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Emerging Technologies and Behavioural Cusps: A New Era for Behaviour Analysis?

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A "behavioural cusp" is a special instance of behaviour change that comes into contact with new contingencies that have far-reaching consequences. A behavioral cusp opens access to new reinforcers and new environments, occasions new behaviours and behaviours in new classes, and it impacts other around the behaving organism. New technologies (e.g., tablet computers, smart phones, software development, social networking, etc.) are already in use in education, organizational behaviour, self-management, and personal improvement domains, but rarely with the benefit of a thoroughgoing behaviour analytic model. A synthesis of these two seemingly independent domains has the potential to greatly advance the value of both. The emergence of these new technologies may also be viewed as a sort of "cusp" for behaviour analysis, providing opportunities for unheralded access, measurement, and analysis of a world of behaviour in real time, opening the door for far-reaching consequences for the individual and society. By bringing about robust, reliable, socially valid behaviour change, behaviour analysis has the potential to be both integral and desired across wide-domain of new technology applications.
Key words: behavior analysis, emerging technology, mobile devices, cusp, contingency analysis

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Milestones are considered markers, usually of significant points along a way. They can denote an important event a person's career, or in the progression of a company or the history of a nation. Developmental milestones, such as rolling over, babbling, walking, or other significant points in a child's physical or mental growth are thought to indicate stages and are used to assess maturation and detect developmental delays (Prudham, 1969). They are seen as indicators of a predictable succession of emerging and changing periods of an individual's life, ones that often come about within an expected period via the passage of time. While many aspects of behaviour development are cumulative and thus somewhat sequential or hierarchical (due to dependencies on prior learning), a *behavioural* analysis of environmental contingences offers more to than change due maturation and the passage of time (Bijou, 1993; Rosales-Ruiz & Baer, 1996). A behavioural analysis of these types of contingencies looks for similarities of selected behaviour-environment interactions across lifespans and the outcomes of these contingencies across individuals (Hixson, 2004; Rosales-Ruiz & Baer, 1997).

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Certain behaviour changes make possible an entirely new set of possibilities (new contingencies and behaviour-environment relations) leading to the concept of a "behavioural cusp." "A behavioural cusp, then, is any behaviour change that brings the organism's behaviour into contact with new contingencies that have even more far-reaching consequences" (Rosales-Ruiz & Baer, 1997, p. 533). As defined by Rosales-Ruiz and Baer, a behavioural cusp provides the organism with access to new environments—environments that contain new reinforcers or punishers, new sources of stimulus control, and new contingencies to occasion novel behaviours and behaviours in new classes while increasing competition for old or less efficient behaviour. It can even change the behaviour of other organisms. When any or all of these events happen, the organism's repertoire may rapidly change or expand, due to the selection process occasioned by the behavioural cusp (Hixon, Reynolds, Bradley-Johnson, & Johnson, 2009; Rosales-Ruiz & Baer, 1997). Examples include learning to walk (which allows faster and greater mobility, provides access new environments, leads to running and thus opportunities for new games with other children, and greatly changes parental behaviour with regard to the child), decoding or fluent reading (which leads to new information, a range of new reinforcers, new and even faster ways of learning and of being taught), generalized imitation (which has an important role in the acquisition of a variety of new unrelated skills), or echoic behaviour (which allows for the individual's vocal utterances to be controlled by others, greatly increasing the learning of vocal speech) (for additional examples see Hixson, 2004).

What Are Emerging Technologies?

Technology is the use and knowledge of tools, techniques, systems or methods in order to solve a problem or serve some purpose. Technologies can significantly affect human as well as other animal species' ability to control and adapt to their natural environments (see http://en.wikipedia.org/wiki/Technology). New and emerging technologies are those reflecting current advances and innovation in various fields and disciplines. In biotechnology it may be advances in genetic engineering and animal husbandry or plant modification. In energy systems it may be concentrated solar power or wireless energy transfer. In computing, wireless technology, and social integration it may be robotics, 3D display, social networking, smart phones, tablet computers, sensors, remote controllers, augmented reality, or software development. And of course these fields and innovations frequently overlap and support each other.

Various implementations of technology influence the behaviour of a society, with new technologies often leading to additional discovery (McGinn, 1991). Technology can be "low-tech" (i.e., devised or made simply or with common low cost resources) or "high-tech" (i.e., requiring more sophisticated resources and materials). The term technology refers not only to materials, tools, hardware, or software, but also to knowledge and processes. When referring to technology, the focus is not just on things but also ideas and actions. While there is a noted behavioural technology applying known principles and methodologies, for the purposes of this paper the term "new" or "emerging technologies" will primarily be used to refer to recent hardware and software developments in the fields of computer and information technology and the like.

Integration of the Two

Several new technologies are already in use in education, organizational behaviour, self-management, and personal improvement domains (e.g., application software development, tablet computers, remote controllers), but rarely with the benefit of a thoroughgoing behavioural framework and a contingency-analysis of behaviour change.

Evidence of a contingency-based science of behaviour is woefully lacking when reviewing various characteristics of recent technologies, especially with regard to instructional design, functionality, stimulus control, consequences, and other characteristics related to how or why people behave. While it seems unmistakable that a science of behaviour could inform and improve the function or outcomes of many new technologies, it may be less apparent that the emergence of these new technologies could serve as a boon for behaviour analysis. They have the potential to provide opportunities for unheralded access, measurement, and analysis of a world of behaviour in real time (including physical corollaries), across settings and with great precision and control, thus potentiating far-reaching consequences for the individual and society. This paper is an attempt to illustrate how emerging technologies, infused with a thoroughgoing behavioural science approach, can provide new settings and opportunities for behaviour analysis while also offering more effective applications for these technologies.

Using the structure of a "behavioural cusp" as an instance of (1) behaviour change that brings an (2) organism's behaviour into contact with (3) new contingencies with (4) far-reaching consequences (via reinforcers, new environments, new behaviours, and increased impact) this paper proceeds using the following variables: (1) behaviour change ~ behavioural application of new technologies; (2) organism's behaviour ~ behaviour human organisms exhibit frequently (such as the use of smart phone to track salt intake or post comments about "green" behaviour just emitted); (3) new contingencies ~ behaviour-environment relations that can be arranged via new virtual communities and social media, or powerful (portable) observation, recording, and feedback technologies; and (4) far reaching consequences ~ better lives, better societies, and a better world (such as decreased blood pressure, longer life expectancy, or more efficient households with an individual yet cumulative effect on ameliorating climate change).

