Design for All

Guest Editor: Prof Sharon Joines, Ph.D
North Carolina State University
USA

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Other regular features

Dr. Sharon Joines, *professor of industrial design at NCSU, is a researcher and ergonomist, teaching studios and courses in human centered design, ergonomics, design methods, and interdisciplinary solution development. Her interests reside in co-creation, universal design, and applied product and process research. Her research focuses on quantifying the interaction between individuals with diverse abilities, products and their environment. Sharon works with engineers, designers and user experts in all phases of the design cycle. The challenges addressed traversed consumer markets, warehousing and distribution, medical and military applications, and manufacturing environments ranging from forging to clean rooms.*

Dr. Joines was named a University Faculty Scholar in recognition of significant achievements in scholarship, teaching and/or service. Recent recognition of her work includes:

2016 Outstanding Graduate Faculty Mentor Award in the area of the Humanities and Design

2016-2017 Alumni Association Outstanding Research Award

2017 Member of NC State's Academy of Outstanding Faculty Mentors

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Sharon is director of the Research in Ergonomics and Design (RED) Lab and a member of IDSA, the Human Factors and Ergonomics Society, the Design Research Society, the Order of Thirty and Three, and Alpha Pi Mu. Sharon received her BS, MS, and PhD degrees in Industrial Engineering from North Carolina State University.

In addition to providing a solid understanding of the strengths and limitations of the human, one of Joines's teaching goals is helping students understand how to evaluate product solutions as they develop them. In courses she has developed, students are exposed to formal and informal assessment methods using quantitative and qualitative methods focusing on user experience, ergonomics and human factors. Product development cycles have been shortened by rapid prototyping, agile manufacturing methods and interdisciplinary teams. Thus, she address the designers' evaluation of product performance during the development process resulting in better product solutions highlighting this as a highly valued skill in the field. In addition to opportunities in the traditional studio and classroom environments, her mentoring and project work has allowed 9 PhD, 39 masters and 5 undergraduate students to have had hands-on experiences with design research by working on projects in the RED lab.

Guest Editorial

Sharon Joines

Nine years ago, I had the pleasure of serving as guest editor for this Design for All Newsletter (Vol 4, No 6) to pay tribute to Ron Mace. Since that issue of the Design for All newsletter, many things have changed; the Center for Universal Design at NC State University was defunded by the state of North Carolina, our College has a new Dean and I have been tenured and promoted to Professor. What has not change has been my support and dedication to Universal Design; it has been my privilege to educate each group of students about Universal Design, human factors, ergonomics and safety in Industrial Design (ID) at NC State University for more than a decade. In addition, I have had the pleasure of working with ID students (bachelors, masters and PhD) on UD projects designing everything from infant bassinets to shower drain pans. I have lead and sponsored UD research and have had the good fortune to have my research publish. One of my most memorable endeavors was co-chairing a Universal Design Symposium in 2015 with Tsai Lu Liu. The UD Symposium convened people from across the US and from 7 different nations who are passionate about or interested in Universal Design providing them with the opportunity to meet, converse, and interact. Attendees included designers, architects, planners, researchers, educators and consumers of UD products, processes, spaces and places. The symposium[1] included expert speakers, design charrettes with subject matter experts, designers, and expert

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[1] *Optricity was the Charter Sponsor of the Symposium. We thank them for their leadership in inclusivity in the workplace. NC State's College of Design supported the Symposium in so many ways; individual sponsors were: Alex Lee and Chris Downey.*

users. Our speakers included: Chris Downey, Ricardo Gomes, Alex Lee, Deana McDanaugh and Pattie Moore.

In 2008, after 20 years of architectural practice and 2 degrees in Architecture including a BEDA from NCSU in 1984, Chris Downey, AIA of San Francisco unexpectedly and instantly lost all sight but did not lose his profession.

Refusing to yield to conventional presumptions, Chris instead immediately engaged his creative training to find promise and value from his new point of view. Through this intense journey, he has discovered a new fascination of a more multi-sensory immersive approach to design and a profound commitment to a more inclusive environment. As one of the few architects in the world practicing without sight, Chris shared insights of architecture, design, technology and the City through the apparent paradox of a blind architect.

Ricardo Gomes, Professor and Director of the Design Center for Global Needs, San Francisco State University shared the globalized development for UD by highlighting inclusive design principles unifying the Olympic and Paralympic Games.

Alex Lee, President, OXO, shared the OXO brand story and design strategy. OXO, the world's most admired housewares brand, was founded in 1990 on the philosophy of Universal Design. Lee noted that, for OXO, Universal Design does not mean designing products fully usable by everybody, since there is no product that can truly fulfill the needs of all users. But when all users' needs are taken into consideration in the initial design process, the result is a product that can be used by the broadest spectrum of users.

Deana McDonagh, Ph.D., Professor of Industrial Design, University of Illinois at Urbana–Champaign, highlighted the role of empathy in

designing for others, and offer the individual tangible ways in which designers, design teams and anyone involved in new product development and architecture to get closer to their user. Tools, techniques and approaches were explored specifically from the perspective of Universal Design. McDonagh underscored that Empathic Design, as a design research strategy, can enrich the design process outcomes.

Patricia A Moore, President, Moore Design Associates, build on the foundation of the early years of the Universal Design methodology and provided direction for the creation of current and future inclusive environments and products for the lifespan.

I remain humbled by the dedication of my colleagues, the tenacity of those who helped the UD symposium come to fruition, and by each project in which UD is leveraged to the betterment of our society — one individual at a time. I would like to thank all contributors for sharing their ideas and reflections on Universal Design in their current works. I would also like to thank Professor Sunil Bhatia for allowing me to engage with the Design for All Institute as a guest editor for their Newsletter, again. Congratulations Professor Bhatia on your continued success!

Sharon Joines, PhD,

NC State University Faculty Scholar

Professor of Industrial Design

Director of Graduate Programs in Industrial Design

RED Lab | College of Design

North Carolina State University, USA

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*Throughout her academic and professional life, **Helen Armstrong** has moved between the written word and the graphic image. After Ph.D. coursework in English literature, Armstrong gravitated to the world of art and design. She earned an M.A. in Publication Design from the University of Baltimore and launched a career as a graphic designer. Her design work—for such clients as Sage College of Albany, US Internetworking, and New College of Florida—has won regional and international awards. Her projects have been included in numerous publications in the US and the UK, including the How International Design Annual, The Complete Typographer, The Typography Workbook and Design Elements.*

After ten years as a graphic designer, she returned to her passion for theory, research, and teaching. At the Maryland Institute College of Art she earned an M.F.A. in Graphic Design while teaching in the Department of Art History, Theory and Criticism. Prior to coming to North Carolina State University, Armstrong was an Assistant Professor of Graphic Design and Graduate Director of Experience Design at Miami University in Oxford, Ohio. She currently serves as a member of the AIGA Board of Directors and is on the editorial board of Design and Culture. In addition, she is a past co-chair of the AIGA Design Educators Community Steering Committee.

Armstrong authored Graphic Design Theory: Readings from the Field (Princeton Architectural Press, 2009) and co-authored Participate: Designing with User-Generated Content (Princeton Architectural Press, 2011) with ZvezdanaStojmirovic. Her new book Digital Design Theory: Readings from the Field explores works by both designers and programmers, examining the two threads of discourse—design and computation—that have rapidly merged to define contemporary graphic design.

Currently, Armstrong is combining her knowledge of participatory practice with computational thinking to explore the potential of intelligent interfaces to address the needs of individuals with disabilities.

Kelly Umstead is an Assistant Professor of Industrial Design with professional experience rooted in research. She began her career as a biomedical engineer focusing on biomechanics and human movement with applications ranging from gait analysis and rehabilitation to sports science and aquatics.

Prior to joining the Industrial Design faculty, Kelly was a medical device product manager at Bioventus LLC, an orthobiologics company. During the last 10 years, Kelly worked in product development, specializing in medical device design and product usability. Her work employing a design process which integrates multiple stakeholder voices received the Human Centered Design Award, presented at the Human Factors and Ergonomics Society International Meeting.

Kelly's experience in product design has always been human-centric, from acquiring user needs to translating those needs into viable products. Her research interests focus on healthcare, medical device development, user-centered design, and design methodology.
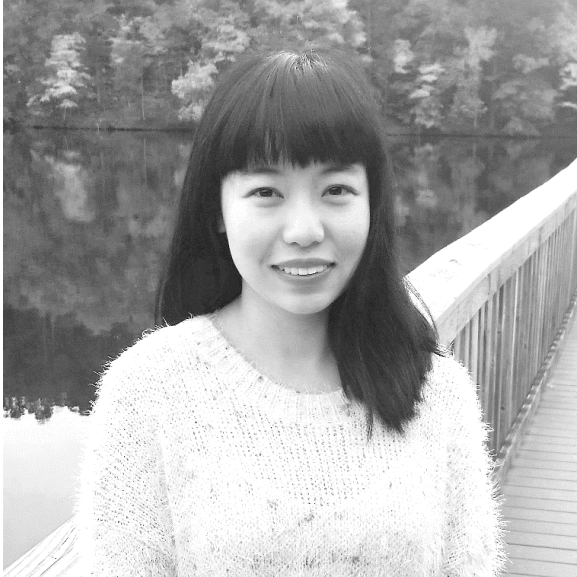
Byungsoo Kim is a Ph.D. in Design student at North Carolina State University, College of Design and works as a research assistant at the Research in Ergonomics and Design Lab. Byungsoo has several years of working experience as a design researcher and a designer in Republic of Korea and interned at JLG and General Motors in the U.S. He won domestic and international design awards including Reddot Design Award, iF Universal Design Award, GM Interactive Design Competition.Byungsoo's research interest resides in universal design, ergonomics and user experience design.

***Raunak Mahtani** is a track 3 Masters of Industrial Design student at NC State University. Before coming to NC State, Raunak received his Bachelors in Mechanic Engineering from M.I.T. College of Engineering, Pune, Maharashtra, India. His objective in pursuing his graduate education was to use his creativity, design thinking and functional application in thefield of Product Design. He worked as an industrial design intern at Futuring Design Pvt. Ltd. in Pune as part of a team responsible for designing a domestic composter system for a largemultinational consumer goods manufacturer.*

Hongyang Liu is a doctoral candidate at the College of Design, North Carolina State University with specialization in researches on interaction design and user experience assessment. She is also pursuing her graduate minor in Cognitive Science. Hongyang's dissertation research focuses on exploring how the learning process of new technology among seniors can guide the interaction design from the ease of learning perspective.

Catalina Salamanca is an Industrial Designer with 15 years of professional experience. She undertook her undergraduate studies at Pontificia Universidad Javeriana, where she graduated in 2002. Prior to moving to Raleigh to pursue her graduate studies, she directed her own design consultancy in Villavicencio, Colombia. In May of 2017, she received her Master degree of Industrial Design from NC State University. Catalina is interested in design research and medical design device.

Joshua Wall is a Track 3 Graduate Industrial Design student at North Carolina State University, College of Design. Joshua has an Undergraduate degree in Marketing from Winston Salem State University. He has won 2 scholarships while attending NC State and won the Graduate School Diversity Enhancement Grant in 2016. He currently works as a footwear design assistant at Guy Marshall Design Consulting.

Joshua's research interest include footwear design, biomechanics, and sports product design.

Shelby Forrest received her BA in Secondary Education and Teaching from Freed-Hardeman University. After teaching for several years, Shelby joined the Masters of Industrial Design program at NC State University. She is interested in focusingon the psychology behind user interaction with products and systems; she remains excited about coming up with ideas to make students' and teachers' lives easier.

Throughout her academic and professional life, Helen Armstrong has moved between the written word and the graphic image. After Ph.D. coursework in English literature, Armstrong gravitated to the world of art and design. She earned an M.A. in Publication Design from the University of Baltimore and launched a career as a graphic designer. Her design work—for such clients as Sage College of Albany, USInternetworking, and New College of Florida—has won regional and international awards. Her projects have been included in numerous publications in the US and the UK, including the How International Design Annual, The Complete Typographer, The Typography Workbook and Design Elements.

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Harnessing Technology to Re-envision the North Carolina Museum of Natural Sciences as an Autism-friendly Space

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Abstract This article defines impairment and disability as fluid conditions that fluctuate depending on context. Mapping this spectrum of impairment and disability for specific users enables designers to identify opportunities for technology to sense and respond to unique user needs. In fall 2017, North Carolina State University graphic design students used this approach to create assistive tools for transforming the Acrocanthosaurus Exhibition of the North Carolina Museum of Natural Sciences into an Autism-friendly space. The resulting projects raised questions around the tension between intelligent customization and privacy of users, while exploring the potential for technology to not only lower barriers of access but also generate responsive moments of delight.

Index Terms—Inclusive Design, Autism, User-Centered Design, Accessibility, Intelligent Interface Design.

1. A Spectrum of Impairment

Our lives fluctuate along a spectrum of impairment [1]. Impairments might be permanent, temporary, or situational. Lennard J. Davis notes in *Bending Over Backwards*, "Impairment is the rule,

and normalcy is the fantasy" [2]. Design consultant Graham Pullin suggests a similar idea in reference to the concept of disability: the boundaries between disability and ability are unstable, changing depending environment, activities, or even states of mind [3]. A user-centered design approach that focuses not just on lowering barriers to access, but also upon improving the overall user experience, asks designers to question binary conceptions of ability and disability [4]. Once designers begin to understand ability as a fluid state, they can utilize user-centered design methods to map out a spectrum of impairment for specific users. This deeper understanding of the variability of impairment supports the need for interventions through which technology can sense and respond uniquely to each user. This, in turn, enables designers to support delight—in addition to access—at multiple points for a specific user and his/her changing needs.

2. Responding to Impairment through User-Centered Design

To grasp the fluid nature of impairment and the possibilities for technological intervention, NC State University graphic design seniors collaborated with the North Carolina Museum of Natural Sciences (NCMNS) on a project focusing on young adults with Autism Spectrum Disorder (ASD). The museum approached the College of Design because one of the museum's key exhibitions—the Acrocanthosaurus Exhibition—repelled visitors with ASD. The space was so overwhelming for these visitors that they often could not enter the room. Instead they sat on benches outside to avoid the exhibition despite their interest in the content. Some of the problems with the space, as identified by student research and the NCMNS

Office of Accessibility & Inclusion, included: a heightened noise level, multiple distractions, the large scale of dinosaur models, an inability to familiarize visitors with the environment in advance, a lack of concrete descriptive language within the exhibition, and the lack of a clear linear route through the exhibition. In short, the museum recognized that it failed to meet the needs of visitors with ASD but wished to do so.

Via an advanced graphic design course, GD400, students worked in teams to first delineate the scope of the problem and the needs of these visitors. Crucial to the scope was the sheer number of adults with ASD—particularly those living in group settings—that visited the NCMNS. Of these adults, specific needs ranged from communication difficulties to social challenges to repetitive behaviors. As the students began to research they realized that, in addition, the needs of a specific visitor might vary greatly from day to day or even from hour to hour. The reach of this problem also became apparent. In addition to the number and diversity of visitors with ASD adversely affected by the Acrocanthosaurus Exhibition space at the NCMNS, the common occurrence of similar spaces—with similar issues— in Natural Science museums across the world compounded the impact of this problem. Few of these museums, including the NCMNS, had the funding to fundamentally transform existing infrastructure. The NCMNS, instead, looked to the College of Design to provide insight into ways they could use technology to respond to unique visitor needs on a more individual basis.

Using technology to address impairment is quite problematic. Technology can paradoxically provide access while excluding users in

unexpected ways. As Alan Roulstone, Professor of Disability Studies at the University of Leeds, maintains, "Technologies have the power to enable, yet also disable, to foster greater control and surveillance, and conceivably to embody the very symbol of alienation for disabled people" [5]. Designing technology to meet individual needs requires that the technology sense and gather information from users—critical, private, health-related information. Addressing the tension between intelligent customization and privacy became a key theme of critical discussion early in the NCMNS project.

With this tension in mind, I framed the following brief for GD400 students: "Working with the NCMNS Office of Accessibility & Inclusion, develop an assistive tool to transform the central exhibition into an autism-friendly experience. This new assistive tool (phone, tablet-based, physical artifact or other embedded or wearable technology) should customize the exhibition to better serve young adults on the Autism spectrum." The intent here was not to create what could easily be developed by off-the-shelf technology, but rather to design prototypes that challenged what it meant to enter a space of tangible artifacts as a visitor with impairments. Students were asked: How can technology personalize the space to meet the needs of each user, thus creating a welcoming, inclusive environment? How can technology augment and enrich individual experiences? How can such an experience tap into current cultural shifts to encourage participation, collaboration or co-creation between users? How can the resulting system maintain the privacy and security of users?

Engaging in user-centered design methods to address this brief, the students first consulted with the Autism Society of North Carolina, as well as the NCMNS, to research and subsequently build personas of museum visitors with ASD. Each of the six teams—three students per team—defined the needs of their persona and then paired those needs with a secondary condition to generate a more representative persona. For example, Team Two delineated social/pragmatic communication issues, hyper focus and difficulties with temperature regulation as primary manifestations of ASD, while identifying Sleep Dysfunction as a secondary condition. Each team mapped out the defined needs of their particular persona, while, as a class, creating a more comprehensive map of the range of experiences individuals with ASD might have while visiting the Acro Exhibit. This larger, more comprehensive understanding enabled the students to position the needs of users along a wider spectrum of impairment.

The students then benchmarked current assistive technology, established research guidelines appropriate to their specific personas, generated User Journey Maps to isolate persona pain points, and sketched out User Experience Storyboards of how the experience might improve. To broaden their approach during the ideation phase, students engaged in an improve exercise. In this exercise, students read assigned prompts and then riffed upon their initial responses using the phrase, "What If" [6]. Later in the design process students tested rough prototypes within the museum environment by engaging in a physical ideation technique called Body storming—utilizing rough prototypes and props the students acted out the user experience within the existing Acro Exhibit space

[7]. Each phase of this eight-week design process centered on the needs of the personas and considered how an interface might respond differently to each user.

From this research the student teams harnessed technologically-driven approaches—bone conduction tech, messagebots, conversational interface, sensor embedded-networked objects, and gesture-driven participatory interfaces—to build hi-fi prototypes and construct scenario videos that redefined the visitor experience. Via a series of studio visits, the NCMNS Office of Accessibility & Inclusion provided feedback throughout the project. At project end the students presented their design solution scenarios to stakeholders. The work involved no Non-Disclosure Agreement. Instead, the findings were made freely available for use not just by NCMNS museum staff but anyone interested in the research findings. To view final scenario videos, visit helenarmstrong.site or goo.gl/EAhwNa

While the senior student concepts were unfolding, my NC State colleague, Associate Professor of Graphic Design, Scott Townsend, led a parallel studio project. Townsend, who was teaching a sophomore graphic design studio, framed a student project around researching design, disability, and autism in the context of an awareness campaign for the NCMNS. This parallel organizational structure encouraged sophomore and senior graphic design students at the College of Design to share research findings throughout the semester, thus building community vertically within the graphic design curriculum. The sophomores joined the seniors to present their final work to museum stakeholders.

Student Projects
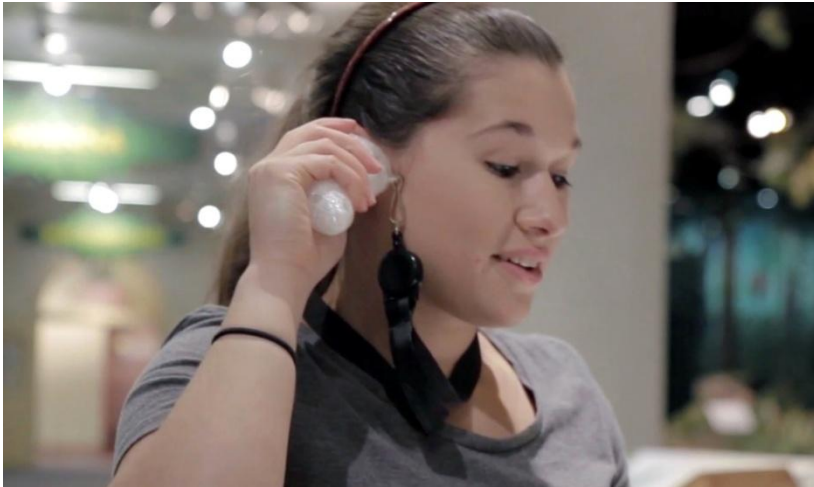
Sleuth Tooth: Matt Kubota, Blair Torres, *Aubrie Phillips*

Sleuth Tooth, a tactile, networked wearable object, guides the visitor as he/she moves through the museum space. This object uses data collected prior to the visit to map out an individualized route. The visitor can fidget with the tooth or use a shaking gesture to transform it into a companion who provides intimate information about each exhibit.
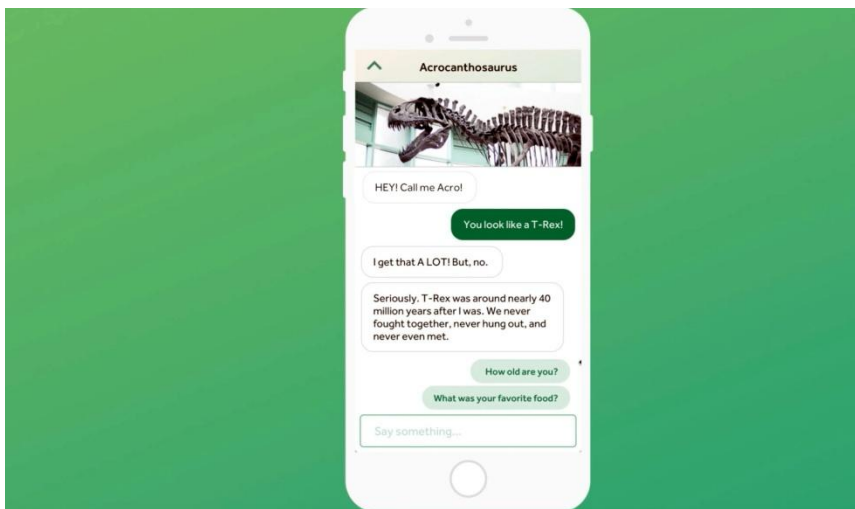
Imprint: This messagebot system syncs with personal devices. Imprint offers curated personalities who converse with non-verbal visitors via text. Bluetooth beacon technology initializes the system based on visitor location.

Sound Imaginings: Lisa Callister, Mallory Schultz, Monica Ampolina and Nicole Robertshaw

Sound Imaginings creates calm, subdued soundscapes throughout the museum. Bone conduction technology conveys these exhibit-specific soundscapes when individuals place their hands over their ears—normalizing this stance. These spaces, slightly removed from visitor traffic, enable visitors to experience the exhibition content in a quiet, relaxing environment.


