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Reflections of the extended self: Visual self-representation in avatar-mediated environments☆

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ABSTRACT

We examine the relationship between avatars in virtual environments and the people they represent. We find that people (balancing the motives of self-verification and self-enhancement) design their avatars to be similar to their real selves, but with some enhancements that are more attractive. In particular, users most enhance on physical attributes that they perceive to be weak in real life. We also find that avatar attractiveness affects online behavioral traits such as extroversion and loudness. Lastly, we find support for a hierarchy of physical variation across online roles whereby people retain core identity elements (such as gender and race) across all their avatars, but they change peripheral elements (such as hair and clothing, and even face). We conclude by discussing implications of our findings for business and society.

1. Introduction

Visual representations known as avatars[1] mediate people's interaction with other users in some online environments. The avatar is the first point of contact – the "face" of a person to the world. First impressions are created, and the visual representation of one's self constitutes an ever-present nonverbal component of communications with others. Because of this, much importance is attached to avatar appearance; and, as an example, participants in the virtual world Second Life have been reported to spend an average of 93 min per week solely on customizing their avatars (Ducheneaut, Wen, Yee, & Wadley, 2009; Second Life is an early "virtual world" in which Internet users interact in a three-dimensional online environment). For an overview about virtual worlds with an emphasis on business, see Messinger et al. (2009), and for a review about digital representations in computer-mediated communications, see Nowak and Fox (2018).

We study whether people's avatars in such environments are similar to or different from their physical selves. We ask three specific questions: (1) How does a person's primary avatar differ from the individual the avatar represents? (2) How are in-world behavioral traits affected by the relative attractiveness of one's avatar compared with the real person? And (3) when people use multiple avatars for different roles or activities, what are the points of difference between the avatars?

When each of us dresses in the morning, we go through many of the same considerations that a person does when designing and dressing an avatar: How am I projecting myself? How will others respond to my appearance? How confident will I feel? What kinds of people do I want to interact with and in what contexts? These are important issues in psychology regarding the projection of one's self-image. Much less is known, however, regarding how people project themselves through

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[1] As used in this paper, an avatar is a 3D anthropomorphic digital representation of a person. The term "avatar" derives from the Sanskrit word "avatara," which means "incarnation." In the context of on-line virtual worlds, the term denotes a graphical object corresponding to the user's virtual body in the world. Neal Stephenson made this use of the term "avatar" popular in his novel Snow Crash (Stephenson, 1992).

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avatars in virtual worlds. Do the psychological principles of self-presentation found in the real world apply for virtual environments?

The current paper examines visual self-representation in avatar-mediated environments. Questions about how people design their avatars are important because "virtual first impressions matter" (at least according to the title of a recent study about virtual teams by Cummings & Dennis, 2018). And the motivations behind decisions about these digital but visually rich identities are, as of yet, understudied. This is so despite the increasing popularity of virtual spaces. This topic is relevant to a special issue on virtual reality, because virtual worlds are still a novel venue for communications, entertainment, and business activity, and people increasingly use avatar-mediated communications as part of their social interactions.

In a larger sense, the current paper also provides a window into how people represent themselves generally in the digital world. From this perspective, the three questions we ask in the current paper can be viewed as addressing issues about the extended self in the digital world that are articulated by Belk (2013). First, people actively construct themselves in the digital realm, and avatars provide a good example of digital *reembodiment* of the self. Second, there is a partial collapsing of the distinction between the physical world and the virtual world, and digital self-representation can have repercussions for behavior in both worlds. Third, people may have multiple different forms or versions of themselves in digital environments, leading Belk to consider whether "the old idea of a core self is an illusion" (p. 478) and to conclude that "[t]he existence of a core self is a belief rather than a fact." (p. 490).