By bringing about robust, reliable, socially valid behaviour change, behaviour analysis has the power to be both integral and desired across wide-domain of new technology applications. It could acqure "such great value or popularity that it assures the success of the technology with which it is associated," or become "a feature or component that in itself makes something worth having or using" (also known as a "killer app", Merriam-Webster, 2011). Using these new technologies, behaviour analysis can greatly impact contingency arrangement and how people behave, generating sweeping consequences for the individual and society, and even further advancing the mission to "save the world with behaviour analysis" (Malott, Vunovich, Boettcher, & Groege, 1995).

Prevalence of Technology

The rate of adoption of a technology is "the relative speed with which an innovation is adopted by members of a social system" (Rogers, 2003, p. 27). Numerous writers have noted the increased rate of adoption of a number information and communication technologies (ICT) such as home computers, cellphones, and the Internet (e.g., Arrison, 2011; Comin & Hobijn, 2004; "Mobile Internet, 2007). For example, while electricity took just under a half a century to reach 90% penetration, cellphones reached that mark in less than half that time ("You are what you spend," 2008).

More than 2 billion people use the Internet worldwide (as of Spring 2011) and there has been over a 400% growth in Internet users within the last decade (See Table 1 for a breakdown by region.). In Europe, over 58% of the population has access to the Internet, with Germany and Russia reporting the most users (Internet World Stats, 2001). Shorter adoption rates are attributed to faster communication networks and transportation infrastructures, the ability to design, build, and distribute new technologies more quickly, and even an increased willingness and ability by the general population to accept and adopt new technologies. As Robert Greenhill noted in the preface of *The Global Information Technology Report 2010–2011*, "[t]he last decade has seen information and communication technologies dramatically transforming the world, enabling innovation and productivity increases, connecting people and communities, and improving standards of living and opportunities across the globe" (p. v).

The types of devices people use to access the Internet are increasing as well. Eighty-five percent of Americans 18-years and older own a cell phone, and two in five of those (42%) are smartphones (Pew Internet, 2011). In the European mobile phone market the sales of smartphones have now overtaken those of simple feature phones (Arthur & Garside, 2011). A Westcoastcloud (n.d.) survey of 2,000 UK parents of children aged ten and under revealed 1 in 10 primary school children have iPhones®. Worldwide, the market for touchscreen mobile devices surpassed 360 million devices in 2010, a 96.8% increase from 2009 (Gartner, Inc., 2010). By 2013, it is anticipated that touchscreen mobile devices will account for 58% of all mobile device sales worldwide, and more than 80% in North America and Western Europe.

It has been reported that the growth and proliferation of information and communication technologies (ICT) has had a substantial impact on almost all sectors

Table 1. *World Internet Usage and Population Statistics as of March 31, 2011*

World Regions	Population (2011 Est.)	Internet Users Latest Data	Penetration (% Pop.)	Growth 2000-2011	Users % of Table
Africa	1,037,524,058	118,609,620	11.4 %	2,527.4 %	5.7 %
Asia	3,879,740,877	922,329,554	23.8 %	706.9 %	44.0 %
Europe	816,426,346	476,213,935	58.3 %	353.1 %	22.7 %
Middle East	216,258,843	68,553,666	31.7 %	1,987%	3.3 %
North America	347,394,870	272,066,000	78.3 %	151.7 %	13.0 %
Latin America / Caribbean	597,283,165	215,939,400	36.2 %	1,037.4 %	10.3 %
Oceania / Australia	35,426,995	21,293,830	60.1 %	179.4 %	1.0 %
WORLD TOTAL	**6,930,055,154**	**2,095,006,005**	**30.2 %**	**480.4 %**	**100 %**

NOTE: (1) Internet Usage and World Population Statistics are for March 31, 2011. (2) Demographic (Population) numbers are based on data from the US Census Bureau (3) Internet usage information comes from data published by Nielsen Online, by the International Telecommunications Union, by GfK, local Regulators and other reliable sources.
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and occupations in Europe, fundamentally changing the face of the workplace. According to Weiler (2005), information technology use and skills are "vital elements in achieving the European objective of becoming the most competitive knowledge-based economy in the world." Within the education domain, there is now a clear trend towards more acceptance and use of technology in the classroom, especially tablet computers and wireless devices, and even with younger children (Hu, 2011; Quillen, 2011).

Interlocking Contingencies

One explanation for the increased rate of adoption of ICT is the "network effect theory" (NET), in which a product or service becomes more valuable as more people use it thereby encouraging ever-increasing numbers of adopters (Katz & Shapiro, 1994). The invention of the telephone provides a classic example. One or two, or even twenty telephones might have been an interesting novelty, but would not functionally change the lives of most people. However the more people own telephones, the more useful and valuable the telephone is to *each* owner, and to *all* telephone owners. In the 1980's fax machines were subject to the same effect. They became increasingly valuable as more people purchased fax machines and more business and individuals relied on faxed forms. More recently Facebook® and other online social networks have become prevalent in the same way. Each of these "innovations" created a positive external network where individual users entered the system without intending to create value for other users, but their behaviour did so in any case. Researchers on network effects and network externalities have identified several sub-types (such as direct, indirect, local, or two-sided) and the conditions under which they occur, that dwell within the realm of behaviour analysis (but are beyond the scope of this paper). Interested readers are directed to Sundararajan (n.d.) for a summary of these concepts.

The network effect theory is relevant to successful behavioural applications of emerging technologies, and related to a behavioural view of individual and group contingencies (Cooper, Heron, Heward, 2007), particularly to Glenn's (1886, 1988, 2004) concept of metacontingencies. Metacontingencies describe the "interlocking contingent relations between cultural practices and the effects of those practices for the group" (as cited in Pierce & Cheney, 2004, p. 410). It describes the interaction behaviours or classes of operants, each with its own reinforcement contingencies, yet also with a shared long-term consequence. Glenn (1988) identifies the unit of analysis within a metacontingency as the cultural practice (consistency in behaviour across individuals) with all its individual variations, and the summative outcome of all those variations. Examples include the sets of behaviours involved in teaching children to read, reducing crime, or ensuring safe drinking water. Several individual behaviours (subject to individual contingencies) must come together to occasion these outcomes. Failure to achieve these outcomes results in dire consequences for the group and the individuals within it. The metacontingency is useful in that it describes functional relationships at the cultural level.

Metacontingencies are also pertinent to the concept of behavioural cusp, which looks at the fitness of the new behaviour within a context of the receiving environment (Rosales-Ruiz & Baer, 1997). Due to its inter-related impact on the receiving environment, a successful behaviour cusp leads to increased behaviour change and an increased probability of social adaptation and cultural fitness. Relevant to the context of this paper, new and emerging technologies have the potential to impact great numbers of individual behaviours in a relatively short time, perhaps almost instantaneously. Understanding how individual behavioural contingencies and metacontingencies interact and how they affect cultural practices may greatly aid in the development of technologies with far-reaching cultural impact.

