Virtual humans: transforming mHealth for veterans with post-traumatic stress disorder (PTSD)

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Provenance: This is an invited Editorial commissioned by Editor-in-Chief Dr. Steven Tucker, MD (Tucker Medical, Singapore).

Comment on: Lucas GM, Rizzo A, Gratch J, *et al.* Reporting Mental Health Symptoms: Breaking Down Barriers to Care with Virtual Human Interviewers. Front Robot AI 2017;4:51.

Received: 03 February 2018; Accepted: 09 March 2018; Published: 30 March 2018. doi: 10.21037/mhealth.2018.03.03 **View this article at:** http://dx.doi.org/10.21037/mhealth.2018.03.03

The use of virtual humans (VHs) in mHealth to manage health conversations, ranging from screening and education to changing attitudes and behaviors that reduce risk and increase treatment compliance, and treatment itself, holds tremendous potential to cost-effectively transform worldwide healthcare as we know it. Advances in simulation and gaming technology have resulted in the ability to create emotionally responsive, three-dimensional VHs that possess personality, memory, and non-verbal gestures, and react like real people engaged in health conversations. As a result, individuals experiencing signs of post-traumatic stress disorder (PTSD), substance use, and suicide risk often report feeling less judged, safer, and more likely to reveal information to VHs when compared to face-to-face conversations of a similar nature (1-3). This is due to the development of algorithms that enable VHs to consistently and reliably establish rapport with users, provide accurate knowledge, and can react to user responses with evidencedbased communication strategies such as motivational interviewing (MI) (4), all contributing to their effectiveness and high fidelity. Thus, within conversation dynamics, VHs can respond predictably and efficaciously, never fatigue, do not age, and are not subjected to transference and countertransference reactions that can compromise communication such as a provider's own sets of expectations, beliefs, biases, and emotions that may impact the quality of care. Clearly, VHs hold tremendous potential to leverage healthcare conversations resulting in changing attitudes

and behaviors, the importance of which is captured in *The Journal of the American Medical Association* article which summarized the importance of communication in healthcare this way: "Excellent medical care combines sophistication in scientific knowledge with equally sophisticated communication skills to understand the needs of the individual patient, to address his/her feelings and concerns with sensitivity and compassion, and to educate patients about their choices in care.... The benefit of good communication on patient care and outcomes is unequivocal" (5).

In the present editorial, we review and expand upon the contributions of Lucas and colleagues (6) in furthering research on the use of VHs in clinical assessment, connecting their study to similar interventions on the market (i.e., those of Kognito). In addition, we recommend avenues for future research and potential broader applications of VHs in workplace settings.

Contributions of the present research

The study conducted by Lucas and colleagues (6) has made a significant contribution in our understanding of, and the potential for using, VHs in conducting screenings that utilized the Post-Deployment Health Assessment (PDHA) symptom checklist with active duty service members and veterans. Data from two groups of participants, one National Guard service members (N=29) and the other, active duty service members and veterans (N=132), show that in both groups, the anonymized conversation between

the VH interviewer and participants elicited more PTSD symptoms when compared to the standardized face-to-face PDHA screening or an anonymized computer version of the PDHA. The authors point out that the two anonymized conditions (VH and computerized screening) controlled for stigma and resulted in increased disclosure of PTSD symptoms. However, VH screenings resulted in increased reporting of PTSD symptoms over the computerized version due to the rapport established between the VH and participant. Rapport was established in several ways beginning with the VH asking non-threatening introductory questions to set the tone. Secondly, the VH asked slightly modified PHDA questions so they would seamlessly fit them into a conversation dialog. Lastly, the VH responses to participant answers included open-ended questions with empathic verbal and non-verbal feedback via gesture backchannels. The screening ended with the VH asking questions designed to bring about a positive mood to help ameliorate any anxiety brought about by the screening. Thus, anonymized screening with rapport building by VHs was superior in providing a safe environment where service member participants and veterans revealed more PTSD symptoms. The building of rapport, and willingness to honestly self-disclose symptoms to VHs, not only increases the accuracy of PTSD diagnoses, but also can increase the number of service members and veterans receiving evidenced-based treatments to help prevent the chronic suffering and maladjustment brought about by untreated PTSD on the individual, and the secondary impact on spouses and children.

The authors of this study demonstrated that service members and veterans are more likely to reveal symptoms of PTSD to an anonymized VH that builds rapport. To put this in perspective, this is a tremendous accomplishment that holds great promise in helping the many service members and veterans whose direct or indirect battlefield experiences have rendered their lives irrelevant. Lives often characterized by sleepless nights interrupted by horrific nightmares and flashbacks plaguing them in waking moments. Lives often filled with uncontrolled rage resulting in failed relationships that lead to increased divorce rates and violence against spouses and children. From the service member or veteran perspective, having PTSD and anticipating undergoing a PDHA screening often prepares them for the worst. Being hyperaroused, service members and veterans may dread the screener's request for them to recall haunting traumatic memories. As attempts to escape the traumatic memories, dissociation or

numbing contributes to nights (and days) of substance and alcohol use and suicidality. Now, imagine the screening is being done by a VH. The participant cautiously wonders, "what this is going to be like?" Schemas, beliefs, and past experiences that accompany prior PTSD screenings and the associated increased cognitive load that contribute to one's trepidation, anxiety, and fear now have a new element introduced: the VH. This brings into play competing schemas involving prior gaming history, movies with virtual characters, children playing computer-based games, educational experiences, etc. No wonder the user eventually feels safer, less judged, maybe even curious, and more likely to "open-up." To provide such a screening experience for this population is an amazing accomplishment.

