Transgenerational Design
Design for Every Age
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All education springs from images of the future and all education creates images of the future… Unless we understand the future for which we are preparing we may do tragic damage to those we teach. — Alvin Toffler

Introduction: Three features - a long standing interdisciplinary collaboration, a university rapidly developing ground-breaking approaches to innovative learning, and an educational mission to inspire students to challenge status quo - formed the nucleus of an ongoing project to design for all ages. This paper will describe results of recent interdisciplinary work at Philadelphia University. It relates experiences developing in learners an awareness of all audiences. We will describe what happened when we took the focus from the applications of technology and economy and looked instead to applying our abilities to design for people of all ages. Technology will change, the economy certainly must change, aging will remain constant. In this spirit, we asked the questions: what happens when one re-designs a familiar environment from the perspective of safety and comfort of users of every age? Moreover, how do you instruct a diverse group of learners to respond to the demands aging places on practice?

The project, called the Summer Project on Aging, used a single space as its main example – the home bathroom. Bathrooms are a locus of activity in most homes. In bathrooms serving users of all ages, one finds many areas for design improvements. As a representative section of the bathroom topic, the Summer Project used the vanity area comprised of the sink, faucets, counter, backsplash, storage, mirror, lighting, and flooring. A team of disciplinary experts applied their skills to studying, redesigning, and promoting designs for a vanity area that would meet the needs of users from post potty-training age to the older members of a household. Narrowing the topic space to the area around the vanity did not narrow the number of aspects that required study. The project sought to study a transgenerational environment to isolate tools and practices that would inform our teaching about design for all ages.

Why aging? Our future is going to be populated by more individuals over fifty than ever before. Our future has the potential to offer independence to individuals in ways never imagined by our grandparents. Today's designers should be trained to meet the needs of a different, less homogeneous, more mobile, longer-lived population. This paper discuses two related programs developed at Philadelphia University to evolve methods of training future practitioners of several disciplines to meet the needs of this different audience.

OT/ID Collaboration: We have experience in meeting different needs. Since 1998, the Ergonomic Studies course in the Industrial Design (ID) Department of the School of Design and Media has participated in a unique collaboration. ID students collaborate with students in the Occupational Therapy (OT) graduate program in the School of Science and Health to design adaptive and assistive devices for real OT clients. At the University, ID teaches a form of Experiential Ergonomics, using the human body as a textbook. Experiences, abilities, understanding, and motions are analyzed in learning experiences prompting learners to develop theories as to how to manage relationships humans have to the built environment. OT learners are required to work with clients living in the community for several portfolio projects as part of their fieldwork education. In the OT/ID collaboration, clients are interviewed to select areas of everyday living where objects could be redesigned to either perform better for the client or the client's caregivers, or enable the clients to manage daily living activities more independently. Student Industrial Designers and Occupational Therapists meet with the client, interview, observe, and measure. Clients are often filmed and photographed as they complete tasks they have selected to improve.

OT learners gather information using a variety of tools, one of which is the Canadian Occupational Performance Measure (COPM) (Law et al., 1998). This assessment identifies areas of need for the project. ID learners conduct field measurements and collect data for task/tool analyses. Together, teams study results, selecting one task that each client would like assistance in accomplishing. To begin the design process, teams search for existing adaptive/ assistive devices, rating them for usability against performance criteria. Teams then generate initial proposals, through drawings and mock-ups, for revised or new devices to address their clients' needs. Users and experts review these proposals, test mock-ups, and suggest refinements. Teams then dimension proposed solutions and prepare functioning prototypes for client tests. Testing reveals other improvement opportunities. Teams then make a public presentation of the devices.

