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SPECIAL SECTION: TECHNOLOGY AND THE CONSULTING PSYCHOLOGIST

DEVELOPING A VIRTUAL ASSESSMENT CENTER

Alex C. Howland
University of California, San Diego

Ronald Rembisz
Rembisz & Associates, Coronado, California

Tiffani S. Wang-Jones
Alliant International University

Sherilin R. Heise and Sheldon Brown
University of California, San Diego

The assessment center (AC), with its origins in World War II and its steady evolution in the decades since, is 1 way that consulting psychologists can help organizations in their selection and development of effective managers. With the emergence of powerful new technologies and the simultaneous imperative for organizations to globalize, the AC is at a pivotal moment. It can become obsolete, or it can greatly expand its reach and effectiveness. A transformation needs to occur. One way this transformation can occur is through the development of a virtual assessment center (VAC) that takes advantage of emerging technologies to make it possible for participants from all around the world to take part. This article considers the viability—affordances, challenges, and opportunities—of new technologies for use in a VAC, and offers a report on how a virtual-world platform employed to conduct a global business simulation is a proof of concept for the VAC, especially in its taking advantage of big data for individual and team assessment. Suggestions for future research and some implications for practice are provided.

Keywords: assessment center, big data, serious games, simulations, virtual worlds

Alex C. Howland, Rady School of Management, University of California, San Diego; Ronald Rembisz, Rembisz & Associates, Coronado, California; Tiffani S. Wang-Jones, California School of Professional Psychology, Alliant International University; Sherilin R. Heise, Rady School of Management, University of California, San Diego; Sheldon Brown, Visual Arts Department, University of California, San Diego.

Sherilin R. Heise is now a PhD graduate student at Riley College of Education, Walden University.

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Correspondence concerning this article should be addressed to Alex C. Howland, 829 Ormond Court, San Diego, CA 92109. E-mail: alexhowland123@gmail.com

Recently a special issue of this publication (Lowman, 2013b) looked at possible future directions for consulting psychology. Not surprising, technology was given particular notice (Leonard, Freedman, & Kilburg, 2013; Lowman, 2013a, 2013c; Winsborough & Chamorro-Premuzic, 2013), and there is no doubt that it has tremendous potential to augment and transform the way that consulting is done today. In particular, virtual-world technology, which makes it possible to immerse participants in selection and development experiences and also to gather large amounts of valuable data about those experiences, is poised to make a significant contribution. However, the practicability of such technology and the most effective ways to deploy it are still to be determined.

We are members of a team that developed a virtual-world platform that we believe could provide the basis for transforming a number of organizational activities facilitated by consulting psychologists. For example, the traditional assessment center (AC), which brings participants together in one place for "a standardized evaluation of behavior based on multiple inputs" (International Workforce on Assessment Center Guidelines, 2009, p. 224), could be conducted virtually, with people taking part at a distance from various locations. There are currently an estimated 50,000 ACs in operation worldwide (Schlebusch & Roodt, 2008), but the development of a virtual assessment center (VAC) could greatly expand the number of people who could take part, both as participants and evaluators. In addition, it could provide participants with experiences that more closely match the global and technological environment of contemporary organizations, as well as enhance the scope and quality of its assessments.

In what follows, we describe recent and emerging technologies that could be applied in moving from a traditional AC to a VAC; discuss the potential and the limitations of the technologies; and then report on a global business simulation that we conducted, which could be seen as a proof of concept and first iteration of a VAC. We conclude with a discussion of what the simulation project taught us about the viability of the VAC as an aid to selection and development.

Recent and Emerging Technologies

There are many technologies, both recent and emerging, that could be applied in transforming the AC into a VAC. These must be evaluated according to how well each helps accomplish the basic purpose and practices of the AC. That is, first, they must further the two basic aims of the AC: to make selection decisions or to promote development. Second, the technologies must enhance the nine essential elements identified in the guidelines set forth by the International Workforce on Assessment Center Guidelines (2009): job analysis, behavior classification, assessment techniques, multiple assessments, simulations, multiple assessors, assessor training, behavior scoring and recording, and data integration. In fact, they must go beyond these activities if possible; for instance, in addition to simulations, there are many other types of exercises (e.g., in-baskets, leaderless group discussions, management games) that are used in ACs, and the use of exercises has become a defining practice.

The technologies that could be applied include, but are not limited to, the following.

Internet Access and Connectivity

Rapid changes in Internet technology are transforming global connectivity. Worldwide Internet access has been rapidly expanding. In 1995 less than 1% of the world had Internet access. Today that number has grown to about 40%, with almost 3,000,000,000 Internet users in the world (internetlivestats.com), and the number of destinations they can visit online is likewise increasing. In 2000 the Internet had 154,000 destinations; as of January 2014 the number had grown to more than 263 million destinations located in 33 countries on six continents, according to University of California at San Diego (UCSD) Center for Applied Internet Data Analysis (caida.org).

This means that VACs, using the technology mentioned in the following, among others, could increase participation at a distance, involving more people without greatly increasing costs and time commitments, while at the same ensuring a truly global experience.

VoIP and global bandwidth. The global communications system is rapidly transforming into an entirely broadband Internet protocol (IP) network, with phone calls using voice over IP (VoIP; calls made over the Internet) replacing traditional services as an application on the broadband infrastructure. The convergence of voice and data networks into one offers substantial cost savings over the previous traditional long-distance telephone service technology, in that international phone calls can be made free. This trend toward an IP-based network is unleashing new opportunities (as well as vulnerabilities). The result will be more cost efficiencies due to continued strong growth in the global system. Unified messaging means accessing various forms of communication, voice messages, and e-mails from a single access point, such as MS Outlook with an inbox. These communications applications can make it easier to collaborate internationally within a VAC simulation.

