner nations throughout Africa. Jonathan completed his MS in Mechanical Engineering at Stanford University in 2019 focusing on Dynamics and Manufacturing and is currently an Instructor in the Civil and Mechanical Engineering Department at USMA. Jonathan enjoys exploring national parks with his wife and children and traveling to francophone countries.

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Barbara A. Karanian, Ph.D., Lecturer, formerly visiting Professor, in the School of Engineering, in the Mechanical Engineering Design Group at Stanford University. Barbara’s research focuses on four areas: 1) grounding a blend of theories from social-cognitive psychology, engineering design, and art to show how cognition affects design; 2) changing the way people understand the emotion behind their work with the intent to do something new; 3) shifting norms of leaders involved in entrepreneurial-minded action; and 4) developing teaching methods with a storytelling focus in engineering and science education. Founder of the Design Entrepreneuring Studio: Barbara helps teams generate creative environments. Companies that she has worked with renew their commitment to innovation. She also helps students answer these questions when she teaches some of these methods to engineering, design, business, medicine, and law students. Her courses use active storytelling and self-reflective observation as one form to help student and industry leaders traverse across the iterative stages of a project- from the early, inspirational stages to prototyping and then to delivery.
Implementing Abbreviated Personas
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Abstract

Personas are fictional archetypal consumers that aid designers and engineers in more effectively creating products with a human interface. As more products shift from strict utilitarian function to meeting additional physical and psychological needs, designers and engineers must implement emotional design in more domains. Learning to employ personas to explore elements of emotional design is beneficial in an academic course and capstone project as these personas allow students to consider engineering requirements from the perspective of Donald Norman’s three aspects of emotional design: visceral, behavioral, and reflective. In this paper, we present an approach to evaluate the efficacy of using abbreviated personas, which are truncated personas containing typical user biographic information, goals, habits, or experiences. In our first experiment at Stanford University the students focused on the use of and outcome from the abbreviated personas and not the persona generation itself. The lessons learned from this experiment were then applied in a capstone course at the US Military Academy to better understand the full extent of implementation into engineering education. The automotive design capstone originated in a mechanical engineering course focused on engineering engagement through story-telling and included three distinct presentation methods for abbreviated personas at a public exhibition. Over 250 participants interacted with the abbreviated personas and manipulated an analog display based on their understanding of each persona. From these participants, 82 provided written feedback and completed exit surveys on the presentation methods for the abbreviated personas. The data indicate that despite some differences between the presentation methods, all the abbreviated personas contained enough information for making design decisions based on user emotion and requirements. The second application of abbreviated personas builds on this notion and unifies the presentation method to focus on the inputs of the abbreviated personas throughout the design/build process in the capstone. Team member interviews and surveys will capture the data from this iteration.

Introduction

As a first-time undergraduate instructor in mechanical engineering and US Army Special Forces Officer, I would receive strange looks when I would tell my colleagues that I was investigating the use of personas and emotional design. Was there an assumption that technical engineers do not need to consider a user’s emotional response to their product or potentially that Special Forces soldiers should be immune to emotions? While I would challenge both of those notions, I specifically embarked on an investigation with my co-author to focus on the first element: all engineers need to be aware of emotional design. We believe abbreviated personas offer an effective method to formally provide engineers with a tool for accounting for emotional design and that they have a clear fit into engineering capstone projects during an engineer’s degree program. Personas are detailed, archetypal users based on consumer demographics and scripted with names, characteristics, backgrounds, habits, goals, and experiences that aid in product development and production. Abbreviated personas contain only minimal information to assist engineering students in learning how to effectively apply emotional design in engineering and bypass the robust demographic/market research that accompanies a persona. We explored their implementation process during a design capstone involving a multi-disciplinary team. The capstone team was a diverse group of graduate students,
including two in mechanical engineering, one in management, science and engineering, and one student in education. The team collaborated through a course which uses the automobile as a lens for understanding how engineers communicate. The data was collected through our capstone project at a private west coast college during an end of year interactive showcase experience in June 2018. This showcase features numerous engineering capstone courses that created interactive experiences with products they had developed over the past quarter and year. Ultimately, our work shows that abbreviated personas contain enough information to help create a dialogue around effectively implementing emotional design into an engineering project. As much of our research consists of qualitative data from the end of year showcase, we begin this conversation considering the story of the actual engineered product.

Once products surpass a basic utilitarian threshold, emotional design should be considered [1]. PW Jordan tells us that the hierarchy of consumer needs is functionality, usability, and pleasure [2]. Once engineers are creating viable products that function, then they should be considering emotional design elements. Even for utilitarian products, an engineer should at a minimum acknowledge that the consumer interaction with the product can influence how it is used and willfully reject further product development with regard to emotional design. Historically, engineers leave any aspects of emotional design to designers, marketers, and executive staff. However, as more products surpass the basic utilitarian threshold, consumers, users, and maintainers of products will come to expect function without question and seek products based more on emotional responses. For this reason, it is imperative that engineers are familiar with aspects of emotional design.