Pause Pods: **Maddie Bone, Morgan McNeill and Mackenzie Robinson**

Pause Pods interject quiet, reflective spaces into busy zones throughout the museum. The companion sensory map responds to user traffic and environmental factors to guide visitors to Pause Pods and help visitors avoid stimuli that they find upsetting.
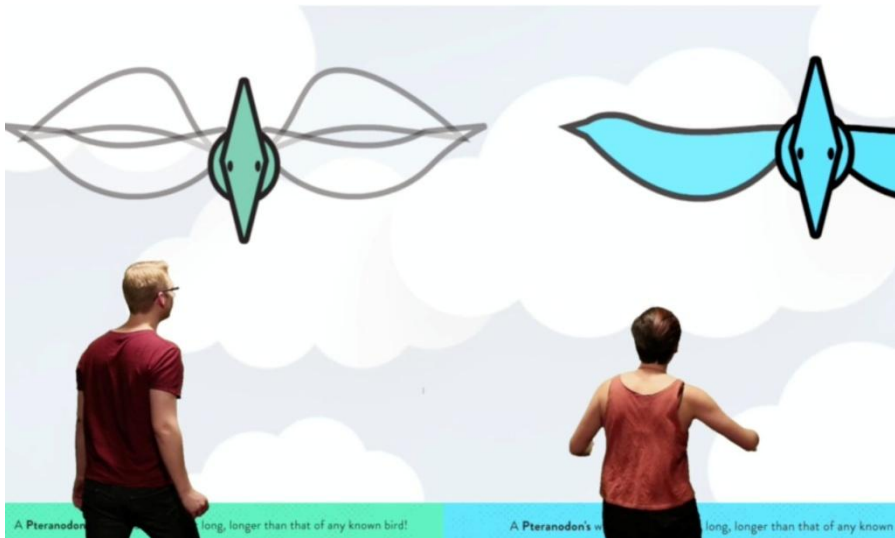
Colossal Callings: Sarah Hardison, Amanda Pearlswig and Jonathan DeBruhl

Interactive exhibition invites users to engage in movement as a way to learn about dinosaurs. Interaction with the exhibition unlocks additional information that is sent to a companion app for later discussion. Multiple participants can participate without the need to communicate directly with one another. Adding participants changes the content.
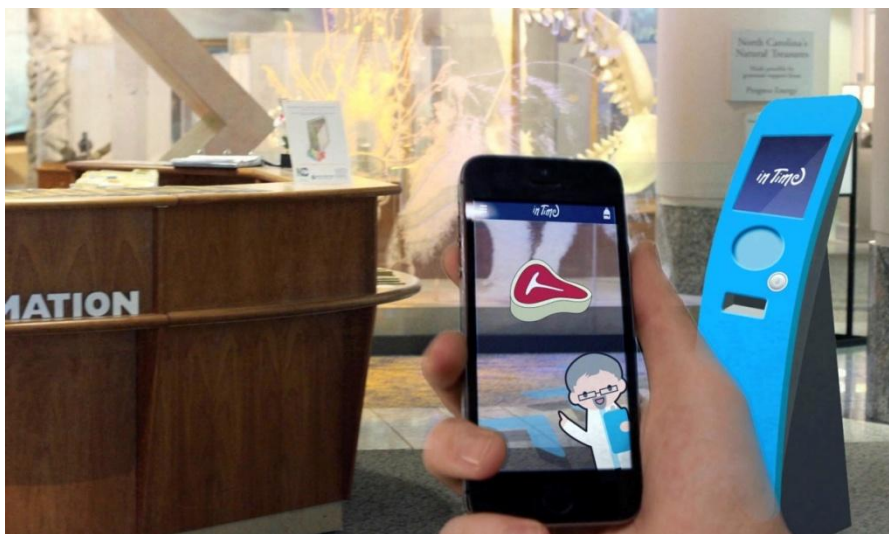
In Time: Maris Hall, Brandon Edwards, Megan Fowler

In Time uses a wearable to empower visitors to explore the museum independently, bolstering confidence through exploration. The AR component creates a customized, gamified, wayfinding system with specific goals for each exhibition space. The wearable also provides a social script for interaction throughout the museum.

3. Conclusion

The NCMNS project situates Inclusive Design within a data-driven design space. Networked objects—mobile, wearable or embedded into an environment—can gather data. Intelligent systems can analyze the data for patterns, make predictions, and respond accordingly. This technology opens up a range of possibilities for mapping out complex individual needs and responding to those needs beyond functional access.

The NCMNS Office of Accessibility & Inclusion is currently exploring the implementation of student concepts presented—sensory maps, bone conduction technology, etc. The scenario videos presented at the end of the project, more importantly, serve as provocations for strategies through which natural science museums might harness technology to facilitate useful and desirable museum visits for young adults with ASD experiencing a wide range of impairments. The tension between privacy and customization is unresolved in these provocations and demands further investigation to establish best practices for balancing individual needs with issues of surveillance and control.

References

[1]   Impairment is defined here as a loss or problem of body function or structure

[2]   Davis, Lennard J.,Bending Over Backwards: Disability, Dismodernism& Other Difficult Positions.London:Macmillan,2016, p 31.

[3]   Pullin, Graham, Design Meets Disability.Cambridge: MIT, 2009, pp 91-92.

[4]   Pullin's discussion suggests the social model of disability in which an impairment becomes a disability when society constructs barriers to access.

[5]   Roulstone, Alan,Disability & Technology: An Interdisciplinary and International Approach.London:Macmillan,2016, p. 4.

[6]   To read more about using improv, see Denise Gonzales-Crisp, "Improvisation in the Design Classroom," unpublished.

[7]   To read more about Bodystorming, see Bella Martin and Bruce Hanington, Universal Methods of Design. Beverly, MA: Rockport, 2003, p. 20.

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Reflection, Empathy and Play: *necessary tools for understanding within the design process*

Shelby Forrest, Raunak Mahtani, and Kelly Umstead
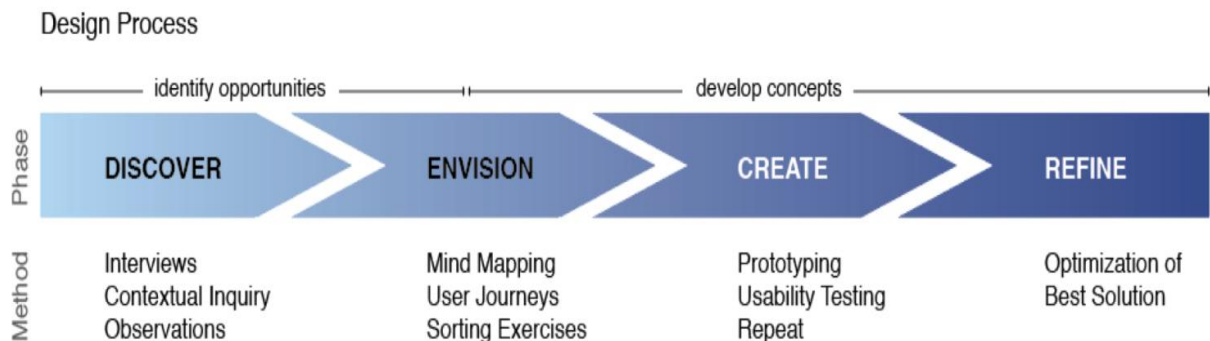*Department of Graphic + Industrial Design*

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1. Helping Hands

Every year there are hundreds of cases of children born with missing fingers or hands which have not fully formed. Some of these children have reduced functionality of the hand that may be supplemented with the use of a prosthetic device. Although beneficial, these devices may be quickly outgrown by a child and require a significant financial investment of the family. The Helping Hand Project (HHP) is a non-profit organization which provides upper limb prosthetic devices to children, free of cost, using 3D printing technology. A first-year graduate level studio in industrial design partnered with HHP to help these children meet their goals. This article presents a case study following the experiences of the industrial design students and their journey of designing prosthetic devices for children.

The general design methodology used for the project was as follows:

Design Process

	identify opportunities		develop concepts	
Phase	DISCOVER	ENVISION	CREATE	REFINE
Method	Interviews Contextual Inquiry Observations	Mind Mapping User Journeys Sorting Exercises	Prototyping Usability Testing Repeat	Optimization of Best Solution

The discovery portion of the process promotes empathetic understanding of stakeholder needs. The envision phase enables synthesis of the primary and secondary source data obtained in the discovery phase which informs the direction of the project. The create phase is characterized by iterative prototyping with increasing levels of fidelity over time. The best solution is optimized in the refinement stage. Each phase of design is flexible enough to allow for iterative development in pursuit of the right solutions to the right problem.

2. Discover Your Perspective

As the class embarked on the research journey, it became evident that students were exploring apt language to describe the project and the children involved with HHP. After the initial project kickoff, which included the current president of the Helping Hands Project and some engineering student members, each design student was recorded describing an overview of the scope of the studio project. Initial terminology utilized included terms such as 'disabled kids' or 'kids without hands'.

Through awareness of language, the studio began to consciously critique chosen terminology used to communicate. The studio was introduced to people-first language. This facilitated discussions that people with disabilities are everyday people. And if that person is a child, they may have the same goals and desires as other children their age. People-first language helps eliminate stereotypes and generalizations associated with disabilities by focusing on the person first and foremost.

Very quickly, students referred to the children simply as 'kids' or 'children', with no clarifier. In situations where they needed to differentiate the particular children population they utilized terms such as 'child with a limb difference'.

3. Primary and Secondary Empathy

Through secondary source research such as literature reviews and patent searches, the students set out to understand the current body of knowledge on prosthetics. Beyond the standard market analysis, peer-reviewed articles and patent searches, student research teams analyzed blogs, YouTube videos, and Facebook groups in an attempt to better understand the attitudes and challenges of the children and parents. Students realized through this research that there were many complicated opinions about the benefits of prosthetics in general. Many of the students came into this project with the assumption that a prosthetic is a necessary aid for anyone with an upper limb difference, but discovered that there are many who refuse to use prosthetics at all. This could be because of limited comfort or functionality of the prosthetic, but was often an expression of independence and acceptance of their difference. This insight helped students move away from the idea that they were fixing a problem, and embrace the idea that the device was only a tool, and may not be serving an immediately visible need.

During primary source research, students conducted interviews and observations of current HHP prostheses with the intention of seeing how children utilize their current prosthetic device in their home environment. In addition to the benefit of seeing children play in

their 'native' environment, the students also began to observe the implications of not taking into consideration inclusive aspects of design. They were able to identify 'work-arounds' that children and their families have developed, when products were not able to satisfy their needs.

A general observation that emerged almost immediately after the studio began research was the high level of ability and confidence these children have. They involve themselves in any and every activity they choose. Whether it is a day-to-day activity like wearing shoes or a specific interest like playing a sport or a musical instrument, they are capable of figuring out a way to go about these activities. In some cases, their body adapts and they manage to do these activities by altering the technique involved. Students saw blogs talking about techniques to tie a shoelace with one fully functional limb and even saw one of the children interviewed demonstrated how he does it. Their fully functional limb tends to adapt and compensate, while the affected limb may be used to assist the fully functional limb. In some cases, the children and families design their own tools as workarounds. One family had designed a workaround guitar playing tool for the child using an allen wrench, duct tape and a guitar pick. The size of the children's dreams is not inhibited by disability. Some of these children are interested in design and some have already designed prosthetic limbs for different activities.

The children interviewed by students expressed various needs and wants for a prosthetic device based on their personalities and interests. The children often viewed their desired prosthetic device

as an opportunity to achieve very specific things. Overarching themes were identified such as prosthetics as tools (returning function to increase independence), prosthetics as a communicator of identity (using them as personal expressions), and impression management (a social icebreaker and a cool object to share with friends).

4. Play as a Communication Tool

The students were quite comfortable conducting interviews, however when asked about interviewing children, they demonstrated less confidence. It is already challenging to conduct interviews with adults who are able to articulate their needs and emotions and who have enough self-control to engage in conversation for an hour. With children, the challenge is greater. Depending on the age, children may or may not be able to fully verbally articulate their needs or desires. They may not be accustomed to being 'interviewees' and depending on how the interview is structured, they may not be interested in participating at all.

As traditional interview tactics quickly proved ineffective, play subsequently emerged as the common ground between the designers and the children. Through physical activities such as kicking a soccer ball, running around, as well as more quiet activities such as drawing and building structures with blocks, the designers were able to observe how the children interacted with their environment. Once asked by the designers to demonstrate how they do a certain play activity or to do a certain play activity with them, the children were usually more comfortable, cheerfully willing to

give the designers a tour of a fun aspect of their everyday lives. They were not reticent of their limb difference and conducted activities with confidence. Play also allowed for more fluid conversations between the students and the children. There were no worries of awkward pauses that sometime happen between interview questions, since there was the continuous participation by the children and designers in the activities.

Using play as a communication tool also gave students insights that might never have come out through standard interview techniques. One student research team was playing with a particularly quiet child whose mother suggested that he show them his "bed trick". The child proceeded to climb up his parents' headboard and do a back flip onto the bed. This trick, besides getting the child more involved and excited about the interview, showed the students how much functionality the child had in his differently-abled hand. Students realized that giving this child a device that obstructed this hand would actually limit, rather than enhance, his ability. This led them to ask the parents more targeted questions about expectations for the device, and eventually revealed that what they really wanted was a tool to help the child introduce his limb difference to others. Through empathetic research, students were able to drop their assumptions and dig to find the actual needs of the children. The NOT-Hand Solutions

The students started with truly understanding how children are utilizing the 3D printed hands provided by HHP. They were able to identify relevant insights regarding how and why they are being used. These informed the subsequent designs, some of which were not hand-like at all, but instead focused on the true needs of the

users. The class presented to HHP along the way for feedback and advice. The students attended an HHP family gathering to share prototypes with the children and their families and gain additional feedback. The resulting design solutions ranged from a website that streamlines the flow of information between HHP and families requesting a prosthetic device to modular attachments that remedy dexterity issues. Helping Hand Project gained a number of concepts, some of which could be immediately implemented into their offerings. Students were able to refine their design process and increase their aptitude for inclusive design.

Figure 1. Students participating in a Helping Hand Family Get Together, sharing early stage concepts and prototypes.

Figure 2. Student getting feedback on social ice breaker hand design concepts. Photos courtesy of Will Reuther.

5. Student Reflections

"Looking back at our project research and solutions created by our studio class, it seems to make sense to work to develop a large variety of solutions for the population of these children. Every child has different needs. Not only are there physical differences between each cases of limb difference, but children tend to cope and perceive their limb difference individually too. While one child may want a prosthetic which acts as a social buffer as they interact with people around them, another may want a prosthetic which works as tool, allowing them to do a certain activity. While some children may want to wear the prosthetic all day, some may only want to wear it only from time to time. In this light, it is great to see organizations like HHP taking efforts to design customized prosthetics for each child and take on each child's case with individual attention.

As designers, this kind of a project is interesting in the sense that we may have the opportunity to design for a single person as a user (the way it is practiced by HHP). This is in contrast to when we design for 'user groups'. Such a project may be an opportunity to conduct a deep inquiry into the needs of our user and develop a solution tailored to them. This does not mean that the solution wouldn't benefit other people or serve an iteration which may lead to solutions for them. More so, it is a starting place for other children to begin their prosthetic device explorations."
-Raunak Mahtani

"I found working on this project very enriching in the way that it allowed me to lose tightness as a designer. Having worked on

industrial design related projects for a little while previous to this project, I was freshly opinionated, had some levels of rigidity with my thinking and my process, and some (if I may use the term here) 'ego' attached. I found it much easier to let go of these and try things out because of the importance and purity of the cause. When the needs and happiness of these little kids is what we're aiming for, it's so much easier to lose our biases.

One of the greatest lessons I learned through this project was to abandon my assumptions about what the user needs are. If we had completed this project without all of the initial research, the results would not have solved for any of the true user needs. I would never have imagined that children needed a tool for explaining their limb difference to other children. It would never have occured to me that some prosthetics might actually limit what a child can do. I assumed that we were designing a device to mimic a fully functional hand, but came to understand that the needs and desires of these children were infinitely more complex, and not always related to physical limitations."

-Shelby Forrest

The studio was introduced to a vibrant community of people involved in the Helping Hand Project. Thanks to HHP, students engaged with children and families, designers and engineers working on solutions from different approaches and experts volunteering to share their knowledge and time. Students were also introduced to a vast network of people online. There are families and children sharing their experiences via blogs and videos. There are institutions providing occupational therapy services for the children. There are open-source design databases for prosthetic hands of various types

and networks of 3D printing services helping print these hands. Apart from the direct work done by the elements of this vast community, there is a strong positive energy being shared and amplified by this group.

Please visit Helping Hand Project to find out more about their great work and join the open source network, Enable, supporting prosthetic devices for children.

http://www.helpinghandproject.org/

http://enablingthefuture.org/get-involved/

Byungsoo Kim *is a Ph.D. in Design student at North Carolina State University, College of Design and works as a research assistant at the Research in Ergonomics and Design Lab. Byungsoo has several years of working experience as a design researcher and a designer in Republic of Korea and interned at JLG and General Motors in the U.S. He won domestic and international design awards including Reddot Design Award, iF Universal Design Award, GM Interactive Design Competition.Byungsoo's research interest resides in universal design, ergonomics and user experience design.*

Dr. Sharon Joines, professor of industrial design at NCSU, is a researcher and ergonomist, teaching studios and courses in human centered design, ergonomics, design methods, and interdisciplinary solution development. Her interests reside in co-creation, universal design, and applied product and process research. Her research focuses on quantifying the interaction between individuals with diverse abilities, products and their environment. Sharon works with engineers, designers and user experts in all phases of the design cycle. The challenges addressed traversed consumer markets, warehousing and distribution, medical and military applications, and manufacturing environments ranging from forging to clean rooms.

Dr. Joines was named a University Faculty Scholar in recognition of significant achievements in scholarship, teaching and/or service. Recent recognition of her work includes:

2016 Outstanding Graduate Faculty Mentor Award in the area of the Humanities and Design

2016-2017 Alumni Association Outstanding Research Award

2017 Member of NC State's Academy of Outstanding Faculty Mentors

2017 Member of NC State's Research Leadership Academy

Sharon is director of the Research in Ergonomics and Design (RED) Lab and a member of IDSA, the Human Factors and Ergonomics Society, the Design Research Society, the Order of Thirty and Three, and Alpha Pi Mu. Sharon received her BS, MS, and PhD degrees in Industrial Engineering from North Carolina State University.

In addition to providing a solid understanding of the strengths and limitations of the human, one of Joines's teaching goals is helping students understand how to evaluate product solutions as they develop them. In courses she has developed, students are exposed to formal and informal assessment methods using quantitative and qualitative methods focusing on user experience, ergonomics and human factors. Product development cycles have been shortened by rapid prototyping, agile manufacturing methods and interdisciplinary teams. Thus, she address the designers' evaluation of product performance during the development process resulting in better product solutions highlighting this as a highly valued skill in the field. In addition to opportunities in the traditional studio and classroom environments, her mentoring and project work has allowed 9 PhD, 39 masters and 5 undergraduate students to have had hands-on experiences with design research by working on projects in the RED lab.

Universal Design for unfamiliar environments

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Abstract— **Individuals with disabilities are one of the main user groups considered to be included to accomplish the concept of Universal Design in products and environments. 'Disabilities' is defined as permanent disability and temporary disability and temporary disability is mainly discussed in this paper. To be more specific, 'Individuals situated in unfamiliar environment' is discussed to be considered as one type of 'temporary disabilities'. Because sharing economy, one of the current and upcoming trends, often situate people in the unfamiliar environment. A case study, 'usability study to improve interaction design for drivers in car-sharing system', is introduced as an example of designing for individuals in unfamiliar environment.**

Index Terms—*Universal Design, definition of disabilities, temporary disability, car interaction design, and sharing economy*

4. Universal Design and Individuals with Disabilities

Universal design is a paradigm of designing products and environments that are easily accessible for all including individuals who are not often considered in 'conventional ergonomics'[1].

Individuals with disabilities are frequently mentioned to be included as one of main user groups to accomplish the concept of Universal Design. Hence, it is important to understand the definition of individuals with disabilities and who is considered as individuals with disabilities to apply Universal Design principles in products and environments. The ADA defines people with a 'disability' as 'a person who has a physical or mental impairment that substantially limits one or more major life activity'[2]. The definition of 'people with disabilities' also includes 'individuals who have a record of an impairment, even if they do not currently have a disability'[3]. The second definition implies that there are two different types of disabilities, individuals with 'permanent disability' and with 'temporary disability.' The detail of the two types is introduced in following sections.

According to Census Bureau Reports and the world bank, one billion people 'experience some form of disability' in the world and one in five people has disabilities in the USA in 2012. Also, older adults over 65 in general can be considered as people with disabilities because individuals identify themselves as 'disabled' as they grew older and experience decreased health [4]. Because baby boomers born in 1946-1964 started turning into 65 from 2011, the population over 65 will be dramatically increased in next few years [5]. Also, because there has been noticeable increased in elderly care market segment [6], the inclusion of older adults as one of main target users of designing products and the environment becomes more important than past.

Because of these large population of individuals with different disabilities, the companies and organizations applying Universal Design principles in design process for their new product and

environment development can include larger number of users [7] which can lead them to make a larger amount of revenue than other competitors who does not include these population.

5. Permanent Disability

The definition of permanent disability is 'an injury which impairs the physical and/or mental ability of a person to perform his/her normal work or non-occupational activities supposedly for the remainder of his/her life' [8]. This definition is close to 'acquired disability', which is 'a disability that has developed during the person's lifetime – that is as a result of an accident or illness.' The opposite term of acquired disability is 'congenital disability.' Congenital disability is 'a disability that the person was born with' [9].

6. Temporary disability

US Americans with Disabilities Act (ADA) defines temporary disability as 'a physical or mental disability which hampers individual's discharging of responsibilities for a short period of time' [10]. A temporary disability can be caused by not only physical injury but also by different circumstances, such as pregnancy and way-finding in foreign countries. Pregnancy is one of the most well-known temporary disabilities and there are numerous well-designed products and environments to include pregnant women as one of user groups, such as assigning a certain portion of parking lots and bus seats priority for pregnant women. Way-finding in foreign countries is also considered as temporary disability not only because of the unfamiliar environment but also because of the language barrier. There are a number of way-finding system design guidelines

including the suggestions based on the concept of Universal Design, such as the 'sign system should include foreign languages and should use universally readable fonts with consistent layout' [11].

While there are a number of examples easily found suggesting possible solutions to include individuals with temporary disabilities regarding pregnancy women and way-finding in foreign countries, there are still certain circumstance that situates people temporarily having disabilities yet do not have possible solutions or suggestions. For instance, people often encounter 'unfamiliar environments 'and they cannot fully show their ability compared to when they are in a familiar environment. The importance of recognizing the effect of an 'unfamiliar environment' to individual's capacity becomes important because of growing 'sharing economy'. The sharing economy is a service or system that people can access what they need by paying for accessing the experience to fulfill their needs instead of buying and owning products and environments[12]. The sharing economy is expected to rapidly grow from $14 billion in 2014 to $335 billion by 2025 [13]. Examples of applying the concept of sharing economy include Airbnb, Zipcar and Uber. Sometimes an unpleasant user experience that individuals endures while using such a service can be bearable because even though users cannot fully access the full utility in an unfamiliar environment, such as a stranger's house or apt, the experience does not threat the user's safety. This is because people may have previous experience staying in unfamiliar places, such as staying at a hotel or friend's house; they are accustomed to not fully accessing utilities in such unfamiliar places. However, there are different type of services that decreases individual's capacity which directly relates to safety. For instance, for Zipcar users, the unfamiliar environment sometimes creates more than simply limit

accessing to control certain functions. Because Zipcar users drive an unfamiliar car for a short amount of time, such as an hour, they might decide to start driving without having enough familiarization time with unfamiliar controls. Since the distraction from unfamiliar driving environment can cause serious safety problem [14], such as car accidents, people with 'unfamiliar environment' in car sharing situation is vital to be considered as one type of 'temporary disability' and the situation needs to be improved by applying the concept of Universal Design.

7. Case Study

A case study, 'usability study to improve interaction design for drivers in car-sharing system', investigates the car interaction design for Zipcar users. It is a suitable example of showing the importance of designing products for individuals in unfamiliar environment because the purpose of the case study is to understand the difficulty of interacting with secondary controls (*e.g.* the control for audio and temperature system) while driving an unfamiliar car, such as Zipcar car. The scope of the case study is the secondary controls because each car companies uses different interaction type (*e.g.* knob or button type) and/or location even for the same function for the secondary controls whereas almost every car company use the same interaction type and location for primary controls (e.g. an accelerator or brake pedal). The case study not only suggest the suitable location and the interaction type for the most frequently used secondary controls in car sharing context, but also introducing the methodology to conduct a usability test to evaluate the safety and ease of use for the secondary controls while driving a car. The case study is valuable because this is one of the first studies investigating the difficulty that

individuals experience while driving unfamiliar vehicles in car sharing context and suggesting possible solutions. Even though the case study has not explicitly mentioned applying the Universal Design principle, most of the recommendations and suggestions are based on the concept of Universal Design. The case study has been recently accepted to be published with minor modifications in Journal of Usability Studies and expected to be available in 2018.

8. Discussion

The case study introduced in this paper is an extreme case of addressing the lack of capability when individuals are in the 'unfamiliar environment' because drivers cannot fully focus on controlling the secondary functions while driving even in their own cars and even small distraction caused by the lack of capability in unfamiliar car can directly lead to serious car accident. In other words, other services and systems following sharing economy trends would not be as closely related to user's safety as car sharing context. However, as sharing economy keeps growing, there is always a possibility that other business models in sharing trend would create other 'unfamiliar environments' that treats not only usability but also safety. Because of the reason, designers and design researchers should consider individuals with 'unfamiliar environment' as 'temporary disability' when developing objects and environment following sharing economy trend by applying the concept of Universal Design to improve safety and usability of the services and the systems.

9. Bibliography

[1] R. Bradley, "Evidence Based Practice in Search," Search, pp. 728–732, 2008.

[2] "A Guide to Disability Rights Laws." [Online]. Available: https://www.ada.gov/cguide.htm. [Accessed: 09-Dec-2017].

[3] "What is the definition of disability under the ADA? | ADA National Network." [Online]. Available: https://adata.org/faq/what-definition-disability-under-ada. [Accessed: 09-Dec-2017].