The current paper provides evidence about the first two issues and partially departs from Belk's perspective on the last. We find, first, that people create avatars (in Second Life) that are a blend of their physical selves and more attractive versions of themselves. Second, people with avatars more attractive than their physical selves are more extroverted, loud, and risk-taking in the digital realm than in the physical realm (confirming and partially extending results of Yee & Bailenson, 2007; Yee, Bailenson, & Ducheneaut, 2009; Blascovich & Bailenson, 2011). And, third, across multiple avatars, people retain core traits, such as the human form, gender, and race, while peripheral appearance traits, such as hair color and clothing, show much variation (and elements of facial and body appearance show a mid-range of variation). We, thus, find greater evidence of consistency of visual self-representation in the digital realm than appears to be suggested by Belk (2013). The current special issue provides an opportunity to extend our previous work (Messinger et al., 2008 and Messinger et al., 2009) and refocus it to address these three issues discussed by Belk about the extended self in the digital realm.

The rest of the paper is organized as follows. Section 2 examines the literature on self-presentation theories, reviews empirical findings regarding avatar creation, and develops our hypotheses for the two studies carried out in this paper. Section 3 (Study 1) considers the relationship of people's avatar appearance and their real appearance. Section 4 (Study 2) examines the differences in multiple avatars that people design for themselves for different online objectives or identities. Section 5 discusses implications of our conclusions for business, the workplace, communications, education, and society at large, and provides suggestions for future research.

2. Literature and hypotheses

In the last two decades, researchers have taken increasing interest in people's representations of themselves in various forms of online environments. We describe this research and how the current paper builds on it.

2.1. Empirical findings about avatar creation

Early work focused on people's judgments of avatars in response to the avatars' appearance. Some of the key issues include how the presence (i.e., yes vs. no), format (e.g., human vs. non-human form), and characteristics (e.g., attractive-looking vs. expert-looking) of an avatar image influence the perceived attractiveness and credibility of the virtual agent (Dehn & Mulken, 2000; Holzwarth, Janiszewski, & Neumann, 2006; Nowak, 2004; and, more recently, Khan & Sutcliffe, 2014; Waddell & Ivory, 2015). This work partially reflects the well-known view in psychology that attractive (real) persons are perceived to have more attractive personality traits and do better in life (Dion, Berscheid, & Walster, 1972).

Further work asks whether user experience of a game is influenced by the type of avatars used in the game. Jin (2009) demonstrates that game players report a greater sense of interactivity when they are instructed to create an avatar reflecting one's ideal self rather than one's actual self. Lim and Reeves (2009) show that when a player is allowed to pick the character for him/herself in the game, the player experiences a higher level of arousal (especially for males) relative to when an avatar is assigned to the player.

A different stream of research goes beyond physical appearance to understand the feeling of presence and identification with an avatar. One paper suggests that multiple factors (physical similarity, value homophily, wishful identification, perspective-taking, liking, and embodiment) jointly influence gamers' identification with and sense of connection with their avatars (Downs, Bowman, & Banks, 2017). Another paper focuses on whether people with a particular individual difference – more interdependent self-construal – will interact more with their avatars and feel a greater sense of self-presence (Jin & Park, 2009).

None of the above work, however, studies how the user designs his or her own avatar as the focal dependent variable.

Reflecting increasing participation in virtual communities, some work investigates how users construct their virtual identities in these communities. Examples of this research include the building of one's text-based online dating profile (Hancock, Toma, & Ellison, 2007) and creation of avatars in social media (Vasalou, Joinson, Bänziger, Goldie, & Pitt, 2008). Both studies find that virtual self-representation tends to be realistic in general, with frequent but slight enhancement of essential characteristics in an attempt to project a more attractive self. This result is perhaps not surprising in these contexts: anticipation of future face-to-face interaction with others from an online dating site or with friends and family who share social media may serve as a check to over-embellishing one's virtual self-representation. On the other hand, Ducheneaut et al. (2009) suggest that avatar customization is different in virtual worlds where participants interact with strangers with little expected subsequent real-life engagement. In particular, Second Life participants (compared to players in the game worlds "World of Warcraft" and "Maple Story") demonstrate a preference for avatars that are reflective of their ideal selves. Yet other work takes a broader approach by considering multiple factors to explain the presentation of self in virtual game environments (Dunn & Guadagno, 2012; Mancini & Sibilla, 2017; Meredith, 2014).

