The education of a Gerontechnologist: Patterns in my life

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N. Charness. The education of a Gerontechnologist: Patterns in my life. Gerontechnology 2020;19(2):96-101; https://doi.org/10.4017/gt.2020.19.2.002.00 **Background** Gerontechnology is a growing field with a mission to shape and develop technology tools and training that can enhance the quality of life of aging adults. It offers the opportunity to researchers in a diverse set of disciplines to learn and grow together in the service of that opportunity. The goal of this paper is to describe my career trajectory from the perspective of a developing gerontechnologist. **Research aim** Describe patterns, influences, and influencers that have shaped my career. The review focuses on identifying significant events that led me from early work on understanding expert performance to the field of aging and cognition and on applied aging research making use of human factors methodology. **Methods** I review my formal and informal educational experiences as new research challenges arose in the context of societal changes. **Results** Opportunities provided by academia through formal education (McGill University, Carnegie Mellon University) and later through employment (Wilfrid Laurier University, University of Waterloo, Florida State University) coupled with happy accidents, as well as privileges such as sabbaticals, leaves, and new writing assignments, provided me with the chance to shift research areas multiple times, eventually settling into gerontechnology research. My research was also shaped by societal trends such as the microcomputer revolution and the shift in funding from individual to team research (CARNET, CREATE). **Conclusion** The range of research challenges that I have been fortunate to pursue was made possible by a complex web of influential teachers, students and colleagues, universities and institutes, professional associations, taxpayers in multiple countries, and most importantly, through family support.

Keywords: Gerontechnology, education, aging, technology, human factors, CREATE, family

It is always a risky business to look back on a career and pinpoint how it developed, because, as one of my former colleagues at University of Waterloo has shown, we are quite prone to interpret past events in the light of current understanding (Ross, 1989), substituting theorizing for memory. Nonetheless, I attempt to highlight some of the many events, collaborations, and influences that are at least partly responsible for nudging me into the field of gerontechnology.

Undergraduate education (1965-1969)

I was fortunate to be admitted to McGill University in 1965. McGill was then, and still today, a leading-edge university in Canada. I had graduated from the Province of Quebec's 11-year high school program, from a science class at Westmount High School, so entered the Bachelor of Science program taking a standard set of courses for the first year. I found out that I did not enjoy physics, chemistry, biology, calculus, so switched to Arts in my second year, taking psychology, sociology, philosophy, English literature, and French. My performance improved and I was particularly intrigued by Donald Hebb's 'Introduction to Psychology' class. Hebb, a giant in the new field of physiological psychology (today we would call it neuroscience), made psychology quite understandable and appealed to my interest in the scientific method, in this case, applied to behavior. I specialized in psychology in my third year, taking courses in topics such as perception, motivation, and statistics. I did well enough to qualify for the honours program in my final year and had to choose an advisor. I was given a list of potential candidates in alphabetical order. I vaguely remember that Professor A was not in his office the day I went looking and moved on to Professor Albert Bregman. In that meeting, we established an easy rapport and he became my advisor. Under his guidance, I started working on a problem area that shaped my way of thinking about one aspect of human cognition.

At the time, there were two theories of pattern recognition: prototype theory and feature theory. The problem to be solved was how people recognized visual objects when the pattern that even identical objects formed on the retina was always slightly different, depending on point of view. Feature theory drew on work by Hubel and Wiesel that would later be awarded a Nobel

prize in medicine. The retina fed information to the cortex that had layers of specialized cells that picked up basic features such as edges and bars, that were concatenated into objects by further layers, perhaps culminating in a cell deeper in the system that would recognize your grandmother's face when she cast an image on your retina. Features were somewhat invariant over visual transformations such as angle of view and motion in a particular direction, hence, in theory, the same object could be matched to its internal representation as long as it was not seen from too different a perspective than its original encounter because its features were always present. Prototype theory suggested that experience with an object, seen from different points of view, led to an abstract representation, a prototype, that may never have ever been encountered (e.g., Galton's work on superimposing faces, which one of my colleagues at University of Waterloo, Joseph Psotka, later took up). We tried to bridge this debate by generating abstract lobular (not edge demarcated) shapes from different visual perspectives, shapes generated courtesy of my brother Michael's sketching and doodling abilities, concluding that people stored not only prototypes but also specific transformations that enabled them to map to perspectives that they had not previously encountered. (Charness & Bregman, 1973).