[4] T. Mcmahon, P. C. M. Van Zijl, and A. A. Gilad, "When Do Older Adults Become 'Disabled'? Social and Health Antecedents of Perceived Disability in a Panel Study of the Oldest Old," vol. 27, no. 3, pp. 320–331, 2015.

[5] A. P. Rahrer, "Designining and Creating the Oregon State Age and Disability Simulation Suit," Oregon State University, 2013.

[6] B. Kim, H. Liu, and S. Joines, "Designing for Empathy," IDSA Educ. Symp. Seattle, 2015.

[7] S. Joines, "Enhancing quality of life through Universal Design.," NeuroRehabilitation, vol. 25, no. 4, pp. 313–326, 2009.

[8] "Permanent disability legal definition of permanent disability." [Online]. Available: https://legal-dictionary.thefreedictionary.com/Permanent+disability. [Accessed: 09-Dec-2017].

[9] "Acquired Disabilities." [Online]. Available: http://www.employerdisabilityinfo.ie/advice-and-information/what-is-disability/acquired-disabilities. [Accessed: 09-Dec-2017].

[10] "Temporary Disability Law and Legal Definition | USLegal, Inc." [Online]. Available: https://definitions.uslegal.com/t/temporary-disability/. [Accessed: 09-Dec-2017].

[11] "Gyeonggi-Do Public Signage System Design Guideline." [Online]. Available: https://design.gjcity.go.kr/filedown2.jsp?name=public

information design guideline.pdf. [Accessed: 10-Dec-2017].

[12]F. Bardhi and G. M. Eckhardt, "Access-Based Consumption: The Case of Car Sharing," J. Consum. Res., vol. 39, no. December, 2012.

[13]N. Yaraghi and S. Ravi, "The current and future state of the sharing economy," Brookings India, no. December 2016, pp. 1– 27, 2017.

[14]D. L. Strayer, J. M. Watson, and F. a. Drews, Cognitive Distraction While Multitasking in the Automobile, 1st ed., vol. 54, no. 2010. Elsevier Inc., 2011.
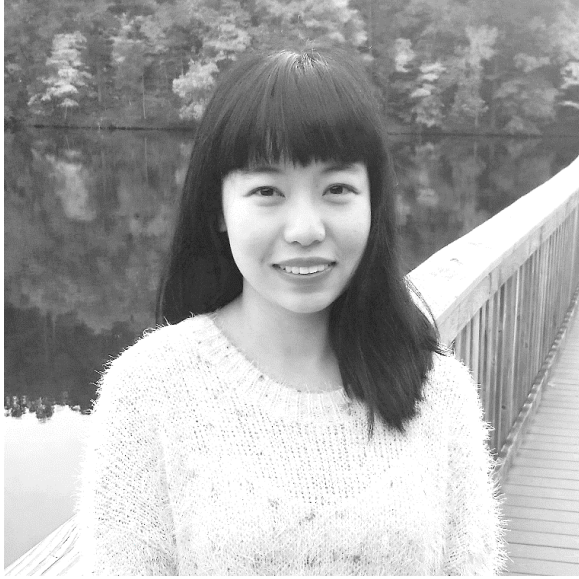
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Universal Design, Inclusive Design, and Intergenerational Design: Where Does My Research Fit?

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Abstract—Universal design, inclusive design, and intergenerational design are all different names of concepts and approaches that primarily focus on increasing the accessibility and usability of the products, systems, services, and built environment for the broadrange of use. However, in what way do all these concepts differ andin what way do all these concepts unify? Based on the definitions, all three concepts have very similar goal in terms of considering the user as a high priority. However, there is little consensus regarding the use of these concepts, and consequently, there is a risk of bringing less accessibility and usability to the user if the approach associated with the concept has been usedunsuitably.

Index Terms—*Universal Design, Inclusive Design, Intergeneration Design, Design for Older Adults*

10. Introduction

The population of the world is aging. Between 2012 and 2050, the US will experience considerable growth in its older population (aged 65 and over). In 2050, the older population is expected to be 83.7 million, almost double its estimated population of 43.1 million in 2012 [1]. As people age, their abilities change, including declines in the cognitive, physical, and sensory functions, each of which declines at different rates. The needs of these growing groups are significant, raising significant concerns about how products, systems, services, and built environment will address the daily needs and activities of an aging population.

The increasing awareness of these groups and their needs have attracted the interest of designers and researchers to enable them to obtain an increased usability regarding support for performing everyday tasks. For instance, as technology is perceived to be more difficult to learn, especially for older adults, the decision to attempt learning a new technology becomes more difficult. As a consequence, it is important to explore the intersection of this challenge and opportunity. The author's area of interests is to investigate and examine the factors in new technology that can influence the learning process among older adults. To investigate the barriers that older adults have and explore the interventions that can improve the issue, designers and researchers need to consider older adults' capability, limitation, as well as their diversity, such as older adults with different levels of new technology expertise. Several terms, such as universal design, inclusive design and intergenerational design, have emerged in recent years that describe similar though somewhat different design concepts which support the idea of

considering user diversity, user capability, and limitation during the design process.

The following sections will briefly compare and contrast the concept and approach of universal design, inclusive design, and intergenerational design. Meanwhile, the article will go through various design research studies where the approaches align with those design concepts were used in the context of designing for people with limitations, such as older adults and people with disabilities. Finally, the article will discuss how these design approaches may apply to the design process of interaction design of new technology for older adults.

11. Universal design

Universal design is a design term which came up by Ronald L. Mace, a highly influential architect, product designer, and educator. As he mentioned, the term universal design is a concept of designing products and environments for "the needs of people, regardless of their age, ability or status in life [2]". This term is mostly used in the US and Japan. Universal design is defined as "the design of products and environmentsusable by all people to the greatest extent possible, without the need for adaptation or specialized design [3]".

Universal design is a user-centered approach. Its emphasis on considering the needs, wants, and limitations of end users during the design process [4]. In terms of design for "all people," it is necessary to take a broader range of people as target users into account in the design process. To achieve this goal, it needs to ensure that a wide range of users, including older adults and people with disabilities, can use the majority of products and environments. According to

more research, the term universal design can be used interchangeably with the term design for all [5].

One of the most frequently cited explanations of this term is the "seven principles of universal design" (TABLE 1). According to the Center for Universal Design in NCSU, these principles "may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments [3]". There are lots of products and environments in our daily life which attempted to design according to these principles. For example, a museum that allows visitors to choose to listen to or read descriptions. This design feature adopted the Principle 2: Flexibility in Use. Another example, when designing the door handles, use the lever handles for opening doors rather than twisting knobs. This design feature adopted the Principle 6: Low Physical Effort.

TABLE 1. Seven Principles of Universal Design [6]

Principle	Explanation
Principle 1: Equitable Use	The design is useful and marketable to people with diverse abilities.
Principle 2: Flexibility in Use	The design accommodates a wide range of individual preferences and abilities.
Principle 3: Simple and Intuitive Use	Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
Principle 4: Perceptible Information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the

	user's sensory abilities.
Principle 5: Tolerance for Error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
Principle 6: Low Physical Effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
Principle 7: Size and Space for Approach and Use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Designers might think that the primary goal of design for all people is to remove the barriers from the process of their user journey. However, to just remove the barrier is not enough. Mace once argued that "what can be barrier-free for one person can be a barrier for someone else" [6]. When designers think about designing *for* older adults, especially in the context of new technology design, one of the common issues that come out with this consideration is the older adults' attitude toward the concept of design *for* them. Considering age differences in new technology use performance and the potential benefits of new technology use, it seems fair to say that without using a proper approach to address the problem, the ideation or the design solution might incapacitate people and make them feel older and outdated regardless of their age. In that case, universal design approach has solved many real-world problems in terms of benefit "all people" but still without compromising their feelings. The study suggests that applying the universal design approach into interactive devices design could contribute to maintaining independent living

and societal integration for older adults [7]. Another study shows that working in a universal design manner for communities and transportation systems design could address the safety and mobility needs of older adults as well as make other people in the environment remain comfortably able to accommodate [8].

12. Inclusive design

Besides the concept of universal design, other researchers have also examined how the needs of older adults and people with disability could be included in the design process. Inclusive design is one of them. This term is mostly used in the UK. There are a couple of different definitions of inclusive design. The inclusive design was defined as "the design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible on a global basis, in a wide variety of situations and to the greatest extent possible without the need for special adaptation or specialized design" [9].Based on the definition given by the "inclusive design research center," inclusive design has been defined as "design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference" [10]. In addition, inclusive design has also been defined by the UK Department of Trade and Industry (DTI) as a business goal where "designer ensure that their products and services address the needs of the widest possible audience" [4].

Compare this definition with the definition of universal design, two design terms are very similar. Based on the literature, universal design can sometimes be used as a synonym for inclusive design [11]. However, from the definition, it is also noticeable that these two design terms are different. First, the phrase "as many people as

reasonably possible" in the definition of inclusive design shows one of the main differences. "As many people as reasonably possible" means that the inclusion of older adults or people with disabilities has certain requirements. On that note, the use of the term "inclusive" rather than "universal" reflects the view that "inclusivity" is a more achievable, and in many situations, appropriate goal than universal design or design for all. If we refer all people of all ages and capabilities as the whole population, then the wholepopulation represents the maximum number of people who can be included and use the products or services. However, law, safety consideration, and lack of capability can prevent people to be included to use the products or services [4]. People can be excluded if considered too difficult to achieve in the design process [2]. The population who can use the products or services under the ideal condition is referred as ideal population.

Moreover, the population will be changed based on how the requirements develop. This populationis referred as negotiable maximum population. The range of the population is dependent upon the choices of company management. As the design process going on, the population who can actually use the product or service is referred as included population.

Another difference between two terms is that they focused on the different place of the design cycle. Universal designfocuses on modifying mainstream products [12]. It indicates that the universal design concept towards the end of the design cycle. For example, a study has shown that incorporating universal design principles in the design plan for the Digital Accessible Information System (DAISY) player interface prototype can help with analyzing the critical elements of the existing DAISY players as well as constructing a new

prototype [13]. However, inclusive design is more than just a fixed set of design criteria and principles [14]. Unlike the scale rating for the universal principals [13], the measures of success for inclusive design can be conducted by using inclusive merit (i.e., Inclusive merit of ideal product = (ideal population/whole population) x 100% [4]). The concept of inclusive design is mainly focusing on the design process by highlighting the design exclusion and population capability.

13. Intergenerational design

Intergenerational design is the design of products which promote greater understanding and respect between generations. It aims to bring "children, youth, and older adults interact together", and requires designers consider the specific needs of the young as well as for the old adults and "involving them in the design process" [15]. Many intergenerational design projects introduce participatory design approach as their main approach to involve users or multiple stakeholders (e.g., children, youth, and older adults). In that case, feedbacks from users in the design process allow a larger, deeper, and more frequent conversations from the earliest to the final stages in the process.Most of intergenerational design projects conducted participatory design approach by inviting multiple users as a part of "co-designers" (e.g., grandparents and grandchildren). Studies have shown that the with multiple stakeholder groups involving, the design process can be benefited by enhancing the participation and facilitating the information exchange [16][17][18].

During the intergenerational design process, designers or researchers invite different stakeholders of the design project to become partners in the development process, and respect their skills

and consider them as co-designers or co-creators. Unlike the user-centered approach where designers focus on the users but still maintain primary control over the design process, the intergenerational design with participatory design approach involved positions designers alongside users so that design is a collaborative process [19]. This shift from user-centered approach to participatory approach has changed the roles of designers, researchers, and users in the design process. As for the former, users are considered only as a target of the design process, who can benefit from the product or service. As for later, users reach the position of "expert in their experience"[20] and plays an important and active role in extending knowledge, idea generation, and concept development during the design process [21]. Moreover, this shift can be considered as one of the most significant differences between universal design concept and intergenerational design concept in terms of their real-world application.

Social interaction is an important motivation for technology use by the older adults. By adding the intergenerational aspect to the design process, intergenerational interaction can reduce the prevalence of ageism, and significantly help improve the mental and physical health among older adults[18]. Many studies have focused on families and homes as the environments for theintegrational design [16][18][23][24][25]. They mostly focused on family relationships, such as the (grand) parent and (grand) child relation. By using the participatory design approach underlying the intergenerational design concept, it helped design participants from different, and sometimes conflicting, perspectives to achieve to a shared understanding of patterns of interaction between different

generations and to come to a common view about the design of appropriate environments.

However, there are still some concerns that emerge while inviting the participatory design approach into the design process. For example, when it comes to past behavior investigation, the user typically moves away from the truth [22]. When reporting their experiences, the user is actually telling what he remembers having done. Because human memory is unreliable, the user typically rationalizes behavior and emotions, justifying failures with statements that may be merely hypothetical. Due to the capability limitations (e.g., memory) among older adults, when involving them in the participatory design process, it may lead to unnecessarily complicated results. From the perspective of designing for new technology, the challenge may be due to the older people's lack of confidence (e.g., they feel less confidence for things they don't use before) to learn the interfaces of new technology, or knowledge (e.g., they don't have a mental model for a certain type of new technology) to conceptualize design concepts.

14. Conclusion

Universal design, inclusive design, and intergenerational design can all be associated with design for older adults. However, as users, older adults play different roles in these design processes, and the interaction between designers and older adults are varied. In universal design concept, older adults will benefit from the design deliverable because their needs and limitations need to be considered by the designers during the design process. In inclusive design concept, older adults will only be included in the design process after designers define the level of inclusivity based on

stipulated requirements during the design process. In the intergenerational design concept, older adults will be co-designing with others and will be part of the end-users along with younger generation. Regarding to the research topic of interaction design and older adults' learning process, depends on the nature of the problem or the barriers of the target users (e.g., older adults with different levels of new technology expertise), designers can choose the appropriate concept to invite into the design process.

15. References

[8]   [1]   J. M. Ortman, V. A. Velkoff, and H. Hogan, "An aging nation: the older population in the United States," United States Census Bureau, Economics and Statistics Administration, US Department of Commerce, pp. 25–1140, 2014.

[9]   [2]   R. Mace, G. Hardie, and J. Place, "Accessible environments: Toward universal design." [Online]. Available: https://www.ncsu.edu/ncsu/design/cud/pubs_p/pud.htm [Accessed: 10-Dec-2017].

[10] [3] "What is universal design?: Provoking thought, discussion, argument, creativity, and consideration of universal design." [Online]. Available: http://www2.lib.ncsu.edu/catalog/record/NCSU3121773 [Accessed: 10-Dec-2017].

[11] [4]   S. Keates and J. Clarkson, Countering design exclusion: an introduction to inclusive design, Springer, London, 2003.

[12] [5]   C. Stephanidis, "User Interfaces for All: New perspectives into Human-Computer Interaction,"User Interfaces for All-Concepts, Methods, and Tools, pp. 3-17, 2001.

[13] [6]   B. Connel, M. Jones, R. Mace, J. Mueller, A. Mullick, E, Ostroff, J. Sanford, E. Steinfeld, M. Story, and G. Vanderheiden, "The Principles of Universal Design," [Online]. Available: https://projects.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm[Accessed: 10-Dec-2017].

[14] [7]   M. Sengpiel, "Supporting older adults technology use through universal design and instruction.," International Conference "Aging and Cognition" 2010 Dortmund Germany, vol. 25, p. 27, 2011.

[15] [8]   E. Dumbaugh, "Designing Communities to Enhance the A Universal Approach," Journal of Planni, vol. 23, no. 1, pp. 17–36, 2008.

[16] [9]   H. Persson, H. Åhman, A. A. Yngling, and J. Gulliksen, "Universal design, inclusive design, accessible design, design for all: different concepts---one goal? On the concept of accessibility---historical, methodological and philosophical aspects," Universal Access in the Information Society, vol. 14, no. 4, pp. 505–526, 2015.

[17] [10] "What is Inclusive Design." [Online]. Avaiable: http://idrc.ocadu.ca/index.php/about-the-idrc/49-resources/online-resources/articles-and-papers/443-whatisinclusivedesign [Accessed: 10-Dec-2017].

[18] [11] I. Gonzalez and P. Morer. "Ergonomics for the inclusion of older workers in the knowledge workforce and a guidance tool for designers," Applied ergonomics, vol. 53, pp. 131-142, 2016

[19] [12] A. F. Newell, P. Gregor, M. Morgan, G. Pullin, and C. Macaulay, "User-Sensitive Inclusive Design," Universal Access in the Information Society, vol. 10, no. 3, pp. 235–243, 2011.

[20] [13] P. Huang and M. Chiu, "Integrating user centered design, universal design and goal, operation, method and selection rules to improve the usability of DAISY player for persons with visual impairments," Applied Ergonomics, vol. 52, pp. 29-42, 2016.

[21] [14] S. Keates and P. Clarkson, "Countering design exclusion through inclusive design," Paper presented at the ACM SIGCAPH Computers and the Physically Handicapped, no. 73-74, pp 69-76, 2003.

[22] [15] "A Guide to Intergenerational Practice." [Online]. Available: from http://www.ageingwellinwales.com/Libraries/Documents/Guide -to-Intergenerational-Practice.pdf [Accessed: 10-Dec-2017].

[23] [16] S. Pedell, F. Vetere, T. Miller, S. Howard, and L. Sterling, "Tools for participation: Intergenerational technology design for the home," International Journal of Design, vol. 8, no. 2, pp. 1–14, 2014.

[24] [17]J. Derboven, M. Van Gils, and D. De Grooff, "Designing for collaboration: a study in intergenerational social game design," Universal Access in the Information Society, vol. 11, no. 1, pp. 57-65, 2012.

[25] [18] M. Rice, Y. Cheong, J. Ng, P. Chua, and Y. Theng, "Co-creating games through intergenerational design workshops," Paper presented at the Proceedings of the Designing Interactive Systems Conference, pp. 368-377, 2012.

[26] [19] E. Sanders and P. Stappers, "Co-creation and the new landscapes of design," Co-design, vol. 4, no. 1, pp. 5-18, 2008.

[27] [20] F. Visser, P. Stappers, R. Van der Lugt, and E. Sanders, "Contextmapping: experiences from practice," Co-Design, vol. 1, no. 2, pp. 119-149, 2005.

[28] [21] D. Szebeko and L. Tan, "Co-designing for Society," Australasian Medical Journal, vol. 3, no. 9, pp. 580-590, 2010.

[29] [22] J. Nielsen, "First Rule of Usability? Don't Listen to Users." [Online]. Available: https://www.nngroup.com/articles/first-rule-of-usability-dont-listen-to-users/ [Accessed: 10-Dec-2017].

[30] [23] E. Khoo, T. Merritt, and A. Cheok, "Designing physical and social intergenerational family entertainment,"Interacting with computers, vol. 21, no. 1, pp. 76-87, 2009.

[31] [24] F. Vetere, H. Davis, M. Gibbs, and S. Howard, "The Magic Box and Collage: Responding to the challenge of distributed intergenerational play," International Journal of Human-Computer Studies, vol. 67, no. 2, pp. 165-178, 2009.

[32] [25] I. Digital and G. A. Systematic, "Benefits and Factors Influencing the Design of Intergenerational Digital Games: A Systematic Literature Review," Societies, vol. 7, no. 3, p. 18, 2017.

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Dr. Joines was named a University Faculty Scholar in recognition of significant achievements in scholarship, teaching and/or service. Recent recognition of her work includes:

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2016-2017 Alumni Association Outstanding Research Award

2017 Member of NC State's Academy of Outstanding Faculty Mentors

2017 Member of NC State's Research Leadership Academy

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In addition to providing a solid understanding of the strengths and limitations of the human, one of Joines's teaching goals is helping students understand how to evaluate product solutions as they develop them. In courses she has developed, students are exposed to formal and informal assessment methods using quantitative and qualitative methods focusing on user experience, ergonomics and human factors. Product development cycles have been shortened by rapid prototyping, agile manufacturing methods and interdisciplinary teams. Thus, she address the designers' evaluation of product performance during the development process resulting in better product solutions highlighting this as a highly valued skill in the field. In addition to opportunities in the traditional studio and classroom environments, her mentoring and project work has allowed 9 PhD, 39 masters and 5 undergraduate students to have had hands-on experiences with design research by working on projects in the RED lab.

'H' Orthotic device. Improving the user experience for infants with hip dysplasia

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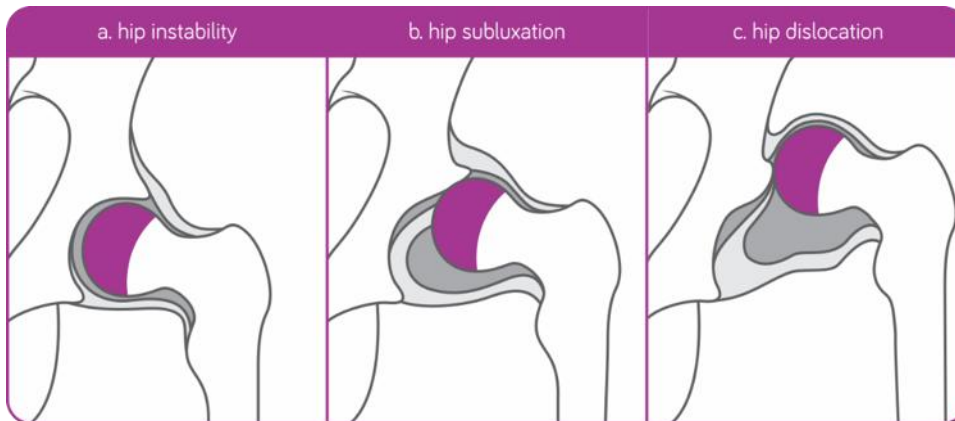
Abstract—Each year over a million infants worldwide are diagnosed with Developmental Dysplasia of the Hip (DDH). Treatment for DDH involves the reduction of the hip and can be achieved by using orthotic devices. These devices (splints and harnesses) were first invented by orthopedic surgeons in the 1950's and have seen little innovation in the past sixty years.

This study informs the design and development process for a new orthotic device that aims to improve the user experience for caregiver/infant dyads during treatment for DDH. By investigating how current orthotic devices effect mother/infant dyads during DDH treatment, it's possible to understand the challenges encountered, how these affect their life, their daily activities, and their interaction with people and their environment. Participants involved in the study are medical practitioners (pediatric orthopedics) and mother/infant dyads currently going through treatment for DDH living the United States and internationally. Research methods include semi-structured interviews and observation sessions of daily activities.

Index Terms— Developmental Dysplasia of the Hip (DDH), hip dislocation, orthotic devices, pediatric orthopedics, Pavlik harness. Universal Design, definition of disabilities, temporary disability, car interaction design, and sharing economy

16. Developmental Dysplasia of the Hip (DDH)

Developmental Dysplasia of the Hip (DDH) refers to the abnormalities in the immature hip joint that can happen before, during or after birth. One percent of all newborns are diagnosed with DDH, hence over a million infants all over the world require treatment each year. DDH patients with reducible hips are treated with orthotic devices to achieve hip reduction.

As seen on Figure 1. Anatomically, the hip is a ball and socket joint held together by a joint capsule formed by ligaments and tendons. The ball, refers to the femoral head of the femur, and the socket to the acetabulum in the pelvis. In DDH patients, capsular laxity can cause hip instability, hip subluxation or complete dislocation of the hip.
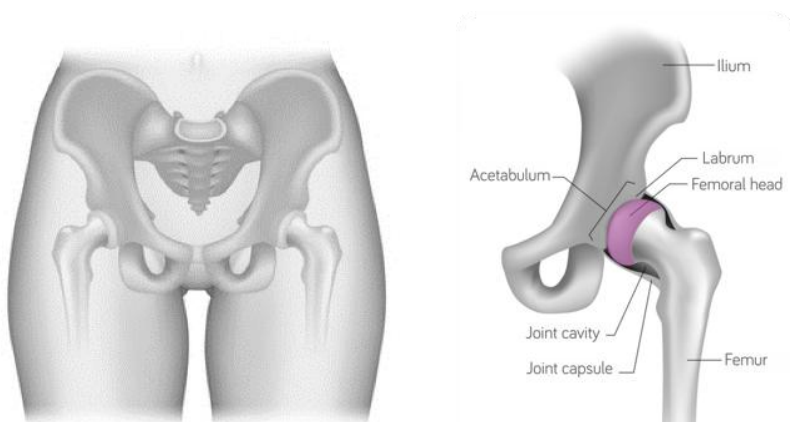
Fig 1. Normal hip anatomy

DDH is the most common orthopedic disorder in newborns with a reported incidence of 1:1000 for cases of hip dislocation and 10:1000 for hip instability or subluxation. Yet, when Ultrasound (US) screening is implemented the incidence can rise to 25:1000- 50:1000[10]. In terms of side effected, eighty percent of DDH patients are diagnosed with unilateral dysplasia (60% left hip, 20% right hip) and only 20% with bilateral dysplasia

To diagnose DDH, infants are screened using two different approaches. Firstly, a routine clinical examination performed to all newborns by a pediatrician (since the 1950's). Next, patients that show signs of DDH from the clinical exam or family history are further assessed with an ultrasound (US) to confirm diagnosis.