Our work goes beyond Ducheneaut et al. (2009), Meredith (2014), Dunn and Guadagno (2012), and Mancini and Sibilla (2017) in the following ways. First, Ducheneaut et al. take a descriptive approach without considering theoretical motivations behind avatar construction. By comparison, we use psychological principles of self-presentation as theoretical underpinnings for our hypotheses. Second, whereas Ducheneaut et al.'s, Meredith's, and Mancini and Sibilla's methods rely on self-reported questionnaires (as well as interview and focus-group techniques for Meredith), we also examine objective assessments of avatar-photo pairs perceived by third-party coders and compare the results with self-reported questionnaires. Meredith's work, in addition, is mostly interested in self-reported motivations for avatar construction, not in measured avatar-person differences. Instead, our methods are closest to those of Dunn and Guadagno (2012), who also use self-reported questionnaires coupled with avatar-photo comparisons and are interested in understanding the determinants of differences between avatars and the people behind them. However, third, unlike Dunn and

Guadagno, who rely on a lab experiment, we rely on a study of extant behavior in a particular virtual world (Second Life) measured with both self-reported in-world intercept surveys and avatar-photo comparisons. And while the latter authors rely on two coders for their avatar-photo comparisons, when we tried using three coders, the large variation across coders led us to use much larger numbers of lab participants to assess each avatar-photo pair (about 40 participants/coders). Fourth, and most important, the scope of our research extends beyond customization of the appearance of a single avatar to also examine: (1) commonalities and differences that exist across multiple avatars used by the same person for different online roles or identities, and (2) whether and how avatar appearance influences people's in-world behavioral traits. These are important topics – yet limited work to date has been devoted to them. With these ends in mind, we now consider principles related to self-presentation to motivate our hypotheses.

2.2. Interplay between self-enhancement and self-verification

Self-enhancement, which constitutes an important psychological principle relevant to self-presentation, is a fundamental human tendency to "propel the ego upward" (Koffka, 1935). According to self-enhancement theory, individuals are motivated to promote a positive self-concept and solicit positive feedback from other people (simple self-enhancement); furthermore, those who hold negative self-views tend to distort personal information in a positive direction (compensatory self-enhancement) (Hull, 1943; Kaplan, 1975). The self-enhancement motive, as moderated by different cultures, has been applied by Sedikides, Gaertner, and Toguchi (2003) to demonstrate that individuals from Japan (with a collectivistic cultural background) self-enhance on collectivistic attributes, whereas individuals from the U.S. (with an individualistic cultural background) self-enhance on individualistic attributes. This finding provides support for the general applicability of the self-enhancement motive (applied in different ways across cultures). As well, research into online presentations through personal web sites found the creation of "an idealized [digital] self" where all revealed identity aspects were carefully chosen to reflect a desired image (Schau & Gilly, 2003).

In contrast to the preceding view, self-verification theory contends that people are motivated to maintain a consistent self-concept, preserve the truth about themselves, and seek objective feedback from others (Swann Jr., 1987). People are motivated to self-verify because portraying one's self-concept in a stable, self-congruent manner helps avoid psychological and interpersonal anarchy, bolsters a person's confidence in predicting and controlling the world, and facilitates social interactions (Swann Jr., Pelham, & Krull, 1989). The self-verification motive can be used to explain why people sometimes prefer to interact with a critic rather than with someone who says flattering things about a performance: the feedback provided by the critic is perceived to be accurate and identity-confirming (Robinson & Smith-Lovin, 1992).