In the world of new technologies, we have seen the explosion of social networking sites and applications that rely on interlocking social contingencies (such as *LinkedIn*®, *Badoo*, or *Orkut*™). Web-based social networking occurs through online sites that encourage members to interact, share content, and develop "communities" around similar interests. At the time of this writing, there are over 300 active, non-dating, social networking sites listed on *Wikipedia*® ("List of social networking websites", n.d.) establishing communities of general interest (such as Facebook© with over 640 million members) to ones with more specific interests (such as *WiserEarth*, an 45,000 member online community space for the social justice and environmental movement, or VampireFreaks.com with its almost 2 million members interested in the gothic and industrial subculture).

Behaviour analysis has a track record of highly successful applied programs that employ interlocking social contingencies in a face-to-face arrangement. A short list of examples include: School-Wide Positive Behavioral Interventions & Supports (SWPBS, www.pbis.org) which targets improving student academic and behavior outcomes by using a decision making framework guiding the selection, integration, and implementation of the best evidence-based practices within a system that efficiently and effectively supports the implementation of these practices; CABAS® (Comprehensive Application of Behaviour Analysis to Schooling), a research-driven system-wide schooling approach developed by R. Douglas Greer and colleagues at Columbia University Teachers College and around the world (Greer, 1997); Mark Mattaini and colleagues' PEACE POWER® (www.peacepower.info), a strategy and system for building community and organizational cultures incompatible with violence, threat and coercion; and the Food Dudes (www.fooddudes.co.uk/en) programme created by C. Fergus Lowe and Pauline Horne which uses a motivational reward system and other individual and group behaviour change techniques to improve children's eating habits for life.

Behaviour analysts need to leverage what is known about these interlocking social and cultural contingencies to better inform and shape the cultural practices that now can change at a much faster rate. The growing ability for rapid change in cultural practices provides an unheralded opportunity for research and better understanding of metacontingencies and how practices change, the individual and combined effects of interlocking contingences, how to promote best practices, and many other queries surrounding organizational and cultural change.

Commercial Tech Products Using Behaviour Analysis

There are a number of examples of successful commercialized electronic technology products or systems either built by behaviour analysts or overtly using a behavioural or contingency analysis to noteworthy effect. One of the earliest commercially distributed computer-based programs openly using behaviour analysis to teach behaviour analysis to a wide number of college students, researchers, and other interested individuals was *Sniffy The Virtual Rat* (www.wadsworth.com/psychology_d/special_features/sniffy.html). It offers an interactive, realistic simulation of a rat in a "Skinner Box" and covers the major phenomena in a typical psychology of learning course.

In many ways *Sniffy* has come alive via another commercial (and in this case life-saving) overt application of behaviour technology, APOPO. APOPO (www.apopo.org) researches, develops, and deploys detection rat technology for humanitarian purposes. Active in Mozambique, Tanzania, and Thailand, APOPO turns African giant pouched rats into "HeroRATS" via life saving scent detection (Poling et al., 2011). Rats are trained to sniff out landmines, use scent to increase TB case detection rates, and are used in a remote scent tracing research program, using local residents as specially trained handlers and researchers. All efforts are based on operant conditioning procedures and protocols developed under the direction of behaviour analysts. As of this writing APOPO has been responsible for over 1,730 landmines found and destroyed, over 2.7 million square meters of mine-free land, over 2,262 new TB positive-patients diagnosed, and a 43% increase in TB case detection rates.

Another commercially viable entity leveraging both behavioural technology and the Internet is Headsprout® (www.headsprout.com) and its behaviourally based learning products (e.g., Headsprout *Early Reading* and *Reading Comprehension*). Headsprout was founded by behaviour analysts who focused on using empirically based known procedures from the basic, applied, and instructional sciences to create highly effective products that could be delivered and have reliable, robust effects across "at scale". Using a scientific formative evaluations process (Layng, Stikeleather, & Twyman, 2006) Headsprout products have increased the reading abilities of tens of thousands of learners across the U.S. and the world.

While these are just three examples of the explicit use of behavioural technology, there are numerous other commercially available software or hardware technology products and systems that clearly overlap with a behavioural paradigm yet do not directly claim to come from those roots or to be developed by recognized behaviour analysts. Many of these products, while successful, conceivably could be better served by a more direct application of the science of behaviour and behavioural contingencies. One example is *MannersMinder*®, a remote-controlled reinforcement system that trains dogs to behave at home and perform better in competition. It employs auditory and treat-based operant conditioning similar to "clicker training". Clicker training (Pryor, 1999) has become ubiquitous in animal training and management, across a wide range of species species (such as dogs, cats, horses, or dolphins), and even people in the form of TAGteach™ (Orr, 2005). Clicker Training is but one illustration of the large and pervasive animal training movement, which is firmly routed in operant training principles and procedures. One way to come in contact with some of the most fascinating applied and basic work in this domain is through the Organization for Reinforcement Contingencies with Animals (ORCA, http://orgs.unt.edu/orca), an organization founded and operated by Jesús Rosales-Ruiz and his colleagues. Its mission is to enhance the lives of animals and their guardians through behaviour analytic research and to inform the public about these discoveries.

An example of Internet technology employing behavioural procedures, this time in the education domain, is the popular Khan Academy™ (www.khanacademy.org), a not-for-profit organization that provides a "world-class education to anyone anywhere" via free self-pace online video tutorials and a user-friendly performance management system. The self-paced structure and mastery-based criteria of the instruction shares features with the Personalized System of Instruction (PSI) (Keller, 1968). Other appealing features of Khan Academy include the "just in time" (available when needed anywhere, anytime) encapsulated units of instruction, and the data available for the students, teachers, administrators, and parents. Via a token system (also a well-researched behavioural procedure, see Hackenberg, 2009), students earn points and badges to measure progress, while parents, teachers and administrators have access to detailed and aggregate online reports on what their students are learning. The large number of students using this system, varied topics covered, as well as the continuous data collection on numerous learning and performance variables makes it ripe for a scientific investigation of the impact of this or similar systems on student outcomes. These types of systems are great fodder for behavioural researchers, as the field has a long history of evidence based educational research and in classroom systems (see the collection of reprints by the Society for the Experimental Analysis of Behavior, 1988).