Once the diagnose is confirmed, the orthopedic surgeon proceeds to classify each case of DDH and suggest treatment. Several methods have been developed for DDH classification. The most widely accepted is the Graf Method, first described by R. Graf in 1980 [10]. This method combines alpha and beta angles, determining type and subtype accordingly. DDH patients are typically diagnosed with hip instability (Fig. 2, a), hip subluxation (Fig. 2, b), or frank dislocation of the hip (Fig. 2, c). Dislocated hips can be irreducible or reducible. Irreducible hips require surgery.

Fig 2. Developmental Dysplasia of the Hip (DDH) classification

Treatment for DDH involves the reduction of the hip, and can be achieved by surgical or nonsurgical approaches. Surgical treatment (closed and open reduction of the hip) is necessary for infants with irreducible hips or in cases where nonsurgical treatment fails. On the other hand, reducible hips can be treated with the use of nonsurgical treatments that include: casting (Spica cast), traction, or the use of orthotic devices. This study focuses on DDH treatment using orthotic devices (success rates for current orthotic devices found in the literature range from 90 to 100%). Early diagnosis (before six weeks of age) has been documented to decrease treatment time and improve effectiveness [10].

Since the 1950's, various orthotic devices have been invented to treat DDH including: the Frejka pillow (Fig. 3, a), the Pavlik harness (Fig. 3, b), the Von Rosen Splint (Fig 3., c), the Craig Splint (Fig. 3, d), the Denis Browne abduction brace (Fig. 3, e), and the Tübingen hip flexion splint (Fig. 3, f) among others [1] [12][14] [21]. From these devices, the Pavlik harness is the most frequently used to treat patients under six months of age due to its dynamic structure and

reduced indices of avascular necrosis. However, stronger patients tend to overpower it. Consequently, at 9 months of age if hip reduction has not been achieved, infants will be required to switch to an abduction brace (rigid).

Treatment with orthotic devices requires 24/7, 23/7, or naptime and night bracing (~13/7). Infants with very unstable hips will require bracing 24 hours a day (these patients will not be allowed to take the device off). Babies with stable hips require 23/7 treatment, meaning they can take it off for 1 hour a day (normally for bath time and/or diaper changes). To finalize treatment, infants will be recommended to wear the device for ~1month during nap times and while sleeping at night. DDH treatment demands constant professional follow-up and screening. Treatment duration ranges between 6 weeks and 12 months depending on: age when infant was first diagnosed, accurateness of treatment among other conditions. The recommended angles to achieve hip reduction are <90° flexion and 45°-70° of abduction.
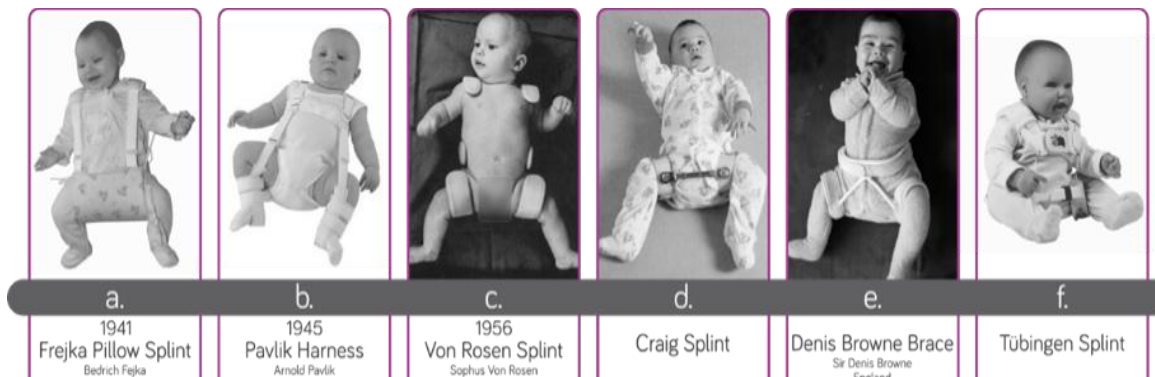
Fig 3. Orthotic Devices for DDH

Although the literature review reports high success rates for DDH treatment with orthotic devices, caregivers and medical practitioners constantly express frustration associated to the use of these splints and harnesses (affecting their daily lives, their interaction with baby gear and daily activities). Therefore, there is an opportunity to develop physical products to improve the user experience for DDH patients and their caregivers while going through treatment.

17. Market Review: DDH Orthotic Devices

DDH patients represent a potential market of 1.3 million infants per year, of which 40,000 are born in the United States.

As seen on figure 4, an inventory of the manufacturers and distributors of these devices was developed to better understand the current market. Each manufacturer was studied individually to determine number and types of products offered. Next, each product was analyzed in terms of: a. price, b. sizes, c. angles of abduction/flexion, d. materials, e. colors, f. features, and g. distribution channels.

The manufacturers studied were: 1. Alimed Inc., 2. Weaton Brace Co., 3. Fillauer, 4. Boston Brace International, 5. Becker orthopedic, 6. Allard USA Inc., 7. Truelife, 8. IsakssonsGummifabrik AB, 9. Orthomerica, and 10. Rhino Pediatric Orthopedic Designs, Inc.

The main insights and takeaways from the Market Review were:

- *Current manufacturers offer one or more of the following orthotic devices: 1. Pavlik Harness, 2. Hip Abduction Brace, and*

3. Von Rosen Splint. It´s relevant to mention that the name and specifications can vary between manufacturers.

- *Although the Von Rosen Splint is widely referenced in the literature, the market review revealed little participation in the US market. From eight manufacturers studied, only two (one in the US and one in Sweden) offered it. The original manufacturer is Swedish, hence 90% of their product is sold in-house.*

- *Prices: The Pavlik harness ranges from $75 to $100 US Dollars; the abduction braces between $150 (for the non-adjustable model) and $190 (for the adjustable model). No price range was found for the Von Rosen Splint.*

- *DDH Orthotic devices are sold exclusively under medical prescription and are typically sold directly to hospitals and clinics. Only two manufacturers were found to sell the Pavlik harness online (they require the prescription to be sent via e-mail).*

- *All the current products offer a range of sizes to encounter infant's growth during treatment. These can vary from 2 to 7 different sizes depending on the manufacturer and type of device (no standardization of sizes). The criteria for classifying these sizes (age, waist circumference, chest bundle range and in fewer cases weight) also varies from one device/manufacturer to another. This lack of standardization can create challenges for doctors when having to switch between brands (manufacturers) or devices (type of orthotic device).*

- *The positioning of the hip recommended in the literature for DDH treatment suggest: >90° flexion and 60°-70° abduction.*

While some of the devices found in the market review meet the standard, others do not.

- *Keeping these devices clean is a critical challenge. For Pavlik harnesses some products are manufactured to be machine washable and dryable, others can be hand washed with light detergents. For abduction braces they promote their products to be easy to clean (supported by their material choice).*

- *In terms of materials: the Pavlik harness uses a soft inner lining made from materials like: Polyether Polyurethane Foam, Nylon Camel, felt, among others, and uses hooks and/or fasteners to buckle and adjust; Abduction braces use: PP Polypropylene lined with closed-cell foam, Plastazote (lightweight, closed-cell, cross-linked polyethylene foam), Synthetic Latex Rubber/Polyethylene and LDPE (Low Density Polyethylene); and lastly the Von Rosen Splint is made from a flexible metal core cut sheet and covered with either natural or synthetic rubber.*

- *Products associated with us of these orthotic devices are: baby clothing designed to fit or better accommodate infants using these devices, as well as part replacements of the device that wear out with use, most commonly the feet pieces in the Pavlik harness.*

- *Fillauer is the manufacturer that offers the greatest variety of orthotic devices for DDH. It is the only one that offers the three types.*

Fig 4. Market Review

18. Participants

Caregiver-infant dyads (Users): Ten (10) Dyads formed by caregivers (mother/father) and infants (aged 0-12 months) were recruited for this study (see Fig. 5). Dyads were excluded if they if they presented associated conditions to DDH. Participants were recruited in three groups of caregiver-infant dyads: Group A was formed by three (3) dyads where infants were DDH patients currently going through treatment with orthotic devices, and living in

the US; Group B included four (4) dyads where infants were also DDH patients currently going through treatment with orthotic devices, but living abroad/internationally (3 from Colombia, South America and 1 from Australia); and Group C, was composed by three (3) dyads where infants were healthy patients (not diagnosed with DDH). Group C served as a control group (to compare daily activities between DDH and non DDH patients). As seen on Fig. 6, participants ranged from a one month old baby in a Pavlik harness, to one year old infants finalizing treatment who had gone through two or three orthotic devices.
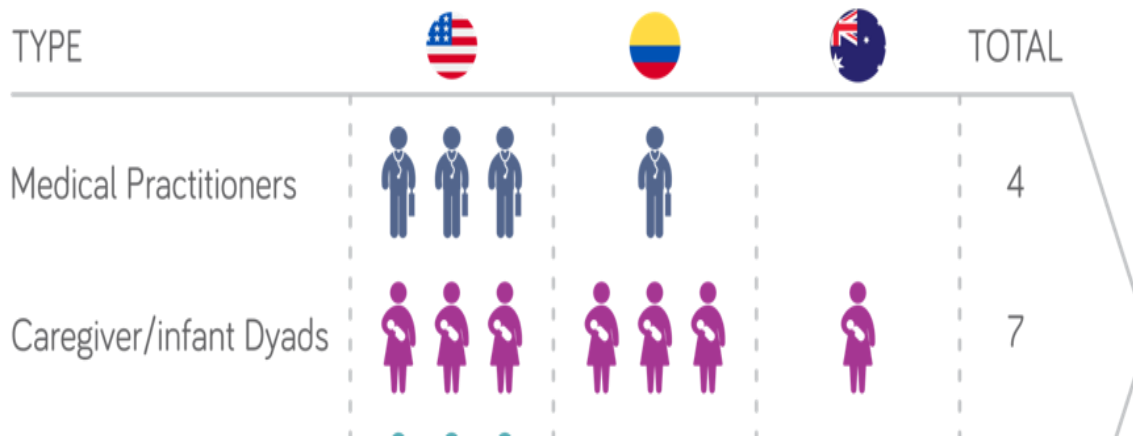

Fig 5. Participant Recruitment

Fig 6. Caregiver-infant Dyad DDH Patients Participants

   Medical Practitioners (Experts): Four (4) medical practitioners participated in this study: three (3) pediatric orthopedists (two practicing in the US and one in Colombia, S.A.) and one (1) orthopedic surgeon (practicing in the US) (See Fig. 7)
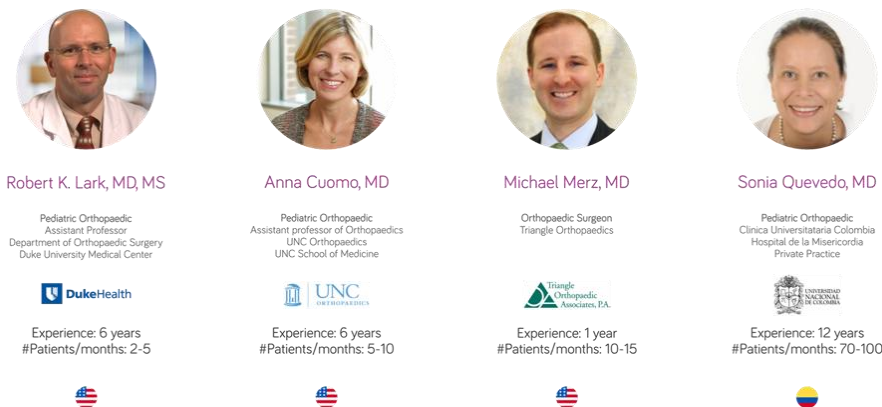

Fig 7. Medical Practitioner Participants

19. Research Methodology and Data Collection

This ethnographic study was conducted by using a combination of qualitative methods (see Fig. 8) which were planned according both types of participant.

Fig 8. Research Methodology Plan

For the Caregiver-infant dyad, data was collected by using three different research methods: *1. Semi-structured interviews:* A flexible questionnaire was used to guide the course of the interview towards understanding the user's perspective (thoughts and feelings) associated with the diagnostic and treatment process for DDH, as well as their perception on how the infant was affected. *2. Observation sessions:* Dyads were observed in their homes (natural environment) over a period of ~2-4 hours while performing up to seven (7) daily activities (eating, breastfeeding, sleeping, bathing, transportation activities, diaper-changing and mother-infant interactions). During the observation sessions, the researchers were focused on identifying challenges encountered while using these devices, how these affected their daily activities, and the impact on the infant's interaction with people, their environment and physical

products (baby related gear).*3.Online forums: Three* Facebook groups (closed support groups for DDH caregivers) were used to collect data from the asynchronic interactions between members. Information from groups was scraped periodically for information regarding participants posted comments, reflections and questions about daily of daily living, and members responses with answers and feedback (improvised solutions).

Experts (Medical practitioners) were studied by using semi-structured interviews. They were asked questions guided by a base questionnaire, to fill or clarify the gaps in the literature, understand their perception of the current orthotic devices (benefits and challenges), and their thoughts over how the use of these devices affect the caregiver-infant dyads.

Different techniques were used to collect data. For the semi-structured interviews and observation sessions, data was captured by recording video, audio, images (photographs) and by taking notes using paper based forms. For online forums, excel sheets were used to record daily posts.

Depending on the participant's geographic location, some data collection techniques varied. Observation sessions and semi-structured interviews for participants living in Raleigh (NC) were conducted in-person (in-home for caregiver-infant dyads and in the office for medical practitioners), while participants living in other cities of the US (e.g. New York city) or internationally (e.g. Colombia, Australia) were conducted virtually using Skype or Facetime and recorded with screen-casting software (which records screen activity in video format).

20. Data Analysis and Synthesis

A content analysis was performed to synthesize the data collected through the different research methods (sources of information): a. Observation sessions b. semi-structured interviews and c. online forums. A total of ~24 hours of video, ~24 hours of audio, 253 pictures, 8 observation forms, 8 interview forms, and data scraped from Facebook forums were analyzed (see Fig. 9).

Fig 9. Data Synthesis

Analysis and Synthesis from Medical Practitioners: **Data collected from the medical practitioners was used to explore the differences in DDH diagnostic and treatment processes between US and Colombian medical practices. A significant difference was number of patients treated per month. While the Colombian medical practitioner participant reported treating 70 to 100 patients per month, US participants treated between 2 to 15 patients each month. Later, while mapping the differences between the diagnostic process between both countries (shown in Fig. 10), the cause of this disproportion in numbers of patients was uncovered. While both countries follow a similar protocol during the initial examination of the newborn, the Colombian public medical system performs universal screening of the hip with a 2D X-ray for all infants at four**

months of age. By doing this, the incidence of DDH diagnosis increases from ~10:1000 to ~100:1000. Usually, the type of DDH diagnosed for infants through this 4-month screening X-ray corresponds to mild ace tabular dysplasia. The Colombian medical practitioner expressed that the purpose of this universal X-ray is to reduce cases of hip replacement surgery in older patients.

In terms of insurance coverage, another difference was found. Orthotic devices are covered in the US, while in Colombia they are not. The third difference was related to the manufacturers (of orthotic devices). The US offers branded mass produced products (offered in different sizes). In contrast, these devices in Colombia are manufactured by small orthotic studios, where they custom make the devices, personalized for each patient (size).
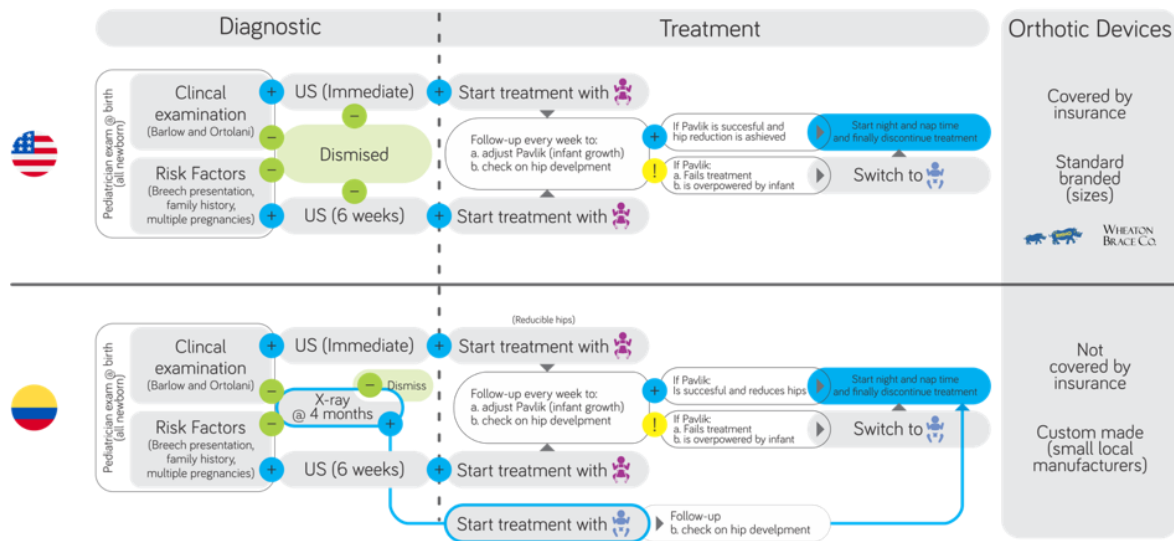

Fig 10. Differences of Diagnostic and Treatment Processes between the US and Colombia.

Medical practitioners from both US and Colombia agreed on the main issues associated with the use of these devices. Their highest concern about the Pavlik Harness was the lack of an effective system for strap adjustment (straps that control the angles of flexion and abduction). The current system forces them to use improvised solutions (use of sharpie marks) to guide caregivers at home to put the device back at the right angles. Another issue discussed was rubbing on the skin (in neck and knees) which they solved by asking caregivers to bring undies and leggings or long socks to wear under the device. The car seat was also a concern. Infants wearing an orthotic device usually don't fit in regular car seats, and to overcome this situation, doctors suggest using a folded blanket to elevate the infant, by doing this they create a space for their legs (see Fig. 11). Finally, breastfeeding was reported as a challenging activity (due to the new posture of the infant), to reduce the mother's frustration medical practitioners provide guidance on breastfeeding techniques (posture).

Fig 11. Improvised solutions from medical practitioners to overcome problem areas.

Analysis and Synthesis from Caregiver-Infant Dyads: **The data was grouped into 5 main categories: benefits, problems, frustrations, desires (wish-lists), and improvised solutions. Next, these results were synthesized (by evaluating grade and frequency) by using affinity diagramming. As a result, a list of insights in the form of pain-points were defined according to type of participant and type of orthotic device(see Fig 12). Orthotics were grouped in two categories: Pavlik harness (dynamic) and abduction braces (rigid).**

The Pavlik Harness was found to be effective for treating infants from 0 to 6 months of age, with unstable and stable hips, requiring either 24/7, 23/7 or 13/7 treatment. The benefits established for this device were: allowing diaper changes with device on, having a dynamic structure, and the softness and flexibility of the material from which the device was made. The main problem: older, larger and stronger patients can overpower the device. The associated frustrations included: Rubbing on the skin; Hygiene (difficult to clean and wipe), for 24/7 babies not allowing normal baths; challenging to put on and off; clothes not fitting well over the device (not being able to dress infants with normal baby clothes); and infant's general appearance (creating a physical and psychological barrier between the infant and the caregiver as well as other individuals).

The Abduction braces were effective devices for treating stable hips for infants during 23/7 and 13/7 bracing. The main problem was not being able to access the diaper without having to take the device off. This created frustration for the caregivers during the following activities: dressing, diaper changing and bathing. In terms

of positive characteristics, this device has a rigid structure that puts the infant in the correct position without having to control it manually by adjusting straps, and provides an alternative for infant's that overpower or cheat the Pavlik harness by flexing their knees. Finally, the recurrent frustrations expressed by caregivers were related to infants developing rashes (from heat), the barrier that this bulkier device created between infants and their caregivers (compromising bonding), the weight of the device, and finally caregivers reported specifically the Rhyno abduction brace to have issues related to the foam material coming out and not staying in place.

Fig 12. Data synthesis diagram

As a conclusion of the data synthesis process, the resulting insights suggested that one single product couldn't resolve all DDH related problems and associated frustrations; therefore, this study proposed a system solution (See Fig. 13) that would require design interventions in three main areas:

a. *Improving current DDH orthotic devices: All devices were graded poorly in terms of user experience and required a better*

design solution. Two different devices were required: a dynamic harness and a rigid splint.

b. *Designing DDH specialized baby gear: Infants with DDH typically will not fit in baby gear (car seats, high chairs, rock and play seats among others). Designing DDH baby custom gear would improve the performance of daily activities for the caregivers and the interactions of infants with their environment.*

c. *Designing custom accessories for DDH patients: DDH caregivers are forced to improvise solutions to accommodate and dress their babies. Baby clothes and accessories offered in the current market present fitting issues when having to wear them over current orthotic devices. Also, the specific positioning of the legs requires for special pillows to be designed to better accommodate the infant during activities like sleeping and playing.*
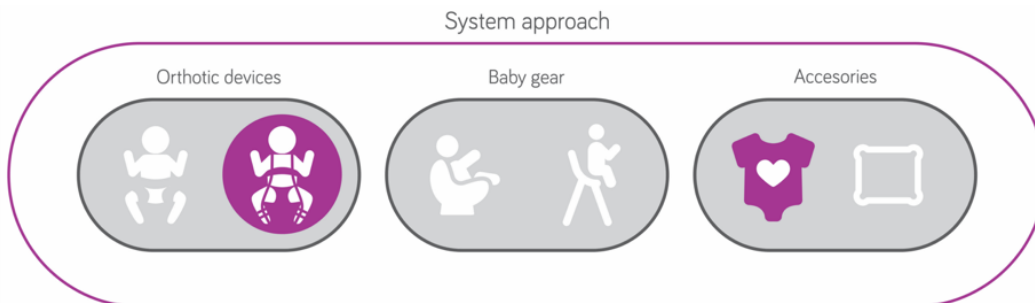

Fig 13. System Solution Projection and Project Focus

For the scope of this project, the design development process was focused on developing an orthotic device that could replace the current Pavlik harness (a dynamic brace for infants between 0 and 6 months of age), as well as developing a line of accessories (clothes) that integrate tothe device.

The reasons to pursue this direction were: first, the Pavlik harness is the most frequently recommended orthotic device by pediatric orthopedics for infants between 0 and 6 months of age who are starting treatment. Secondly, it's one of the three most widely referenced (has high success rates) orthotic devices in the literature. Lastly, this study found the Pavlik harness to have the most associated frustrations from the user's perspective.