Given that I had caught the psychology bug a bit late as an undergraduate, as I wrapped up my honours thesis, and had not thought of where I might go next, Professor Bregman suggested applying to graduate school and mentioned that at Carnegie Mellon University (CMU), researchers there were exploring chess playing in the cognitive program that they had developed. The idea of doing research on chess piqued my interest because I was an avid chess player (and bridge player) at the time, a game I was taught by a camp counselor one summer and had even participated in a high school championship tournament a few times, losing in the last round to Camille Coudari, the winner, but getting my first chess book, Reshevsky's Best Games of Chess as a prize. The idea that there were books on chess was quite novel and opened my eyes to the idea that you could study chess. It was natural for me to have joined the McGill chess club which opened opportunities to take a leadership position, invite famous Grandmasters to give simultaneous exhibitions such as Paul Keres, Bent Larsen, Boris Spassky. I managed to draw games with the first two and lost to the latter, probably because the former players were gracious enough to let me draw given my role in the club.

Hence, I went to CMU, without ever having taken a cognitive psychology course, though I had been reading some of that literature for my honours thesis with Professor Bregman.

Graduate Education (1969-1974)

My first-year advisor, a newly hired faculty member, William Leaf, who came from Abelson's 'hot cognition' lab at Yale, was not interested in chess nor pattern recognition research. Given that I was not interested in his social cognition work, we parted ways after a year, and I had the good fortune to witness William Chase and Herbert Simon start collaborating on chess expertise research around that time and I switched to Bill Chase. Bill was a master experimentalist and conducted truly creative studies. I was a bit late for the very first studies on a novice, Class A, and Master player (Chase & Simon, 1973b), but did participate on the set that became a chapter in the Carnegie Mellon Cognition series volume 'Visual Information Processing' (Chase & Simon, 1973a) that Bill edited. Some years earlier Herbert Simon and Allen Newell had established the new field of information processing psychology at CMU and graduate students were reading portions of their huge tome on Human Problem Solving (Newell & Simon, 1972) that outlined their influential theory. The graduate program at that time had two informal tracks, what would soon be called computer science, and the new field named cognitive psychology. If you worked with Allen Newell or Herb Simon you typically did computer simulation studies and experimental studies with others.

That chess research study enabled me to sit in with Bill on meetings with Herb Simon. Herb was a true renaissance person (soon to win a Nobel prize in economics and share the Turing award in computer science with Allen Newell), from whom I learned a lot about rigorous theory building. That research project also meshed perfectly with my interest in pattern recognition, because Chase and Simon had just uncovered chess chunks, small clusters of chess pieces that served as the scaffold for expert performance in chess perception and memory tasks. Following work by de Groot (1965), they developed memory tasks such as the 5 s exposure to a chess position that was either a structured or a random one. They found that their master (Hans Berliner, a fellow graduate student in computer science, and soon to be world champion in correspondence chess) did not appear to have a larger short term memory capacity than their A-player (Bill Chase) or their novice (Michelene Chi). The three players performed about the same on the random configuration of pieces but there were strong differences in the structured position where more expert players could take advantage of their store of chess knowledge, specifically, familiar chess patterns. (Later, Gobet and Simon, 1998, found evidence for chess templates, larger con-

figurations of pieces).

My guidance from Bill and experience with Herb led me to choose chess research as the topic for my doctoral dissertation. That work, on skilled chess memory, did not involve simulation work. A younger graduate colleague, Kevin Gilmartin, did generate a simulation model estimating the size of the vocabulary of chess patterns that players at different levels of skill must-have. Rather, I followed Bill's example of using experimental studies to uncover basic information processes supporting expert performance.