Another example from the area of language development is Deb Roy's merging of cutting edge technology and in-depth analysis to capture first words (Roy, 2011). For a number of years Roy recorded his infant son and the family's every movement and word via a series of fisheye lenses installed in the ceiling of every room in their house. His purpose was to understand how language is learned in context, through the words we hear. New software and human transcription were used to parse mountains of data to capture and pinpoint the emergence and refinement of specific words, and how location and activity influenced word development. This empirical investigation fits nicely with Skinner's analysis of verbal behaviour, especially "behavior reinforced through the mediation of other persons" (Skinner, 1957, p. 2). Roy's "time worms" charted the family's movement from room to room, capturing:

> the precise mapping of tight feedback loops between the child and his caregivers—father, mother, nanny. For example, Roy was able to track the length of every sentence spoken to the child in which a particular word--like "water"--was included. Right around the time the child started to say the word, what Roy calls the "word birth," something remarkable happened. "Caregiver speech dipped to a minimum and slowly ascended back out in complexity." In other words, when mom and dad and nanny first hear a child speaking a word, they unconsciously stress it by repeating it back to him all by itself or in very short sentences. Then as he gets the word, the sentences lengthen again. *The infant shapes the caregivers' behavior, the better to learn* (italics added) (Kamenetz, n.p., 2011).

These are the sorts of tools and abilities to collect and analyze data needed by behaviour analysts. A robust and relevant understanding of the functional relationship between speaker and listener and the prominent impact of context first described by B. F. Skinner (1957) and paralleled by Ernst Moerk (2000) requires this type of thorough, specified, comprehensive, and massive empirical investigation and analysis. While Skinner's "theory" has been elucidated in numerous applied studies (see *The Analysis of Verbal Behavior* for many examples) and Moerk's position of the importance of frequency of input and other environmental variables has since been supported by longitudinal analysis (see Hart & Risley, 1985), a comprehensive validation of a contingency analysis of language has yet to be done.

The form of research (and tools) used by Roy is also ripe for collaboration with behaviour analysts. He and his colleagues have been pursing the development of a device for video and audio recording the development of children at-risk of having developmental disorders (i.e., PlayLamp) (Steger, 2008), with plans to "use the recorded information to develop computer models of behavioural patterns associated with these disorders" (n.p.). Other engineers, developers, and researchers across the world are embarking on similar or related projects such as: the Computational Behavioral Science group at Georgia Institute of Technology in Atlanta (U.S., www.cbs.gatech.edu); the Quality of Life Technology (QoLT) Center at Carnegie Mellon University in Pittsburg, PA, U.S., whose mission is to transform lives for people with reduced functional capabilities due to aging or disability (www.cmu.edu/qolt); or the Convergent Science Network in Barcelona, Spain, which is working on the development of future real-world technologies that impact quality of life and health, information and communication technologies, and brain-machine interfacing (http://csnetwork.eu/the_project).

There is an abundance of online programs, products, and services commercially available today that loosely incorporate some form of findings from behaviour

Table 2. Sampling of Products/Services that Focus on Behaviour Change

Program/Website	Snippets from the Website	Some Underlying Behavioural Phenomenon
StickK (The Commitment Contract) www.StickK.com	• people don't always do what they claim they want to do, • incentives get people to do things[1]	• contingency contracting • response cost
Moodscope www.moodscope.com	• monitoring something regularly can lead to positive change • the very act of knowing that someone else is keeping an eye on your mood may well help to raise your spirits"	• (subjective) daily measurement • daily posting • visual display • data sharing • positive reinforcement
Track Your Happiness www.trackyourhappiness .org	• scientific research project investigating what makes life worth living • notifications by email or text; asked to report how you are feeling and what you are doing • Happiness Report shows how your happiness varies depending on what you are doing, who you are with, where you are, what time of day it is, and a variety of other factors	• self-report • measurement • setting events • environmental control
The Quantifed Self www.quantifiedself.com	• collaboration of users and tool makers who share an interest in self knowledge through self-tracking • use a computer, mobile phone, electronic gadget, or pen and paper to record your work, sleep, exercise, diet, mood, or anything else	• frequent measurement • visual display • data sharing
Daytum www.daytum.com	• helps you collect, categorize and communicate your everyday data	• measurement • visual display • data sharing
LifeMetric http://lifemetric.com	• social experiment that aims to track the factors of our lives that shape our society • lifemetric creates stunning graphs of the dynamics of your life that you can share with your friends	• measurement • visual display • data sharing
me-trics http://beta.me-trics.com	• improve your life by tracking the things you do every day • create customized, personalized life graphs • find correlation between activities • compare overall activity over time	• measurement • visual display • data analysis • data sharing
Tally-Zoo http://tallyzoo.com	• If it's important to you, TRACK IT • easy to track the things that are important to you, and share only those activities that you want to	• measurement • visual display • data sharing
Track-n-Graph www.trackngraph.com	• find (or create) ready tracking templates for just about anything: weight, workout schedule, blood pressure, car mileage • easily visualize tracking progress on various types of graphs	• measurement • visual display • data sharing
Your Flowing Data http://your.flowingdata .com	• we make tiny choices every day; choices become habits, habits develop into behaviours • *your*.flowingdata helps record these choices	• measurement • visual display • data analysis • data sharing • choice

[1] Steven Levitt, noted behavioral economist and co-author of Freakonimics, said of StickK: "I think there is little doubt that commitment contracts of this type help us accomplish our goals. People find it much easier to stick to a diet after a heart attack scare, or to quit smoking after a cancer scare. Whether people are willing to impose costs on themselves remains an open question. ***In part, it comes down to whether people really want to change, or whether they are just faking it***" (Italics added) (Levitt, 2008). This quote exposes the ongoing conundrum for behavior analysis: the applications of the science can readily demonstrate behavior change, yet most of society (including scientists like Dr. Levitt) still attribute the cause of behavior change to "something" within the individual.

analysis, although the processes used are not often referred by those terms (see Table 2 for a sample list of those focusing on behaviour change). Most incorporate measurement and visual displays as well as public posting to help change behaviour. While many of these examples may be interesting or amusing from a personal standpoint, they are included in this article as illustrations of increased public acceptance of measurement and of behaviour change as being influenced by environmental variables--but that are not necessarily informed by a contingency analysis of such.

One example, "Track Your Happiness" was constructed primarily for research purposes by Dan Gilbert, author of *Stumbling on Happiness.* He and his colleagues are attempting to identify the contextual variable occurring when someone self reports what they are doing and feeling and provides a good example of how new technologies can assist in field and applied research. A collaborative effort with behaviour analysts on this project might involve something like a "Contingency Finder" or the development of an algorithm that takes all these data and inputs and finds the contingencies in operation, perhaps even incorporating Mechner's (2008) contingency diagram system to discover and display the contingencies in effect. Real-time virtual coaching/mentoring could be provided to improve quality of life.