This collaborative project has created over 200 adaptive and assistive devices. Original prototypes from the project's first years are still in use. Data from real world testing of the prototypes is valuable in shaping further assistive design development. A pedagogical reality of the project is that learners are usually healthy nineteen and twenty – something people. Physical performance profiles of these learners vary little, whereas a range of ages and variety of physical, cognitive, and sensory challenges influences performance profiles of the clients. Project participants must consider performance that is usually far different from their own. Collaboration with OT on this project presents designers with opportunities to explore extremes of human performance. This experience raises awareness in the ID learners of their designs impact on the everyday activities of people. To date, teams have designed a range of devices, including:

- body-positioning devices for adults with arthritis in the back and hips, allowing them to perch while working at the kitchen counter, returning them to a task they truly enjoy.
- devices for children with weak foot muscles to provide the stability needed for their feet to stay on pedals and facilitate bike riding.
- for older persons who use wheelchairs, devices that support and reposition areas of the body to promote computing or sewing activities.
- a study of our daily chores has yielded many everyday devices for the kitchen, some supporting food preparation safety while using only one hand.
- devices for bathing and grooming that help individuals with cerebral palsy present a fresh, confident face at their place of work.
- some devices support hobbies; such as tools that allow a gardener with an inability to bend to return to her beloved flowers.
- the collaboration has investigated assistive devices for helping children and others to learn to tie their shoes, type, hold pencils, draw, and a host of eye/hand control manipulative devices.
- students have developed cognition/organization devices, such as a money-counting wallet, helping a teenager living with Downs' Syndrome to bus to the mall to buy a CD and lunch.
- teams were challenged to investigate sensory augmentation to make visually "noisy" toys for toddlers with hearing impairments.

Figure 1: OT/ ID Project examples – Philadelphia University

Ten years of OT/ID collaborations serve as a basis for other collaborations and research into meeting the needs of more diverse audiences through Science, Architecture, Engineering, and Design. A recurring theme in these additional efforts is how to make design decisions affecting very broad audiences.

Evolving Transgenerational Design: A new collaboration between ID, OT, and Architects
In 2008, the Board of Trustees approved a Strategic Plan to shape the future direction of the University. Many of the plan's objectives stem from the design disciplines and pose challenges to the University community as a whole. The Plan charges the University to "promulgate an academic learning community that will embrace the key elements of the design, engineering, and commerce curricula where constant collaboration and teamwork are the keys to creating successful leaders" (Philadelphia University, 2008). The plan calls for a new school, DEC – for Design, Engineering, and Commerce. As the DEC model develops, collaborations are also forming to develop what might be called a commonwealth of innovation. In this structure, design problems are solved from opportunity to concept to product to market all within the University.

In 2009, the University studied topics affecting our future as subjects for DEC projects. Aging, aging in the home and aging in a multi-generational family setting were among topics proposed for study as the University sought to draw together disciplines to share language and methods. In this spirit, the Deans of the Schools of Science and Health, Architecture, and Design and Media decided to group the team and methods from the OT/ID collaboration with members of the School of Architecture to study aspects of aging in the home. A larger DEC workshop, called a Charrette, met in the Spring of 2009 and isolated the topic of safer bathrooms for the multi-generational home. The new OT/ID and Architecture team decided to select the bathroom as the topic for a special Summer Project. A proposal for the 2009 Faculty Grant was written with the purpose to explore evaluation methods, propose design solutions, and promote new educational content around the topic of bathrooms serving the very young to the very old. The grant was awarded in April of 2009, and the Summer Project began in June of 2009.

Project participants and structure: The project's three principal researchers and team members were drawn from each of the participating disciplines. (See Appendix A). The OT participants were one professional and two soon-to-graduate Master's learners. The ID participants were volunteers representing all years of the program, recent graduates, and professionals with one and two years of experience. The Architecture team was comprised of members of the 5th year Architecture studio course. In all, the project had a 25 - member team. For six weeks, the team worked to 1) isolate the needs of the various age groups, 2) identify the limitations and opportunities presented by the bathroom space, 3) build mockups and models, 4) measured, 5) created and reviewed drawings, and 6) produced computer simulations. At the end of the six weeks of studio work, the team restructured into separate teams for 7) refining design proposals, 8) creating full-scale test models, and 9) preparing project documentation.