Design Criteria: Findings from the data synthesis process were translated into the design criteria, and guided the product design development process. The new product had to achieve the following 6 conditions:

1. *Respect the angles of flexion and abduction of the hip joint (<90° of flexion and 45° to 70° of abduction) recommended to achieve the reduction of the hip.*
2. *Be easy to clean (wash and wipe).*
3. *Allow bathing (for infants during 24/7 treatment).*
4. *Be approachable (Improve infant's appearance).*
5. *Be convenient to use (easy to put on and off).*
6. *Allow strap adjustment easily (only controlled by medical practitioners).*

21. Design Development

Ideation: **Maintaining the effective functional structure of the Pavlik harness (one upper and two bottom structures that hold the baby's hips in the correct position, by using tensile straps to control and adjust the angles of flexion and abduction as the infant grows), this study used divergent ideation to explore different ways of**

achieving the goals set up as design criteria which were described in the previous section. As shown in Fig. 14, the first round of ideation was inspired by the concept of "underwear" aiming to create a new device that would be worn directly over the skin and under the clothes to allow bathing (comparable to a swimsuit). Different configurations of the upper structure were generated thinking of aesthetics, function and adjustability. For the bottom structures a shift in the hip positioning control point from the foot (current Pavlik) to the knee was proposed.
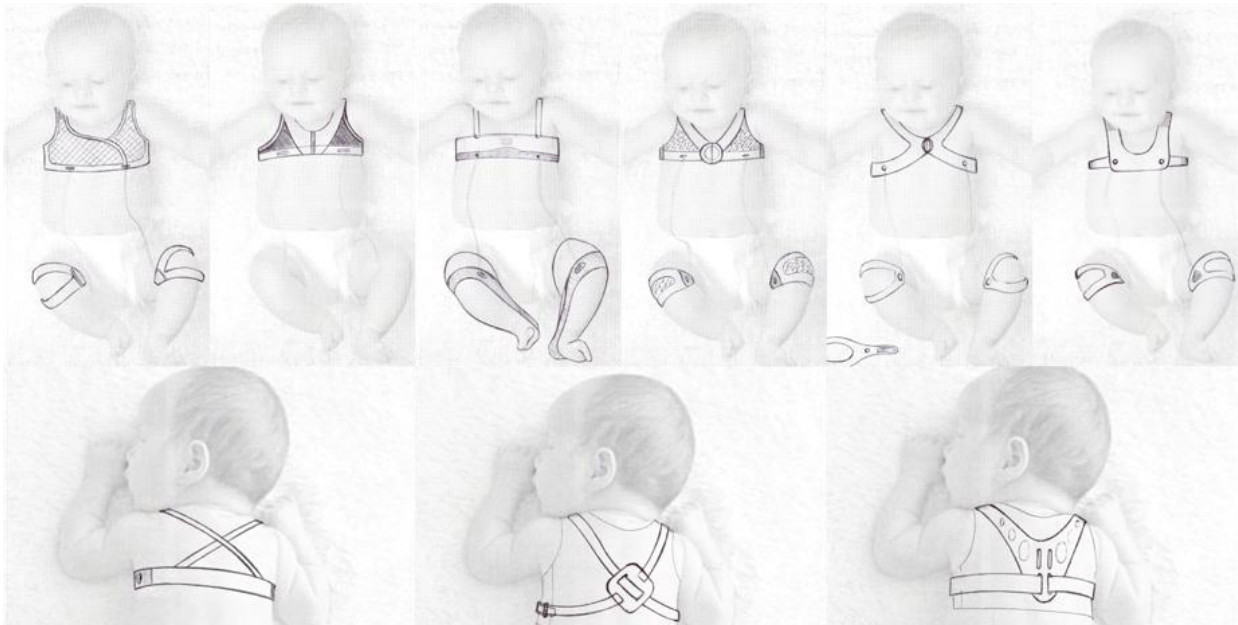

Fig 14. First round of Ideation

Next, medical practitioners and caregiver-infant dyads provided feedback on the initial ideation. Medical practitioners reacted positively to the idea of changing the bottom control point (currently on the foot), but were concerned about using the knee (anatomical consequences). As an alternative, they suggested the use of the

thigh as the new control point. Caregiver-infant dyads voted on their ideal upper structure, and the top two concepts were: 1. Vest shape, 2. Bib shape. Ideation was refined and can be seen in Fig. 15. Proposing half cuffs under the thigh integrated to clip on socks that would prevent from rubbing on the skin. Both vest and bib concepts were explored, evaluated and refined during the prototyping process.
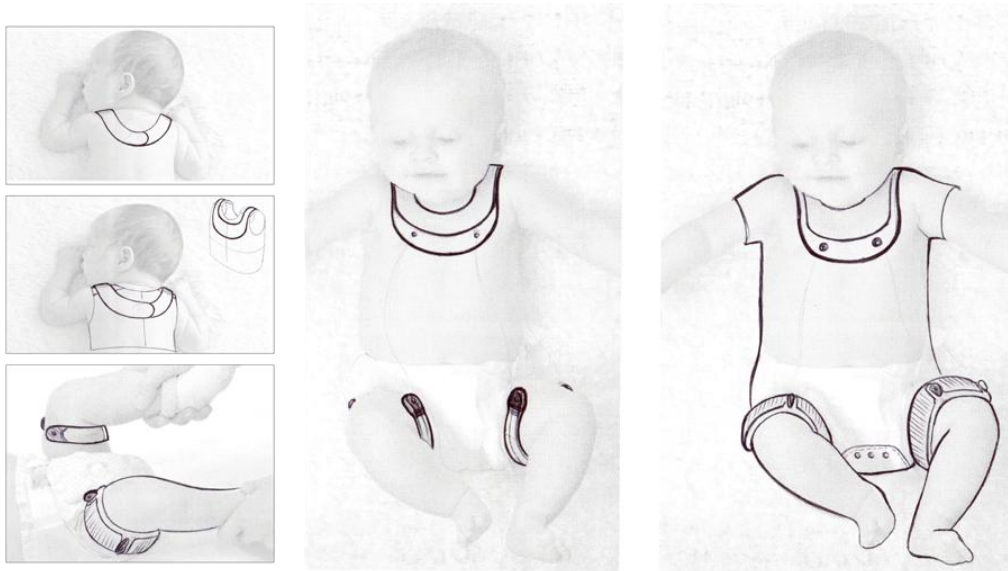

Fig 15. Second round of Ideation

Feedback sessions: A set of feedback sessions were completed throughout the product development process. During the first feedback session, both users and experts were asked to provide feedback over paper based divergent ideation. During a second feedback session, participants were asked to give their opinion about a selection of working prototypes regarding: material selection, aesthetics, convenience of use, and perception of safety.

Material Research: An important part of the design development process was finding the right materials. The materials selection was driven by two design criteria: 1. Be easy to clean (wash and wipe), and 2. Allow bathing (for infants during 24/7 treatment). The upper structure required a material with the following characteristics: a. breathable, b. waterproof or water resistant, c. soft, and d. non-stretchable. A market review of products that met one or more of these requirements was completed as shown on Fig. 16.

Material exploration including advise from faculty in the NC State College of Textiles guided this project toward a non-woven microfiber (polyester-polyethylene) that met the desired characteristics. Samples of this material generously provided by the Textile's faculty was used for prototyping and testing purposes.
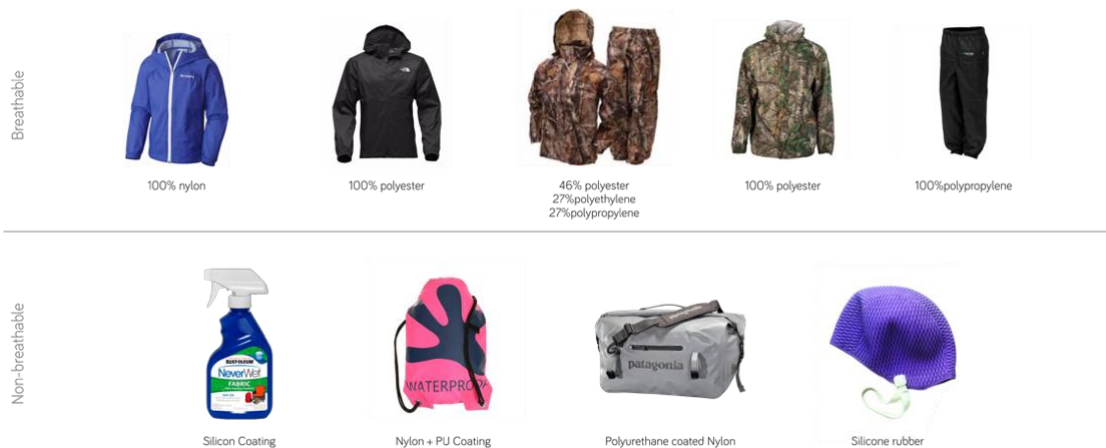

Fig 16. Material research

Prototyping: To move forward with the product development process, a series of prototypes were created to explore materials, dimensions, patterns, aesthetics, functionality, and

manufacturability. As seen in Fig. 17 prototypes evolved and iterated culminating in the development of two final prototypes. A functional prototype that simulated all the strap adjustment mechanisms was used during feedback sessions as well as for testing and evaluation. A final prototype was made mimicking the real materials and overall aesthetics of the final product. Besides prototyping the orthotic device, accessories such as socks and undershirts were also prototyped and iterated. Socks were made to keep the cuffs in place and to prevent the device from rubbing the skin. An undershirt was designed in 100% cotton material to be worn under the device. Both the socks and the undershirt were designed such that they could be removed and put back on without having to take the orthotic device off.

Fig 17. Prototyping Process

Testing and Evaluation: Prototypes were tested and evaluated on a simulated infant (training doll) generously provided by NC State's College of Design RED Lab directed by professor Sharon Joines. (see Fig. 18). They were evaluated on:

1. *Load distribution supporting comfort: Two prototypes (a. vest, b. bib) were made using an identical section of elastic nonwoven microfiber on the shoulder strap. Next, using the same weight on both prototypes, the percentage of deformation on the elastic material was measured. Both prototypes produced the same amount of deformation. Consequently, there was no anticipated difference in comfort in terms of pressure over the shoulder between the vest and bib designs.*

2. *Aesthetics: Participants voted in favor of the bib concept over the vest. They stated the bib shape was classic and resembled the aesthetics of baby accessories.*

3. *Drying time: Prototypes were tested by simulating a bath, and comparing drying times. Here, the bib shape (due to less material use and reduced skin contact) dried faster than the vest shaped prototype.*

4. *Safety: One concern noted by some participants regarding the bib concept, was safety. A 1:2 scale prototype was built and tested on an 8-year-old female girl who was asked to perform several movements for a period of 30 minutes (sit, lay down facing up, kick). The results showed that the straps held the bib in place with no risk of choking the patient when using dynamically.*

Fig 18. Testing and Evaluation

After testing and evaluating the two final prototypes, the bib shape was selected over the vest type as it had superior aesthetics,shorter drying times, and was perceived to be equal in performance to the vest in safety, load distribution and comfort.

22. Final Design

The outcome for this design research project is "H" (Happy Healthy Hips): A new dynamic orthotic device that improves the user experience for infants (0 to 6 months old) and their caregivers during treatment for DDH.

As seen in Fig. 19, the product integrates the orthotic device onto custom designed accessories (undershirt and socks). This new simplified design makes it possible to use clothes over the device, and allows 24/7 DDH patients to have daily baths. Moreover, by using the device as 'underwear' rather than 'outerwear', it normalizes the infant's appearance (see Fig. 20).

The product meets all the design criteria proposed: it respects the angles of flexion and abduction of the hip joint (<90° of flexion and 45° to 70° of abduction), the materials used to manufacture the device arewater repellent, fast dry, and easy to clean (wash and wipe). The colors and patterns enhance the appearance and make it more approachable (removing the interaction barrier). Finally, by redesigning the strap adjustment mechanism (to be controlled only by medical practitioners), it becomes more convenient to use, and simple for the caregiver to put on and take off.

Fig 19. Final Product "H": Orthotic device + Accessories

Fig 20. Final Product "H": with clothes vs. without clothes

The bib shaped upper structure is made from non-woven microfiber (polyester, polypropylene) and over-molded with a clear silicone rubber layer that provides rigidity and structure. The bib is secured around the infant using two snap fasteners on the back. The plastic cuffs (that go under the infant's thigh) are injection molded in a translucent polypropylene and over molded with clear elastomer (to prevent rubbing). The cuffs have snap fasteners on each side to clip onto the socks. Finally, the straps that join the bib structure to the cuffs, are made of an elastomeric material with a woven inner core (to add strength). These straps have a textured side that contribute to the grip and prevents the infant from overpowering the device. To adjust the straps, the device has 4 spring-loaded sliding clips (see Fig. 21).

Fig 21. Final Product "H": Manufacturing details

Colors and patterns are designed to offer options for bothmale and femalegender, aswell as gender neutral. (See Fig. 22).

Fig 22. Final Product "H": Colors and Patterns

23. Conclusion

The new orthotic device H has been designed maintaining the functional structure of the Pavlik harness (reported with high success rates in the literature for DDH treatment), while mitigating the frustrations observed and expressed by the participants of this study. By enhancing both the aesthetics and functionality, an improved user experience for both the caregiver-infant dyad and medical practitioner is expected. A future study is required to validate this hypothesis by replicating the methods used in this study with participants using the H orthotic device during DDH treatment.

9. References

[1] *Atalar, H., Gunay, C., &Komurcu, M. (2014). Functionaltreatmentofdevelopmental hip dysplasiawiththeTübingen hip flexionsplint. Hip International, 24(3), 295–301. http://doi.org/10.5301/hipint.5000128*

[2] *Bauer, G. C. H. (1965). SophusVon Rosen. Acta OrthopaedicaScandinavica, 36, 1–7. http://doi.org/10.3109/17453676508989366*

[3] *Bracken, J., Tran, T., &Ditchfield, M. (2012). Developmentaldysplasiaofthe hip: Controversies and currentconcepts. JournalofPaediatrics and Child Health. http://doi.org/10.1111/j.1440-1754.2012.02601*

[4] *Causon, E. (2010). The nurses' role in educating, counselling and preparingparentstocarefor a childwithDevelopmentalDysplasiaofthe Hip (DDH). International JournalofOrthopaedic and Trauma Nursing, 14, 40–47. http://doi.org/10.1016/j.joon.2009.07.048*

[5] *Dickson, J. W. (1969). Pierre Le DamanyonCongenitalDysplasiaofthe Hip, 62, 572–577.*

[6] *Hamilton, B. E., Martin, J. A., Osterman, M. J. K., Curtin, S. C., &Matthews, T. J. (2015). National Vital StatisticsReportsBirths : Final Data for 2013. National Vital StatisticsReports, 64(12), 1– 104. Retrievedfrom http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_12.pdf*

[7] *Hansson, G. (2013). Screeningfor Hip Instability in NewbornInfants and Treatment in the Original von Rosen Splint, 1–67.*

[8] *Hareendranathan, A. R., Mabee, M., Punithakumar, K., Noga, M., &Jaremko, J. L. (2016). A techniqueforsemiautomaticsegmentationofechogenicstructures in 3D ultrasound, appliedtoinfant hip dysplasia. International JournalofComputerAssistedRadiology and Surgery, 11, 31–42. http://doi.org/10.1007/s11548-015-1239-5*

[9] *Kolb, A., Schweiger, N., Mailath-Pokorny, M., Kaider, A., Hobusch, G., Chiari, C., &Windhager, R. (2016). Low incidenceofearlydevelopmentaldysplasiaofthe hip in universal ultrasonographicscreeningofnewborns: analysis and evaluationofriskfactors. International Orthopaedics, 40, 123–127. http://doi.org/10.1007/s00264-015-2799-2*

[10] *Kotlarsky, P. (2015). Developmentaldysplasiaofthe hip: What has changed in thelast 20 years?WorldJournalofOrthopedics, 6(11), 886. http://doi.org/10.5312/wjo.v6.i11.886*

[11] L. Breysem. (n.d.). ULTRASONOGRAPHIC EVALUATION OF HIP DYSPLASIA: review.

[12] Lauge-Pedersen, H., Gustafsson, J., &Hägglund, G. (2006). 6 weekswiththevon Rosen splintissufficientfortreatmentof neonatal hip instability. Acta Orthopaedica, 77(2), 257–261. http://doi.org/10.1080/17453670610045993

[13] Merog, H., Md, ˘lu, Köse, N., &Akceylan, A. (1999). SuccessofPavlikHarnessTreatmentDecreases in Patients C 4 Months and in UltrasonographicallyDislocatedHips in DevelopmentalDysplasiaofthe Hip ClinicalOrthopaedics and RelatedResearch ®. ClinicalOrthopaedics and RelatedResearch®, 474, 1146–1152. http://doi.org/10.1007/s11999-015-4388-5

[14] Mubarak, S. J., &Bialik, V. (2003). Pavlik:The Man and HisMethod CLOSED REDUCTION AND ABDUCTION BRACING. JournalofPediatricOrthopaedics, 23, 342–346. http://doi.org/10.1097/01241398-200305000-00012

[15] Mulpuri MBBS, K., MHSc, M., Schaeffer, E. K., Kelley MBChB, S. P., Tr, F., Castañeda, P., … Narayanan, U. G. (1999). WhatIstheImpactof Center Variability in a Multicenter International ProspectiveObservationalStudyonDevelopmentalDysplasiaofthe Hip? ClinicalOrthopaedics and RelatedResearch ®. ClinicalOrthopaedics and RelatedResearch®, 474, 1138–1145. http://doi.org/10.1007/s11999-016-4746-y

[16] Narayanan, U., Mulpuri, K., Sankar, W. N., Clarke, N. M. P., Hosalkar, H., Price, C. T., & International Hip DysplasiaInstituteStudyGroup. (2014). Reliabilityof a New RadiographicClassificationforDevelopmentalDysplasiaofthe Hip. JournalofPediatricOrthopedic.

[17] Nilsson, B. (1996). Sophusvon Rosen 1898-1996. Acta OrthopaedicaScandinavica, 67(3), 313. http://doi.org/10.3109/17453679608994699

[18] Novais, E. N., Kestel, L. A., Carry, P. M., & Meyers, M. L. (2016). HigherPavlikHarnessTreatmentFailureIsSeen in Graf Type IV Ortolani-positive Hips in Males. ClinicalOrthopaedics and RelatedResearch®, 474, 1847–1854. http://doi.org/10.1007/s11999-016-4776-5

[19] Storer, S. K., &Skaggs, D. L. (2006). Developmentaldysplasiaofthe hip. American FamilyPhysician. http://doi.org/10.1053/j.sult.2010.10.004

[20] Wenger, D., Samuelsson, H., Düppe, H., &Tiderius, arl J. (2016). Earlytreatmentwiththevon Rosen splintfor neonatal instabilityofthe hip issaferegarding avascular necrosis ofthe

femoral head. *Acta Orthopaedica, 87(2)*, 169–175. http://doi.org/10.3109/17453674.2015.1126158

[21] *Wilkinson, A. G., Murray, G. D., Ed, F., Wilkinson, A. G., Sherlock, D. A., & Murray, G. D. (2002). THE JOURNAL OF BONE AND JOINT SURGERY TheefficacyofthePavlikharness, the Craig splint and thevon Rosen splint in themanagementof neonatal dysplasiaofthe hip A COMPARATIVE STUDY. J BoneJointSurg [Br], 84, 716–9.*

[22] *Williams, D., Protopapa, E., Stohr, K., Hunter, J. B., &Roposch, A. (2016). Themostrelevantdiagnosticcriteriafordevelopmentaldysplasiaofthe hip: a studyof British specialists. BMC MusculoskeletalDisorders, 17, 1–38. http://doi.org/10.1186/s12891-016-0867-4*

[23] *Zgoda, M., Wasilewski, P., Wasilewska, I., &Golicki, D. (2010). Influenceofthetreatmentofdevelopmentaldysplasiaofthe hip bytheabductionbraceon locomotor development in children. JournalofChildren'sOrthopaedics, 4, 9–12. http://doi.org/10.1007/s11832-009-0219-0*

[24] *Bowen, J. R., &Kotzias-Neto, A. (2006). DevelopmentalDysplasiaofthe Hip (1st ed.). FnvnVxnje \uhicz`cdkJbm\nds. Retrievedfrom https://es.scribd.com/doc/20123397/Developmental-Dysplasia-of-the-Hip*

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Manumit Cymbals

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Abstract— **The making of art has long prompted discussion on difficult topics between artists, the products of their work, and their art; it all gave the artist a voice and then spoke to those who viewed (or consumed) their art. Using this basis, can "athleisure" product (and associated brand) be created such that it provides a voice to those who create it (the designer) and ultimately foster community and prompt dialogue between the product/brand consumers? The dialogue relevant to the creation of this product brand is rooted in the timeless, contemporary challenge that, 'Ignorance is known to give rise to conflict.' Tensions between people of varied faiths persist; interfaith dialogue is one method of mitigating ignorance. The term faith is emotionally charged in contemporary society; as a result, a more acceptable term of spiritual discussion will be used. Within this context, and to address this unmet need, to promote candid interfaith dialogue, this project will build a brand targeting millennials in order to engage in discussions revolving around common human experiences.**

Index Terms— **"Athleisure", Interfaith Dialogue, Manumit, Millennials, and Modest Fashion.**

1. Religious Conflict

It could be determined that religion doesn't kill people, but people kill people. Religious conflict is caused by a particular attitude towards a particular approach to religion (Reychler). So, could it be that religion or spirituality has healing properties, but when used corruptly religion has killing properties? I would contend that where there is difference, especially religious difference there will always be conflict. "Individuals are often ignorant of other faiths, which can lead to potential tension, but does not mean conflict will result (Brahm 2005). Some ways conflict can arise are through religious extremist, who have radical methods of fulfilling their deities' commands. It could be clear from this statement that if we want to reduce religious conflicts, we should take a closer look at the approach that causes people to go to the extreme (Reychler). To give a fuller scope of religious conflict I would like to show a few examples of religious conflict in the U.S. the Declaration of Independence. In the declaration it states, "We hold these Truths to

be self-evident, that all Men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty, and the Pursuit of Happiness." After stating this a few lines down the document states, He has excited domestic insurrections amongst us, and has endeavored to bring on the inhabitants of our frontiers, the merciless Indian savages, whose known rule of warfare, is undistinguished destruction of all ages, sexes and conditions. Why is this relevant? It is believed that America's founding was deeply shaped by Christian moral truths (Hall 2011). Additionally, Indian tribes were following the belief of Animism, which is the belief that natural objects, natural phenomena, and the universe itself possess souls. Indians believed that all living creatures had spirits and souls. The Americans tried to convert the Indians to their own beliefs, which created conflict between the Indians and the Americans. Next, a 2012 shooting in Wisconsin, truly explains that lack of understanding leads to conflict. In this tragic story, A Christian man who identified this Sikh community as Muslim shot and killed six people. Lastly, in the most recent shooting that happened in 2017 the shooter killed close to 30 people in Texas. In conversations with people who knew of the shooter they say that the shooter was a militant atheist. "He thought Christians were stupid (Jones 2017)." As you can see, conflict can come from contrasting beliefs.

Although, this is the case in some instances tensions can arise when someone is trying to convert someone to their beliefs with the intentions of telling someone they're wrong, which can lead to conflict if done offensively or in an in your face" type of way. This may even be offensive to someone even if it isn't done in an, "in your face" type of way, but would building a relationship before

sharing a belief with someone be more palatable? It seems like a plausible thought that people are more open to having a conversation about differing opinions or beliefs with those they trust to listen to them vice coach or talk down to them. I believe that understanding differing faiths has the power to mitigate ignorance. Where silence and misunderstanding are all too common, learning about other religions would be a powerful step forward. Being educated about other religions does not mean conversion, but may facilitate understanding and respect for other faiths (Brahm 2005). So, the problem statement I plan to explore is can an "athleisure" product (and associated brand) be created such that it provides a voice to those who create it (the designer) and ultimately foster community and prompt dialogue across faiths between the product/brand consumers?

2.   Can a product lead to discussion?

There are examples of direct ways fashion leads to conversation. A major example of this is found in Nike where they have the Nike Doernbecher freestyle. Every year, Nike designers and developers partner with Doernbecher Children's Hospital patients who have fought serious illnesses to build a shoe unique to each patient. The children are the actual designers, choosing the colors, styles and materials that reflect their stories and personalities (Get Help). These stories from these patients lead to conversations about the hospital and the disease that the child is dealing with. Another example of fashion led conversation would be the Breast Cancer Awareness symbol being applied to a shoe. The fashion alone doesn't lead to conversation, but the fashion that adds a symbol leads to conversation about that particular subject. In this case the

subject is breast cancer awareness. This symbol and the color pink have been implemented on many different sports team's jersey's, shoes, socks, etc. While applying this symbol or logo to so many product categories it not only drives awareness for the fashion brand, but also helps those who raise money to help others in need. Fashion brands that usually makes a difference in raising money are Aerie, who gives their 100 percent of sales for particular products to a company called Bright Pink. This is all done to bring awareness to the cause. As well as Athleta who gives 12 percent of their sales from a particular bra to a company called Recovery on Water, a company for breast cancer survivors. These are all examples of direct ways that fashion has led to fashion, but there is one more interesting way that fashion has led to faith-based conversation. A fashion trend that started in 2013 could also be considered a more direct way fashion has led and continue to lead to conversation. The fashion trend I am referring to is called Modest Fashion. Modest Fashion is a fashion that includes loose clothing, comfortable dressing and covering of the body according to a person's own comfort.

3.   Interviews

   After talking to many different people from many different backgrounds including Professors' of Architecture, Professors' of Religion, Footwear designers, company owners, Painters, Sculptors, and Artists I found quite a bit of interesting information (see Figure 1). Some of the most important information that I received came from the Professors of religion. Some key quotes came from Imam W., a professor of the Islam faith at Duke University, where he explained, "Dialogue respecting the views of others helps wherever

there is conflict." He continued by saying, "Talking through matters eases the tension spiritually, socially, politically, and culturally. Next, I was able to talk to a professor of the Christian faith, Dr. Jason S., and he told me that he believes there is no real long-term solution to religious conflict. He continued with, "Dialogue is successful when a common human experience is found." Lastly, speaking to a professor of the Islam faith, Dr. Anna B., at NCSU I was shown the 4 types of Interfaith dialogue that helped me to understand what methods have been used in the past. An interesting quote from Dr. Anna B. is, "Out all of the methods used for Interfaith Dialogue I think the most interesting is the one that includes common human experience." So, you can see that common human experience has been and still is an effective method to propose interfaith dialogue, but how can this be done in a different way?