A multitude of these types of products and services are available (and provide convincing indication that many people want help). Conceivably many of these could be enhanced when designed within a comprehensive behaviour analytic framework. Perhaps there are other ways of measuring behaviour (rather than moods or attitudes), or seeing improvement in outcomes (such as building fluency in component skills before going to the composites (Binder, 1996)). The relevance here is that (1) people ARE interested in measurement and tracking important things in their lives; (2) new tools are out there for us to leverage; and most importantly, (3) these systems would be much more effective if they were informed by a science of behaviour, one that could help identify contingencies, establishing operations, setting events, multiple sources of control, shaping mechanisms, and the myriad of other variables empirically known to influence behaviour.

Popularity Across Domains

Of course the applications of a behavioural paradigm are not limited to computer-mediated or website-based projects. "Apps" [1] appear to be the quickest growing market for tools and technology to assist behaviour change, across a variety of fields and domains. In the last 2 years pharmaceutical companies have reported an almost 80% increase in investments in mobile phone applications and educational websites to get patients to take their drugs, eat right and exercise, diagnosis disease, and monitor treatment (Randell, 2011). Businesses have utilized mobile device apps to spur growth and increase revenue (Ransom, 2010). Apple® reports over 500,000 apps in their App Store™ (Apple, 2011), with education and lifestyle in the top 5 categories for number of apps available (Haynie, 2010). The more recent Android™ Market has over 250,000 apps and growing (Rapoza, 2011).

The website, software program, and application market is rife with mobile and laptop "autism-friendly" and special education apps available to parents and educators. The Apple Education Page in the iTunes® App Store now has its own Special Education category with hundreds of apps across communication, literacy and learning, emotional development, and other domains. In addition, literally hundreds of software programs are available for early learning and teaching such common yet critical skills as letters, numbers, shapes, and vocabulary.

1. "Apps" (for application software) is a term commonly used for software designed for specific purposes and generally used on mobile devices such as smart phones or tablet computers.

Effectiveness

This rapid growth indicates strong parental and educator desire for educational programs and applications, however "caveat emptor" or let the buyer beware. Even while many public school technology expenditures are increasing worldwide ("Unleashing the Potential of Educational Technology", 2011), some purchasers are questioning the value recieved for the dollars spent. In the U.S. "amid a classroom-based software boom estimated at $2.2 billion a year, debate continues to rage over the effectiveness of technology on learning and how best to measure it" (Gabriel & Richtel, 2011, n.p.).

Quantity does not indicate quality. Nor does the novelty of new technologies and devices translate into educational outcomes. Historically there is great hope for educational reform and improved outcomes when a new technology takes hold in the classroom (e.g., lectern, chalkboard, overhead and slide projectors, videos, DVDs, desktop computers, interactive white-boards, etc.). However it is not the medium that changes outcomes, it is the interaction between the learner and the medium, and the contingencies that ensue. As stated most clearly by Rumph et al., (2007):

> Not all computer-based learning products or even designed instructional products are effective in teaching students. Any computer-based instruction product is only as good as the instructional design within it. There are many poorly designed computer-based instructional products. Like any instructional product or model only scientific demonstration of effectiveness is an assurance of quality. It is important that the scientific evidence requirement be maintained. (p. 48-49)

Daniel Donahoo, a researcher and father, stated something similar when writing about the iPad® and autism in a technology blog (Donahoo, 2011):

> [T]he potential of the iPad is not achieved by the iPad alone, nor by simply placing it in the hands of a child with autism. The potential of the device is realized by the way professionals like speech pathologists, educators, occupational therapists and early childhood development professionals apply their skills and knowledge to use the iPad to effectively support the development of children. The potential is realized by engaged parents working with those professionals to explore how the device best meets the individual needs of their child.

So how are parents and educators (and all consumers) to distinguish quality programs from the overabundance of choices that are available to them? How are they to know what works best for their child or student (and for what behaviours under what conditions)? Currently there are hundreds of reviews of educational apps, lists of "10 best" or "favorites" posted on blogs. How does a consumer know what is accurate or whom to trust? Possibly this is another way in which behaviour analysis can contribute. With its emphasis on science-based methods (Baer, Wolf, Risley, 1968), compendium of effective instructional practices (e.g., Lovitt, 1994; Maurice, Green, & Luce, 1996), as well as its common ancestry and framework with leaders in instructional design (viz., Susan Markle, Phil Tiemann, and others), perhaps behaviour analysis should establish a publicly recognized clearinghouse or create a "seal of approval" to help consumers weed through the maze. An independent, not-for-profit organization such as the Cambridge Center for Behavioral Studies (www.behavior.org) or even a newly founded organization might provide such a mechanism.

Behaviour Analysts Creating Technology

In addition to the handful of behaviourally based commercial products described previously, several of apps have been released within the past couple years. A search using the term "behaviour analysis" in the Apple App Store returns over 50 iPhone and iPad apps (covering behaviour tracking, flash cards, solving behaviour problems, etc.). Some were designed by published or certified behaviour analysts, and focus on data collection and measurement (such as ABC Data Pro by CBTAonline, Behavior Tracker Pro & Skill Tracker Pro by Marz Consulting Inc., or D.A.T.A. by BehaviorScience), while others (such as Behavior Breakthroughs™) are designed to teach behaviour analytic concepts. Others applications openly use behavioural terms and techniques yet clearly state they were not developed by behaviour analysts[2].

Within the field, there has been continual growth in online teaching of behaviour analysis, with over 25 online Behavior Analyst Certification Board® course sequences (see www.bacb.com) and even more individual distance learning university courses covering basic and applied behaviour analysis topics [(which should not be surprising given our history in programmed instruction (viz Holland & Skinner, 1961)]. Online training modules for service providers and parents are becoming more prevalent in applied settings such as SimpleSteps Autism (www.simplestepsautism.com) or the Autism Curriculum Encyclopedia® (ACE) (www.necc.org/programs_services/ace-curriculum.asp). As hardware and software capabilities expand, video supervision and remote coaching seems to be increasing, especially for the supervision for BCaBA and BCBA's (e.g., ReThinkAutism, www.rethinkautism.com). Enhancements in technologies continue to be developed that could greatly improve and enrich supervision, including live video streaming, multi-room fish-eye lenses or remote yet interactive devices. Of course, well-designed training programs will be necessary to ensure effective use of these technologies. As noted earlier, it's not the tool; it's what we do with it.