At that time, the CMU Psychology department encouraged graduate students to present research at the Midwestern Psychological Association meetings in Chicago, a regional meeting of the American Psychological Association. I was probably in my 3rd year of studies and newly married to Beth. At that meeting, with the chess research garnering national attention (Charness, 2018), Bill introduced me to Robert Solso, who was looking to hire a new faculty member at Loyola University, Chicago. I had a brief interview with him, and even though I had only one publication to my name (from my Bregman collaboration), he offered me a job. I went to Bill and he advised that it was not wise to take a job before finishing my dissertation, so I turned down the offer. A recession hit the next year as I was preparing to graduate in the then-standard 4 years, and with few prospects in sight, drew out my research toward the fifth year. I applied for and received a postdoctoral fellowship from my home province of Quebec to continue research at CMU.

Employment at Wilfrid Laurier University (1974-1977)

At the last minute, a job interview appeared from Wilfrid Laurier University (WLU), a small liberal arts university in Ontario, Canada. I had interviewed at Bell Northern Research in Ottawa, Canada around the same time for a non-academic position, but didn't receive an offer. However, Laurier offered me the position in August, just weeks before the new semester started. Given my goal to return to Canada after my PhD, I took it, despite it being a one-year position.

I applied for other positions as that year was coming to a close, because my wife was pregnant with our daughter, Michelle, and was offered a position at the University of Guelph, but Laurier extended my contract to a 3-year tenure track one so I stayed put.

Employment at University of Waterloo (1977-1994)

I was invited around my third year to present my research at the up and coming university down the street from WLU, the University of Waterloo (UW). They held a brown bag cognitive area lunch that I started attending, and I must have made a good impression because they offered me a job at UW without a formal interview. It was a difficult decision as Wilfrid Laurier was offering me tenure, but my goal was to teach in a PhD program. UW had a PhD program in psychology, but Laurier did not (master's level only). Except for sabbaticals, I stayed at UW for 17 years following three years at Laurier.

Education on the topic of aging

When I first went to Wilfrid Laurier, I continued my research into expert performance by drawing on my second hobby, bridge playing. I had divided my 'leisure' time at McGill between bridge playing in a balcony of the old student union and playing chess in the chess club. I decided to replicate the Chase and Simon work to see how well it generalized to bridge expertise (card patterns, instead of chess patterns: Charness 1979, 1983). Instead of recruiting undergraduate students as I had at CMU, I solicited bridge players from the community to participate in studies. That brought in players with a wide range of ages and skill levels (using acquired duplicate bridge 'masterpoints' as a measure of skill instead of chess ratings). For reasons that escape me now, I recorded age and gender in my short demographic survey. To my utter astonishment, when I looked at memory performance, recalling a sorted or unsorted bridge hand after 5 s, using regression analysis, both player age and skill level were strong predictors. In graduate school I was required to study both ANOVA and regression analysis, though it was very clear to me that as an experimentalist, regression was going to be useless because studies were always analyzed with ANOVA. How wrong I was! This training was at a time when we ran analyses at the computer center on IBM mainframes after midnight using card decks. However, on the problem-solving tasks (bridge bidding, a play of the hand), the only skill was a predictor.

I had taken a developmental psychology class in graduate school, but at the time Guy Groen's course went up too early childhood. I knew nothing about aging. However, given that it was clear that aging degraded memory and that skill improved it, and that theories of skilled performance emphasized how important memory was too skilled performance, I had a conundrum. How were older bridge players able to maintain skilled performance despite failing memory capabilities? That puzzle kept me busy over the first 20 years of my career as a researcher. I shifted back to chess expertise research because it was a better-understood domain than bridge playing.

Technology education

By the time of my move to UW (1977), I was firmly in the grips of cognitive aging research. I started joining organizations dealing with aging, such as the Canadian Association on Gerontology, taking leadership roles. Also, the microcomputer revolution was in full bloom, and at UW one of my colleagues, Phil Bryden, kindly offered to provide me with a Commodore PET computer to run experiments. Equally importantly, another colleague, Phil Merikle, was exploring how to use them to get accurate timing information for perception and response time studies. I learned to program in the Commodore Basic language, initially to run bridge-playing experiments using the existing built-in playing card character sets. I also, circa 1982-83, bought a Commodore 64 home computer, both for the option of programming at home and that the family could use.