Donald Norman describes the three levels of emotional design as they coincide with three levels of processing: visceral, behavioral, and reflective [3]. Other studies suggest the term ‘product experience’ to denote all possible affective experiences involved in product interaction [4], [5]. Engineers need to know how their products and components nest within the overall design and account for all aspects that include emotional design. Accounting for a seemingly unquantifiable, qualitative measure creates a monumental task for the engineer accustomed to using established equations, methods, and requirements. However, personas create a definitive tool and roadmap for the engineer to consider these qualitative aspects of emotional design and deliberately incorporate them into the overall design. Personas allow multidisciplinary teams to account for emotional design needs and effectively communicate with a common operating picture. Exposing engineering students to this process during their education, specifically during a culminating capstone project, presents the best venue.

Ultimately, the goal of this investigation is to demonstrate how abbreviated personas enhance and are applicable in engineering education. Persona development can be a time-consuming, labor intensive process that is not conducive with a shortened course or capstone timeline. Rather, as more engineering disciplines consider how to implement emotional design elements, engineering educators should look to abbreviated personas as a low-to-no cost alternative to full personas that emphasizes using abbreviated personas to implement emotional design instead of overemphasizing industry level persona development. Implementing abbreviated personas into courses and capstone projects introduces the need for engineers to address emotional design while providing a viable solution. The abbreviated persona offers a quantifiable inclusion mechanism for qualitative attributes while providing the choice for a tailored presentation.
method enhances the product experience for the engineering student and end user. This paper examines how abbreviated personas can be powerful design tools for engineering students and multidisciplinary teams by facilitating discussion on emotional design, reducing personal biases and stereotypes, and providing a common design language for team members from different domains.

Background and Literature Review

Alan Cooper introduced engineers to the idea of using personas for design by presenting them as an archetypal user specifically focused on Human Computer Interface (HCI) in 1998 [6]. In an effort to understand why supposedly useful, new technology drives us crazy and help design new “tech” products that the average person can use and enjoy, Cooper illuminated a path that welcomes more than software developers and home-entertainment manufacturers. Kim Goodman continued with Cooper’s thread with “Designing for the Digital Age” and comprehensively covered persona development and requirements for developing software and digital products. The fictional persona characters are robust, detailed, and expertly scripted in order to understand all possible facets of users and their interactions with products [7]. The persona effectiveness comes at a cost of significant time and resources, both of which are often lacking in education programs.

The need for personas in engineering education is clear but the costs seem prohibitive. Our response to meet this need without incurring the cost is the abbreviated persona, a truncated version of a fully developed persona that includes only the essentials required to support the specific nature of the engineering capstone project. The idea to include the abbreviated persona into engineering education is new and it borrows from some industry examples. Goodman acknowledges the difficulty in fully developing personas for every project and provides examples for provisional personas that contain less information at the benefit of saving time [7]. When the provisional persona does not facilitate a solution however it at least starts the discussion among team members. Similarly, Don Norman advocates for the use of Ad Hoc Personas which use whatever minimal information is needed to focus the designer on establishing empathy with the user [8]. Norman does not provide specific metrics for building Ad Hoc Personas in education, however, and focuses on industry.

Industry is the immediate application for personas as it relates user requirements to the engineers developing products to meet those requirements and provides excellent examples for how to develop and use personas. John Pruitt, as a product developer at Microsoft, describes the extensive use of personas in order to fully understand who used various products and how they used them [9]. Personas also serve as a means to verifying established processes and shape future change for not only products but also services. Campbell University in North Carolina used personas to validate undergraduate selection procedures and ensure their application process produced the desired class composition [10]. Industry leaders are using personas to address emotional design considerations with their users and ultimately stay relevant in their field.

Emotional design includes all design considerations that elicit an emotional response – the human body receiving a sensory input and producing a response. In order to understand this
broad definition, one must understand the emotional processing in humans. Donald Norman describes the three levels of processing as visceral, behavioral, and reflective, the same three levels he ascribes to emotional design [3]. Emotional design shifts focus away from the entity being designed to what is actually experienced [4]. Hekkert helps define this experience to include the aesthetic pleasure, attribution of meaning, and emotional response to a product [11]. Another way to simplify thinking about emotional response to a product is to consider PW Jordan’s idea of product pleasure which includes the “emotional, hedonic, and practical benefits associated” with a product [12]. On opposite sides of the spectrum of human product interaction (HPI) are utilitarianism and hedonism; both have the expectation that functionality is met and both carry unique emotional responses. The un fulfillment of utilitarian goals creates negative emotions, anger, or higher arousal of harsh feelings. On the other hand, fulfillment of hedonic goals creates emotional delight and satisfaction [13]. This duality can also be viewed through Norman’s levels of emotional design in how humans love or hate things. These polarizing sensations serve as the connective tissue between all three levels of emotional design and emphasize why emotional design is important. It is easy to think about how a consumer may viscerally love a new product, the allure of new technology and sleek packaging, but may ultimately not buy it after deeper reflection on the product’s true function, cost, and integration with the consumer’s lifestyle. What about a maintainer who is never consulted on which new product is easiest to repair and maintain? When that maintainer viscerally and behaviorally hates a product due to unnecessary complication in replacing parts and difficulty in accessing routine service ports, then the maintainer will be less motivated to conduct proper maintenance. The product will not be fixed as readily when it breaks and ultimately the product’s utility, however great initially, will diminish due to failing to account for emotional design. Emotional design touches every viable product an engineer helps create and not including emotional design omits critical considerations in the overall design process and product experience.