Shauna M., PhD.

Ideals (Interfaith Diversity Experiences and Attitudes Longitudinal Survey), gauges college students' affinty for interreligious cooperation, their appreciation for various worldview groups, and their religious diversity expectations of higher education institutions.

Imam W.

"Dialogue respecting the views of others helps wherever there is conflit and it's the best means to diminish the conflit. **Talking through matters eases the tension spiritually, socially, politically and culturally.** It's wise to seek to understand others before being understood."

Jason S., PhD.

"There is no real long-term solution. I think most things in Interfaith Dialogue **are successful when a common human experience** is found."

Anna B., PhD.

"Interfaith Dialogue, is one of the most popular solutions to religious conflict . There is about four different types of Interfaith Dialogue that have been used in the past. An interesting one is one that includes **common human experience**."

Fig1.Interviewing people from different backgrounds

Before explaining this different method to incorporate Common Human Experience I would like to go over the 4 types of Interfaith Dialogue (see Figure 2). The first is Everyday Life Dialogue, a dialogue where people of different faiths and spiritual traditions strive to live an open and neighborly spirit that includes socializing and hospitality. Next, is Action Dialogue, is when people of spiritual commitment and faith collaborate with others on working for justice. Religious Experience Dialogue is the 3rd type, which consists of people of different faiths sharing their belief by explaining the different forms of worship within that particular religion. Lastly, Theological Exchange Dialogue, is when people participate in a discussion in order to understand each other's religious traditions, ways of life, and values. Further understanding these different types of Interfaith Dialogue led me to my proposed solution. My proposed solution is combing three methods of Interfaith Dialogue being Action, Religious Experience, and Theological Exchange to build a brand targeting millennials. The brand's goal is to share personal faith-based perspectives on common human experience through "athleisure" products. In hope that by having these discussions it will combat religious conflict in the U.S.

Everyday Life Dialogue

A dialogue where people of different faiths and spiritual traditions strive to live in an open and neighborly spirit that includes socializing and hospitality.

Action Dialogue

Is one in which people of spiritual commitment and faith collaborate with others in building a just society that includes service and working for justice.

Religious Experience Dialogue

In this type of Interfaith Dialogue people share their faith by explaining the experience of their particular form of worship. So, they would explain how they pray, their beliefs, and their religious practices.

Theological Exchange Dialogue

When people participate in a discussion in order to understand each other's religious traditions, ways of life, and values.

Fig.2 Four types of Interfaith Dialogue

4.   Why Millennials?

Approximately 16-percent say interestingly that the opinions and viewpoints they see are mostly different from their own (2015). Equally compelling, 26-percent of millennials actually explore or investigate this difference of opinion (2015) (see Figure 3). This can inform a brand that if you have a cause that helps the community, that cause can be an emotional connection for millennials. They don't have to agree with everything to support the cause. This insight also can lead a brand to believe that Millennials are open to discussion because of their willingness to explore different opinions. Further, I think a brand that brings up differences may be of interest to millennials, but bringing up these differences has to be done in the right way. After running several surveys, I found the following findings below about Millennials interest in learning about other faith's different than their own. It was 81 percent of respondents

that were both interested in learning about other faith's and also learning how those of different faith's deal with common human experiences. This perfectly aligns with secondary research found that millennials are open to explore difference of opinion. In this 81 percent mentioned within the above two categories, I believe there is more work to be done. I think I should know if the same people who are interested in learning about other faiths are the same interested in learning about how those of different faith's deal with common human experience.

Fig 3 Why should this design endeavor target Millennials?

5.   Common Human Experience

Common Human Experience are things such as love, shame, heartbreak, hurt, joy, peace, etc. To give more of a visual interpretation of how this common human experience can be applied to "athleisure" I've given an example of a CMF shown below. This image shows this color, material, finish (CMF) where the Common Human Experience is love. You can see here that love to me is described by the two words "Beautiful Sacrifice". In the (CMF) shown below I have given imagery that are visual examples of "Beautiful Sacrifice" such as Jesus Christ, a soldier fighting for his/her country, and a woman giving birth. In all of these examples someone is denying their comfort, denying themselves their needs in order for others to live. I have found materials/semiotics that can be applied to athleisure products so that the story of beautiful sacrifice can be told through product. These materials will act as a visual analogy for love based off my belief. Materials chosen are things like distressed denim, dyed leather, and stitching. The product made acts as the conversation starter. After presenting the product to the world as what love is to me I will then present a response question through the packaging. The question will be, what is love to you? Then the consumer will be able to respond.
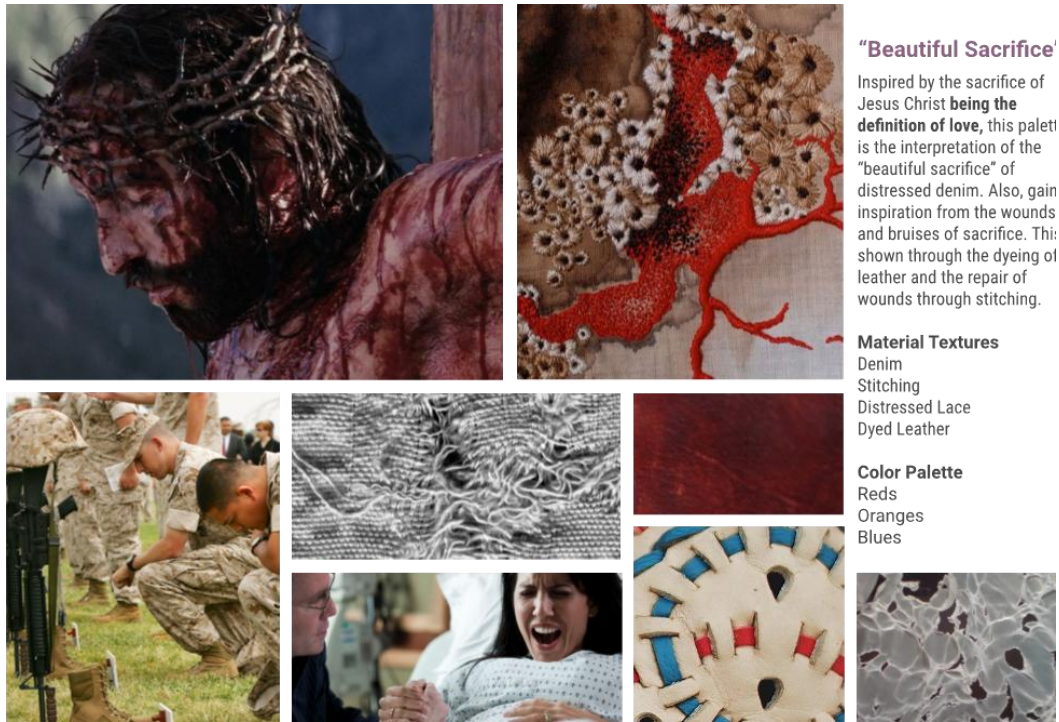
Fig 4. Color, Material, Finish (CMF) for the Common Human Experience of Love

6.   Plan

   I plan to take the research I've done and begin to ideate, develop designs, and prototype designs for my brand called Manumit Cymbals. Manumit means free. In order to have this conversation I am looking to start we must be free from ego. Cymbals defines humans as instruments with their own distinct sound. So, in building this brand next semester I plan to take 5-7 different common human experiences that my respondents from my survey say is most important to them. I plan to give my perspective on these different common human experiences through product. I would like to do full product runs (apparel, shoes, etc.) for each of the common human experiences that time will allow me to tackle. After designing these "athleisure" products I would like to test them within a focus group to see if the product can actually start conversation.

7. References

1. 1. All, David. "Reach Millennials Through Storytelling for Good" *The Huffington Post, TheHuffingtonPost.com, 23 July 2013, under "The Blog," http://www.huffingtonpost.com/david-all/reach-millennials-through_b_3639040.html . Accessed 24 Aug. 2017.*

2. *Alper, Becka A. "Millennials are less religious than older Americans, but just as spiritual." Pew Research Center, 23 Nov. 2015, www.pewresearch.org/fact-tank/2015/11/23/millennials-are-less-religious-than-older-americans-but-just-as-spiritual/. Accessed 17 Sept. 2017.*

3. *Brahm, Eric. "Beyond Intractability." Religion and Conflict | Beyond Intractability, Nov. 2005, www.beyondintractability.org/essay/religion_and_conflict%20 . Accessed 15 Sept. 2017.*

4. *Barnard, Malcolm. Fashion as Communication. London, Psychology Press, 2002.*

5. *Bauck, Whitney. "What Does Modest Fashion Mean?" The New York Times, The New York Times, 1 Nov. 2016, www.nytimes.com/2016/11/03/fashion/what-does-modest-fashion-mean.html?mcubz=1. Accessed 23 Aug. 2017.*

6. *Benitez, Cristina. Faith: Spiritual Architecture. Barcelona, Loft, 2009.*

7. *Bradley, Steven. "The Meaning Of Shapes: Developing Visual Grammar." Vanseo Design, 5 Apr. 2010, vanseodesign.com/web-design/visual-grammar-shapes/. Accessed 17 Sept. 2017.*

8. *Bramston, Dave. Visual Conversations. Lausanne, AVA Academia, 2010.*

9. Brown, Stephen. *Brands and branding. Los Angeles (Calif.), SAGE Publications, 2016.*

10. Conceptkicks. *"5 Reasons Why 3d Printing is the Future of the Footwear Industry and How Best to Utilize it." ConceptKicks, http://conceptkicks.com/5-reasons-why-3d-printing-is-the-future-of-the-footwear-industry-and-how-best-to-utilize-it/* . Accessed August 24, 2017.

11. Connolly, Emmet. *"Design is a Conversation." Thoughtwax, 2 Oct. 2015, thoughtwax.com/2015/11/design-is-a-conversation/. Accessed 17 Sept. 2017.*

12. Cook, Peter Bell and Nancy. *"How Millennials Spend." The Atlantic, Atlantic Media Company, 8 Sept. 2014, www.theatlantic.com/business/archive/2014/09/how-millennials-spend/379713/. Accessed 20 Sept. 2017.*

13. Coughlin, Sara, et al. *"We asked 11 Millennials to Define their spirituality- & The Results Are Profound." Spiritual But Not Religious, SBRN Millennial Trend, Feb. 2017, www.refinery29.com/2017/02/141240/spiritual-but-not-religious-meaning . Accessed 1 Sept. 2017.*

14. Fromm, Jeff. *"How Brands Build Authority to Win with Millennial Consumers." Forbes, Forbes Magazine, 21 Apr. 2017, under "CMO Network," https://www.forbes.com/sites/jefffromm/2017/04/21/how-brands-build-authority-to-win-with-millennial-consumers/#af661224a0c9 . Accessed 24 Aug. 2017.*

15. *"GET HELP." Doernbecher Freestyle Project | Nike Help, help-en-us.nike.com/app/answer/article/doernbecher-freestyle/a_id/3508/country/us.*

16. *Hancock, Joseph. Brand/story: cases and explorations in fashion branding. New York, Bloomsbury; Fairchild Books, 2016.*

17. *Hine, Thomas. The total package: the evolution and secret meanings of boxes, bottles, cans, and tubes. Boston: Little, Brown and Co., 1995.*

18. *"How Millennials use and control social media." American Press Institute, 1 Oct. 2015, www.americanpressinstitute.org/publications/reports/survey-research/millennials-social-media/. Accessed 21 Sept. 2017.*
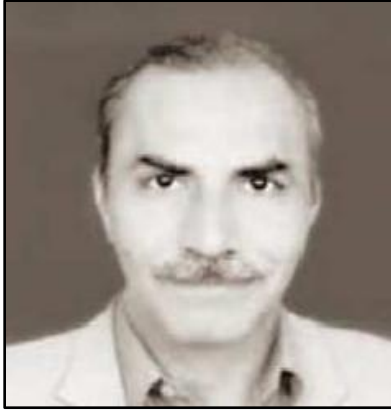
Letter from the Chairman's Desk

By Sunil Bhatia PhD

I side parked my snagged vehicle just over a flyover while seating inside waiting for service person from the company for fixing the problems , I realized flyover was vibrating with amplitude that anyone could experience and scared it might fall any moment specially when heavy loaded vehicle would be speeding over it. It surprised me as a designer that there was no need to be panic of breaking it because designers might have considered this problem from all angle and they might have tackled by accommodating of vibrations that could damage the construction by introducing the flexibility for not to break . I am aware that by introducing design flexible platform made of iron plates that was so strong that could bear the load of the flyover by fixing between column and beam for absorbing the vibrations and leave no room to meet hard possblity . That flexibility was demand of the situation to meet the challenges of vibration due to heavy load speeding vehicles and needed attentions of designers to avert the accidents. The moment vehicle struck to my mind, I realized it has number of parabolic spring leaf arrangement between chassis and body of the vehicle to provide flexibility to meet the challenges of the roads.   As my thinking focused on driver seat of the vehicle that was fixed over hard iron structure and was designed to absorb the impact of the shock at the time of accidents for saving the life. Best thing is passenger safety

seat belt that is designed with flexibility at the time of wearing but worked strong and does not allow the belt to move at the time of accident to bear the pressure of accidents , supported with air bags to meet the impact of accidents for protection of assets. Flexibility plays great role to keep thing in order and beautifully it is reflected in the design of wheel they designed wheel with tyre and tube to keep the vehicle in order. Sometime designers introduce the flexibility for achieving the desired outcomes, at a few places by controlling the flexibility and introducing the rigidity for proper functionality of the products, and occasionally combination of both for desired results. Our ancestors used this concept of flexibility for progress of the society in various ways and identified the natural flexibility of in built character of the items for achieving their objects, sometime where ever natural was missing but essential by developing artificially , in few occasions preventing it for getting desired results, action of the flexibility of one items for crating effects by introducing for gaining flexibility on another rigid items and in a few places by using mix of both for proper outcomes.

Primitive people were generally governed by observation of experience, earned through trial and error, identified the natural flexibility in different products and later developed artificial means to design the products for achieving their desired results and this methodology was in practice for optimum use for solving their problems that led for progress of the society. They realized the importance of flexibility for killing the animals for food or where ever hand plucking was not possible. They invented the trick of climbing the tree for plucking the edible items at heights by selecting those branches those could bear their body weights and it should be strong enough but flexible reaching for plucking the fruits

or hitting the running animals by holding the stone in hand by moving backward that much body flexibility was allowing and threw with jerk. That was the flexibility of human body that helped in design of hitting. Spear-throwers appeared very early in human history in several parts of the world. Later they realized thread has very low flexibility but tied with both end of the thin branch developed flexibility and they designed bow to hit the target with arrow. Catapult or slingshot was designed where Y shape branch that was strong and hard used to be fixed with rubber band for using the flexibility to throw the stone. Primitive nomadic lifestyles required the continual task of hunting and gathering food for survival and more fit by keeping themselves flexible. Agricultural developments brought sea-change in their lifestyles and added new dimension by including animal domestication for foods as well in eliminating as much as possible use of physical human power by focusing on designing various types of agriculture tools either based on flexibility or on rigid concept and it was apparent in every era of human developments. Marvelous design of the plough where flexibility of animals were used with designed rigid plough made of iron and wood for preparing the fields in fact astonished me .

This simple tool helped in allowing staying in one place and grew foods sufficient to survive. Another tool of axe that was based on opposite of flexibility that was rigid was so powerful that had revolutionized the thoughts of people and ever a simple man turned to be super human for over powering other living beings Ultimate superiority was there by established when people learnt the art of management by designing various tools and equipment for management of fire and no other living beings could do so till today. That was the period where extensive physical labor of primitive

people was replaced in moderate and laid the foundation of agriculture based society. They were no more dependent on hunting and gradually shifted on other explored areas of getting food from different methods designed a process of making a developed person who was thinking and applying mind and gradually shifting from physical hard work that led to keep physically fit for flexibility and devised various techniques of systematic exercises. Iron Age was the reason of design of spade that has rigid wooden bar not to effects the hand of the users at the time of digging that generates strong vibrations and to lower its impact they used long bar for holding. This human progress due to proper application of flexibility made it possible for hunting-gathering tribes to obtain vast amounts of food while remaining in the same area. There are many reasons why having a flexible body is essential to our health and well-being. I admire the wisdom of our ancestors who not only designed products for making their lives simple and error free not to hurt for avoid death by various design application of flexibility for achieving the objective was based on common sense where modern people are failing miserably. A nut bolt with rubber washer or metal or metal cut washer at the time of tightening nut are nothing but creating space of flexibility. Flexibility ensures the greater economy, adaptability and evolution of the product. Springs are designed to create flexibility. A concept of welding prevents flexibility and helps in joining the two or more metals for desired results.

 A flexible design would reduce redesigning costs and allow quicker response to the users with increased performance. Identify the critical uncertainties that may harm the products functionality and lower its impact by using the concept of flexibility. Our shoes are designed with keeping flexibility around our feet and leather was the

best material and later sole of poly urethane artificially developed with extreme flexibility compared to leather sole. Shoes with laces for tying or strap with hole and buckle creates flexibility and uses fixes with convinces. Design of belt with hole and buckle or for adjusting the length of the strap of the carrying bag is designer concept of introducing the flexibility.

It was the flexibility that allowed our ancestors to design knots later they designed button with hole that has little flexibility. Hooks are extension for flexibility where in button entire unexpected pressure comes on thread for placing button where design of hooks hold the pressure on hooks that is the reason bra strap has hooks not button .Lifting heavy weights with iron hook on cranes where loads nature is to fall and hook holds and prevent falling and it is designed that is convenient for lifting instead of using clamped for holding the load. Clamped system is useful where possible falling weight can slip while lifting preventing the flexibility to avoid accidents.

Theoretically speaking rigidity and flexibility are opposite to each another. It is the beauty of human minds that they know when to use flexibility or introduce rigidness at right place at right time or when to emphasize on mixture of both for desired outcomes. A human jaw is designed by nature where upper part is fixed and lower part has flexibility for proper use. In Stone Age they designed pestle and Mortar based on same principle where one part is fixed and another grinds by crushing. Concept of grinding came into existence because of flexibility where two stones are arranged where one can be manually rotated and another is fixed. Design of weighing machines are based on flexibility where pans are attached with threads to the end of the horizontal straight bar. Modern

electronic weighing machine has platform that can sense the weight because of flexibility.

In the domain of human progress that made us different from rest of living beings is our language and it has come to us from flexibility. Our brain was designed for organizing our body for proper function and mind was with limited role to function the body in proper manner. As human moved from crawling to running his brain started equipping with changed environment for better management and at one point when our mind switched its prime role of taking care of function of body to think pre emptive or beyond this role made us unique . That changing role of brain created a new dimension of flexibility in our mind to adapt the environment and through experiences understand hidden danger in it for countering for safety of life and we called it intuition. That safety in us was responsible in living in group and helped in designing communication. Flexibility that was the reason of developments of languages and different voices for different situations and later it reached to singing. Singing needs control of flexibility in voice. Bed ridden patients biggest problem is they suffer with pressure skin problems that turned to ulcers and to meet this challenge designers introduced the air or water filled bed that shift pressure with slight moment . No animals has that flexibility of thumb what humans enjoy and they can touch their fingers with thumb and that helps us in designing various products holding like pen.

To take the water out of deep well our ancestors designed flexible rope made with locally available natural fibre and rolled over the fixed wooden pulley with groove for guiding the rope to slip. Later on humans were replaced with animal power for lifting the water filled bucket from the well. Design of belt with holes and buckle is

for creating flexibility. Similarly shoes lace with eyelets or strap with buckle for flexibility design for individual comfort. Regulator Knob of electric fan is design for flexibility for revolution per minute as per need of user comfort.

It is very great moment for any publication for approaching some kind of milestone and this special issue has achieved many distinctions. First, we never miss single issue since its inception in year 2006. Second, it is entering in thirteen years of its monthly publication and best part is inaugural special issue is from North Carolina state university that has given foundation of universal design. I am thankful to Prof Sharon Joines for accepting our invitation for Guest Editor and coordinated her students for contribution of articles.

Wishing prosperous New Year 2018 and Happy republic Day 26th January 2018

With regards

Dr. Sunil Bhatia

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Forthcoming Issues

February 2018 Vol-13 No-2

Colleen Kelly Starkloff is the Founder and Co-Director of the Starkloff Disability Institute in St. Louis. She is also the Founder of the Universal Design Summit series of conferences focused on home and community design. She remains the Conference Organizer of these summits. These conferences, 5 of them already, have brought best practices in Universal Design together into one national/international conference since 2002. Ms. Starkloff did not want an "academic" focus on Universal Design for these conferences. Rather a focus on what works, what doesn't, what's the difference between Universal Design and Accessible Design and how the use of universal features in home and community design best integrates all people in communities and improves housing choice for all.

March 2018 Vol-13 No-3

Christian Guellerin has been the Executive Director of L'École de design Nantes Atlantique since 1997, an institution of higher education in design, which has campuses in Nantes (France), Shanghai (China), São Paulo (Brazil) and (Dehli) India. The institution has developed significantly, striving towards the professionalization of design studies and establishing relationships with businesses.

He was President of Cumulus, the International Association of Universities and Colleges of Art, Design & Media from 2007 and 2013 (250 members from 46 countries). He is also President of the France Design Education and Honorary Consul of the Republic of Estonia for the West of France since 2009.

He has regularly taught courses and given academic lectures on design and innovation.

He was a consultant for various institutions and worked on a frequent basis as an expert to set up design centers.

In 2015 and 2016, he was elected by L'Usine Nouvelle magazine in the "50 people who made innovation in France".

Chevalier de l'Ordre National du Merite since 2016.

April 2018 Vol-13 No-4

Dr.Lee Christopher is the Director of eLearning at Arapahoe Community College and also an ACC instructor. Lee has a BA in Philosophy, an M.Ed, and a M.F.A in Writing and Poetics. Dr.Lee is currently in the dissertation phase pursuing a Doctorate in Education from Capella University. Her dissertation title is Universal Design for Learning: Implementation and Challenges of Community Colleges.   Lee's publications include: "Digital Storytelling" in Handbook of Research on Transformative Online Education and Liberation: Models for Social Equality, Kurubacak and Yuzer, Eds., IGI Global, 2011, "Hype versus Reality on Campus: Why eLearning Isn't Likely to Replace a Professor Any Time Soon" with Brent Wilson,   The E-Learning Handbook, Carliner and Shank, eds. Pfeiffer, 2008 , and "What video games have to teach us about learning and literacy," located at http://edrev.asu.edu/reviews/rev591.htm, Lee is on the Colorado Community College System Task Force for Web-IT Accessibility. She has a passion for Universal Design for Learning.

May 2018 Vol-13 No-5

Dr. Antika Sawadsri" ,She is an Assistant Professor and the Director of Inclusive Designed Environment and Research (IDEaR Unit) at School of Architecture, KMITL, Thailand. As both professional and academic interested in Inclusive City, her contribution ranges from home modification to urban public space development for users with all life's spectrum."

June 2018 Vol-13 No-6 (150th milestone issue)

Prof Ricardo Gomes will be the Guest Editor for our 150th special issue. Professor Ricardo Gomes has been a faculty member in the School of Design (formerly the Design and Industry (DAI) Department) at San Francisco State University for nearly 25 years. He was the Chair of the DAI Department from 2002-2012. Prof. Gomes coordinates the Design Center for Global Needs and the Shapira Design Archive Project in the School of Design (DES). This non-profit international research and development center is dedicated to promoting responsive design solutions to local, regional and global issues such as: inclusive/universal design, health care, the aging, community development, social innovation and sustainability of the built environment.

Prof. Gomes is on the Board of Directors of the Institute for Human Centered Design in Boston. He is also a member of the Industrial Designers Society of America; and Epsilon Pi Tau International Honor Society for Technology.

Prof. Gomes received his MFA in Industrial Design for Low-Income Economies from the University of California, Los Angeles (Design of a Container System for Mobile Health Care Delivery in East Africa).

July 2018 Vol-13 No-7

Professor Maria Luisa Rossi, Chair of MFA Integrated Design Program at CCS, has agreed to be the guest editor for the issue. Students in her program as well as other programs at CCS have developed a number of socially responsible design projects.