Given my blossoming interest in aging research, I took the opportunity for my first sabbatical at UW (after achieving tenure and promotion) to spend time at a VA Outpatient Clinic in Boston, in Leonard Poon's Aging and Human Performance lab in 1984-85. Most of my time was spent with a neuropsychologist there, William Milberg. However, I did not have secretarial support there so I had to buy my own computer and learn to do word processing. At the time, the Canadian dollar (what I was being paid in) was significantly below the US dollar and I had two young children and a wife in tow on 80% of my regular salary (UW's one-year sabbatical pay level). Consequently, I purchased an IBM PC clone machine with what was rated as the top word processor program, called Leading Edge, instead of an Apple computer that was considerably more expensive.

I also took advantage of the Boston Computer Society, an early club for computer enthusiasts, to learn about other issues, particularly the need for backup to safeguard data on those large 5.25 inch 'floppy disks'. I also conducted an attitude study toward computers at the new Boston Computer Museum, hanging out in the entranceway to corral participants. Technology startups were in bloom in that city, and I had the opportunity to see early graphics programs through John Cerella, cementing my view that the microcomputer revolution was going to change things for academics in a very good way. I also met many young investigators in the cognitive aging community through a George Talland conference that took place that year in the Boston area. In addition, I had the opportunity, courtesy of Bill Milberg to do a skill acquisition study with a severe amnesic, complementing some work I had done earlier with a musical savant, thereby setting the stage much later in life (2019) to participate in a grant dealing with cognitive impairment in older adults.

However, it was a conversation about a year after my return to Waterloo, over my backyard fence with my neighbor, a middle-aged physics professor, Ron Aziz, that really pushed me to recognize the importance of aging and computer use issues. He had just purchased an IBM PC, the first consumer-oriented microcomputer that IBM released. Back in those days, the CPU and motherboard resided in a case that resembled a box and the CRT monitor stood on top of it. He was complaining that he had to strain to see the text in the display because he had bifocals and had the monitor perched a bit too high for seeing comfortably through the lower half of the bifocals without straining his neck. I thought to myself that if these microcomputers ever became popular, we would need to think about how to accommodate older workers.

About that time, DEC Canada donated a large batch of equipment to UW for a tax write-off (DEC was later bought by Compaq, and Compaq by HP). The university entertained grant applications to use the equipment and I applied for some of the Rainbow computers to study workplace aging issues. Those computers had two then-popular operating systems: CP-M and DOS and came with relatively rare color monitors (as opposed to the more common monochrome monitors). I started looking into aging and color perception issues around text color. I also was studying skill acquisition instead of skill differences and started investigating skill acquisition differences in aging adults, using then popular software packages such as Borland's Sidekick (e.g., Zandri & Charness, 1989).

By the time of my next sabbatical opportunity, I had joined up with the Canadian Aging Research Network (CARNET) team, consisting mainly of sociologists and psychologists in Canada with aging interests. It was led by Victor Marshall, a sociologist at University of Toronto, whom I knew through a stint as editor of the psychology section of the newly launched Canadian Journal on Aging for which he was editor-in-chief. Other psychologists included David Hultsch and Roger Dixon at University of Victoria, Fergus Craik, Morris Moscovitch, and Gordon Winocur at University of Toronto, Larry Jacoby at McMaster University, Dolores Gold, and Tannis Arbuckle-Maag at Concordia University, and Michael Stones and Albert Kozma at Memorial University of Newfoundland. This was my first opportunity to work on a team grant, and before it kicked off, I set my sabbatical for University of Victoria to work with Hultsch and Dixon. The sabbatical in the Fall of 1990 was the perfect opportunity to finish writing an invited chapter on human fac-

tors in the Handbook of the Psychology of Aging (Charness & Bosman, 1990). I had been chosen, perhaps, because of my work on skill acquisition dealing with software learning. However, it was a new topic area (much like aging had been) and a year's sabbatical enabled me to read intensively in the area. I realized that one of my graduate school colleagues, Stuart Card, had co-written a new book with Moran and Newell some years earlier on the Psychology of Human-Computer Interaction that took an information processing approach to performance with computer systems. My research on Human Factors areas also took me into the realm of driver and pedestrian research which later became a focus in the US.