2. For example the following disclaimer "Applications created and sold by Kindergarten.com were not designed by a certified behavior analyst." found at http://kindergarten.com/contact-us/about/

All of these efforts mark a good start for behaviour analysts working with new hardware and software technologies, for the presentation of discrete trials, data collection, graphing and visual display, curriculum sequencing, supervision, and online learning (perhaps the field's proverbial "low hanging fruit"). Yet why aren't we designing, producing, and using more of these types of tools? Kahng & Iwata (1998) identify the high cost of transitioning to electronic data collection as one reason for the commonness of paper and pencil recording, although hardware and software costs have been decreasing especially within the app market (Haynie, 2010). Ineffective contingencies for transitioning to technology-based data collection may be a reason for lack of pervasive adoption (O'Donnell, Malady, Pritchard & Dubuque, 2011). Given our knowledge of contingency analysis and arrangement, our growing exploration of variables related to treatment integrity or fidelity of implementation (Gresham, MacMillan, Boebe-Frankenberger, & Bocian, 2000), and the framework of the metacontingency (Glenn, 1988), the investigation of the benefits of and barriers to technology integration seems ideal subject matter for behavioural research.

Research Opportunities

A science of behaviour based on contingency analysis provides the ability to identify, strengthen, and replicate the conditions that lead to seamless integration of new technologies and successful behaviour change. There are a multitude of research opportunities for behaviour analysis, from outcome evaluations to determine if specific programs or products improve student learning compared to baseline or relative to any other education intervention, or parametric analyses of consistent variables across effective programs. Measurement is a critical dimension of behaviour science (Baer, Wolf, & Risley, 1968) and research is needed to develop and validate instruments used in screening, observation, progress monitoring and ongoing learning, and outcome assessments. How well do these measures inform the behaviour of teacher, parents, other caregivers, or the individual? Implementation variables need to be assessed, as education settings are now grappling with effective and efficient distribution and maintenance of new technology programs and devices. Scalability issues (those having to do with maintaining effects across widespread adoption) are especially critical with technology and devices that can be used across large numbers of individuals. Research will be needed to determine whether or not program or products are effective when implemented first under routine conditions, then at greater scale (across classrooms, schools, districts, etc.).

Social media technologies provide opportunities for research as well. Twitter® offers suggestions on how to conduct research using input from potentially millions of users[3]. For instance, could one design and run an experiment using Twitter to evaluate the effects delay or probability discounting on treatments choice by families of children with autism spectrum disorders? Or a more direct, applied study might involve the use of Twitter with adolescents or adults with developmental disabilities sharing day-to-day information with caregivers while in community. Another study might involve the creation and use of simple blogs within either a controlled or open social network to increase the social interactions of people with disabilities. Ultimately, the ability to connect with hundreds or even thousands of people via the Internet and social networks allows for previously unrecognized opportunities for social contact and research into the effects of individual, group, and meta-contingencies.

Research can also be merged with product development (and of course product development should always be merged with research). In the U.S., the Federal Government provides financial assistance to encour-

3. See www.twitip.com/twitter-for-research-why-and-how-to-do-it-including-case-studies and http://social-media-lab.wikispaces.com/Twitter+Tip+Sheet+for+Experiments

age small businesses to engage in research and development that has the potential for commercialization[4]. Project awards are highly competitive and must fit within their Federal research agenda, including the areas of education, health, and technology. In the U.K. the Technology Strategy Board Grant for Research and Development supports R&D projects grants to help small and medium-sized businesses in any sector, while the Small Business Research Initiative (SBRI) supports UK businesses in developing innovative technology products and services. Similar projects are probably in existence in many other countries as well. More globally, the European Union formed an international scientific cooperation (INCO, http://ec.europa.eu/research/iscp/index.cfm) to address the needs and opportunities of an interconnected world and provides funding for applied research.

Potential Applications

There appears to be an almost limitless potential for combined research and development projects ideal for behaviour analysts. With "intelligent" software (i.e., designed to automatically make decisions based on previously specified parameters, or to automatically adapt to changing conditions), behaviour analysts should be well prepared to design and test (and develop and market) tools that provide instant fine-grained analysis of data and response patters, evaluate dimensions of stimulus control based on response frequency and strength, and of course automatically individualize educational programs based on learner behaviour.

Current applications provide great fodder for new behavioural apps. For example, the popular TouchPet™ Dogs (and Cats, www.ngmoco.com/games.php) offers a simulated world where players nurture and play with their virtual puppies through screen. They feed, bath, exercise and train their puppy by interacting with it; the happier, healthier the puppy, the more puppy bucks earned (as well as puppy love!). The game appears to be a more cute, somewhat less contingent version of Sniffy or CyberRat (www.cyberrat.net), however it is quite clear how something like it could be converted into a program to teach young kids about reinforcement, shaping, chaining, schedules, and extinction. Another example using the cameras embedded on smart devices Camera Word Translator, a program that instantly translates text through the device's camera (e.g., point the camera at the word "salida" and the word "exit" appears on screen). Similar technology could be leveraged to provide location based (or imaged based) prompts for learners with intellectual and developmental disabilities.

The remarkable array of new hardware devices similarly presents tremendous opportunity for behaviour analysis. "Live" remote supervision is more feasible with low-cost Internet cameras that provide acceptable quality audio and visual two-way feeds, allowing for direct observation and feedback while half a world away. Physiology sensors are becoming smaller, more portable, and unobtrusive. For example, researchers are using such devices to measure the galvanized skin response of children with autism, to gain personalized information about the individual and to detect the onset of tantrums or other undesirable behaviour excess before they manifest overtly (Farr, 2010; Paul et al, 2006). This information, paired with what is known about establishing operations, setting events, and functional behaviour analysis (FBA, Hanley, Iwata, & McCord, 2003) could have a tremendous impact on treatment. The use of portable, connected, intuitive devices, coupled with the ability to add sensors and controllers and deploy them in a multi-user environment offers exciting opportunities for cross-discipline integrated research and development.

4. One example of simultaneous research and product development by behaviour analysts is the University of Texas-Pan American's research project to build and evaluate the usefulness of interactive 3D simulation software on the perception, knowledge, and skill of pre-service teachers, regarding their treatment of children who display severe behaviours. Their current product, mentioned previously, is Behavior Breakthroughs™.

Light, portable, interactive, connected tablets are already functioning as a form of electronic, individualized response cards (Narayan, Heward, Gardner, Courson, & Omness, 1990), promoting class wide active student responding (Arreaga-Mayer, 1998). The teacher can create questions and response choices (or allow constructed responses), with the device automatically tabulating, analyzing, and displaying individual and group student responding. Either the teacher or the system can then determine the best next question(s) or area for further study. Such systems are already in use (e.g. ClickerSchool, www.clickerschool.com), and yet again could serve as an area for research as well as potentially benefit from a comprehensive application of behavioural principles.