She is the Chair and Professor of MFA Integrated Design at the College for Creative Studies in Detroit where she brings an entrepreneurial culture, globally-focused and cultural empathetic approaches to the growing of the next generation of designers. Her works focus on the seamless capacity to deal with tangible and intangible aspects of user experiences, preparing "facilitators" capable to address global-glocal grand challenges. Strongly centered on the design process, the program prepare students for the practice of designing omni-channel journeys [products-strategy-services] focused to the quality of the users experience with a special eye to socially relevant solutions. As an undergraduate in Florence, Italy, her wearable computer project work was featured in the prestigious Domus magazine, earning her a scholarship to attend the premiere master's program in industrial design at the Domus Academy in Milan were she got her Master of Industrial Design.

August 2018 Vol-13 No-8

Sameera Chukkapalli (1992) is currently a fellow at the FabCity Research Laboratory, Barcelona, Spain. She founded needlab, a non-profit organization to create a model of optimized practice to deliver maximum impact with the objective of making a difference to the communities. She was the project director and tutor for the Needlab_Kuwait Matters, India Matters, Vietnam Matters. She is working as Space Designer with CARPE LA Augmented Reality project in Los Angeles, USA, funded by the LA2050 program, to eliminate gray zones in public parks and to make them user-friendly. She has represented needlab and lectured in five countries on three continents, actively initiating a conversation about Human Centered design with Policymakers.

Sameera graduated, with MAArch in Digital Matter and Construction, and completed Open Thesis Fabrication, on Large-Scale Natural additive construction using robots, from IAAC, Barcelona, Spain. Obtained B.Arch degree from BMSCE, Bengaluru, India, and the University of Berkeley, USA; Worked with External Reference Architects in Spain; Worked with VTN Architects in Vietnam, on the Tokyo pavilion "Bamboo Forest" for Japan and "S House"(low-cost housing prototype) for Vietnam.

December 2018 Vol-13 No-12

Robert Nichols ,an Owner of Nichols Design Associates, Inc., Washington, DC has been extensive experience in Architectural Design and Universal Design for over 35 years. His expertise within this area of specialty includes building surveys and ADA Accessibility checklist for the public and private clients. He is President and Chairman of the Board of World Deaf Architecture, Inc. (WDA), a new knowledge group of American Institute of Architects (AIA), since a non-profit organization was established in 2016. Received B.Arch.& M.Arch. degrees in Urban Design under the leadership of Prof. Colin Rowe from Cornell University will be our Guest Editor .

New Books

Disability, Rights Monitoring and Social Change:
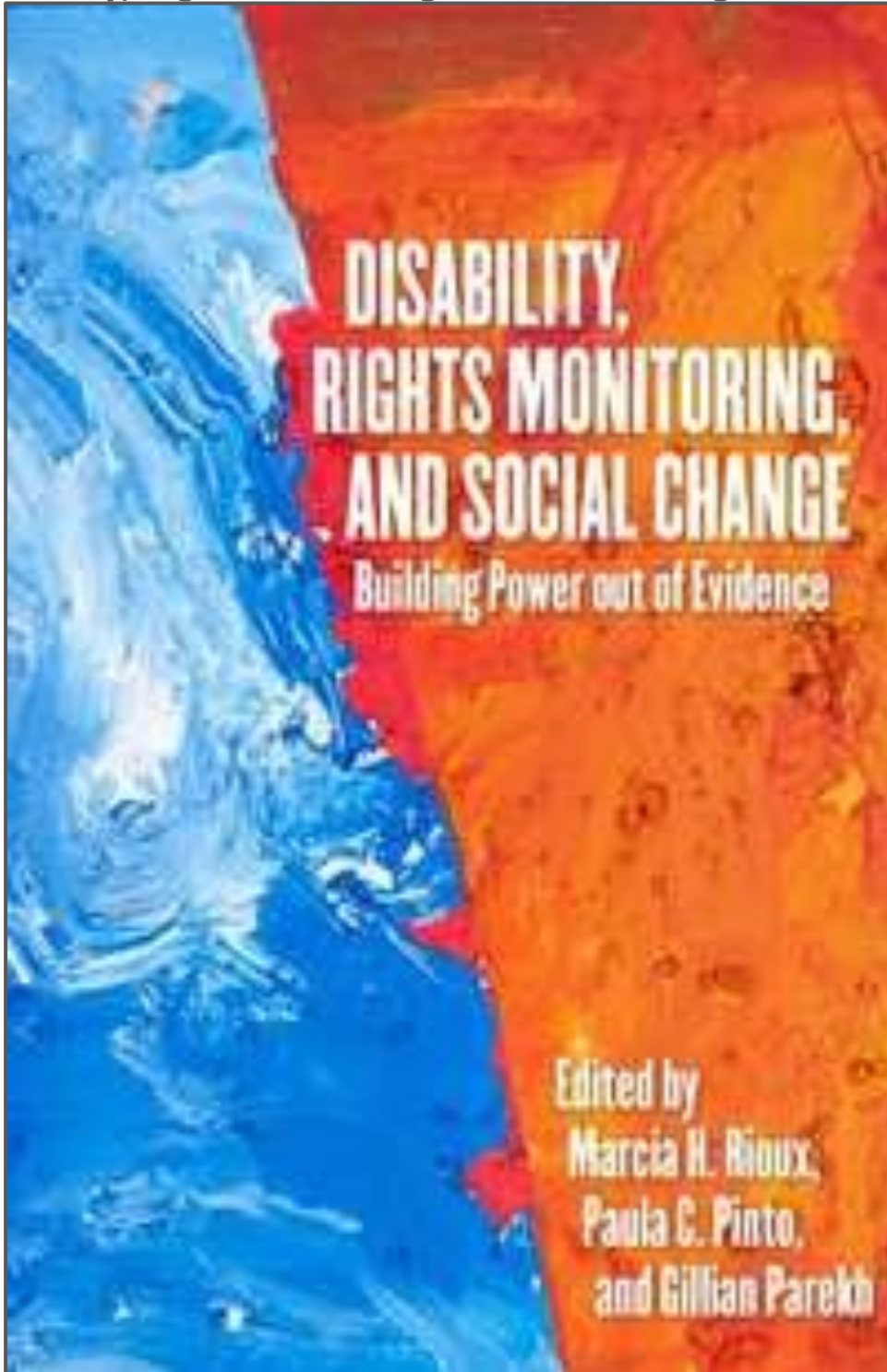
Amazon.co.uk

http://www.amazon.co.uk/Product-Design-course-first-principles/dp/1784562939/ref=sr_1_fkmr0_1?m=A2U321JN96E0UZ&s=merchant-items&ie=UTF8&qid=1456434788&sr=1-1-fkmr0&keywords=Bonollo+Prrroduct+Design%3A+A+course+in+first+principles

Amazon.com

http://www.amazon.com/Product-Design-course-first-principles/dp/1784562939/ref=sr_1_sc_1?ie=UTF8&qid=1456434322&sr=8-1-spell&keywords=Bonollo+Product+Design%3A+A+course+infirst+principles

Product Description

In this book, Elivio Bonollo takes us on a 'learning journey' about design including a scholarly explanation of the characteristics and power of the design process. It provides valuable insights into the attitudes, knowledge and skills that underpin the design discipline at an introductory level of expertise, and has been developed to meet the needs of aspiring designers in many areas including industrial design, design and technology, art and design and architecture. Elivio uses an operational model of the design process - along with related educational strategies, learning outcomes and an ordered set of design briefs - to develop a systematic, problem-based method for learning design from a first principles viewpoint. The beauty of this approach is that it brings structured learning to aspiring designers whilst being mindful of diverse cultures and backgrounds. Each part of this book encourages self-expression, self-confidence and exploration: it is has been carefully designed to take the reader on a highly motivating journey of design thinking and creativity, supported by excellent sample solutions to design problems, lucid discussions and extensive references. These solutions, developed by design students, serve as novel examples of how to solve real problems through innovative design without restraining creative freedom and individual personality. The design learning method and strategies in this book will greatly assist design and technology teachers, students of design, aspiring designers and any individual with an interest in professional design practice.

I cannot recommend this book highly enough, it was a complete lifesaver throughout my undergraduate studies and honours degree and now continues to serve me well as I move into industry practice. The content is easy to understand and follow, providing a practical guide to understanding design principles and every aspect of the design process. It includes great project examples and reflects the wealth of knowledge and experience possessed by this accomplished educator. I have purchased multiple copies of this book for peers and would suggest any student who is studying a design discipline to pick up their own copy as this has quickly become the most useful book in my design collection.

Comment | Was this review helpful to you?   Yes   No   Report abuse

★★★★★ A 'Must Have'.
By Amazon Customer on 7 April 2016
As a Design Education professional of many years standing, I endorse this book without reservation. It is comprehensive, lucid and above all, useful in a very accessible level at the coalface. Professor Bonolo has an enorrnous cache of experience as an engineer, designer and design educator and his experience is well demonstrated in this book. A 'must have' for anyone in the business of educating or being educated in the product design arena.

TAPPING INTO
HIDDEN
HUMAN CAPITAL

How Leading Global Companies Improve their
Bottom Line by Employing Persons with Disabilities

DIS **ABILITY**

DEBRA RUH
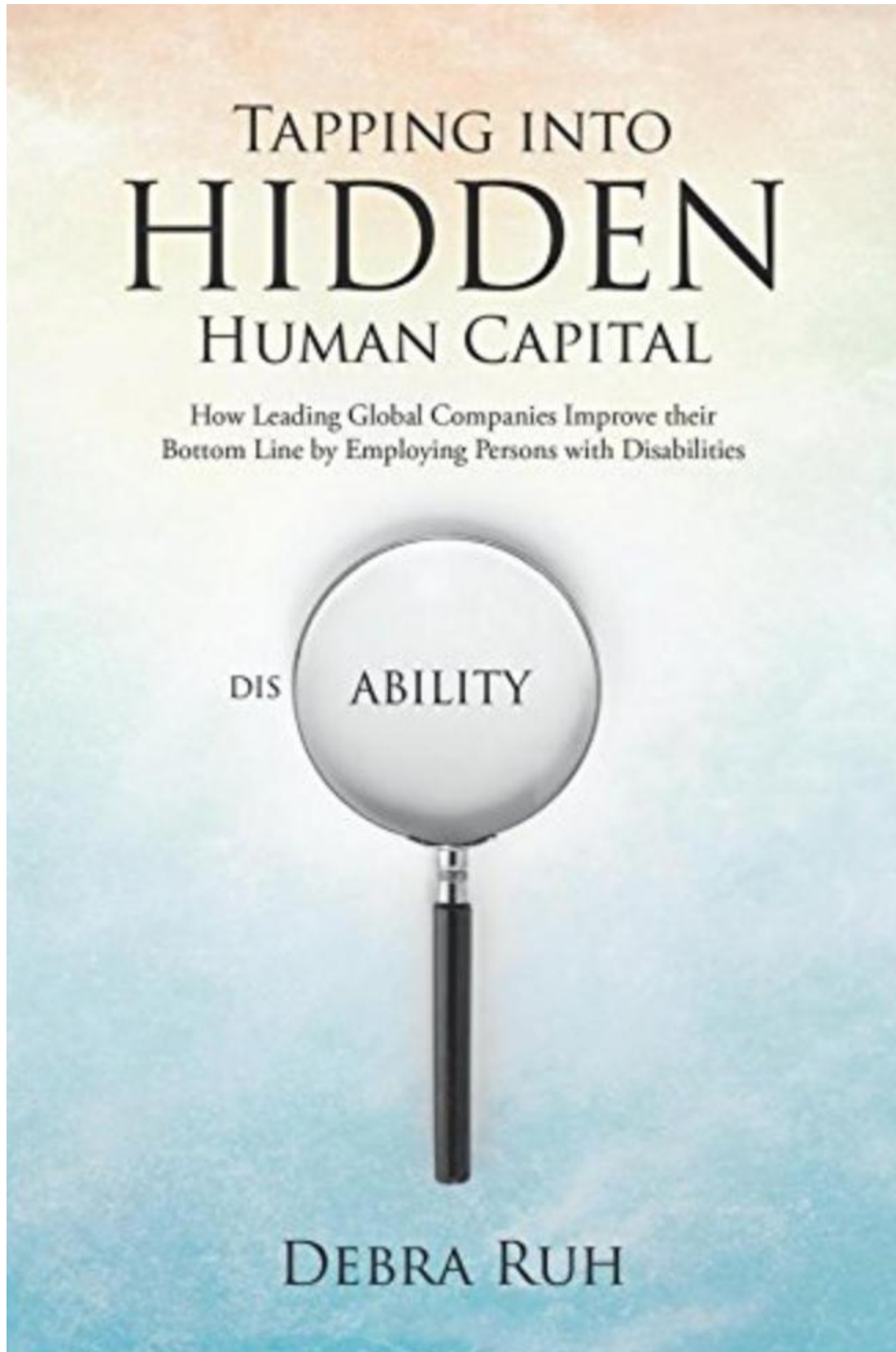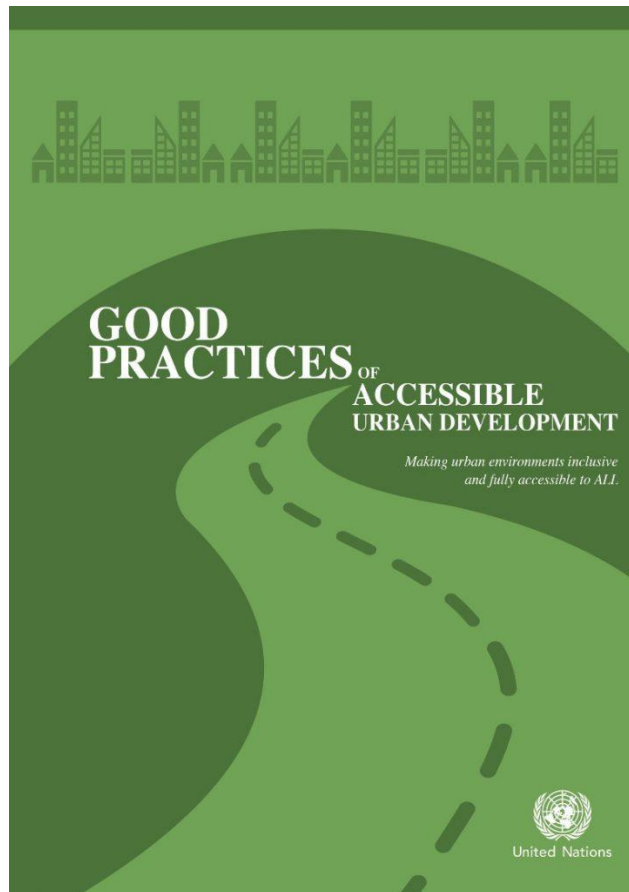
In light of the forthcoming United Nations Conference on Housing and Sustainable Urban Development (HABITAT III) and the imminent launch of the New Urban Agenda, DESA in collaboration with the Essl Foundation (Zero Project) and others have prepared a new publication entitled: "Good practices of accessible urban development".

The publication provides case studies of innovative practices and policies in housing and built environments, as well as transportation, public spaces and public services, including information and communication technology (ICT) based services.

The publication concludes with strategies and innovations for promoting accessible urban development.

The advance unedited text is available at:http://www.un.org/disabilities/documents/desa/good_practices_urban_dev.pdf
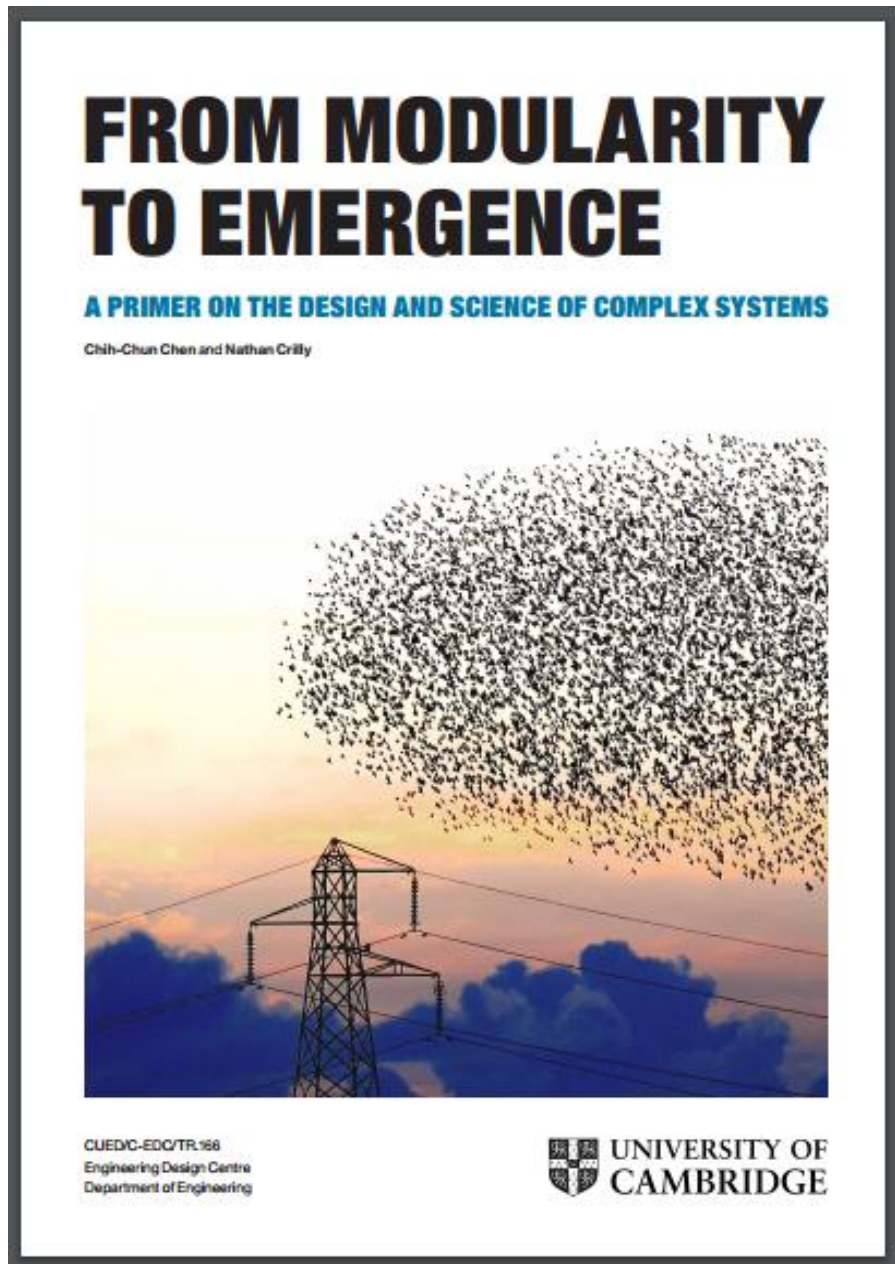
Dr Chih-Chun Chen and Dr Nathan Crilly of the Cambridge University Engineering Design Centre Design Practice Group have released a free, downloadable book, _A Primer on the Design and Science of Complex Systems_.

This project is funded by the UK Engineering and Physical Sciences Research Council (EP/K008196/1).

The book is available at URL:

http://complexityprimer.eng.cam.ac.uk

Changing Paradigms:
Designing for a Sustainable
Future

Editors:
Peter Stebbing
Ursula Tischner

CUMULUS THINK TANK
Publication No 1 of the Think
Tank Series from the Cumulus
International Association of
Universities and Colleges of
Art, Design and Media

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Changing
Paradigms:
Designing for a
Sustainable
Future

New iBook / ebook:
HOW TO DO ECODESIGN

ECODESIGN HANDBOOK

HOW TO DO ECODESIGN

PRACTICAL GUIDE FOR ECODESIGN –
INCLUDING TOOLBOX

ISSUED BY THE
GERMAN FEDERAL ENVIRONMENT AGENCY

Authors:
Ursula Tischner,
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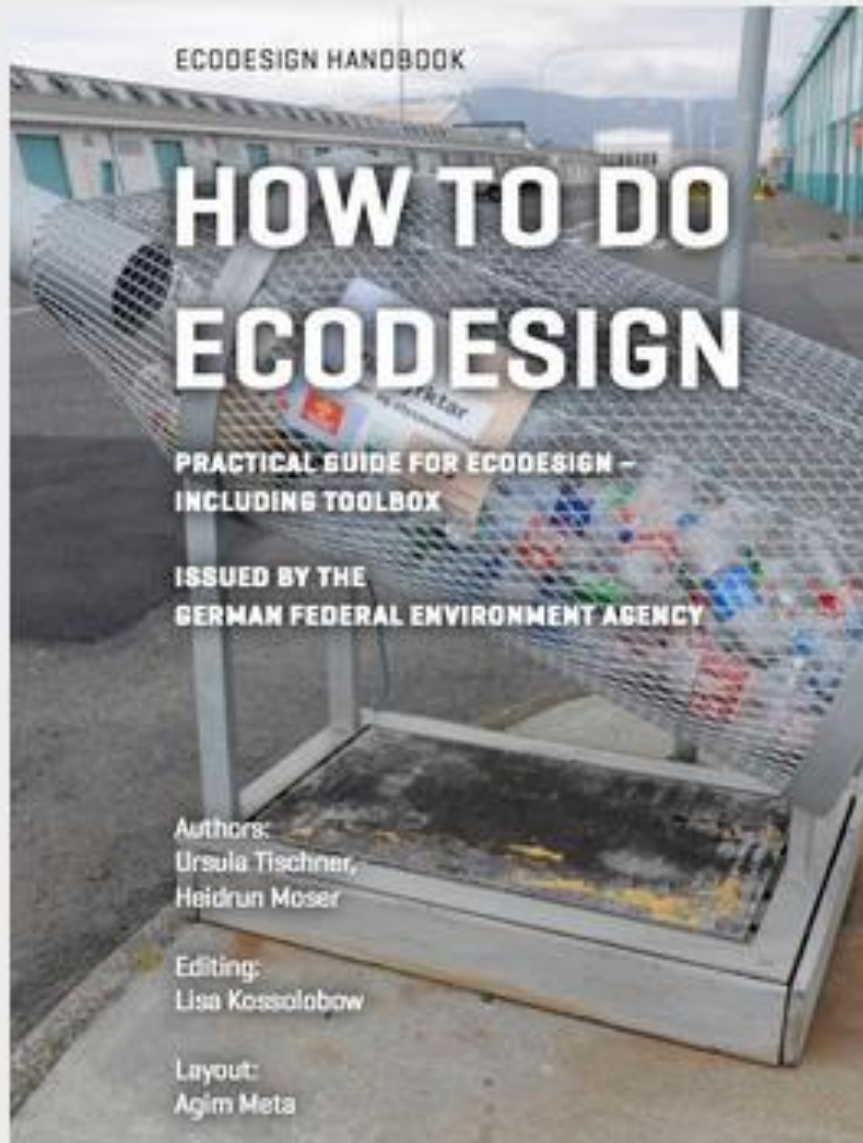
Practical Guide for Ecodesign – Including a
Toolbox
Author: Ursula Tischner
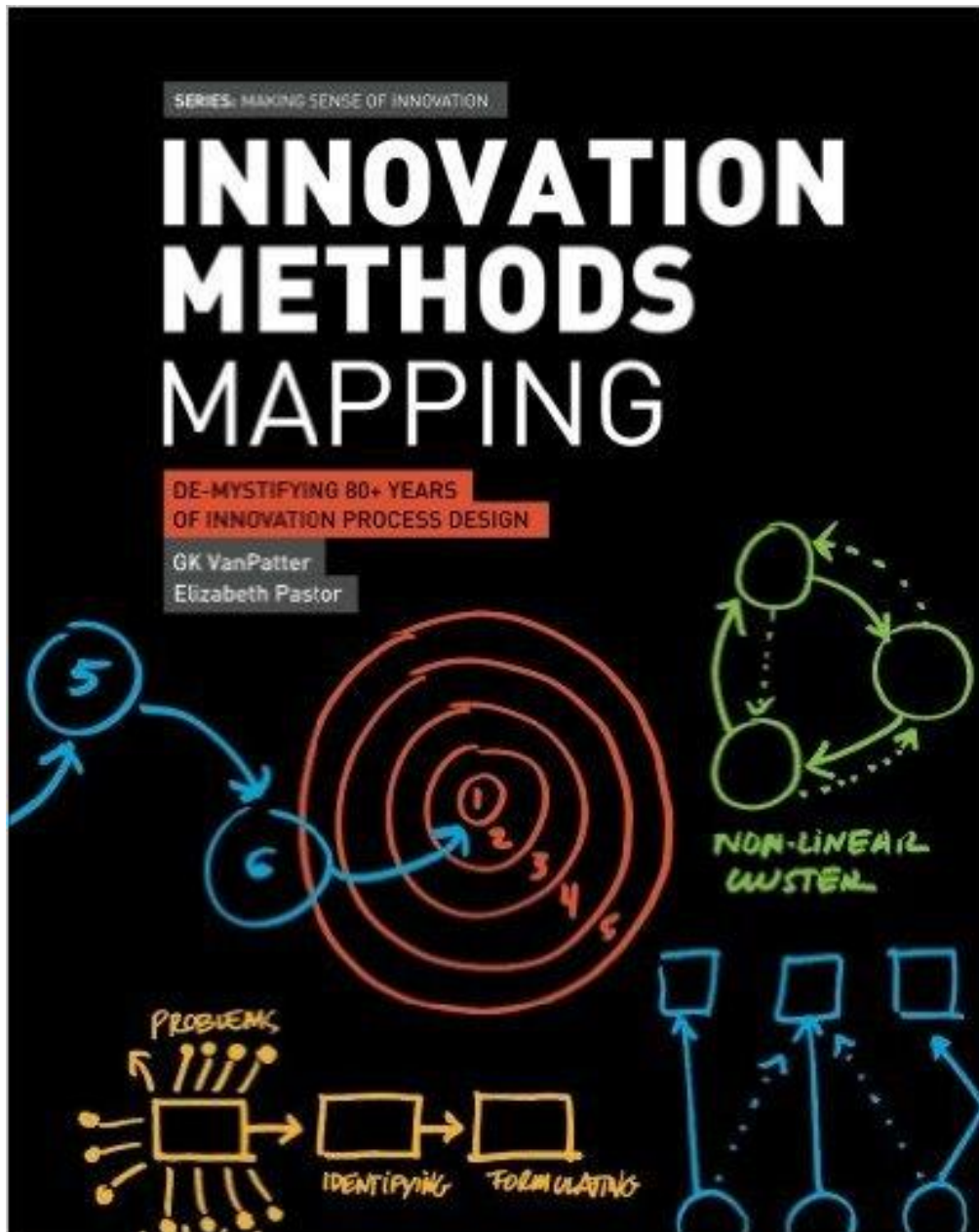
Humantific's new book: Innovation Methods Mapping has just been published and is now available on Amazon.