Automobiles provide an excellent lens for considering emotional design and product experience. The co-author notes after teaching the course Tales to Design Car By at Stanford University for 8 years that people tell stories differently about cars and the research supports this notion in multiple forms [14]. Starting with the simple aesthetics of a car, different designs elicit different responses and some designs simply make users smile [15]. This idea translates into the interior and ultimately to the driving experience [16], [17]. Everything about a car elicits an emotional experience. General Motors recognized these aspects and took deliberate efforts to incorporate contextual design into a new infotainment and navigation system [18]. Since the car experience includes all possible “cognitive processing and affective responses,” then cars not only meet transportation needs and aesthetic pleasure but also serve as a status symbol and significantly frame certain social interactions [19]. Engineers cannot account for all these considerations with engineering requirement alone and point out that even with awareness of emotional design components, they lack the tools to apply those components into the design and manufacturing process [20]. Personas address this gap and offer a solution to all fields of engineering and abbreviated personas specifically introduce engineers to this concept during the education process.

Method
Student Design Team: The student design team included four undergraduate and graduate students enrolled in an Engineering Design Methods class. The student design team included two females and two males. Two student design team were working on masters of science in Mechanical Engineering, one was finishing an undergraduate in Management, Science, and Engineering, and one working on a doctorate in education creating a diverse and multi-disciplinary team. The student design team attended class throughout the quarter learning about how to effectively communicate through storytelling with the automobile as the form and worked collectively to build the personas and interactive experience used in a one-day public showcase at the end of the course.

Audience Participants: Audience Participants included the 250 visitors that came through the showcase experience produced by the student design team and interacted with the personas. Of the 250 visitors that interacted with the personas in the showcase, 82 completed exit-surveys. From the exit surveys, the audience participants were 68% male and 32% female with an average age in the range of 23-30 years. The audience participants self-identified as 59% car non-enthusiasts, 40% car enthusiasts, and 1% unsure. The audience participants were other students from engineering and non-engineering disciplines and also included individuals from the local and international community who provided rich feedback and observations. By choosing to interact with the showcase experience, audience participants were able to step into the “driver’s seat” of each abbreviated persona to better understand how personas drive products. While the audience participants collectively determined which cars each persona would love or hate, they ultimately provided feedback on the three very distinct persona presentation methods.

Persona Development: The student design team developed the three different abbreviated personas - a California Couple, a Corporate Professional, and a College Student - and displayed the information in three distinct formats. The team decided on the three titles collectively through brainstorming and then individually or in pairs compiled the content. The student design team deliberately chose not to include a name(s), age(s), gender(s), or a head-shot picture(s) for each abbreviated persona. The individuals/pairs presented the abbreviated personas to the student design team who decided on the final form of each of the three abbreviated personas. All three abbreviated personas were printed on A1 posters (~24”x33”) and affixed to the wall. A sample of the posters are in Figure 1 and full-page versions are in Appendix A.

The CA Couple persona includes two prose pieces (narratives) depicting a recent story about the couple and their family background, a list of life facts, interests, and driving habits, and also includes a collage of visual images representing their life. This is the most information-dense persona and the average observer takes about four minutes to digest the information. This persona deliberately includes two individuals (Figure 1).

The Corporate Professional persona includes a resume-styled poster which includes a brief overview of professional experiences, education, skills, and personal interests. A collage of visual images completes the poster. This format is the least information-dense persona and takes the average observer one minute to digest (Figure 1).
The College Student persona includes a detailed schedule of one day’s activities and a weeklong calendar view of scheduled events. A few personal facts and a visual collage are also included on the poster. The format contains a medium amount of information and takes the average observer two and a half minutes to digest (Figure 1).

Accompanying each abbreviated persona poster was a “garage” of 13 cars that could move laterally along a Likert scale into categories ranging from 1-7 (1 as object hated, 7 as object loved). All the cars started in a neutral position of “4” and each audience participant was allowed to move three of the cars up to two spaces. The student design team deliberating chose to use the words “love” and “hate” specifically because they focused on inanimate objects despite some research recommending using other words such as like and dislike, commonly associated with the liking factor [21]. While the individual cars varied by persona, the 13 categories remained the same along with their placement on the board. From the top to the

Before the exhibit, the student design team established a control palette for all the cars associated with each abbreviated persona. The design team deliberately defined the control palette to be the ideal position for all 13 cars based on the design team’s intent for the abbreviated persona and did so before any interaction with the audience participants. The control palettes allow a comparison between the final car position from the showcase exhibit and the intent of the student design team. Since the student design team developed the personas and established the control palette for which cars the abbreviated personas would love and hate, we can directly compare how the audience participants digested the abbreviated personas and ultimately moved the cars.