LinkedIn and social networks. Social networks are web-based communities of people grouped into common interests. They provide a structure for people to express their individuality and to meet and interact with people having similar interests. A primary focus of groups is for interactions between users in discussions posted online. Most of the social networking websites support discussion boards for groups. Business social network services, such as LinkedIn (www.linkedin.com; NYSE: LNKD), are proving to be a very effective business technique for recruitment, expanding the search to the top talent from around the world. Social networks could be used as a means to recruit participants and increase the number of people taking part in VACs.

E-Learning and Learning Management Systems

The e-learning market is growing at an incredible rate. In 2011, an estimated $35.6 billion was spent on e-learning across the globe. The market research firm Global Industry Analysts, Inc. (2012) expects the market to grow to $107 Billion in 2015. Emerging e-learning classrooms and learning management systems (LMS) can manage, organize, and analyze massive amounts of data related to training and professional development, which can now be mapped to performance indicators (e.g., sales, customer satisfaction, error rates). Because LMS and e-learning systems can capture large amounts of data available for analysis, organizations are becoming more able to measure the return on investment of learning opportunities, going far beyond just measuring learning outcomes and engagement, to see the impact (or lack of impact) of learning and development initiatives on the bottom line.

As an enhancement to e-learning platforms, and utilizing the Internet, emerging online collaboration technologies are rapidly advancing, such as WebEx, GoToMeeting, MyTrueCloud, Google Hangouts, and Skype. These provide various collaboration methods that go beyond voice, such as text chatting over voice, video, and text; the sharing of documents; and the simultaneous viewing of presentations. They all utilize two-dimensional (2-D) metaphors, such as desktop, video screen, and presentation window. The potential of these technologies to be adapted to VAC activities is high, not only for conducting the experience for those being assessed, but also for training the people who administer the VAC and assess participants.

Immersive Technologies and Virtual Worlds

Virtual-world technologies are emerging as an immersive and alternative interface providing an environment for social and experiential learning currently not otherwise possible via other e-learning approaches. Led by gaming technology (see later), three-dimensional (3-D) computer experiences provide graphic environments that generally differ from 2-D collaborative tools with the ability to evoke a broad range of contexts. These 3-D environments can be effective at creating simulations, allowing people to perform tasks within a virtual world. To do so, avatar representations of participants are used in abstracted models of real-world environments to situate collaborative activities.

For the VAC, virtual worlds would allow the creation of simulated environments in which individuals could interact as avatars and immerse themselves in challenging and demanding experiences that can be used for assessment and development. This approach has the benefit for organizations of being able to test drive future executives. Both internal and external candidates could be assessed using the same simulation for comparison to detect contrasts. Decisions for hiring and promotion could then be based more closely on the actual behaviors of candidates.

Unfortunately, early approaches to virtual worlds were hindered by limitations in commodity technology, such as graphic rendering, Internet infrastructure, and server computation capacity. The virtual-world experience was oversold on the hype of cinematic fantasies, such as *The Matrix* (Silver, Wachowski, & Wachowski, 1999), but they were underdelivered visually and behaviorally. For this reason, the use of virtual worlds was limited until recently, when the speed and power required for better quality experience have advanced.

The advantage of a virtual-world environment is that each individual's presence is represented bodily with an avatar and the ability to interact with others in an immersive environment. In addition to individual assessments, virtual worlds are environments that are conducive to assessing group performance because of the copresence of participants. Furthermore, when these groups stratify multiple departments across organizations and national boundaries, virtual-world environments provide potential means of evaluating systemic efficiencies.

The platforms on which virtual worlds are constructed also are evolving. Open source and the use of commercially available gaming engines, such as Unity3D and Unreal, enable enhanced environments with greater resolution and functionality. An enhanced ability to customize a virtual world could more closely reflect actual work conditions and could be created quickly and developed iteratively. Avatars could become more lifelike, as closely resembling the real person as the creator would wish (see Mixamo: www.mixamo.com). Hardware, such as Kinect from Microsoft, could scan a face and body to create customized, personalized avatars. Movements and gestures could reflect emotions and behaviors that could provide a rich range of information through the virtual medium.

Serious Games, Gamification, and Simulations

As a segment of e-learning, interest in serious games, gamification, and simulations is growing. Games can make learning fun by having motivating interactive elements. Building on this, serious games (or applied games) are computer-based simulations with the look and feel of a game, designed to provide a learning and thinking environment where people can solve problems with gaming elements, including the opportunity to win. Simulation environments for serious games can range from visual simulations to virtual worlds and are intended to be engaging and to motivate while teaching or training (Zyda, 2005).

Serious games and *gamification* (the process of applying game mechanics to activities that are not games, i.e., feedback and rewards) are both focused on trying to create a context in which people can solve problems, motivate learning, and promote game-based thinking and skill development. The use of virtual-world simulations is gaining attention in broad areas, including recruitment and selection and employee training and development.

The use of these technologies is growing. The gamification market alone is expected to increase from $242 million in 2012 to $2.8 billion by 2016 (Meloni & Gruener, 2012). The serious games market is expected to grow from 1.8 billion in 2013 to 2.4B in 2018 (Greer, 2014). Deloitte noted that serious gaming simulations are a top-technology trend and were driving performance and engagement along with skills-based learning (http://deloitte-learning.com/home-3/products/serious-games/).

Furthermore, the growth of these technologies by organizations is notable. For example, there is L'Oréal's website Brandstorm, launched in 1993, which uses business games to identify promising candidates among international undergraduate marketing students. Last year, Brandstorm attracted more than 7,000 participants. L'Oréal has had such remarkable success with this site that a second recruiting game, Reveal, was introduced in 2010. Overall, more than 50,000 students from 43 countries have participated in Brandstorm, and in just 2 years, Reveal has attracted more than

100,000 students from 165 countries (Carter, 2012). From these students, L'Oréal recruited about 150 and 100 participants per year, respectively (Carter, 2012). These simulations provide an excellent example of predicting a performance through the use of serious games, where participants are challenged to demonstrate the skills and abilities that the organization wants in its workforce.