On the basis of the observation that sometimes the same people seem to be subject to both self-enhancement and self-verification, some researchers propose to abandon an "either-or" approach in favor of a more reconciliatory view (Brown, Collins, & Schmidt, 1988; Swann Jr. et al., 1989), suggesting that people are motivated simultaneously by self-enhancement and self-verification and that they will seek to satisfy both motives when possible. It is argued that the dialectic between self-enhancement and self-verification balances these two tendencies, each acting as a check and balance on the other. Researchers also seek to identify conditions that would amplify one motive and attenuate the other. For example, affective response or intuitive, experiential mode of response is demonstrated to favor self-enhancement, whereas cognitive response or rational mode of response tends to favor self-verification (Morling & Epstein, 1997; Swann, Griffin, Predmore, & Gaines, 1987).

Although much of the interplay between self-enhancement and self-verification involves a person's internal sense of self, it should be acknowledged that social factors also play a role. Because self-enhancement involves soliciting positive feedback from others, both simple and compensatory forms of self-enhancement implicitly involve social feedback as a way of augmenting or modifying a person's internal self-image. Furthermore, an internal drive toward self-verification – consistently representing one's essence – may be buttressed by social pressure from peers and societal expectations, particularly as a check on extreme forms of self-enhancement (Buckingham & Alicke, 2002; Exline, Single, Lobel, & Geyer, 2004). Studies on symbolic self-completion also affirm the importance of social influence in balancing the dynamics of both self-enhancement and self-verification – with research topics ranging from how the distracting presence of others affect one's willingness to discuss one's faults or strengths (Gollwitzer, Wicklund, & Hilton, 1982) to how not belonging to a socially prestigious institution correlate with the inclusion of ego-boosting titles or other descriptors in business communications such as departmental web pages and even email signature files (Harmon-Jones, Schmeichel, & Harmon-Jones, 2009). In this work, the mingled desire to simultaneously pursue and balance self-verification and self-enhancement goals is evident (Gollwitzer & Wicklund, 1985).

So generally, the motives of self-enhancement and self-verification may trace their origins to innate personality traits, be socially influenced, or (as we suspect) both. Regardless, we think it plausible to view the motives of self-enhancement and self-verification as working in concert and in balance.

2.3. Implications for avatar appearance

Turning to avatar design, consensus is yet to be reached as to whether people make idealized or realistic avatars. Ducheneaut et al. (2009) indicates that 68% of the respondents across three different virtual worlds reported that they did not want to reproduce their physical features in their avatars; and the more different or idealized the avatar appearance, the more satisfied participants tended to be with their avatars. Other work on avatar creation suggests that avatars are likely to be highly realistic, and people tend to carefully choose avatar characteristics that are essential to represent their true selves (Schroeder, 2002; Taylor, 2002).

Following the logic of the interplay of self-enhancement and self-verification, we believe that both motives are applicable in the context of choosing avatar attractiveness, and that people strike a balance between the two motives in designing their avatars. In particular, self-verification motives balance the self-enhancement motives, preventing the creation of an overly attractive avatar that is totally unrecognizable as the self. We provide our first hypothesis as follows.

Hypothesis 1. People tend to customize the image of their avatars (A) to contain some improvements over, but also (B) to retain similarity to, their real appearance traits.

Furthermore, extending the idea of compensatory self-enhancement (Hull, 1943; Kaplan, 1975) at a more micro level, we believe that people who hold negative self-views about certain appearance traits will enhance particularly on those traits. This is similar to what has been observed concerning choice of muscle definition in avatars among young adult males (Lee-Won, Tang, & Kibbe, 2017). We accordingly consider the following:

Hypothesis 2. People selectively enhance on traits toward which they have negative self-views, and retain traits concerning which they have positive self-views.

These first two hypotheses consider the appearance that people choose for their avatars. A further natural question related to avatar appearance is the potential impact on an individual's behavioral traits in a virtual world.