Procedure: Throughout the showcase event, an audience of approximately 250 individuals interacted with the project by “driving” various vehicles form the perspective of the abbreviated personas. Of the 250, 82 provided specific feedback through an exit survey. The project presentation deliberately ensured that each participant interacted with each abbreviated persona and the corresponding “garage” of cars to receive the total experience. Upon entering the showcase, audience participants were greeted with the poster in Figure 2 which asked them three questions to help determine if they were a car enthusiast or a car non-enthusiast. Car enthusiasts received a red sticker for their hand and car non-enthusiasts received a blue sticker. All audience participants received a brief introduction to the showcase by one of the student design team and started their interactions with a wall of 30 cars that provided an orientation to how the rest of the operated. The experience was self-paced and audience participants moved through each abbreviated persona station in sequence. At the end of the experience, audience participants were asked to complete an exit survey. Audience participants were informed that each abbreviated persona wall and garage was being filmed for data collection purposes but no pictures would be taken of their faces. During the two-hour showcase, ceiling mounted cameras would only capture the cars moving and potentially see whether an audience participant had a red or blue sticker on their hand.
Use of Interaction Design Methodology in Exhibit Layout: To ensure uniform participant interaction with each abbreviated persona, the student design team used a deliberate interaction design methodology that guided audience participants through a directed engagement with the showcase. There are four key elements that effectively structured this experience: exhibit layout, personal connection, abbreviated persona display interaction, and reciprocity. Audience participants visiting the exhibit were greeted at the entrance with an overview of the project and instructions that admittance to the exhibit was a personal contract to complete the exhibit instead of simply browse and observe. Active participation as opposed to passive browsing is the only way that participants could engage with all the abbreviated personas enough to immerse in the experience and provide the feedback necessary to determine which presentation method was the most effective.

The exhibit layout is instrumental (Figure 3) in establishing the environment for deliberate engagement and meaningful data collection. Martelaro and Ju’s research on needfinding emphasizes the importunate of thoughtful interactive design that allows meaningful data collection [22]. While the exhibit appears open and unrestricted, a definitive entrance and one-way flow created by low tables helped naturally facilitate participant pass-through. If an interested visitor did not have the time to interact with the exhibit, they could review the project overview poster at the entrance of the showcase and simply continue to the other projects without interfering with the actively engaged audience participants. A team member at the entrance at all times helped establish this flow and answer questions along with written instructions for the exhibit. Audience participants worked their way around the perimeter of the room to each persona station and were directed to several computer stations to fill out the exit survey before leaving through a separate door.
Once a visitor chooses to participate with the exhibit, it is important to create a personal connection between the audience participant and the material and a personal comfort with the showcase structure. The project used the medium of automobiles to understand the abbreviated personas, so before even prompting the audience participant with information about personas, we asked them if they were car enthusiasts or not car enthusiasts by asking three simple questions. Prompting the visitors to think about their own interactions with cars before addressing the same question through the lens of an abbreviated persona helped build a personal connection with the idea that opposing views on a single topic can simultaneously exist. Secondly, we had a wall of 30 cars ranging from classic designs to practical commuter vehicles and asked participants to “drive” a few cars along horizontal strings representing a Likert scale ranging from Hate it (1) to Love it (7). This experience was entirely their personal choice but mirrored the same layout the visitors would interact with at each abbreviated persona station. Having an easy introductory activity helps instruct the audience participant on the process of the exhibit without simply having a list of written instructions.
The abbreviated persona display interaction took place at three distinct, yet similar stations to provide the participants with a consistent experience at each station. Only the persona information presentation method on the posters was different. The location of the poster, the order of the car categories, and the lighting were all uniform across all three abbreviated persona stations reducing the variables in the experience (Figure 4). While the formatting of the persona information was different across all three personas, all the information was visual and contained on the poster through words or pictures. Due to time and resource constraints, no audio or video mediums were used but could be added to a similar experience. A key component of the persona interaction is the actual tactile interaction with the cars themselves since they required the visitor to “drive” them along their horizontal scale of Hate it (1) to Love it (7). Since audience participants were limited to the number of cars they could move (up to 3 cars) and the number of spaces they could move (up to 2 spaces), no individual could overwhelmingly change the garage. Collective input from multiple audience participants was the only way to create significant change.

Since the student design team voluntarily asked for full engagement (not just a walk and browse engagement) from audience participants, we wanted to acknowledge their involvement with a token of appreciation. While many visitors expressed appreciation for the experience of assuming the role of a persona, we also had a small custom vinyl car sticker available for those audience participants that completed the exit survey after engaging with the showcase.

Results

The showcase highlights two key findings regarding abbreviated personas.

Finding 1: Abbreviated personas, even with reduced amounts of information, are effective mediums for facilitating meaningful discussion about emotional design. Collectively, the
variance between the cars moved by the audience participants and the control palette established by the student design team only ranged from 10.3% to 23.1%.