Other examples of serious game simulations used for recruiting include America's Army Game Project, a video-game platform developed by the U.S. Army to help with recruitment by providing an engaging virtual soldier experience (Mendoza, 2008). Since 2002, America's Army has had many government training and simulation applications developed to train and educate U.S. Army soldiers, as well as for entertainment experiences at events, such as air shows around the country.

The simulation helps soldiers train themselves to get into an emotional state while shooting, that increases their chances of hitting the target.

Big Data and Human Analytics

The exponential growth of technology has resulted in massive growth in capacity of new digital data collection and analytics known as big data (Davenport, Barth, & Bean, 2013; George, Haas, & Pentland, 2014). The shift in focus is from data production to data management, analysis, interpretation, and integration. Characterized by increasingly larger and more complex ways of accessing, analyzing, and integrating data, these technological innovations exceed the abilities of current approaches that often rely on human sensory modalities and disparate sources of information that are difficult to integrate and access. Once institutionalized, big data methods can cut down cost, improve prediction of outcomes, and accelerate the feedback process in VACs.

The automatic analysis of human behavior has progressed as computer systems and computational approaches have improved our ability to understand individual and group behaviors. Research groups have used wearable sensors as a method of measuring face-to-face interactions to detect conversation time and to capture individual and collective patterns of behavior (Kim, McFee, Olguin, Waber, & Pentland, 2012). Banerjee and Rudnicky (2004) described a methodology for using audio data to detect the patterns in roles in team meetings. Pahl-Wostl et al. (2013) made use of audiovisual-sensing and machine-learning techniques to analyze data from virtual-team meetings. By employing voice sensors, researchers have been able to identify, capture, measure, and quantify the social interactions of individuals and group dynamics using talk-time distribution (Paradiso et al., 2010). Some researchers were able to use automated techniques to predict performance outcomes with 80% accuracy (Dong, Lepri, & Pentland, 2012). Other researchers have taken a big data approach to measuring Big-Five personality traits (John & Srivastava, 1999; van der Linden, te Nijenhuis, & Bakker, 2010). These patterns of interaction have been used to predict health outcomes, performance in teams, and many features of socially influenced human behavior (Madan, Cebrian, Moturu, Farrahi, & Pentland, 2012). In addition, Woolley, Chabris, Pentland, Hashmi, and Malone (2010) suggested that big data approaches can provide evidence of a general collective intelligence factor that predicts group performance on a wide variety of tasks. These researchers found that team performance was not strongly correlated with the average or maximum individual intelligence of group members but was instead correlated with the average social sensitivity of group members, as well as the equality in distribution of conversational turn taking and the proportion of women in the group. Considering these findings from the computational sciences literature, big data procedures can potentially augment predictive outcomes by introducing novel techniques and predictors previously unavailable or unknown to consultants.

Biological sensors are another means to gather data, providing information such as heart rate, blood pressure, respiration, glucose levels, electroencephalogram, electrocardiogram, and adrenalin and cortisol levels (Yang et al., 2013). Facial and voice recognition programs could enable us to analyze reactions and responses (Wang, He, Yu, Jiang, & Liu, 2012). Researchers have been able to correlate biometric information with behavior in real time (Bo, Zhang, Li, Huang, & Wang, 2013). These additional sources of information can easily be integrated and managed through big data systems. These data can be added to other VAC data to create a richer mosaic of information to improve predictive and developmental outcomes. As such, consultants can collaborate across multiple disciplines such as computer science, business, education, and physiological sciences to leverage big data to better understand human behavior and performance.

Potential and Limitations of Using Recent and Emerging Technologies in VACs

What are the potential and limitations associated with integrating these emerging technologies into a VAC? As a benefit, the plasticity of virtual worlds allows the creation of activities and simulations that are specific for a job to a degree that cannot be easily managed in the traditional AC. Variables, players, and entire scenes can be adapted to capture the competencies at hand. Once programmed, these virtual simulations are standardized and automated to provide unparalleled consistency across trials. These virtual simulations will not only benefit the candidates but also the assessors because their training will be consistent and easily accessible. Immediate feedback systems can be programmed into the interface to give real-time information to participants.

Technological advancements in data collection and information management are also benefits of virtual technology. The entire assessment can be recorded. Playback would allow for better means of gathering information about performance, multiple assessor evaluations, and data for reliability and validity. In addition, information such as talk time, login time, mouse movements, and movements of each avatar in relation to virtual objects and team members can be tracked and analyzed. The level of proficiency and accuracy in data collection reduces the amount of human error in manual systems of traditional ACs. Furthermore, the integration of data into a single learning record store provides an interactive knowledge-management system that acts as a repository and reporting tool for competency profiles and job analyses that are directly linked to organizational performance metrics. Presently, virtual-world platforms are not specifically designed with an AC framework in mind. However, development of such a technology can potentially herald a new domain of consulting practices focused on the assessment and development of global leaders and virtual teams.