This transgenerational project represents one of the first learning projects based on a DEC Charrette, and as such, the team outlined three broad objectives for the Summer Project. The results in each of these areas of this project will generate additional areas of research for a proposed DEC Aging Institute that will bring together teams of professionals, researchers, and educators to explore the topics in depth.

Outcome 1: Creation of evaluation methodologies/tools: A literature review examined existing transgenerational guidelines, the team studied Universal design standards, guidelines of the Americans with Disabilities Act and best practices recommended by the American Occupational Therapy Association. To these we added, 1) processes for determining transgenerational sizing, 2) relational methods to determine body stance across the years, and 3) conceptual frameworks for observing cognition and motion. We wanted to create some evaluation tools to critique spaces, fixtures, and relationships users have to the bathroom. We wished to inventory and

categorize the space, its contents, and activities occurring within. We used familiar tools developed for the OT/ID collaboration and added to them new variants that exposed potential problems in single generation or condition-based solutions to space problems. While we were able to develop some assessment frameworks to observe and categorize issues, more research is recommended to develop specialized frameworks for evaluating transgenerational concepts.

Occupational Therapists base clinical decisions on information gained from multiple venues including observation, interview, formal assessment, and standardized performance measures. Assessments are selected to evaluate individual person, environment, and occupation factors, appraise occupational performance, or to predict outcomes (Law, Baum, and Dunn, 2005).

Some existing evaluation tools include the Home Falls and Accidents Screening Tool (HOME FAST) (Mackenzie, Byles & Higginbotham, 2000), Safety Assessment of Function and the Environment for Rehabilitation – Health Outcome Measurement and Evaluation (SAFER-HOME) (Chui, Oliver, Marshall & Letts, 2001), and an observational aid, the Westmead Home Safety Assessment (Clemson, 1997). The Environmental Functional Independence Measure (Enviro-FIM) addresses environmental influences on occupational performance linking the demands of the environment with a person's occupational performance capacity (Steinfeld & Danford, 1997). These tools are generally performance-based and require the assessors to rely on their clinical expertise to provide recommendations. There are several consumer-oriented self-assessment tools distributed by organizations such as AARP that focus on improving safety in the home by reducing environmental hazards (such as loose carpets, poor lighting, uneven flooring, etc.)

Occupational therapists typically utilize performance-based assessments to determine an individual's ability to function in an environment. Evaluating how a person performs in his or her environment allows us to create an intervention uniquely tailored to the person's occupational needs. For this project, the team's goal was to establish the person-occupation-environment fit so that the bathroom could be designed to support users across generations who possess a range of abilities. Using the environment as the unit of measure, rather than the person, provided us with the opportunity to focus on what is occurring at the person-environment and occupation-environment levels. To this end, the team identified a series of factors to be considered in the design process.

In the Summer Project, like the OT/ID projects, collaborators share terminology and technique. ID and Architecture learners were exposed to the Canadian Occupational Performance Measure that their OT partners use to "detect changes in a client's self-perception of occupational performance over time" (Law et al. 1998, p. iv). Student therapists interview clients regarding their levels of performance and satisfaction in three distinct areas of life -- self-care, productivity, and leisure. The interview tool provides a meaningful structure to establish rapport and obtain performance-related information from the client's perspective. Results are documented and serve as a baseline for reassessment after therapy ends. The OT faculty at Philadelphia University views the unique focus of the profession to be occupational performance -- enhancing the fit between individuals, their environments, and the occupations in which they engage. This perspective, articulated within the Canadian Model of Occupational Performance highlights the interrelatedness of three aspects of our lives -- the person, environment, and occupation. Change in any part of the person-environment-occupation interaction affects the other parts (CAOT, 1997).