The next major influence on my career was spending the summer of 1993 as a visiting scientist in Berlin at the Max-Planck-Institute for Human Development, at the invitation of one of the directors there, Paul Baltes. The European tradition of casting aging issues in broad theoretical frameworks was somewhat foreign to me compared to the tighter, but much narrower simulation approaches that I was exposed to in graduate school at CMU. But the experimental work going on there was top notch and the scientists whom I spoke to strongly influenced my direction in skill acquisition work that I was still engaged in. Many of them became leaders in the field of aging (e.g., Ulman Lindenberger, Jacqui Smith, Ursula Staudinger, Uli Mayr, Ralf Krampe, Reinhold Kliegl). It was also that summer that I made the fateful decision to move to the Florida State University (FSU) to take up a position in the newly formed program on expertise headed by K. Anders Ericsson, who had earlier done his very influential postdoctoral research with Herbert Simon (and Bill Chase) at CMU after I had left.

Gerontechnology

The other major influence was the newly formed Gerontechnology group at Eindhoven University, led by Herman Bouma and colleagues (e.g., Jan Graafmans, Jan Rietsema, Don Bouwhuis). My initial contact with this group was at the second Gerontechnology conference held in Helsinki, Finland in 1996 (the first one was held in Eindhoven in 1991). It was there that I first met up with many European researchers who were pursuing the applied issues concerning how technology could improve the quality of life for aging adults. I continued to attend the International Society for Gerontechnology (ISG) meetings thereafter and joined the journal's editorial board. Together with CREATE colleagues, we hosted the 2002 Gerontechnology conference in Miami, Florida.

CREATE (1999+)

Probably the most critical influence for me in developing my skills in gerontechnology were my colleagues in the Center for Research and Education on Aging and Technology Enhancement (CREATE). The overarching goal of CREATE has been to ensure that current and future generations of older adults can access, adopt, and meaningfully use existing and emerging technologies. I had been working for some time on studies of software skill acquisition, as had Sara Czaja, then at the State University of Buffalo. Sara and Joseph Sharit were also examining issues related to technology and older workers. They then both moved to University of Miami (UM) in the state of Florida. Around 1997 senior administrators at FSU (and UM) began an initiative to form research partnerships and suggested that if we knew colleagues at UM it would be good to reach out to them. I remember having done a review for a pilot grant program at Sara Czaja's center there, so I contacted her. At the time she was preparing to renew a National Institute on Aging (NIA) Edward Roybal Center grant on age and work, so invited me to participate. That application was not successful. It was then, in part through Robin Barr's (program officer at NIA) suggestion that Sara invited Arthur (Dan) Fisk and Wendy Rogers, also leaders in the field of aging and technology. We combined our efforts, broadened our focus beyond work, and applied for a program project grant (P01) instead. It received funding notice in April 1999, and our CREATE team, which has included Katinka Dijkstra and then Walter Boot at FSU, has been funded continuously into 2020.

Sara and Joe were trained as engineers (though Sara also had a specialization in psychology) and the rest of the team were trained in psychology, Dan and Wendy in Human Factors Psychology. So, we were ideally placed to use ideas and methodology from both disciplines in our projects. As the one least formally trained in aging and human factors psychology, I benefited enormously from this collaboration. Our team (more like a family than a team) has published over 400 articles, chapters, and technical reports together (www.create-center.org), including human factors and aging book series originated by Dan Fisk and Wendy Rogers that includes the third edition of our design book (Czaja, Boot, Charness & Rogers, 2019) which recently won the Richard Kalish Innovative Publication Award from the Gerontological Society of America (2019). It has truly been a fruitful collaboration and one of the high points of my career.