Our enthusiasm for the potential of technologies for VACs is qualified by some of the challenges and limitations of this type of technology. Certainly, the best practices and problems inherent in traditional ACs also will have to be addressed, and there are other concerns. For instance, virtual worlds will lack facial cues and intricacies of body movements of the real world. How individuals interact and present themselves through an avatar will differ to how they are in the real world. Issues of culture may impact how people exhibit various behaviors and expectations of virtual etiquette. Observations and behavioral anchors will need to fit within constructs appropriate for the virtual world that also can be transferable to inferences made about the real world. Confounds in technology also can impact assessment results. For example, learning curves in adapting to novel virtual environments and tools can be steep and may differentially impact some groups more than others. Practically, Internet bandwidth, hardware components, and firewalls will impact function and cost. Protection of confidential information will be more complicated to manage. The initial cost of construction will likely be high in terms of time and financial investments. However, as the process gains momentum so that templates may be created, on which customizations can be added, the cost of virtual-world simulations may be far more affordable than their real-world counterparts. The source of the initial investment of resources, whether private, public, or government based will certainly impact the outcome of the final product and its adherence to scientific rigor. Such challenges must not stifle experimentation and exploration. The following sections discuss our proof of concept and case study of a VAC. Our approach, successes, and limitations are explained, as well as the next steps for future iterations.

Proof of Concept and Case Study for a VAC

In October 2013, using a virtual-world platform that we created called VirBELA (virtual business environment for learning and assessment), we conducted a simulation in which 30 masters' of business administration (MBA) students from 10 countries and eight universities were put into teams and asked to manage a large global automobile manufacturer for 20 quarters (5 years) to build sales, improve profitability, and maximize shareholder value. All individuals participated virtually. A goal of the simulation was to test the viability of virtual-world technologies for conducting assessment—making this, in effect, a VAC pilot.

Selection and Development of the Technology

Our team spent about 2 years conceptualizing the project and securing a grant to sponsor the research. Once funding was secured, we spent about 10 months designing and iterating the technology and program before the proof of concept business-simulation competition was held. Although this project was originally conceptualized by consulting psychologists, the development and implementation of the software, curriculum, and syllabus required expertise from many disciplines, including organizational and behavioral psychologists, learning theorists, MBA faculty, business-simulation designers, computer scientists, learning-and-development practitioners, and virtual-world designers.

With as many disciplines as there were in this project, it was important that the experts have three qualities: (1) the ability to articulate his or her field to other disciplinary experts; (2) an interest in how his or her own discipline may be transformed with new approaches; and (3) a curiosity about how the other disciplines frame their approaches to the problem at hand. In short, it was important that team members be able to collaborate effectively. A successful outcome was dependent on bringing forth the valuable perspectives that each development team member possessed, while encouraging all to think in expansive and nontraditional ways about what might be possible through the invention of a new technological method. Thus, it was necessary for everyone to possess the interpersonal skills necessary for an exchange of ideas, especially the capacity to see other points of view and learn from them. Our initial goal was to create four areas in the virtual world that would facilitate different types of group interaction and information flow: a lecture hall, team breakout rooms, business-simulation rooms, and a central campus.

During the project discovery period, the technology platform experts carefully detailed the types of technological capabilities that were currently, or soon to be, possible, and we evaluated the cost, benefit, and risk basis for assessing and selecting from, among the different choices. Aspects of this also included an understanding of the general concepts of media theory, such as the semantics of representation in virtual worlds—that is, how meaning is made within this medium, and how people perceive virtual worlds as coherent experiences.

Also, devising the most effective strategy for the technology platform required the anticipation of technological developments in the short and medium term (1–3 years), as well as an understanding of what types of user behavior and activities are successful in virtual worlds, and the relevancy of computer gaming to this area. This knowledge base provided an analysis of the medium of virtual environments that informed the goals of the project. It defined what the expectations of users were likely to be in relation to the types of experiences and understandings that people use to approach the virtual environment, based on their encounters with video games, web activities, social-media platforms, other distance collaboration tools, and other virtual worlds. However, although the virtual-world designers in this project had extensive domain knowledge of the all this, they were not as familiar with the types of assessment and collaborative interactions that are typically a part of ACs.

There were a number of virtual-world platforms already available (e.g., SecondLife, Open Simulator, Olive, AvayaLive Engage, ProtonMedia, Cube, and Open Wonderland), as well as virtual-world developers in the market. After a thorough needs analysis and a comparison of the features and limitations of various existing virtual worlds, we decided to create our own platform, using the gaming engine Unity3D, a cross-platform game engine that is used to develop video games for web plug-ins, desktop platforms, consoles, and mobile devices. The decision to go with Unity3D meant that our upfront investment would be higher than with other options, but we would have far more capability to develop the specific attributes of the virtual world to suit our purposes. Had we gone with a preexisting platform, we may have been able to develop an initial, generic, virtual world much more quickly, but such a platform would have been difficult to extend beyond the conventions they were designed to address. In addition, preexisting platforms were not specifically built with management assessment in mind. Creating our own virtual world gave us the ability to integrate organizational science into the design of the program. Using Unity3D also provided more advanced rendering and graphics compared to other virtual-world platforms. Furthermore, our game engine system is functional across platforms, so that although the environment is primarily targeted to PCs, we can relatively easily create Mac clients, and could eventually include tablets and cell phones, for both iOS and Android.

Assessment Design Principles

Beyond selecting a technology platform, a pivotal step was articulating the key design principles that would make the simulation effective for an online, globally available AC. We chose to focus on the assessment of global leadership competencies. Our key design principles were as follows: First, for people working in a distributed work environment and collaborating digitally, the assessment approach used must reflect a similar environment. Second, although self-report and ability measures were helpful, they were not sufficient for assessment; there must be a multimethod approach to assessment, including an evaluation of behaviors. Third, the assessment approach must measure both domain expertise (e.g., business acumen) as well as the ability to work well with (or lead) others; the assessment must occur with groups of individuals interacting with one another on shared tasks. Fourth, the approach must be grounded in science, and the aggregation and analysis of data should be simple, iterative, and robust. Reliability and validity must improve over time through refinement of activities, methodologies of assessment, and greater understanding of predictors of performance on the job. Wherever possible, assessment and analysis of data must be automated and take into account nested structures (e.g., individuals nested within teams). Over time, improved data collection will increase the value of such an approach, whereas helping to reduce the cost of human intervention. Finally, the assessment process must be both enjoyable and challenging for participants.