Industrial Designers offered their OT and Architecture partners two frameworks for performing similar analyses. Design students learn a form of task/tool analysis called *7, 14, 28*, developed as a teaching method by Mike Leonard, IDSA, MA.Ed. Designers observe a simple task and reduce the observation to a set of seven steps. Designers then review these steps while asking questions about the positioning of the person, the tool, the supplies, and any other components. The steps involved in locating the tool and using the tool are added and the original seven steps

become fourteen. One additional task-observation is made. Designers focus on the areas of the task that require user judgment – for example, how much force is required to use the tool, how many turns, and so forth. Combining all of the steps presents the designer with approximately 28 steps. These observations, made at increasingly higher levels of detail, exposes similar information as the Occupational Therapists' task analyses (Kielhofner, 2009). The main difference lies in the attention that the designers pay to the object, as compared to the therapists' attention to the user. Sharing these tools introduced OTs and Architects to the notion of treating tools as though they were clients in need of help.

Outcome 2: Proposal examples as virtual and physical prototypes: As the team isolated, created and debated approaches to the emerging issues faced by all users of the vanity space, dimensional drawing, perspective sketches, and photographs documented new design categories. Proposals were made to relate the measures of human actions in the space to characteristics of the space. Drawings and full-sized mockups were created, bringing humans into the space to verify and challenge new beliefs. Children's dimensions were contrasted with adults and with senior adults. Reach, sightlines, ranges of motion at different stages of development were overlaid to isolate commonalities and to find outlying areas where new ergonomic considerations had to be made. Testing led to more concepts and drawings until a few consensus concepts were generated to be built as full sized models, and digital virtual models.

Figure 2: Images from the Summer Project on Aging and Transgenerational Design - Philadelphia University

The purpose of the Architecture course was to build learners' knowledge of how buildings are constructed. The Architecture team needed to build a wall, make a floor, and understand the structures behind the design. The goal for this aspect of the project was to create a real room to apply the transgenerational thought, not a refined hypothetical room that would avoid some of the features that are in most homes. The OT team performed site visits and gathered examples of many bathrooms, some of which were specially outfitted for the elderly, and some that were multi generational. The OT/ID Architecture team evaluated these rooms and came to some shared conclusions. 1) The existing layouts of most of the fixtures seemed more a function of matching fixtures to plumbing than placing components for ease of use. 2) The retrofitting of grab bars and other assistive components seems to be largely a compromise between the tools and the building's structure than a careful study of where these components are needed the most. 3) The

surfaces and the support systems may need to be advanced beyond standard building practices. 4) Retrofitting an existing space is a high probability for individuals aging in place and for multigenerational families. The compromise bathroom works equally poorly for everyone. In the retrofit bathroom, the Architecture team agreed with the I D team that the OT team showed that the best retrofit answer might be to remove existing fixtures and begin again.

Outcome 3: Guidelines for further studies in classes – content guidelines, lesson plans, seed projects: The last outcome was to disseminate the research, to give other disciplines ideas and to frame future conversations about the topic of transgenerational design. The Summer Project team will share its research in an effort to attract other collaborators in other disciplinary contexts to grow the knowledge base about designing for every age. The team has isolated areas for further study for projects that join Designers, Occupational Therapists, and Architects with Marketing, Graphic Design, and Materials Engineering learners. Connections through projects about designing for all ages can be made throughout the campus:

1) Create programs that investigate the economic realties of aging in the home. In a study of older adults with functional limitations living at home, Stark (2004) found that removing environmental barriers improved the adults' occupational performance and satisfaction in performing everyday activities. This study differs from previous studies that looked at utilization rates of modifications, or healthcare costs as outcome measures. In this study, outcome measures were based on each of the subject's individual goals as measured by the COPM. Following this example, partnerships with the School of Business may further define the market for products and spaces that serve broader age groups. Projects that relate the cost of accidents to individuals to the original costs of products and spaces may resolve any market resistance to transgenerational design.