<table>
<thead>
<tr>
<th>Column</th>
<th>Maximum Spaces (cumulative for all cars away from the control)</th>
<th>Minimum Spaces (cumulative for all cars to move from starting point to control)</th>
<th>Difference in Spaces (Maximum – Minimum)</th>
<th>Observed Spaces moved (cumulative for all cars from starting point to final position)</th>
<th>Space between Observed and Control (cumulative for all cars)</th>
<th>Variance in cars moved by participants compared to control</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA Couple</td>
<td>59</td>
<td>20</td>
<td>39</td>
<td>26</td>
<td>6</td>
<td>15.4%</td>
</tr>
<tr>
<td>Corporate</td>
<td>60</td>
<td>21</td>
<td>39</td>
<td>25</td>
<td>4</td>
<td>10.3%</td>
</tr>
<tr>
<td>Professional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College Student</td>
<td>58</td>
<td>19</td>
<td>39</td>
<td>28</td>
<td>9</td>
<td>23.1%</td>
</tr>
</tbody>
</table>

Table 1: Variance in Cars by Persona

Finding 2: There is no preferred presentation method for an abbreviated persona. Information in the abbreviated persona should be presented in a method that is more relatable and usable for the engineering and design team and their audience. The relatability of each persona and the amount of information contained in each persona (Table 2) allowed the audience participants to collectively adjust each persona’s preference even though individual vehicles only moved 0.360 spaces on average per interaction with each audience participant.

|                   | Relatability | Amount of information (1 – No Enough; 3 – Perfect Amount; 5 – Too Much) | Average space change per interaction |
|                   |              |                                                                     |                                      |
| CA Couple         | 32 of 82     | 3.6667                                                              | 0.385                                 |
| Corporate Professional | 14 of 82 | 2.625                                                              | 0.304                                 |
| College Student   | 36 of 82     | 3.0625                                                              | 0.390                                 |
|                   |              |                                                                     |                                        |
|                   |              |                                                                     | 0.360 Total average space change per interaction |

Table 2. Relatability and Amount of Information for each Persona

To date, there has not been any formal or anecdotal research on formatting personas to maximize utility though current literature encourages complete persona development to include a name, photo, list of goals, narrative containing mental models, skills, frustrations, and attitudes. Using the exit surveys from participants finishing the exhibit, 36 of 82 participants surveyed found the
College Student persona to be most relatable and overall the College Student persona scored 3.0625 on a Likert scale of 1 (Not enough Information) to 5 (Too much information). The CA Couple persona was the second most relatable with 32 of 82 votes and scored 3.6667, indicating more information was provided compared to the score of 3 (Perfect amount of info). The Corporate Professional persona received only 14 relatable votes and an overall score of 2.625, indicating it contained slightly less than the ideal amount of information but this score is still closer to the perfect amount of information score of 3 compared to the CA Couple. The participants clearly digested the persona information differently and demonstrate that abbreviated personas can be presented to their audience in a manner that is most understandable and relatable.

From the video footage, we were able to see the cars move in real time and capture each move for each car. Through analysis, we discovered that each car moved an average of 0.360 spaces per interaction. Even though each individual could only move three cars up to two spaces each, this number helps us see that the cars starting from a neutral position gradually moved based on the emotion presented by the persona.

Of the 250 visitors that interacted with the personas in the showcase, 82 completed exit-surveys. At the end of exit survey, 38 audience participants provided optional comments about what they enjoyed during the showcase. Of the 38 comments, six comments centered around cars, 14 focused on the interactive aspect of the showcase, nine mentioned the personas and overall approach (only the CA Couple received one by-name mention), and nine were miscellaneous.

Discussion

The results clearly support the first finding that abbreviated personas contain enough information for a design team to incorporate emotional design into a project because they are capable of facilitating discussion on emotional design. The fact that the participants engaged with cars through the lens of the personas throughout the entire exhibit and collectively converged on a final palette that only had a variation of 10.3% - 23.1% from the control speaks to the effectiveness of the abbreviated personas. To this point, we would not have expected to see 0% variation between the showcase palette and the control palette because while the abbreviated persona is a tool, it does not provide an absolute metric for integrating emotional design but a medium for facilitating discussion within the design team.

The second finding that there is no preferred persona presentation method opens up numerous expressive opportunities for engineering students and does not constrain an engineering team to using only one presentation method. The fact that the College Student and CA Couple persona ranked above the Corporate Professional persona with respect to relatability is understandable due to the demographics since the showcase took place on a university campus in California that has a large student population from the same state but it does not explain everything. The Corporate Professional persona had the second closest score to the “Perfect amount of information” (3) showing that while the abbreviated persona may not have been the most relatable to the audience participants comprised of 75% under the age of 40 years old, the succinct information was sufficient and potentially more desirable than longer, more detailed prose. On the other hand, of the 82 participants surveyed, 38 left additional comments along
with the multiple choice and scaled answers. The CA Couple persona received the only positive by-name endorsement indicating that the additional depth of the slightly longer prose may potentially create a deeper connection and understanding of the abbreviated persona beyond a technically sufficient understanding. While the results from this project do not conclusively dictate a single presentation method for a persona, the data indicates that several different persona presentation methods can alter the audience’s relatability and understanding of the persona. A single persona presentation method may not be appropriate across all units of a multi-disciplinary engineering team and different presentation methods could elicit different responses from the same audience at different stages in the design process.