Embedding a Business Simulation and Defining Competencies

After creating the virtual-world platform and defining design principles, we needed to design and integrate activities typical to an AC that would evoke behaviors consistent or inconsistent with competencies of interest. We focused specifically on a multiplayer, multiteam business simulation. After much research and vetting, we decided to work with Tycoon Systems, a company that develops business simulations for corporate training and education purposes. Their business simulations are in a 2-D web-page format. So we designed a virtual room whereby these simulations could be displayed in 3-D space, making it possible for participants to simultaneously interpret the information of the exercises and interact with one another in the virtual environment. Therefore, there was an area in which teams would manage their products (for instance, carrying out activities related to such things as pricing, marketing, production, and economies of scale), view market data, set strategic positioning, and review overall company performance (such as key performance indicators, financial ratios, and stock price). In 3-D space these activities can be done by multiple team members in parallel—a significant difference from the way it can be done in a 2-D simulation. The choice to interact either sequentially, in parallel, or in a hybrid manner is one of the primary team decisions that the competing teams make in the simulation competitions.

The final aspect of developing the simulation, done in parallel to building the virtual world, was the definition of specific competencies we wanted to assess in the VAC. Our approach to this was twofold: bottom-up and top-down. First, we went to the empirical literature on global leadership to find competencies. Once those competencies were defined, we created storyboards on how activities in the virtual world would provide behavioral anchors that could be used for assessment. Second, we started testing the virtual world and business simulation to consider which competencies would be amenable to assessing through observation in the virtual platform. The final competencies that we selected, defined, and created behavioral anchors for are listed in Table 1.

Table 1
Global Leadership Behavioral Competencies

Personal dimensions	Leading others	Leading in a global environment
Cognitive agility	Influencing and supporting	Global citizenship
Personal resilience	Transparent interaction	Global leverage
Self-knowledge	Relationship building	Global governance
Cultural adjustment	Team building	Global innovation
Focused drive	Planning and execution	Global execution

Recruiting Participants

Once the simulation was ready, the next step was recruiting people to take part in our pilot case. We decided to use MBA students, and participants were recruited by reaching out directly to universities and through a press release. Students signed up voluntarily via the Internet; we used $50,000 in cash giveaways as a marketing tool. Students applied to the competition via a web application, which was a link on our website. A major criterion for participation was that the participants could speak English. After students expressed interest, they were required to complete a battery of assessments, which included the Strong Interest Inventory (SII; Strong, Donnay, Morris, Schaubhut, & Thompson, 2004), the Mayer–Salovey–Caruso EI test's latest version 2.0 (MSCEIT V2.0; Mayer, Salovey, & Caruso, 2002), the Raven's Advanced Progressive Matrices (RAPM; Pearson, 2009), and the Workplace Big Five Profile 4.0 (WB5P; Howard & Howard, 2009).

Applicants were informed that the results of the assessments would not be considered in selection procedures. The assessment requirement during the application process was employed as a motivation filter. Students participated in the competition on a voluntary basis and did not pay to enter the competition. The rationale was that those willing to invest the time in a longer application process would be more likely to stick with the competition in its entirety. All applicants who completed the assessments, whether selected for the competition or not, were offered the results of their assessments and an individual 1-hr feedback session.

We had 126 MBA students apply to participate in the competition. Out of those applicants, 66 completed the assessment battery. Stratified random selection was used to select 32 students for the competition. We selected participants to maximize diversity in terms of university affiliation and geographic location. In the end, there were 30 participants in eight teams. Two of the selected participants could not participate; one did not have the hardware or Internet connection to effectively run the software, and the other was not actually an MBA student, which we discovered just prior to the competition. The 30 participants were from business schools at some of the top universities in the world, representing the United Kingdom, Mexico, France, Singapore, Japan, Portugal, India, South Africa, the Netherlands, and the United States (see Table 2). We employed stratified random assignment to place the 30 students in teams of four, making sure there were no two people from the same university or country on one team.

Description of Simulation Activities

The eight teams were each assigned a facilitator. The facilitators consisted of four consulting psychologists, with a minimum of 15 years experience in the field, and four consulting psychology doctoral students. They helped participants prepare, observed them during the simulation, and then led debrief sessions around team processes (for instance, decision making, conflict management, and managing cultural differences).

The competition was held over the course of a month, with four synchronous 3-hr sessions, each a week apart. Between Sessions 2 and 3 and between Sessions 3 and 4, there were asynchronous

Table 2
Gender and Country Demographics of Participants

Demographic	*n*
Gender	
Female	11
Male	19
Total	30
Country	
France	1
India	4
Japan	5
Mexico	1
Portugal	1
Singapore	7
South Africa	1
The Netherlands	1
United Kingdom	3
United States	6
Total	30

sessions, in which teams had to find a time to meet in-world during the week to enter their inputs into the simulation.

Before. The week prior to the competition, each facilitator met with his or her respective team in the virtual world for introductions and to provide an overview of the competition. During this time, members chose a team name that they would use throughout the competition. Each day started with a meeting in the virtual-world lecture hall where the agenda for the day was provided and where participants had the opportunity to ask the developers about simulation questions. The simulation developers, who were based in Brazil, Spain, and Scotland, were present via avatars and answered questions in real time via the text and VoIP systems.