The use of VHs to help service members and veteran populations extends beyond screening for PTSD, as evidenced by the work of Kognito (www.kognito.com), a health simulation company that develops role-play conversations featuring VHs to assess and build skills and confidence to lead real-life conversations that drive positive changes in social, emotional, and physical health (7-9). Users practice role-play conversations with VHs, receive feedback from a virtual coach, and are occasionally privy to hidden thoughts of VHs to build understanding and empathy, all to learn and self-assess how to use evidencedbased communication strategies such as MI to better manage challenging health conversations. The behavior change model integrated into the development of these simulations includes comprehensive instructional design and evidence-based conversation components drawn from neuroscience (10). Studies have examined the efficacy of numerous Kognito health simulations including several that support service members and veterans and include screening and brief intervention in primary care (7), supporting military families (8) and military cultural competency, and gatekeeper skills for faculty and staff in higher education that include identifying, talking to, and if necessary, referring student veterans in psychological distress to support services (9). Studies are currently being conducted on the efficacy of a peer-to-peer service member and veteran support simulation that includes recognizing, approaching, and discussing a referral of those peers at risk for suicide, and a simulation for educators to support military children.

The advantages of using VHs to screen service members and veterans for PTSD can extend beyond assessment into treatment. In fact, one should view the PTSD screening as the beginning of treatment. Once rapport is established,

mHealth, 2018

VHs can accompany the user throughout and after their treatment. This can include psychoeducation addressing stigma and introducing the user to evidenced-based treatment modalities, helping to deliver and manage selfregulation exercises such as mindfulness training, providing periodic assessment, and being part of a safety plan for suicide prevention. Truly, this and prior work conducted by Lucas and her colleagues in supporting service members and veterans is a giant step forward in helping those who have given so much and deserve all that can be provided to lead healthier and more productive lives.

Future research

The work of Lucas and colleagues (6) continues to advance our understanding in identifying the efficacy of state-ofthe-art simulation technology. There are several extensions of this work that may be especially valuable, including additional research designs and various operationalizations of PTSD. In particular, randomized between-subjects research within large service member and veteran populations could strengthen claims of VH assessment effectiveness by reducing the potential for sensitization or order effects. Also, it is possible that the additional time spent attempting to recall relevant events leads to additional reporting with automated VH assessments in comparison with short written questionnaires. Therefore, it may be useful to consider the correspondence of automated VH assessments with clinical evaluations with a live person, as well as anonymous pen-and-paper assessments that require longer cognitive processing time, which would provide additional evidence of the value of the combination of anonymity and rapport-building.

Lastly, PTSD can be assessed using a variety of instruments. The 17-item PTSD Checklist (11) is generally considered a valid and reliable measure. Identifying the range of symptoms from this checklist that can be elicited within the context of an automated VH assessment, including if there are differential patterns across symptom clusters, could provide a unique opportunity not only to expand usage of such assessments to document a more complete array of symptoms, but also build existing theory around PTSD (e.g., identification of differing degrees of stigma around certain symptoms). Admittedly, adding more functionalities to such programs may be a highly complex undertaking from a logistical perspective. Page 3 of 4

Applications in workplace psychology

As evidenced by Lucas and colleagues (6), one key advantage of using VHs is the simultaneous maximization of both rapport and anonymity. In addition to the applications mentioned by the authors, there may be several additional wavs in which human resource management would benefit from this technology, although such uses merit rigorous empirical testing prior to widespread adoption. In particular, sexual, racial, and other forms of harassment and discrimination remain a continuing issue for many organizations, but current systems for mitigating such issues may not promote widespread reporting when an incident occurs (12). Victims of harassment may be concerned with potential reprisals or experience embarrassment if they report their experiences. The use of a VH as a first step for reporting could be valuable to promote perceptions of a safe place to report incidents, which is important from an organizational perspective to mitigate legal liability. As a secondary outcome, such a process may also provide therapeutic benefits to traumatized victims, particularly considering that most human resource professionals will probably not have significant mental health training.

Setting the stage for an additional but less straightforward application, current evidence suggests that job applicant personality and integrity are valuable predictors of job performance (13,14), but assessment of these constructs may be subject to applicant faking, both due to social desirability and impression management (15). Although the use of a VH is unlikely to reduce the extent to which applicants' desire to provide a positive impression of their fitness for employment, it is plausible that building rapport with a VH may allow them to feel more comfortable disclosing sensitive information compared to a standard pencil-andpaper test. Ultimately, the practicality and cost-effectiveness of such technology in this setting is an empirical question to be addressed by future research.

Conclusions

Lucas and colleagues (6) provide a seminal foray into the use of VHs for assessment of PTSD in military service members and veterans. We hope that this study spurs additional research into the features of such interventions that are most effective and have broader applications in clinical and other areas of psychology.

Page 4 of 4

Acknowledgements

None.

Footnote

Conflicts of Interest: G Albright is employed by Kognito; JT McMillan received compensation from Kognito as an independent consultant.

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doi: 10.21037/mhealth.2018.03.03

Cite this article as: Albright G, McMillan JT. Virtual humans: transforming mHealth for veterans with post-traumatic stress disorder (PTSD). mHealth 2018;4:7.

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