It is important to see the correlation between the percentage variance and the relatability score. While the college student persona had the highest relatability (36 of 82), it also had the highest percentage variance at 23.1%. The perceived connection between the persona and the people participating in the exhibit could explain this dichotomy. Even though the persona helps removed some bias, these subconscious emotions can still emerge during the design process. Without the assistance of the persona, the variation between the participants and the control could have been even greater. The discussion sparked by the persona was evident during the exhibit, with a particular example from the College Student Persona in Figure 5, where several audience participants were observed pointing out aspects of the persona while adjusting and readjusting the cars in a tit-for-tat exchange based off how they perceived the persona. We would not have expected to see this level of discussion if we had not included the details of the abbreviated persona and only had the general title of the user. Additionally, having a tactile interaction with the cars potentially helped create healthy discussion. Audience participants could only make small changes to the overall garage but the expectation that they would contribute in some form with their limited moves meant that their actions were not antagonistic or domineering but constructive and supportive. The low percentage variance and relatability scores indicate that the abbreviated personas have a voice in the design process but also of significant importance is that personas help ensure that every member of the engineering team has a voice in the design process.
The other significant contribution to the variation is the deliberate choice to have participants move cars on the Likert scale from 1 (Hate it) to 7 (Love it). This deliberate choice was based on a theory by Dr. Barbara Karanian that people have a stronger emotional connection with cars than they do with other inanimate and mechanical devices based on human interaction with automobiles [14]. The student design team deliberately used the scale of Love it to Hate it in an attempt to have participants connect with the personas on a simple, primal level and potentially view the cars with an almost impulsive desire or rejection through the persona lens. We believe this contributed to the fact that each car moved 0.360 spaces per interaction. Despite the apparent simplicity of Love and Hate, the application of these principles on behalf of a persona resulted in a very wide range of responses. Some audience participants questioned the use of the words (and corresponding connotations of) “love” and “hate” but the student design team kept the phrasing consistent throughout the entire project. Don Norman’s visceral, behavioral, and reflective categories of emotional design support the use of this terminology [3]. These terms speak not only to visceral response that can include simple aesthetics but they are also deeply rooted in personal connections that are rooted in our reflective response to objects.

While research has isolated certain aesthetic characteristics that elicit emotional responses, such as Desmet and Heckert’s research into how a car’s front appearance can make people smile in 2000 [15] or the 2013 investigation into emotional response to dashboard design [16], there remain several layers to emotional response to automobiles. Work by Aarts and Marzano tells us that divergence can naturally occur in product experience and explains why there are so many different types of automobiles and automobile manufacturers. The different brands are not simply providing mechanical transportation for the consumer but adding status to consumer [19]. The consumer therefore could hate some aesthetic features of a product but love the public perception associated with that same product. “Consumer” is used lightly in this context because neither metric has to directly indicate the desire to purchase the end product but it does not mean that engineers and designers would simply ignore the data points. In this project, we did not ask the participants to choose a car for the abbreviated persona to purchase or even to drive but simply asked if the persona would love or hate the various choices. The abbreviated persona sought to capture holistic aspects of the persona that would potentially include elements from all three processing levels and collectively arrive at a single output.

Even with the proliferation of automobiles in society over the past 100 years and the recognition that these once utilitarian, industrial machines are now interwoven into daily lives and personal identities, automotive designers are still at a loss as to how to effectively incorporate elements of emotional design into the total design process [20]. And the problem is not isolated to automobiles. The same complexities present in the Human-Computer Interface (HCI) that personas help originally address are now ubiquitous in the broader Human Product Interaction (HPI) [5], [6]. The abbreviated persona provides an outlet for engineers to discuss the human interaction expected from their product and address the emotional design considerations.
The abbreviated personas are not fully developed personas and may not directly translate into commercial setting that require a more robust, data-driven persona developed by a professional team. The abbreviated persona will only contain enough information for an engineering capstone team to adequately discuss the necessary elements of emotional design that pertain to their project. This could include biographical information, hobbies, attitudes, goals, demographics, or personal information but it does not have to contain everything. Every piece of literature on personas required the use of a name for relatability and building a personal connection but our investigation shows that even without names, detailed pictures (including head shots), and genders, abbreviated personas can be relatable. The intent of the abbreviated persona is therefore not even the actual persona but the discussion surrounding the persona. To meet the goal of incorporating personas into a capstone process, engineering students should not invest significant time into the development of the abbreviated personas. Online databases of demographic data, historical user-profiles for similar products, or even assistance from a professor or mentor that has worked in the given field for a few years will provide enough information to build an abbreviated persona. The abbreviated persona can be tailored to the specific project and does not need additional information that would detract from the overall capstone. The abbreviated personas will help minimize personal biases and stereotypes that team members may have towards target consumers, especially if they are actual people. We believe three to five personas are enough for a good starting point, offering multiple user inputs without overwhelming the capstone team with too much work developing the abbreviated personas or sheer information overload during their use throughout the capstone process.

