Watch what I do, not what I say I do: Computer-based avatars to assess behavioral inhibition, a vulnerability factor for anxiety disorders

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ABSTRACT

Behavioral inhibition (BI), a tendency to withdraw from or avoid novel social and non-social situations, is a personality trait which can confer risk for anxiety disorders. Like many personality traits, BI is often assessed via self-report questionnaires where respondents rate themselves for frequency of certain behaviors or feelings. However, questionnaires have inherent limitations, particularly in psychiatric populations where there may be unawareness of deficit. A viable alternative may be virtual environments, in which the participant guides an on-screen "avatar" through a series of onscreen events meant to simulate real-world situations. Here, we report on initial development of such an assessment tool, involving several onscreen scenarios with choice points where the participant can select from response options corresponding to inhibited or uninhibited behaviors. In two experiments involving over 300 college students, scores on the computer-based task were strongly correlated with BI scores attained through self-report questionnaire ($r > .780$, $p < .001$); this relationship held regardless of participant gender and experience with computer games. The results suggest that virtual environments may hold promise as alternative formats for assessment of personality traits in populations unsuited to traditional paper-and-pencil questionnaire formats due to psychopathology, limited attention span, or poor vocabulary and/or literacy skills.

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1. Introduction

The widespread use and development of online and virtual environments opens up new potential for a range of applications, such as studying individual participants' behavior in simulated situations. Prior work has examined how individuals create and express online personalities, and how such online personalities can change in different online settings (Guitton, 2010; Vasalou & Joinson, 2009). Other studies have considered how people use online identities that may be similar to, or different from, their real selves (Joinson & Dietz-Uhler, 2002).

The current study examines whether simple, highly-controlled online environments can be used to evoke behavior that is indicative of specific personality traits which have been implicated in vulnerability to psychiatric disorder. We focus on the personality trait of behavioral inhibition (BI), which confers risk for several psychiatric disorders, and which has traditionally been assessed in adults by self-report questionnaires. Here, we use a short computer-based task in which participants experience several scripted scenes that offer opportunity to display inhibited behavior, to investigate how closely task behavior correlates with BI assessed via questionnaire, and if so, whether this correlation can be modified depending on whether participants are, or are not, specifically instructed to respond in a way that simulates how they

normally behave.

1.1. The personality trait of behavioral inhibition (BI) and risk for psychiatric disorders

Several personality traits and behavioral patterns have been associated with risk for psychiatric disorders. For example, the trait of behavioral inhibition (BI) is defined as a tendency to withdraw from or avoid from novel social and non-social stimuli (Kagan, Reznick, & Snidman, 1987; Morgan, 2006). BI is believed to be one of the most stable temperamental characteristics, although not all children with high BI develop into high-BI adolescents and adults (Degnan & Fox, 2007). BI can be identified in childhood based on structured interview and/or observation of behavior of the child when confronted with unfamiliar people and objects (Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984). Inhibited temperament in childhood is a risk factor for future development of anxiety disorders (Biederman et al., 1993; Hirshfeld et al., 1992; Pérez-Edgar et al., 2010; Svihra & Katzman, 2004) and for post-traumatic stress disorder (PTSD; Fincham, Smit, Carey, Stein, & Seedat, 2008; Kashdan, Morina, & Priebe, 2009).

1.2. Limitations of questionnaire tools for assessing BI

In adults, BI is most often assessed through self-report questionnaires, which ask respondents to rate themselves on perceived levels of inhibition relative to implicit social norms. Tools specifically designed to assess BI and avoidance behavior include the Retrospective and Concurrent Self-Report of Inhibition (Reznick, Hegeman, Kaufman, Woods, & Jacobs, 1992), the BIS/BAS Scale (Carver & White, 1994), and the Adult and Retrospective Measures of Behavioural Inhibition (AMBI/RMBI; Gladstone & Parker, 2005; Gladstone, Parker, Mitchell, Wilhelm, & Malhi, 2005); other widely-used and well-validated questionnaire tools exist to assess broader concepts of state and trait anxiety, such as the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, 1983), the Generalized Anxiety Disorder Severity Scale (GADSS; Shear, Belnap, Mazumdar, Houck, & Rollman, 2006), and the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). Many of these tools ask the respondent to rate his/her personality and feelings with respect to implicit social norms (e.g. "I am shy," "I am nervous"), which are open to individual interpretation, particularly in participants who may not have accurate understanding of social norms.