More investigation is greatly needed on the outcomes of learning (across all populations) within "virtual reality" environments (simulations), where learners explore and manipulate computer-generated, 3-dimensional, multimedia environments in real time, and in total immersion virtual reality environments which are presented on multiple, room-size screens or via a stereoscopic, head-mounted display that allow the user to interact with the virtual environment through normal body movements. Sensors provide the ability to collect fine-grained data on both the environment and the users movements and provide consequences that enable fluid interactivity. Simulations, or computer-generated versions of real-world objects (e.g., a redwood tree or a chemical molecule) or processes (e.g., how light travels or how food spoils) could be used to teach learners stimulus discrimination and object function skills when the actual objects are difficult or too costly to obtain. A comparison of the acquisition and generalization of basic matching to sample skills across real 3D, virtual 3D objects, and pictures would be an important addition to the instructional efficiency and stimulus control knowledge base.

Two of several examples of partnerships linking teacher-educators, researchers, and experts in simulations or immersive media are TeachME™ (Teaching in Mixed-reality Environments)[5], an immersive technology tool for teacher training providing simulated student interactions within a classroom environment and simSchool (www.simschool.org), an online classroom simulation that prepares teachers to analyze student differences, adapting instruction, and collect data. Another research/product development venture, iSocial (http://isocial.missouri.edu/iSocial) is focusing specifically on individuals with autism spectrum disorders, developing three-dimensional virtual learning environments to help improve emotion recognition, theory of mind, and cognitive abilities necessary for regulation and control of goal-directed behaviour. There is a growing research-base showing computer simulations to be an effective approach for improving three main learning outcomes for students: conceptual change, skill development, and content area knowledge. Additionally, numerous commentaries and descriptions of virtual reality projects in education have been published. However, empirical peer-reviewed research studies are still relatively rare (for an excellent review of the topic, including research ideas, see Strangman, Hall, & Meyer, n.d.).

In contrast to virtual reality, "augmented reality" supplements the user's view of the physical, real-world environment with some form of computer-generated sensory input (e.g., sound, video, graphics, location data, or other tags). Interactive information about the situation and setting are overlaid in real-time and in context with the environmental, often via a smart device camera lens or even through user worn glasses. There are numerous ways to augment reality, such as a "low tech" arrangement using index cards printed with object names and taped to the actual object. Today's "high tech" methods could include electronic visual or auditory location and activity-based prompts occurring "just-in-time" as learners interact with the environment.

5. See http://www.ucgreenville.org/news-a-events/press-releases/305-university-center-of-greenville-brings-teachme-simulator-to-simhub.html

A learner working on social skills could be given time-delay based prompts (Ingenmey & Van Houten, 1991) upon joining a group of people for the first time. Students learning to eat healthy foods could be provided with simple nutrition or other information when considering food options. Persons with visual, auditory, or intellectual disabilities may benefit from augmented reality overlays to assist with accessibility.

Other innovations in emerging technologies include multi-touch skins that can be overlaid on an object or device and configured to register and react differently to different types of touches at different areas of the object. A simple application in a reading program example uses the technology to sound out the word as a finger slowly slides over it, pronounces it at a tap, and provides a picture or definition when two fingers spread over the word. More thought-provoking applications however involves applications to toys, learning games and materials, medical devices, accessories, or clothing. Even the entire human body can be used to control devices, as seen in the home gaming system Kinect™ for Xbox 360® (www.xbox.com) which enables users to control and interact with the screen through gestures and spoken commands (and not touching a controller or device, or wearing special equipment).

Not limited to gaming, the technology has now been incorporated to control robots, play air guitars that produce real sound, and manipulate 2D or 3D virtual objects by moving ones hands through the air. Educationally, such technology could be used to teach fine and gross motor skills and activities that involve manipulation of objects, offering a variety of practice opportunities for targeted skills and perhaps providing unforeseen recording and measurement capabilities. The possibilities again seem limitless, however even the most creative or obvious idea is in need of both an understanding of the relationship between behaviour and the environment, and careful and replicated research on effectiveness and other questions.

Technology Transfer

"Technology transfer" is the term used to describe the process transmitting, knowledge, technologies, methods, or skills to others, including the process of converting scientific and technological advances into marketable goods or services. It allows scientific and technological developments to be accessible to a wider range of users, who in turn can further develop the technology into new products, processes, applications, materials or services (Bozeman, 2000; Souder, Nashar, & Padmanathan, 1990). Behaviour analysts have experienced mixed outcomes in the transfer of behavioural technology, with successful applications of behavioural procedures across a variety of domains and seemingly intractable problems (Newland, Pennypacker, Anger, & Mele, 2003) yet without widespread acceptance, understanding, or adoption of principles, procedures, or terms[6] (Heward, 2008; Skinner, 1981).

Behaviour analysts interested in bringing behavioral technology to the mainstream, incorporating new technology devices or not, would be well served to read Pennypacker's (1986) essay on the topic of technology transfer. Noting the lack of wide spread adoption of effective technologies emerging from the discipline of behaviour analysis, Pennypacker stresses the need for an analysis of the contingencies underlying successful technology transfer. Direct, empirical involvement in the marketplace and analysis of the behaviour of potential adopters are essential in insuring the maximum benefits to users. As Pennypacker states, "[t]he extent to which a culture accepts, incorporates, and reflects a body of discovered knowledge varies directly with the technological benefits derived from that body of knowledge" (p. 148). It is clear that not only should we apply an understanding of metacontingencies within the product and

6. A notable exception might be the use of behavior analysis it the treatment of individuals with autism spectrum disorders.

services we design, we should also analyze them to better understand the environments and cultures in which our products and services will be used.

Involvement by Behaviour Analysis

Behaviour analysis has a long productive history in technology development, both in hardware and in methods and practices. When first endeavoring to relate behaviour to environmental conditions, Skinner "constructed apparatus after apparatus as his rats' behaviour suggested changes" (Vargas, 2005). Skinner developed the new technology he called a "cumulative recorder" after building and testing several different apparatus (Skinner, 1956). He continued to build new technologies, such as the "Skinner box" (Staddon & Niv, 2008) or the "teaching machine" (Skinner, 1960) and programmed instruction (Skinner, 1958), which would provide the contingencies and remove the experimenter from any effect on the results (Vargas, 2005). In abundant ways the current "new technologies" (e.g., computer-mediated instruction, virtual interaction, electronic sensors) provide the occasion for behaviour analysts to remove themselves from effecting the results once again.

Why do we not have dozens of amazing, effective, helpful, easy, and fun to use behavioural applications? The brain trust of behaviour analysis must have hundreds of viable ideas (and many projects in the works), both for use by the behavioural community and to assist society at large. How can we work together to broaden dissemination and acceptance, and thus improve lives? Behaviour analysts need increased access to development possibilities and the marketplace, to make an impact at greater scale or in a more widespread way. Perhaps we need to develop a network of freeware or share-ware or other public domain software specifically beneficial to behavioural preparations and applications. Perhaps we can develop a worldwide consortium of behavioural designers and developers to collaborate on what we know and how to design, build, test, and not just to use new technology to do the same old things but to do them more reliably, efficiently, and in ways that could have never been done before. Perhaps collectively we *can* change the world with behaviour analysis.