Integrating the abbreviated personas into the capstone process needs to be deliberate in order to be effective. Visual presentation of personas is common in industry and mirrored in this project. The actual method of information presentation can vary based on how the capstone team best absorbs information. This project demonstrates there is not a perfect persona presentation method; multiple presentation methods can effectively convey the information. Keeping personas visibly posted in a common work space helps the team incorporate them into all aspects of the project, therefore large font and clear pictures that can be read from across the room should be used. Printed posters would be preferred over handwritten boards for clarity purposes but students should be encouraged to update or add to personas by hand during the capstone process. Any digital media such as videos, sound clips, and digital copies of printed material should be saved in a shared folder so that each team member has easy access. Persona use should not be entirely reserved for casual conversations when team members cannot settle on various design aspects however. Capstone teams should deliberately schedule discussions focused on the personas and the product at each major design decision and any intermediate progress reviews (IPRs). This formalized incorporation allows the capstone team to maximize the utility of the abbreviated personas as a feasible design tool instead of an ignored talking point.

Our investigation should alleviate concerns that too little information in the abbreviated person could potentially skew the perception of the capstone team. During this project, the discussions we observed and comments we received from audience participants demonstrated that abbreviated personas sparked discussion and conversation regarding the persona’s perception of the products. These conversations would not have happened without the personas, which would have been the biggest loss in the entire project. Additionally, it helped the design team identify
and recognize some of our own biases and stereotypes that we brought to the team, even if they were unintentional. Also, engineers should not dismiss the use of personas because they feel like their product is purely utilitarian and will be used regardless of emotional response. The lack of a traditional “consumer” can provide a false impression that the engineer does not need to account for emotional design. For example, an engineer capstone team could be building a component for a larger research project and does not need to “sell” their product on an open market. This product will still have a client/supervisor that funds the project, a user that implements the product into the larger system, and a maintainer that ensures its continued function. All of these people are collectively the “consumer” and will have an emotional response to the product. Not accounting for their product interaction is shortsighted and could lead to lack of continued funding, an incorrect implementation of the product, or a lack of maintenance and early product failure. We acknowledge that not every qualitative characteristic may be accounted for and effectively addressed with personas, but many considerations can be considered and the fact that any emotional design components are discussed will be an improvement.

As a first-year instructor in an undergraduate mechanical engineering program at the US Military Academy, the lead author has the recent experience of being a student and participating with this showcase as part of the student design team and is now transitioned to the other side of the classroom as a new instructor teaching Dynamics to mechanical engineer students. These two findings in this paper have directly helped the lead author approach engineering education and his specific classes with a more balanced mindset by replacing individual students with personas. Replacing individual students and their learning styles, struggles, and goals with personas allows the instructor team to serve proper justice to the technically challenging material while also building personnel connections with the students without compromising either. The author team believes this mirrors the broader application of these findings into all engineering courses, especially capstone courses with culminating engineering design. Engineering design is not complete without qualitative, consumer input and currently there is a gap where that input should exist. Abbreviated personas fill that gap with a tangible, low-cost-no-cost method that introduces engineering students to full domain of engineering design.

Future Work

Taking the lessons learned from this project, the lead author as a new instructor has helped implement abbreviated personas into the culminating engineering capstone for seniors in the mechanical engineering program at a public military university. This year long course allows three- or four-person mechanical engineering or multi-disciplinary engineering teams to execute the engineering process from start to finish by working with a real client on a specific need and ultimately fabricating a solution for that gap. Students refine their understanding of the engineering process to include the design process through this hands-on approach that incorporates all their engineering skills learned up to this point in their education. Historically, the students produce excellent functioning prototypes that are developed by using methodical engineering and frequent interaction with their clients, often Army or Department of Defense organizations. The course of study correctly orients the students towards quantifying all engineering requirements while developing functioning products [1],[23] but does not provide a metric for capturing more qualitative characteristics that are important elements in emotional
design. The author led two capstone teams in developing four common abbreviated personas for their projects and has already seen a direct benefit in the discussion surrounding design, prototyping, and testing. To better understand how effectively the teams applied the abbreviated personas, we will record observations throughout the process and interview the team members when they are finished with their project.

Acknowledgement

The author team would like to thank the hard work of the Student Design Team, Veronica Lin, Júlia Amardóttir, and Brandon Warren, with building and executing Personas Driving Products at Stanford University’s ExPe 2018. The class and automobile experience would not have been the same without the wit and insight of Jonathan Summers.
Appendix A: Abbreviated Personas

A CALIFORNIA COUPLE

Introduction: Get to know this couple through the information below and then move over to the adjacent car wall. Choose three cars and move them to the left or right as if you were this persona.

LOCATION
A Suburb of Southern California

EDUCATION
Parent 1: BS Biology
Parent 2: BS Finance

DRIVING HABITS
Daily 10 mile commute
Weekend trips to regional parks

SITUATION
Having known each other for 10 years, they now have two active kids, ages 3 and 8 - the older child enjoys soccer and recently learned to play the piano. They live a busy, suburban life just outside LA, but are always eager to explore their world.

INTERESTS
They are passionate about the outdoors. They enjoy weekend trips to Joshua Tree for climbing and volunteering, are enthusiastic participants in recreational skydiving, and help maintain the vegetable and herb gardens at work during lunchtime.