Collaborators, funders, and family

No one person has the 'bandwidth' to attack as many rich and fruitful areas as I have been lucky enough to pursue across the years. I have relied on my colleagues, mentioned above, but critically, my graduate students, collaborators, and post-

docs who have probably taught me as much as I have taught them. My philosophy has been to allow students to pick topics of interest to them and work with them. The graduate students I have supervised such as Jamie Campbell, Jane Clifton, Jeff Graham, Elizabeth Bosman, Sherrie Bieman-Copland, Mert Cramer, Wanda Towers, Catherine Kelley, Robert Elliott, Tiffany Jastrzembski, Tres Roring, Mark Fox, Cary Stothart, Ryan Best, and Dustin Souders have enormously expanded the range of topics that my lab has grappled with over the years. I have also had a chance to learn from (and guide) many other graduate students on whose committees I have served formally or informally over the years (e.g., Bo Xie, Kyoungsik Na, Nelson Roque, are a few who come to mind). I've also had productive international collaborations with colleagues such as Ralf Krampe, Eyal Reingold, Catherine Vasiukova, Helianthe Kort, and Carmen Moret-Tatay. Postdoctoral fellows such as Katinka Dijkstra, David Mireles, Patricia Holley, Clare MacMahon, David Rodrick, and Jung-Soon Yoon have played important roles in initiating and supporting projects. I have also had the opportunity to work with and mentor junior faculty in my role as Director of the Institute for Successful Longevity at FSU.

Finally, it is worth noting that financial and infrastructure resources have been critical in supporting my research. The universities and institutes that I've been fortunate to work at or visit, as well as the funding agencies supported by the taxpayers in Canada, Germany, the United States, and the Netherlands, have played critical roles in supporting my ideas as well as those of my students and collaborators. The scientific enterprise is a quintessential human endeavor that relies on a huge web of people and resources. At the innermost ring of that web lies family.

I owe an enormous debt to my parents, Mark and Gloria, who kindled my ambition for and supported higher education opportunities, as well as my brothers David, Michael, Peter, and my sister Marilyn. Absolutely critical has been unconditional love and encouragement from my spouse Beth who made many sacrifices to advance my career development. Instrumental too has been backing from our children: Michelle (and her spouse Paul) and Alan, as well as our grandchildren, Benjamin and Madeline. They as well as all my many dedicated teachers helped inspire, nurture, and sustain my love for science and the pursuit of knowledge, and hence my ability to contribute to the development of gerontechnology.

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My Curriculum Vitae can be found at https://psy.fsu.edu/~charness/cv.pdf

References

Card, S. K., Moran, T. P., & Newell, A. (1983). The psychology of human-computer interaction. Hillsdale, NJ: Lawrence Erlbaum Associates.

Charness, N. (1979). Components of skill in bridge. Canadian Journal of Psychology, 33, 1-16.

Charness, N. (1983). Age, skill, and bridge bidding: A chronometric analysis. Journal of Verbal Learning and Verbal Behavior, 22, 406-416.

Charness, N., & Bosman, E. A. (1990). Human factors and design for older adults. In J. E. Birren & K. W. Schaie (Eds.), Handbook of the psychology of aging (3rd ed.). (pp. 446-463). San Diego: Academic Press.

Charness, N., & Bregman, A.S. (1973). Transformations in the recognition of visual forms. Canadian Journal of Psychology, 27, 367-380.

Chase, W. G., & Simon, H. A. (1973a). The mind's eye in chess. In W. G. Chase (Ed.) Visual information processing (pp. 215-281). New York: Academic Press.

Chase, W. G., & Simon, H. A. (1973b). Perception in chess. Cognitive Psychology, 4, 55-81.

Czaja, S. J., Boot, W. R., Charness, N., & Rogers, W. A. (2019). Designing for older adults: Principles and creative human factors approaches (3rd Edition). Boca Raton: CRC Press.

Gobet, F., & Simon, H. A. (1998). Expert chess memory: Revisiting the chunking hypothesis. Memory, 6, 225-255.

de Groot, A. D. (1965). Thought and choice in chess. The Hague: Mouton.

Newell, A., & Simon, H. A. (1972). Human problem solving. Englewood Cliffs, NJ: Prentice-Hall.Ross, M. (1989). Relation of implicit theories to the construction of personal histories. Psychological Review, 96, 341-357.

Zandri, E., & Charness, N. (1989). Training older and younger adults to use software. Educational Gerontology, 15, 615-631.