2) Establish best practices that challenge conservative views of products. ID team members, reviewing the information provided by OT, and structural, space planning concerns of Architect team members, proposed that bathroom vanity areas no longer be viewed as discreet components applied to surfaces. To meet needs of young and old users, they proposed that the vanity and all of its related objects should be treated as though it were an appliance, placed in the space, and attached to its support utilities. Collaboration with Engineering learners could resolve the product opportunities presented by the 'Vanity appliance." Some new designs might be: a) a plumbing manifold placed like an electrical junction box in the wall b) a system of flexible cross-linked polyethylene water and drain lines and compression fittings to manage variations in the as-built environment, c) movable sinks, both height adjustable and approach adjustable, d) adaptable faucets, e) modular storage with variable access, f) graspable surfaces – both in shape and materials, and g) self cleaning, self drying floor surfaces.

3) A further collaboration with Design, Architecture, and Business could develop a bathroom franchise service to install, repair, and upgrade the bathroom appliances. In this proposal, the bathroom could age with the population and take advantage of new developments in technology. Architecture team members could team with Interior Design, and Graphic Design to match space layouts, surfaces and finishes to aid perception, memory, and promote safe use.

Conclusion: As the team concludes the activities of the Summer Project, members are beginning to spread the word about designing for every age. The team notes that they will no longer look at spaces and objects from a single user vantage point. Preventing falls and accidents have dominated recent project discussions. Bathroom spaces once considered safe become increasingly difficult to use because of changes associated with physical, cognitive, and sensory changes experienced by older persons. The health and financial costs resulting from injuries associated with falls and accidents in the home is $179 million for fatal falls and $19 billion for nonfatal fall injuries (Stevens et al. 2006, cited in National Center for Injury Prevention and Control, n.d.). Statistics reported by the National Center for Injury Prevention and Control indicate

that unintentional falls accounted for over 16,000 deaths, and more than 433,000 non-fatal injuries in a single year – 2005 (CDC, 2005, cited in National Center for Injury Prevention and Control, n.d.). Some of the factors associated with falls have to do with elements internal to the person such as history of falling, risk-taking behaviors, sensory changes, and medication side effects. Other elements external to the person, or extrinsic factors, are the result of environmental hazards such as slippery surfaces, unsafe equipment in the bathroom, or temporary obstructions in passageways (Woodland & Hobson, 2003).

The Summer Project results will inform other initiatives at Philadelphia University. The Industrial Design Department will initiate a semester long transgenerational project featuring collaboration with the School of Business. In this project, we will call upon a variety of experts among them, James Pirkl, FIDSA noted expert on transgenerational design to explore the applications of some of the evaluative tools defined in the Summer Project. Student team members of the summer project will present component parts of the work of the Summer Project to other disciplines to explain the practical approaches to adding considerations about aging to existing design methods. The University will use elements of the Summer Project as seed projects to develop a larger Aging Institute that will bring to campus leaders in healthcare, like noted gerontologist Joel Posner, M.D., industry and community representatives, and others to examine new opportunities to remove generational barriers from our built environments. Design proposals from the Summer Project will be evaluated by all of the schools of the University for the potential to become subject matter for class projects.

References

Canadian Association of Occupational Therapists. (1997). *Enabling occupation: An occupational therapy perspective.* Ottawa, Canada: CAOT Publications Ace

Chui, T., Oliver, R., Marshall, L., & Letts, L. (2001). *Safety assessment of function and the environment for rehabilitation tool manual.* Toronto, ON: COTA Comprehensive Rehabilitation and Mental Health Services.

Clemson, L. (1997). Home fall hazards: A guide to identifying fall hazards in the homes of elderly people and an accompaniment to the assessment tool. The Westmead Home Safety Assessment. *British Journal of Occupational Therapy, 62,* 171-179.