Even after knowing each other for several years through college, dating for a few years after graduation, and having two kids ages 3 and 8, they still consider themselves a young couple. The world still seems so big and there’s still so much to explore, which might seem strange considering the bio-geog of the family spent three summers conducting research on threatened species in the daintree and visited several other international locations. But this notion of a “big world” has more to do with a mindset and less about the physical places that someone has been. There’s something that resonates with Heraclitus’ simple and profound statement, “No man ever steps in the same river twice, for it’s not the same river and he’s not the same man...” even if they would argue that they’ve been all over the place and tried to stay clean enough, if not exactly the same, so that their kids can swim in it in a few years.

This is probably why heading out to Joshua Tree for a weekend once or twice a month never gets old. It’s a great break from the busy suburban life that buzzes around their home just outside of LA. It doesn’t mean it’s a chance to show the kids a new climbing spot or volunteer with the Access Fund to keep an old favorite location open. They might actually have a mind to move further outside the city but the kids are getting involved more with their recreational sports teams. Plus, the Bachelors of Science in Finance does not lend itself to work in an isolate rural community. They’ll make the most of where they’re planted and enjoy keeping up with the new fruit trees and vegetable garden that they’ve planted too.

Two years ago, when our youngest was just a few months old, the family took a car trip to Nevada to participate in the largest amateur skydiving formation attempt of 2016. Officials from the American Soaring Pursuits Association would be there, and ultimately it would be a great experience to see old friends while enjoying the baby to its first camping experience. Due to the airfield and Dropzone being located out in the middle of nowhere, we decided to camp would be “a fair and easy alternative to paying for a local motel that would probably amount to the same experience. As much as we had spent time camping before, even with our first kid, we were not ready for this trip. Taking the 5-hour drive did through the Southern California desert and past the twinkling lights of Las Vegas should have been a breeze, it turned into an endurance test for the family. The Honda Element was borrowed from a close friend for the weekend. It cost us 2 hours into the trip to fix a flat tire. The driver’s window only went back up halfway and then remained frozen, making the rest of the trip. “This seat is far too comfortable,” one friend angrily said. They insisted, “You have a comfortable, quiet spot for you and the baby.” With our car just in the shop, we accepted the offered Honda Element and hit the road.

What we got was completely different. The rest of the trip. We arrived just outside of Moab, Utah slightly dumber than expected, but the next morning’s sunrise made up for the travel woes. Having a couple practice skydive jumps in the morning, the first since being the new addition to the family, balanced being back muscle memory and the main 250 Whippets and we broke the 2016 record for 2.5 months until the Skydive chief at the Moab dropped the elastic that rolls up the window. The body flaps did not, and after some worrying online, a replacement part was ordered. The baby also did great camping, and was still up all the time. It’s a funny story to tell and an even better lesson on taking advice and cars from well-intentioned friends.
A CORPORATE PROFESSIONAL

EXPERIENCE

2014 - Present • Partner, Boston Consulting Group (Boston, MA)
2008 - 2014 • Partner, McKinsey & Company (Washington DC Metro Area)
2003 - 2008 • CEO, K-12 Non-profit Organization (Boston, MA)
2000 - 2003 • Operations Manager, Intel (Boston, MA)
1998 - 2000 • President of Sustainable Development Sector, Monsanto (Dublin, Ireland)
1994 - 1998 • Consultant, Bain & Company (Frankfurt, Germany)

EDUCATION

BS in Engineering Management, University of Connecticut (1984)
Masters in Business Administration, Wharton School at UPenn (1993)

SKILLS

● Excellent presentation and verbal / written communication skills
● Dynamic problem solver
● Data analysis
● Business case development
● Strategic planning
● Risk management
● Negotiation

INTERESTS

Golf, traveling, community service, crosswords, chess club
A COLLEGE STUDENT

LOCATION
Grew up in rural Texas, currently attending state university 3 hours away

EDUCATION
HS Graduate
Undeclared College Major

DRIVING HABITS
Drives 8 “shifts” for Uber a week
Drives home once a month

DAY IN THE LIFE
0700 First alarm goes off, snooze for 5 minutes
0707 Out of bed and into trainers for a morning jog
0735 Take a 2.5 mile loop around campus
0800 Shower & breakfast time: coffee, banana, and granola bars
0830 Early physics class today – they’re better in a way because they are less crowded, and it leaves the late morning and afternoon open for more Uber fares
1000 Work a 2 hour Uber shift before meeting my friend for lunch
1200 A good friend from my high school sports team is graduating high school this year and is visiting my state college – we’re from a small town 3 hours away and my friend isn’t sure they’ll be doing away from home. I’m hoping to show them that it’s possible to do well here and adjust to the new environment without forgetting where you came from
1330 Afternoon European history class
1500 Club sports practice. We’re defending our title at a local tournament in two weeks
1900 Shower, homework, and dinner
1910 Video call with my brother and niece – he’s stationed in Japan with the military, which is 14 hours ahead and he has the morning off. I’m really proud of what he’s doing and have a lot of respect for his willingness to serve.
2000 Back out on the road to pick up some more fares with Uber. It always starts getting busy with everyone going to dinner, and I’m more than happy to make some cash.
2300 Planning on calling it a night, but was invited to a lower key get together with some friends from the league.
0600 I will not be running in the morning, good thing I only have class at 1000 tomorrow.

WEEKLY CALENDAR

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- Weekly schedule for academic and extra-curricular activities.
References