During. After the welcome session for the full group, with a period for questions and answers, individuals joined their teams by entering their respective team rooms to acclimate and strategize for the day's activities and decision making. Within each team room, one wall is a shared whiteboard on which all team members could write or post text to take notes. After the strategy session, the teams went to their respective simulation rooms, and the first quarter of the day began. Teams immediately started analyzing simulation data, strategizing, and making operational decisions. All behaviors in the virtual environment were recorded by the software, and each team was observed in real time by a consulting psychologist (or a consulting psychology doctoral student).

At the end of each quarter, decisions were locked in, with all team decision inputs processed by the back-end algorithms of the simulation, and in roughly 30 seconds, all the simulation screens reloaded with the results (displaying the business performance of the simulated company for the previous quarter with the competitive ranking), and the new quarter began. Each quarter, the teams were able to see how their company was doing in the market and what place they were in relative to the other seven teams. Competitive ranking in the market was based on market capitalization. Each day, teams participated in three to six quarters. Earlier in the competition, more time was provided as teams got to know each other, the 3-D environment, and the simulation. Over the course of the competition, quarters gradually got faster, with the last few quarters being 15 min apiece.

The competition—with time pressures, a complex simulation, and working with new team members in a new environment—provided cognitive complexity, which we believe allowed the participants to be themselves. Quickly, the politeness was set aside as the teams got down to the business of debating strategies and struggling over power. Sometimes sneaky tactics were employed and there was cheering and shouting among the teams. Some teams worked in parallel together, while others worked sequentially. Some teams made it through the stages of team development, while others had a tough time getting past establishing the normative expectations and standards for their team. Leaders and team cultures emerged as the teams worked together, and it was observed that power and team dynamics morphed in parallel with changes in performance. For example, poor performance was often attributed to an external locus of control by team members, and complaints were made about the simulation's instructions, the facilitators, the accuracy of the simulation engine, and the suspicion that the system had "changed our input." Some teams made devastating mistakes early, like liquidating a product line after one bad quarter, making it difficult to recover. Many of the teams were running analyses in Excel outside of the virtual world. Between sessions, teammates e-mailed each other to discuss the next week's strategy. They leveraged tools such as WhatsApp to communicate out of the virtual world between sessions. Other teams met regularly in-world. Toward the end, some of the teams performing toward the bottom became somewhat disengaged. Some made extreme strategy changes, whereas others went practically silent. Another team decided to have foot races with their avatars. No team member or team dropped out. Bystanders moved from computer to computer to observe different teams while in action, and at times it was like watching reality TV (with cartoon characters). Some technology experts from our development team were glued to the screen, fascinated by the interactions, after months of skepticism ("What are these psychologists trying to do?"). They became believers and understood the power of the experience they had made possible.

Results

There were many lessons learned from this case study. We went into the project with the goal of learning how recent and emerging technologies can contribute to a VAC, enhancing AC methodologies to provide better, cheaper, and faster service. In particular, we wanted to learn the following:

1. Would virtual-world technology and embedded activities work with a global audience? And if so, how would they work?
2. Would participants become immersed in the activities? And if so, how would they become immersed?
3. Would raters feel that they can observe enough behaviors with sufficient accuracy to make valid and reliable competency ratings?
4. What is gained and what is lost in a VAC versus tradition face-to-face activities in an AC?

The first question simply aimed to explore the feasibility of such an undertaking. The development process showed that construction of a novel virtual environment for an AC is viable. Initial testing of technological and bandwidth capabilities showed that all interested candidates, except one, were able to run the program. Participants across the globe were able to use this virtual environment to meet and work together on the simulation activities. Despite the learning curve of adjusting to this novel program, participants were able to use their avatars to traverse the virtual world and use in-world objects to complete their assigned tasks. This suggests the potential of further refinement, research, and integration of technology as one area of innovative evolution in the field of consulting in response to the demands of globalization and technology.

Our second question aimed to explore the experience of immersion of the VAC. It was evident that participants were fully immersed in the activities. They used the body motions of their avatars to convey tacit communication. For example, they greeted each other with waves, cheered, or nodded heads to show agreement or disagreement; raised their hands to indicate the desire to communicate; and hugged each other during moments of accomplishment. Engagement in the activity also could be inferred from the shifts into heightened states of emotion. Conflicts and disagreements arose in the simulation that sometimes incited frustration that escalated to shouting. In one such argument, a seasoned facilitator was able to use empathic validation to deescalate the situation. Various other facilitators pointed to their observations of how emotionally involved the participants became in the moment.

Participants also shared their experiences of immersion in a survey conducted after the competition. Some of their open-ended responses that suggested immersion were: "The observation of people's avatars provides clues to the state of their awareness." "There is a feeling of physical presence in the virtual world." "I think that the ability to visualize the team makes a great difference." "You see who is doing what, which gives you a sense of togetherness. People are not just names on a side pane." These direct accounts of participants' experiences and observational impressions of the facilitators provide some insight about the levels of engagement and immersion that occurred in this virtual environment.

With respect to the third question, we wanted to explore whether relevant behaviors can be observed in the virtual environment. To gather evidence to answer this question, we conducted structured interviews with the facilitators after the competition. Across the board, facilitators reported ease of observing behaviors related to teamwork, analytical skills, decision-making processes, and some aspects of leadership. For example, facilitators reported that participants solicited different opinions of team members, huddled together in the virtual environment, and exhibited teaching behaviors to explain pertinent information to one another. Major decisions were discussed as a group, so the process was detected through their conversations. The complexity of the business game necessitated adaptive analytic skills. One facilitator said,

> It was a difficult simulation, and when they saw their company going in the wrong direction, the participants were able to see how that impacted their bottom line and were able to change direction quickly, analyzing info quickly and efficiently.