Kielhofner, G. (2009). *Conceptual foundations of occupational therapy practice (4th ed.).* Philadelphia: F.A. Davis.

Law, M., Baptiste, S., Carswell, A., McColl, M.A., Polatajko, H., & Pollock, N. (1998). C*anadian Occupational Performance Measure (3rd ed.).* Ottawa, Canada: CAOT Publications Ace.

Law, M. Baum, C. & Dunn, W. (2005). *Measuring occupational performance* (2nd ed.). Thorofare, NJ: Slack.

Mackenzie, L., Byles, J., & Higginbotham, N. (2000). Designing the Home Falls and Accidents Screening Tool: Selecting the items. *British Journal of Occupational Therapy, 63*, 260-269.

National Center for Injury Prevention and Control. (n.d.,) 10 leading causes of death, United States, Retrieved July 31, 2009 from http://webappa.cdc.gov/cgi-bin/broker.exe

Stark, S. (2004, Winter). Removing environmental barriers in the homes of older adults with disabilities improves occupational performance. *OTJR, (1)*24, 32-39.

Steinfeld, E., & Danford, G.S. (1997). Environment as a mediating factor in functional assessment. In S. Dittmar & G. Gresham (Eds.), *Functional assessment and outcome mreasures for the rehabilitation health professional* (pp. 37-56). Gaithersburg, MD: Aspen.

Toffler, A. (1974). Learning for tomorrow: The role of the future in education. New York: Vantage Books/Random House.

Woodland, J.E., & Hobson, S.J.G. (2003). An occupational therapy perspective on fall prevention among community-dwelling older adults. *Canadian Journal of Occupational Therapy, 70,* 174-181.

Appendix A: About the Project Team

The lead researchers for the interdisciplinary team are:

Wendy Krupnick, PhD, OTR/L, is the OT Program Director at Philadelphia University. She is interested in multi-disciplinary collaborations to enhance project outcomes and increase OT awareness.

David Kratzer, AIA, NCARB, is Adjunct Associate Professor of Architecture at Philadelphia University and a founding principal of BAU Architecture. He specializes in municipal, educational, hospitality and health care projects. In his teaching and research, David focuses on the relationship between technology and architectural making.

Michael J. Leonard, IDSA, MA, Ed is an Associate Professor in the Industrial Design Department. He teaches Design Studios and is responsible for developing and teaching the Experiential Ergonomics course model for Philadelphia University. He is one of the founders of the collaboration with Occupational Therapy, and a DEC Discipline Champion for the School of Design and Media.

The Occupational Therapy team included the following individuals:

Patricia Cheney, M.B.A., OTR/L is an OT and Regional Mentor with Fox Rehabilitation. She has been a fieldwork educator in acute care, geriatrics, and home health settings. She has served on the professional advisory committee for Jeanes Hospital, as a designer for accessible playgrounds, and as a medical writer on Tysabri for multiple sclerosis. She is currently a member of the Fox Dementia Task Force.

Janelle Magee-Murray, Carol Ann Plunkett and Amy Schwab, M.B.A., are all graduate OT students in their final academic year who contributed to this interdisciplinary effort. Janelle brought her experience as a Certified Occupational Therapy Assistant to the group. Amy also has seven years work experience as the Coordinator of Disability Services at Philadelphia University.

The Architecture team - members of the ARCH-402-1 Design VIII course:

Yoshi Hanaoka	*Kristen Joaquim*	*Derrick Linton*	*Aaron Nawrot*
Bill Heidt	*Rachel Krumbach*	*Sheila Mehr*	

The Industrial Design team - professionals, and students from all years of the ID program:

Rocco Avallone, BSID, Project Videographer	*Tim Brown, BSID*	*Seton Spadt*
Eliot Coven	*Ryan Flynn*	*Jeff Steel*
Brian Kennedy	*Geoff Quinter*	*Joe Wengloski*
Erich Spannhake, Project Photographer		