https://www.amazon.com/dp/1540788849/ref=sr_1_1?ie=UTF8&qid=14 82329576&sr=8-1&keywords=Humantific

You can see the preview here:

https://issuu.com/humantific/docs/innovation_methods_mapping_book_ pre

TRANSFORMATIONS
7 Roles to Drive
Change by Design

Joyce Yee / Emma Jefferies / Kamil Michlewski
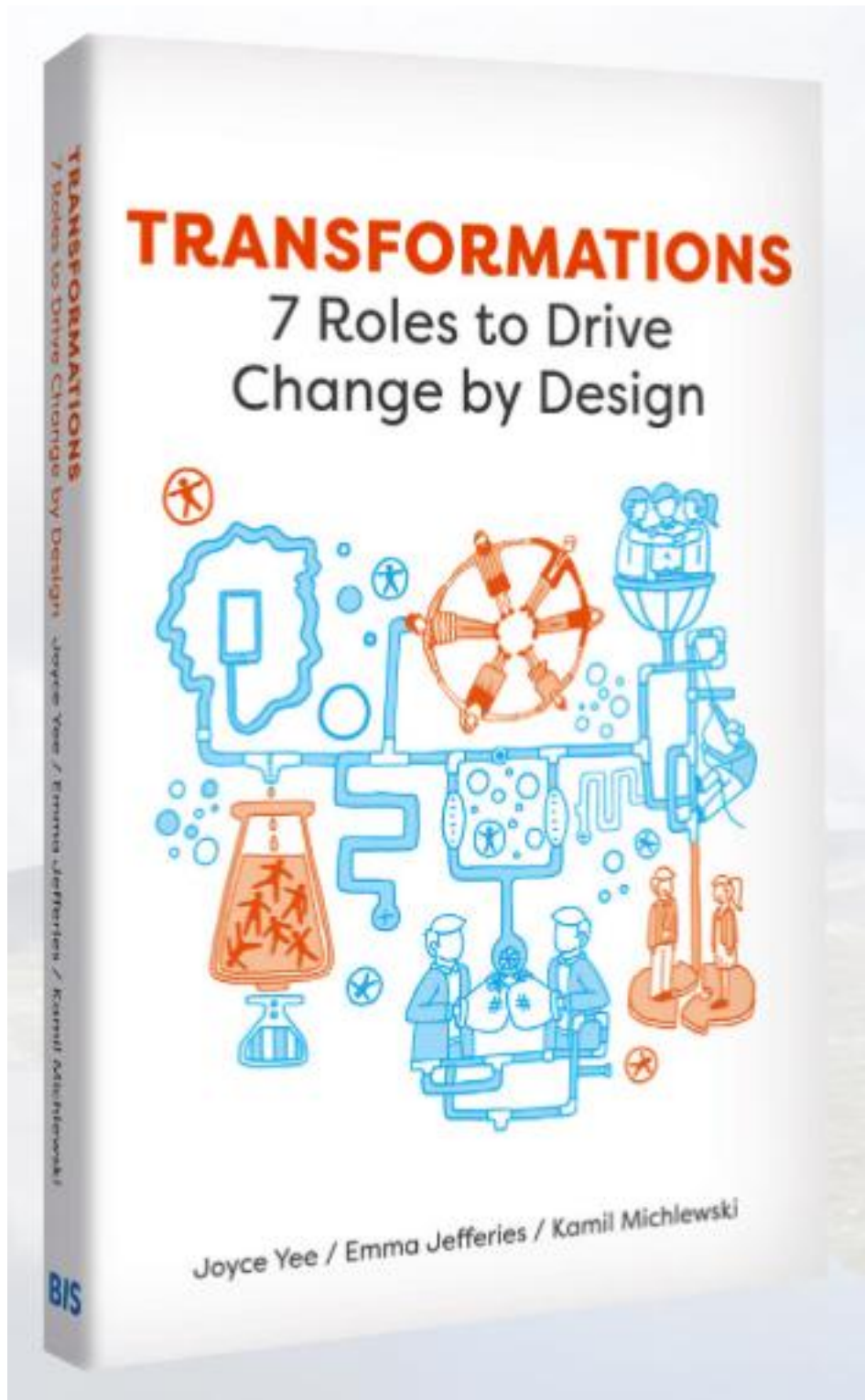
Pre-book form

Thank you for your interest in the book, 'The Design Journey of Prof. Sudhakar Nadkarni'. Few limited copies will be available for purchase on the day of IDC Alumni Meet, on June 11th, Sunday, 5:30 to 6:30 pm. Rest of the book orders will start shipping June 25th, 2017 onward.

* Required
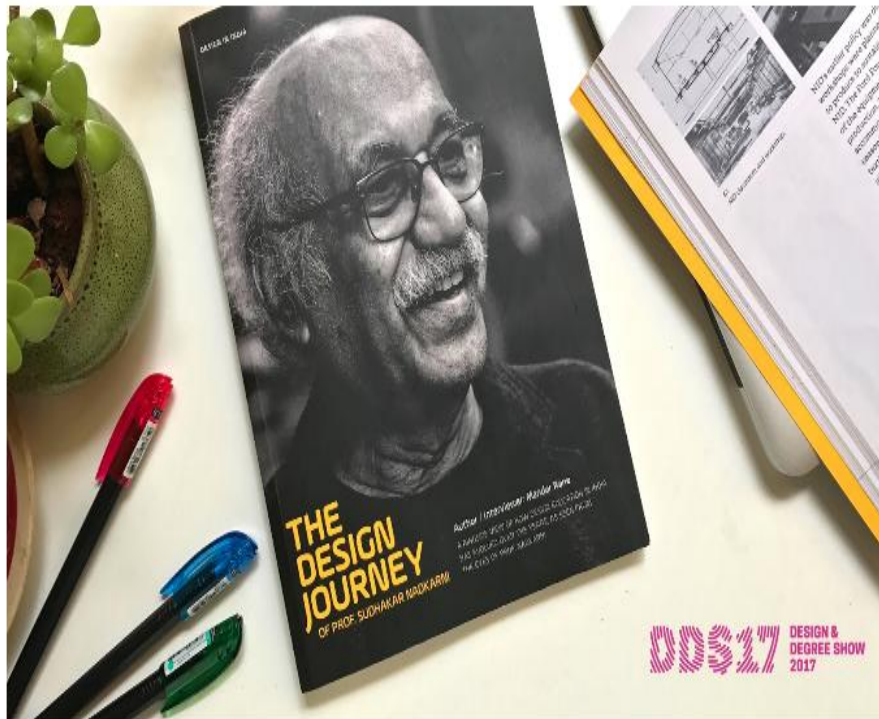
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Universal Design: The HUMBLES Method for User-Centred Business

"Universal Design: The HUMBLES Method for User-Centred Business", writtenby Francesc Aragall and Jordi Montaña andpublishedbyGower, providesaninnovativemethod to supportbusinesseswishing to increase the number of satisfiedusersand clients andenhancetheirreputationbyadaptingtheirproductsandservices to the diversity of their actual andpotentialcustomers, takingintoaccounttheirneeds, wishesandexpectations.

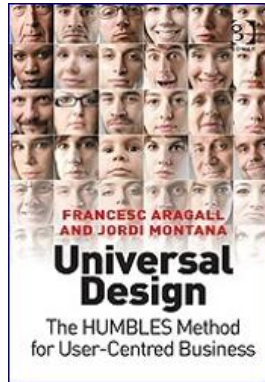The HUMBLES method (© Aragall) consists of a progressive, seven-phaseapproach for implementing Design for All within a business. Byincorporating the user'spoint of view, itenablescompanies to evaluatetheirbusinessstrategies in order to improveprovideanimproved, morecustomer-orientedexperience, andtherebygain a competitiveadvantage in the marketplace. As well as a comprehensiveguide to the method, the bookprovidescasestudies of multinationalbusinesswhichhavesuccessfullyincorporated Design for All intotheirworkingpractices.

According to Sandro Rossell, President of FC Barcelona, who in company withotherleadingbusiness professionals endorsed the publication, it is "requiredreading for thosewhowish to understandhow universal design is the onlyway to connect a brand to the widest possible public, increasing client loyaltyandenhancing company prestige".

To purchase the book, visiteither the **Design for All Foundation website**
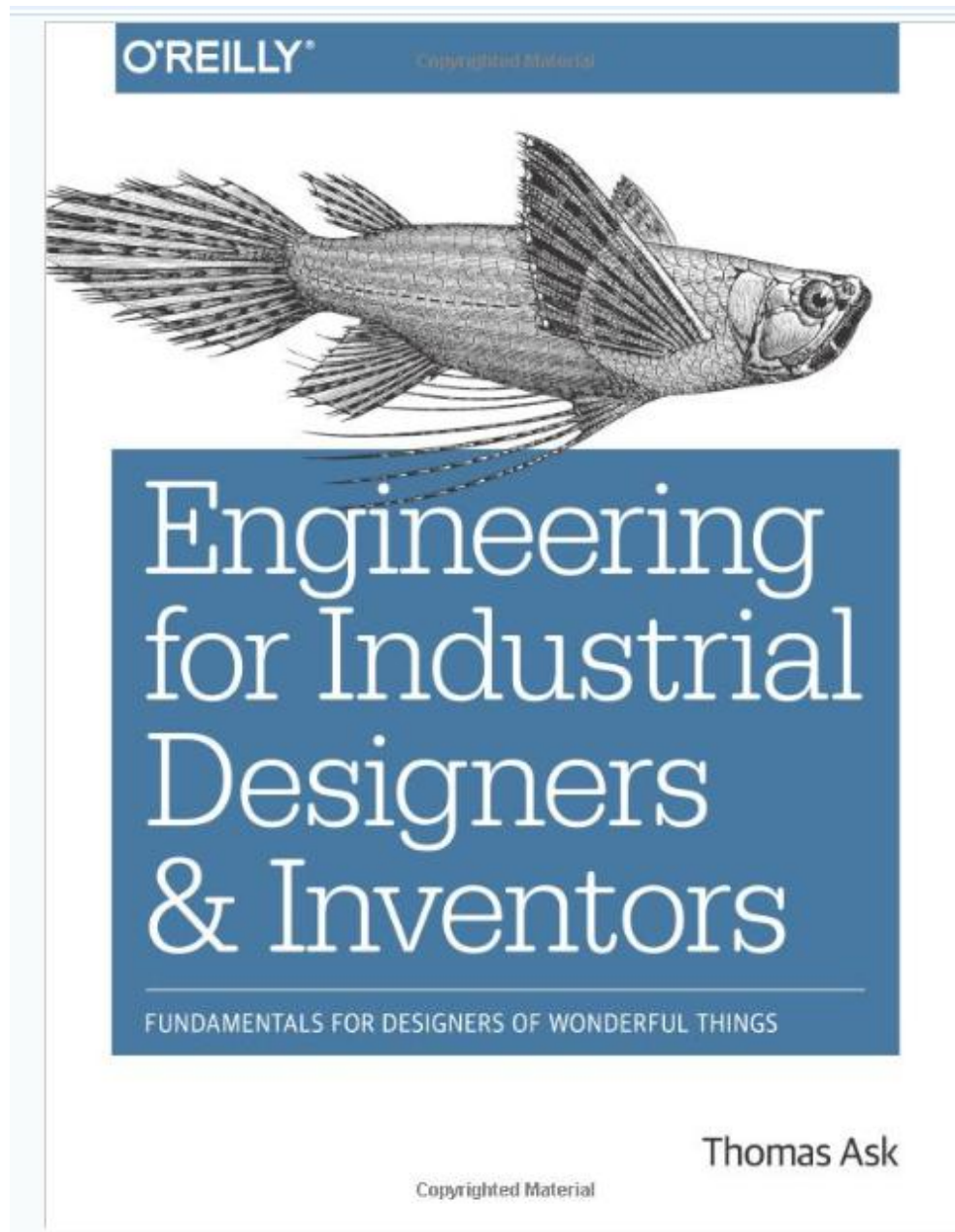
I have a new book that presents fundamental engineering concepts to industrial designers that might be of interest to you. This is the link:

https://www.amazon.com/Engineering-Industrial-Designers-Inventors-Fundamentals/dp/1491932619/ref=sr_1_1?ie=UTF8&qid=1506958137&sr=8-1&keywords=engineering+for+industrial+designers+and+inventors

Appeals

1.

SESSION – Work, Consumption and Social Relations: Processual Approaches to the Platform Society

organised by Chiara Bassetti (University of Trento), Annalisa Murgia (University of Leeds), Maurizio Teli (Madeira Interactive Technologies Institute)

In the last decades, the widespread adoption of digital technologies has been characterised by the increasingly intense use of "platforms" that burst into our everyday professional and personal lives (Huws, 2014; Kalleberg, Dunn, 2016; Srnicek, 2016), from consumption to working activities, from intimate relationships to new forms of organising as both workers and citizens (Scholz, 2016; Schor, 2016; Armano et al., 2017). Governments, companies, unions, and the academic community alike seem to converge on the idea that digital platforms represent a game-changer for economic, political and social activities and relationships. This is what we refer to as the "platform society", in which such platforms are supposed to change, when not to innovate, almost every aspect of social life.

The aim of this session is to critically engage with such an assumption, by focusing on platforms not only as techno-economic objects, but as processes of agencement (Deleuze and Guattari, 1980; Gherardi, 2016), in which subjects, artefacts, regulations, geographical contexts, technologies, knowledge, politics and economics may connect in different ways, in a mixture of

continuity with previous experiences and emerging practices. What is new, in the platform society, and what is a rearrangement of well-known economic and social processes – as the polarization of economic resources – is a crucial question which is not satisfactorily answered yet. Adopting a processual approach to the study of digital platforms allows challenging monolithic views of their nature and to understand the domination or emancipatory effects they may produce.

How are digital platforms designed, developed and implemented? Is it possible, and how, to re-appropriate their use and to challenge the current neoliberal economic model (Bassetti et al., 2017)? To answer these questions, a pluralistic and interdisciplinary analysis is necessary, in order to understand how digital platforms can be regulated, how computable algorithms are applied to several social activities – from consumption to employment relations – and how new forms of organising, involving both trade unions and social movements, can defend the rights of platform-workers at the global level. Finally, if we want to engage in a critical debate of the uses and effects of platforms, we should also interrogate our practices in using platforms both as individuals and in studying/designing them as a research community. An ethnographic approach able to look into the details of everyday practices of use, design, research and interaction, and the discourses surrounding and shaping such practices, represents a powerful tool to tackle the questions above by avoiding rhetoric and unilateral answers.

In this session, we solicit ethnographic and qualitative contributions, including comparative ones, that explore how digital platforms are enacted through different technologies, territories, timings and practices. Contributions may examine any of the following or related aspects:

·   Ethical registers beyond digital platforms;
·   The regulation of online platforms and the protection of workers' rights;
·   Workers and clients in the gig- and sharing economy;
·   The introduction of HR information platforms;

·   **The design and development of mainstream and alternative platforms;**

·   **Platform cooperativism and the counter-use of digital technologies;**

·   **Emerging forms of organising of trade unions and social movements in the platform economy;**

·   **The use of platforms for political actions.**

In this session, we invite an interdisciplinary conversation, and we welcome participation by academics, activists and unionists. Young scholars with "work in progress" papers are welcomed. We are interested in empirical contributions as well as empirically grounded theoretical explorations.

IMPORTANT DATES

- 15th January 2018: Abstract submission deadline

- 12th March 2018: Notification of acceptance

- 16th April 2018: Registrations deadline

- 06th-09th June 2018: Conference dates

2.

CIIC - Centro Innovación

Centro Internacional en Innovación Continua

Partners Search: Work Programme 2018-20

Dear potential partners,

On 27 October 2017, the European Commission presented the final

Work Programme for Horizon 2020, covering the budgetary years 2018, 2019 and 2020 and representing an investment of around €30 billion. Horizon 2020 is the biggest EU research and innovation funding programme ever.

The vast majority of this funding is allocated on the basis of competitive calls which are open to applications from researchers, businesses and other interested organisations located in any of the EU Member States or countries associated to Horizon 2020.

We are preparing applications for the following Projects:

- TRANSFORMATIONS-01-2018: Research for inclusive growth: addressing the socioeconomic effects of technological transformations.
- DT-TRANSFORMATIONS-07-2019: The impact of technological transformations on children and youth.
- MIGRATION-05-2018-2020: Mapping and overcoming integration challenges for migrant children.
- DT-MIGRATION-06-2018-2019: Addressing the challenge of migrant integration through ICT-enabled solutions.
- TRANSFORMATIONS-05-2018: Cities as a platform for citizen-driven innovation.
- TRANSFORMATIONS-14-2018: Supply and demand-oriented economic policies to boost robust growth in Europe – Addressing the social and economic challenges in Europe.

Eligible partners:
- a non-profit organization, association, NGO;
- a public or private, enterprise;
- a public body at local, regional or national level;
- a higher education institution

If you want to cooperate with us, please contact us: info@ciic.eu

News

1.

Ahmedabad design school students launch apparel brand

AHMEDABAD: In a fine example of turning their educational learning into an entrepreneurial opportunity, students of Unitedworld Institute of Design (UID), a constituent of Ahmedabad-based Karnavati University, launched a clothing label - Colour Me Young (CMY) - by organizing a fashion show in Ahmedabad on Saturday. While the show was curated with the help of industry veterans to give the process a professional touch, it was the effort of students that led to the creation of a line of garments.

"We've been working on this project for some three years and it's not an overnight effort. Working with different designers was an enriching learning experience and we came up with different collections of garments using gold fabric and experimental fabric,

among others. Putting it in the form of a fashion show was indeed a cherry on the cake because we wanted people to know what we were doing and getting to showcase it at student level is near impossible," said Drisha Roy, third year fashion design student of the institute, who was part of the team that came up with the collection.

She also added that they received orders which rewarded their efforts. The idea behind the institute engaging students in such an initiative was to give students a completely professional experience. Sharing more details, Ritesh Hada, president, Karnavati University, said, "Fashion is a highly competitive industry. The launch of CMY inspired UIDians to strive for excellence that is at par with the industry standards, which are reinvented by veterans from time to time. It helped students explore the finer aspects of apparel fashion in the fast changing industry."

A number of leading designers with whom the students worked include fashion choreographer, Shakir Shaikh, along with leading designers - Pooja Agrawal, Digvijay Singh, Krunal Parekh and Kasheesh K.

(Courtesy: Times of India)

Programme and Events

The Third International Conference on Universal Accessibility in the Internet of Things and Smart Environments
SMART ACCESSIBILITY 2018
March 25, 2018 to March 29, 2018 - Rome, Italy

THE ANNUAL INTERNATIONAL BERKELEY UNDERGRADUATE PRIZE FOR ARCHITECTURAL DESIGN EXCELLENCE 2018

2018 berkeley prize
Applying the Social Art of Architecture

ABOUT THE PRIZE
ESSAY PRIZE COMPETITION
TRAVEL FELLOWSHIP
PREVIOUS FELLOWSHIPS

Click on photograph for details.

2018 2017 2016 2015 2014 2013 2012 2011 2010 2009 2008 2007 2006 2005 2004 2003 2002 2001 2000 1999

TWENTIETH ANNIVERSARY!

The 2018 NKBA Design Competition Is Open

The 2018 NKBA Design Competition is open and accepting submissions. The annual competition provides the opportunity to recognize the association's designer members for their outstanding kitchen and bath projects completed between Jan. 1, 2016, and Aug. 4, 2017.

Typoday 2018

International Conference, workshop, exhibition:

Typography Day 2018

1st to 3rd March 2018 at Sir J J Institute of Applied Arts, Mumbai, India

http://www.typoday.in

CHI 2018 One Day Workshop on

Designing Mobile Interactions for the Ageing Populations

Sayan Sarcar, Cosmin Munteanu, Jussi Jokinen, Antti Oulasvirta,
Neil Charness, Mark Dunlop and Xiangshi Ren

Montréal, Canada — April 2018

More details to follow....

Global Conference on Integrated Care

GCIC 2018

2018 ADVANCE! Accelerating the Integration of Care

1 - 3 FEB | Resorts World Convention Centre
Resorts World at Sentosa, Singapore
8 Sentosa Gateway, Singapore 098269

REGISTER NOW

Early bird rates end on 30 September 2017

ABOUT THE CONFERENCE

The **Global Conference on Integrated Care (GCIC) 2018** is an international conference that will bring together clinicians, health and social care professionals and practitioners, and policymakers from around the world to share knowledge, experiences, ideas and innovations

Join us for the **2018 EDRA49 Annual Conference** in the **Oklahoma City, Oklahoma!** Walk along the streets of Oklahoma City, home to an attractive variety of historic buildings. Eye-catching religious buildings, and magnificent structures of great architectural and historic significance. **Stay tuned for registration to open in late Fall.** Check out what OKC has to offer, click here.

purpose.do

 The **21ˢᵗ ASEF Summer University (ASEFSU21)** **will take place on 27 January – 10 February 2018 in Melbourne (Australia) and Christchurch (New Zealand) exploring the topic of Youth with Disabilities**

Job Openings

1. Job Opening

If anyone wants to apply for UX/ game design role in a VR startup, then check out the description below. The startup is http://www.livelikevr.com/ and the job is based out of Gurgaon.

About company: LiveLike is a funded and well-endorsed VR/AR/interactive live sports company. We have partnered most notably with FOX Sports to release Social on Fox Sports VR. We also broadcasted Superbowl LI and created French Tennis Open VR with France TV for both Mobile and VR platforms. These are just a few of the many clients we work with and we're actively growing in all four corners of the world.

About team: "Interaction design is an important part of our process and a key element to bring life to the experience. At present we have 2 UI/UX designers, 1 interaction designer, 1 graphic designer and three 3D artists between NYC and Gurgaon."

Responsibilities:
- Working remotely with the design team in NYC on R&D to build new features and rules of interaction. We are developing a new architecture that need to work for mobile native interfaces, Gazed system interfaces as well as VR controllers. The designer will work from the research phase to the final deliverable of features with the design team.
-Working on multiple apps for multiple clients to customize our sports experience. It include upgrading the interfaces and exporting all the assets for the devs (menu, stats, players infos, graphic overlay, etc).
- Working on graphic work for the 3d environment (posters, frames) in collaboration with 3D artists in India.

Bonus:
Strongly interested in designers that can prototype in Unity and have knowledges in game design. Send your resume and portfolio to Jérémie Lasnier, Chief Creative Officer jeremie[at]livelikevr[dot]com

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