In terms of leadership, it was evident that some participants were more dominant and took initiative to delegate tasks. All the facilitators noted that certain members of their group were more active and vocal in taking on leadership roles. One facilitator stated, "There's a social presence that people had—leading, assigning tasks, checking progress, monitoring others' short-term and long-term planning." In some cases, leadership shifted as people became more acquainted with one another and came to leverage each other's strengths. Evidence of this can be seen from facilitators' descriptions such as,

> My group had one specific participant who was the dominant leader at the beginning, but as the competition progressed, the two participants who were more subject-matter experts emerged as leaders and the dominant person took on an encouragement role for the experts . . . [and] . One person was very reserved at first, and that was a cultural issue of not drawing attention to herself, but as she became more comfortable with the group and the competition progressed, she saw [that] she was critical to the team and took on more dominant roles.

These observations showed that facilitators were able to easily identify some of the social and cognitive competencies in the virtual environment.

There were some concerns, raised by facilitators, about challenges to behavioral observation. Most of these challenges resolved around facial cues and intricate body movements that were lost in the virtual environment. For example, although some aspects of emotion can be picked up by voice tones (i.e., raised voices, rapid speech), other emotions and overall emotional intelligence were difficult to ascertain. As one facilitator noted,

> Unless you coach people to voice their emotions, it was hard to pick up on emotional intelligence. When I debriefed with my team, I asked about feelings, thoughts, and behaviors directly, but unless you are guiding that as a facilitator, you might not get those things.

Another facilitator said,

> In the virtual setting, you are always limited to interpreting an individual's full intent. You get the words and tone but that doesn't always convey them effectively because you don't have body language and facial expressions to point to what people are feeling.

One of the experienced facilitators also expressed difficulties with identifying behaviors indicative of more abstract and complex competencies such as "ethics and the dimension of the global leadership framework we used pertaining to global citizenship, leverage, and governance." He believed that this was because of limitations in the business simulation that did not specifically include activities that could solicit these behavioral responses. However, he felt confident that these competencies can be assessed in the virtual world if exercises were designed to yield them. Despite these challenges, the facilitators unanimously agreed that further development of the technology and science of virtual assessments had immense potential for the future of ACs.

Finally, we questioned what could be gained and lost in a VAC. With respect to gains, technology has made it possible for global teams to work together across the world. For internationally dispersed businesses, conducting virtual assessments can reproduce many of the challenges that employees will face in their actual jobs. Matching the medium of the assessment to those of the actual job will likely yield greater fidelity for predicting performance. In addition, the virtual space eliminated the costs of flying and hosting the participants.

The case study also provided a glimpse into the prospects for big data collection. We were able to record all the interactions in the virtual world. Participants' time spent in-world, mouse and avatar movements, and talk times were tracked continuously. The winning team's talk data showed the highest level of participation in communication (in terms of frequency) in comparison with all the teams, as well as a relatively equal distribution of the communication contribution among all team members, in that there was no domination by a single participant, and this was in contrast to the other lower performing teams. Such a finding is consistent with previous big data group communication research of team performance (Woolley et al., 2010). Of course, our results are based on the case study evidence of only eight teams, but they provide an insight to explore empirically as we continue to have more teams participating in simulations. The technology also allowed playback of sessions from the perspective of each individual (participant or facilitator). This provides advantages to the scientific processes of future iterations of program, facilitator training, and gathering evidence of reliability and validity for behaviors and activities. Participants also will have the ability to observe their own behavior, from either a first-person or third-person perspective, much like professional sports teams watch films after a game.

However, there were also things that were lost in the VAC. The lack of facial cues limited the transmission of tacit communication. Body movements were confined to what was available through the program and thus limited the range of body language. The virtual environment may also have affected social etiquette to some extent. For example, on one occasion, a participant became so frustrated that he logged off without warning. Had this simulation occurred in person, perhaps social pressures would have kept him from reacting so impulsively. Advances in commodity computer cameras, facial-recognition software, avatar expressions, and voice-recognition software are expected to continue to improve over the next few years. Soon computers may be able to identify emotion more reliably and accurately than participants or an observing consulting psychologist.

Other losses involved problems that would not have occurred in a real-world situation. For instance, there were a few problems with technology. Some participants' headsets caused static or would cut out, causing frustration. Some people's screens would occasionally freeze, and they would have to log off and then back on. Plus there were human errors in running the virtual simulation. A couple of the directions were misleading. We set one quarter to advance at the wrong time, so the quarter was shorter than planned. And some facilitators answered questions they were instructed not to answer. Such errors emphasize the need for more formal training of facilitators and administrators. Furthermore, human error raises the question of how to automate more of the process from directions, to frequently asked questions, to facilitation and assessment.

Discussion

The business simulation described earlier provides proof of concept for the potential of leveraging recent and emerging technologies to develop a VAC. Participants were able to acclimate easily to the virtual world—using the interfaces effectively, running the software successfully with their own hardware, and employing their avatars while staying focused on the business problem. (Having an avatar made them feel a sense of presence and togetherness that added to their work and team experience.) In addition, facilitators were comfortable with the virtual environment, and they confirmed the ease of observing behaviors that were indicative of teamwork, leadership, decision making, and analytical skills. The complexity of the business simulation, which the technology made possible, created opportunities to solicit adaptive individual and group-level responses. The availability of virtual spaces and tools, and the ability to manipulate objects helped to foster learning, teamwork, and group cohesion. These findings were consistent with virtual-world research showing that the ability to manipulate objects together, the presence of shared space, and the visibility of the entire body and its movements are a few aspects of interactions that are pivotal for augmenting team identity and collaboration (Franceschi, Lee, Zanakis, & Hinds, 2009).