Development Resources

By designing and producing applications that embrace some of these new and emerging technologies, behaviour analysts can merge the science of behaviour to new agents (tools) for behaviour change. While it is somewhat surprising that there are not more products and services using new and emerging technologies created by behaviour analysts, the number appears to be rising. For example at the 2011 EABG conference at least three presentations focused on developing apps or other software programs for use by behaviour analysts.[7] Conceivably one barrier to growth is perceived limited access to new technologies and developers.

The world of programming and application development is changing rapidly and can seem quite complex, especially to those who have not studied or trained in the area. Different devices often require different programming languages, (for example desktop and laptop computers often are different from smart phones or other mobile devices). While a full description is beyond the scope of this paper (and the author's expertise), some points should be made about programming and application development. Several resources exist for building simple to moderately complex software applications and websites, even for individuals with little or no programming experience. For instance, behaviourist Roger Ray's company (AI)[2] has produced *MediaMatrix Presenter* (http://

7. "There's an App for that": Prompting therapist behaviour during Discrete Trial Teaching" Richard May and colleagues; "Using SMS messaging to increase physiotherapy exercise compliance between sessions" by Andrea Deering and colleagues; and "Bringing data to life, a new way to display and present data" Nicola McAuley, Mickey Keenan, and colleagues.

ai2inc.com/Products/presenter.html), a tool that turns Apple's *Keynote* presentations into Internet-delivered synchronous, in-class active-response presentations or asynchronous streaming video presentations with interactive response systems. Adobe® Captivate® (www.adobe.com/products/captivate.html) is an authoring software for creating eLearning content with interactivity, software and scenario simulations, quizzes, tables of contents, etc., purportedly with no programming or multimedia skills necessary.

There are even apps for developing apps. App Inventor for Android (www.appinventorbeta.com) allows you to create mobile apps in your web browser and provides tutorials and assistance along the way. Similar programs for development on Apple or other devices include Appmakr (www.appmakr.com; free) or IntroWizard (www.freeiphone-appmaker.com). Companies like AppBreeder (http://appbreeder.com), Templatis (www.templatis.com) or AppsTemplates (www.appstemplates.com) provide various templates so that users with little or no programming skills can design applications based on the template selected. Technology companies, such as Apple and Google®/Android, specify Software Development Kits (SDK), which must be downloaded by all programmers and contain the requirements, guidelines, software, sample programs and educational materials needed to create an app. Apple also provides Accessibility Resources guidelines (see www.apple.com/accessibility/resources) that provide developers and end users information on how to make software and hardware devices more accessible to all users.

In addition to commercially available programming tools and services, "open source" software may also be used to create instructional programs and other behaviour change applications. Open-source software (OSS) is available in source code form which with some restrictions, allows users to study, change, improve, and at times, to distribute the software (which often requires some programming skills). One popular example is Moodle (www.mooodle.org), a no-cost platform for online training that includes a number of built-in tools for providing instruction and tracking student performance. Another option for development is to hire independent programmers or software development companies (e.g., Appmakr, Mobile Roadie, MyApp), which can be found by searching the web, contacting developers of products and sites you like, or perhaps more reliably, by word mouth. Obviously all of the companies and products mentioned above are for illustrative purposes only, no statements are being made about the quality of work or service provided.

Behaviour Analytic R&D Center

As a community, field, or discipline, how can we promote and support efforts to unite behaviour analysis with emerging hardware and software technologies? One approach is to encourage cross collaboration within our university programs. Students of behaviour analysis could be encouraged to take computer science, technology, or even user interface design courses as electives in their degree sequences. Technology students, looking for applications for their studies could be prompted to take courses in behaviour analysis or to collaborate on cross-departmental projects. A good example of this is the *Master's Program in Learning in Complex Systems* at Oslo and Akershus University College in Norway[8]. The program offers two courses that combine human-technology interaction where students learn to describe and discuss critical success factors when introducing new technology for solving/optimizing work related tasks, describe the main principles and requirements to usability, and record feedback processes in human-technology interaction with a scientific behavioural approach, among many other useful skills.

8. For more information see http://www.hioa.no/Mediabiblioteket/node_52/node_869/HF/node_1001/Studieplan-master-laering-i-komplekse-systemer-kull-2011

Another possibility is to create a dedicated Research, Development, and Commercialization Center (RDnCC) to be a business incubator for behaviour analysis. Incubator centers are designed to accelerate the successful development of innovative products or companies through an array of resources and services, including funding assistance, business or organizational support, product development, evaluation, business-mentoring, or marketing resources, research, and of course the contingency analysis of technology transfer. Imagine if there were such a sight organized and run by behaviour analysts for behaviour analysts, with quality control and publicly posted (and vetted) outcome measures. Such an entity could be developed with a for-profit or profit sharing model with the developers or companies it assists, or as a non-profit entity designed solely to assist new product development. Other possibilities include an enterprise that serves as a clearinghouse for effective products or provide a quality-assurance "seal of approval" to aid in consumer choice, or even an umbrella company to give credibility to separate, independently developed products and services.

Conclusion

Current technological advances, coupled with the economic changes occurring across the world today may be coming together in a way that once again provides tremendous opportunities for behaviour analysis. Many technologies are becoming relatively inexpensive, more durable, and able to reach and be used in remote areas. The emergence of these new technologies may viewed an establishing operation for a whole new set of behavioural cusps for behaviour analysis, providing opportunities for unheralded access, measurement, and analysis of a world of behaviour in real time, opening the door for far-reaching consequences for the applications of a behavioural paradigm.

If we can apply selection at the cultural level or within the metacontingency framework advocated by Glenn (1988), it is not too much of a stretch to see that working with and developing these emerging technologies provides behaviour analysis with access to new reinforcers (e.g., increased attention, approval, credibility, acceptance), new contingencies (e.g., promoting the selection of novel and more adaptive behaviours and establish the control of new stimuli over our behaviours), new behaviours in areas we haven't traditionally worked in, new environments (such as more access to regular education, or lifestyle or health related areas), new related behaviours (generativity of basic principles that can be reused and re-applied, with some variation across novel behaviours and environments), competition with archaic or problem behaviours (that may have hindered behavioural dissemination in the past), and the potential impact future generations of behaivour analysts. In short, research, develop and use new technologies, and help spread and save analysis.

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