The AMBI is one questionnaire tool that attempts to remediate this issue in part by asking the respondent to report on frequency of specific behaviors (e.g., "Do you tend to introduce yourself to new people?" "Do you prefer your own company over the company of others?"), rather than evaluating oneself to implicit social norms. AMBI scores have previously been shown to accurately predict anxiety vulnerability (Gladstone et al., 2005) and to correlate with PTSD symptoms (Myers, VanMeenen, & Servatius, 2012; Myers, VanMeenen, McAuley, et al., 2012).

AMBI and the other abovementioned questionnaires have proven useful in elucidating the construct of BI and its relation to risk of anxiety and PTSD. However, there are inherent limitations to the use of any self-report questionnaire. The most obvious limitation is the potential for response bias and demand characteristics (for a good recent review of these issues, see McCambridge, de Bruin, & Witton, 2012). For example, some participants may (consciously or unconsciously) understate inhibited behavior in order to appear well-adjusted or conform to a positive view of self; others (particularly those with a diagnosed psychiatric disorder) may overstate inhibited behavior in order to conform to expected symptoms (e.g. conforming to an accepted sick role).

Beyond this, some populations (particularly those with psychiatric disorders) may not have particularly good insight into or recall of their own behavior. For example, individuals with major depressive disorder display mood-congruent memory effects, in that they are more likely to recall negatively-than positively-valenced information (Matt, Vázquez, & Campbell, 1992). Individuals with PTSD may be similarly impaired at accurate self-report, due to a tendency to overgeneralize autobiographical memories (e.g., Moradi, Abdi, Fathi-Ashtiani, Dalgleish, & Jobson, 2012; Brown et al., 2013); in fact, a recently-defined subtype of PTSD involves dissociative symptoms, including disruptions in memory, identity, and perceptions (Bennett, Modrowski, Kerig, & Chaplo, 2015 May 25 [Epub ahead of print]; Tsai, Armour, Southwick, & Pietrzak, 2015). Finally, the form factor of a paper-and-pencil questionnaire may not be ideal for use with populations that have limited attention span or poor vocabulary and/or literacy skills.

1.3. Use of interactive, computer-based tools to assess personality

A viable alternative to questionnaires may be interactive virtual environments, in which the user experiences simulated situations via an avatar, a graphical representation of the user whose behavior the user controls (Blascovich et al., 2002). Such environments are common in online computer gaming, and are increasingly used in social networking (Bente, Rüggenberg, Krämer, & Eschenburg, 2008) and educational platforms (e.g., Danforth, Procter, Heller, Chen, & Johnson, 2009; Foster, 2008). In many of these environments, avatars may be customizable in appearance, may be realistically animated, and may move through sophisticated simulated environments and interact with numerous other characters, some of whom are controlled by the computer and some controlled by other users playing the game.

A recent body of literature suggests that, although users tend to create avatars that look like a physically idealized self (e.g., Dunn & Guadagno, 2012), the differences are often surprisingly modest, with most avatars reflecting the user's real or perceived self (Bessière, Seay, & Kiesler, 2007; Ducheneaut, Wen, Yee, & Wadley, 2009; Vasalou & Joinson, 2009), although the similarity of avatar to perceived self may depend on the context in which that avatar is to be used (e.g., social networking vs. online gaming environments; Sung, Moon, Kang, & Lin, 2011).

To date, only a few intriguing studies have compared the personality of online avatars ("in-world" personality) to the real-life personality of the user ("out-world" personality), along the Big Five personality dimensions (Ducheneaut et al., 2009; John, Naumann, & Soto, 2008; McCreery, Krach, Schrader, & Boone, 2012). One study found that, while in-world personalities tend to be idealizations (e.g. slightly higher in Openness and Agreeableness, lower in Neuroticism, compared to out-world personalities), most in-world and out-world personalities are remarkably congruent (Ducheneaut et al., 2009). When participants are asked first to self-report their own personality across the Big Five dimensions and then to create an avatar and rate its personality, the ratings of actual self and avatar are significantly though imperfectly correlated (Sung et al., 2011).

These results suggest the possibility of leveraging virtual environments to probe a participant's personality traits; in effect, instead of using a questionnaire to ask, "How closely does this adjective describe you?" an avatar-based assessment can probe, "How would you normally act in a situation like this?"

1.4. Design of the current study

As a first step towards this goal, in the current study we created