This case study demonstrated that the virtual environment is not only viable but also has the potential to provide advantages over the traditional AC process, especially its ability to collect a great deal more participant data than was previously possible. Future improvements can incorporate data integration, management, and immediate feedback capabilities. Another advantage of the virtual technology is that enhancements and modifications can be made more readily than in traditional physical AC setting. For example, entire environments and situations can be programmed to suit assessment purposes and organizational needs. Simulations and role-plays can be developed that are standardized and simple in execution without added error and expenses of hiring actors. Behavioral observations; exercise execution; feedback generation; and data collection, analysis, and integration can be greatly improved while at the same time freeing up consulting psychologists to focus more on issues of practice.

Finally, conducting a VAC where globally distributed participants use technology to work together provides an opportunity to assess people in situations that are closer to actual organizational conditions. Because the VAC operates in the same medium as virtual teams, it makes it possible to evaluate individual and team attributes that best fit the context.

Next Steps

Although this was only the first iteration of a VAC, many ways for future development were uncovered:

1. Usability and reliability of the technology must be improved.
2. There is opportunity to automate assessment—we did and can record everything. This could help us understand what behaviors tell us about competency.
3. Build in more 360-degree feedback.
4. For VACs conducted to promote development, create additional effective ways to push knowledge back to the participants.
5. Develop back-end machine-learning algorithms to understand individual and team performance.
6. Integrate facial and voice recognition.

During this pilot, we were able to collect large amounts of data that will be used to refine future iterations of the program, train future facilitators, and garner evidence for reliability and validity. The potential for big data will expand our capacity to evaluate the effectiveness of the interventions. This will allow us to demonstrate the value in our work and to foster practical and scientific approaches to increase participation between practitioners and academics in consulting psychology. Start-up costs were high, but future iterations will very likely be more cost-effective and expedient. As this approach improves over time, we expect the virtual process to be faster, cheaper, and better than on-site assessment centers that often incur the exorbitant costs of travel, hosting, and assessor costs when conducting a multinational assessment process.

This VAC also made it possible for us to better understand how to leverage technology to develop individuals and global virtual teams. Recent research has described how individual and group performance in virtual teams could be enhanced through improving collaboration between individuals. These improvements can be made by overcoming difficulties often experienced in resolving conflict (Holahan, Mooney, Mayer, & Finnerty-Paul, 2014), by building stronger relationships (Shen & Fluker, 2013), by building trust and sharing information (Pinjani & Palvia, 2013), by increasing the levels of engagement and participation (Monzani, Ripoll, Peiró, & Van Dick, 2014; Perry, Lorinkova, Hunter, Hubbard, & McMahon, 2013), and by understanding how to help teams make better decisions to support high performance (Bartelt, Dennis, Yuan, & Barlow, 2013; Verburg, Bosch-Sijtsema, & Vartiainen, 2013). It is known that traditional team skills are not sufficient for high-performance virtual-team members (Berry, 2011; Krumm, Terwiel & Hertel, 2013), so fostering team performance requires different ways of selecting, preparing, and developing individuals and teams in dispersed global settings (Bowers & Cannon-Bowers, 2014). Technological innovations in virtual worlds, gamification, and serious gaming are already being used to improve employee development and performance, learning management and feedback systems, and recruitment and selection practices. Development of a VAC is the next logical step to make it possible for consulting psychologists to employ this technology for these purposes in a coherent and effective manner.

We chose to present this exploratory investigation as a case study because of the limitations of making any statistical inferences from such a small sample. Considering that this is the first iteration of the approach, there is much to be said about improvement of the science and technology. The global leadership competencies we developed will certainly need further examination and refinement. More simulations and exercises will need to be developed and included in the process. Videos of the first trial can be used to further refine behavioral anchors and competencies that can be assessed in the virtual world. These videos also can be used to train future facilitators. At that point, an assessor-training paradigm can be created and standardized to meet the International Workforce on Assessment Center Guidelines (2009). Once larger samples of data are obtained from future iterations, we will be able to do a more in-depth evaluation of the theoretical framework, reliability, validity, and effectiveness of the method.

VAC and Beyond

The virtual platform that we created has potential for applications in addition to the VAC. We are already collaborating with education and business venues to gather more data and explore those other applications. Currently, the platform is being used to serve as an online campus to host distance learning for a number of major universities. And a global biotechnology company has tentatively experimented with it to assess its potential to gauge business acumen and performance. The specificity of our platform to serve multinational institutions virtually, the scientific underpinning of our design, and the unique aspects of being able to use avatars to interact and manipulate objects add value to the existent telecommunications and virtual-world tools. As we gain more understanding of how to approach virtual assessments and the technology, the VAC process will become more advanced to actualize tangible utility. Thus, we fully acknowledge the limits of this case study at this stage but point to the main objective of this exploratory endeavor to lay the foundation for invigorating an innovative niche in future consulting psychology.

Conclusions

The business simulation described earlier, conducted in a virtual-world platform, is the first step of a much larger endeavor—creating a completely virtual assessment center. The case study provided a proof of concept of the potential of a VAC and will help shape the next iterations. The empirical methodology does not yet stand up to rigors of the field, but experimentation and exploration are a must for consulting psychology (CP) to remain competitive in today's global technological ecosystem. With new technologies, consulting psychologists should be asking how can technology be used to complement or extend their services, rather than try to simply replicate what is typically done in face-to-face consulting interactions. The research conducted here was made possible by industry–university collaboration. The project was expensive, and iterating on the process until the service meets the scientific rigors of the field will continue to come at a high price. However, the end result could have great scale and potentially improve reliability and validity of an AC, while reducing error and bias. The question is how does the CP field support innovation and exploration? Are there systems in place to encourage consulting psychologists to take risks, which will likely lead to many failures while navigating to a few successes? What are funding sources? How are consulting psychologists interacting with academic research institutions? What opportunities are there in the military? How can consulting psychologists work more intimately with technologists?

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