2.4. Relationship between avatar appearance and behavioral traits

Previous research on people's physical appearance has suggested that attractive individuals have a higher level of confidence and tend to be more extroverted and friendly compared to less attractive people (Langlois et al., 2000). In a similar manner, taller individuals are perceived to be more competent than their short counterparts (Young & French, 1996). In a 3D virtual environment, Yee and Bailenson (2007) demonstrate that participants who were assigned a taller avatar tended to negotiate more aggressively than those assigned a shorter avatar – this effect of avatar's appearance on behavior is referred to as "the Proteus effect." ("after the ancient Greek god who could take on whatever form he wished," Belk, 2013, p. 483). In addition, more attractive avatars of the same gender (regardless of their true appearance) also maintain a shorter inter-personal distance with other avatars in social interactions and disclose more information about themselves than participants assigned to less attractive avatars.

Our work is motivated by similar concerns, but diverges in one important respect: whereas participants in the experiments of Yee and Bailenson (2007) were assigned either an attractive or a less attractive avatar, we consider the attractiveness of participants' avatars *relative to their real appearance*. We thus consider whether the use of an avatar more attractive than a person's actual appearance will induce a behavioral effect. Like Yee and Bailenson (2007), we are interested in whether there is a main effect of avatar attractiveness on a person's confidence and extroversion in a virtual world. But we also believe it interesting to consider an interaction effect whereby, if a person starts out as unconfident or introverted in the real world, then having an attractive avatar may lead to a greater increase in a person's confidence and extroversion in the virtual world than if the person starts out already confident and extroverted in the real world. We, thus, hypothesize the following:

Hypothesis 3. (A) The use of an avatar more attractive than a person's actual appearance will induce confidence and extroversion. (B) But the increase will be greater when the person exhibited low confidence and extroversion in the real world to start with.

The above three hypotheses address the antecedents and consequences of how people design their avatars for virtual worlds. We have not constrained people to have a single avatar in a virtual environment, but neither have we called attention to the possibility that people may have multiple avatars in a given virtual world. We now explicitly address the phenomenon of multiple avatars, and we consider how a person's multiple avatars may be similar to or different from each other.

2.5. Appearance differences across multiple avatars for different roles

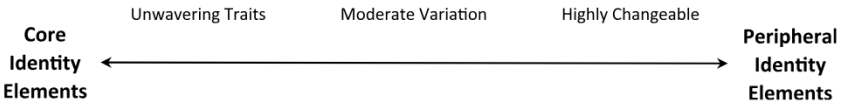
Goffman (1959) considers humans to be actors who take self-presentation actions to fit with social values or meet expectations in a particular situation. In light of this view, we argue that in virtual worlds, where people have high control over how they present themselves visually, people will change their avatar appearance for different roles.

At the same time, reflecting the motive of self-verification discussed above, we believe that people may wish to retain constancy of some appearance traits across different roles. When people set their appearance, they have many design factors from which to choose. Certain physical features of a person appear to be closer to a person's core identity than others, and a progression of physical traits, in relation to one's core identity, appears to exist. In other words, for each individual, some appearance traits are tied with their sense of being a unique individual, while other elements are more peripheral and changeable. Through a combination of biological or sociological processes, more stable dimensions appear to lie at the core of most people's identities. That is, we argue that some physical traits – such as humanity, gender, and race – may be closely linked to a person's sense of identity (perhaps because they are usually unchangeable over a lifetime). Other traits are less closely linked to a person's sense of identity and can change from day to day, as with clothing and hair, according to the roles that one is playing and the people that one interacts with. Yet other traits, such as body and facial appearance, are in the middle range, changing over a person's lifetime, but less variable from day to day (although framed differently daily by hair styles and clothing).

Our argument is a natural extension to the avatar context of the argument in social psychology that some behavioral traits vary across roles and others are consistent across roles (in order to preserve a sense of comfort coming from authenticity). Thus, Sheldon, Ryan, Rawsthorne, and Ilardi (1997) argue that "we hypothesized that Big-Five trait scores, indeed, vary systematically across roles (Smith & Williams, 1992), in addition to showing substantial consistency across roles" (pp. 1381–1382). We similarly argue, in a virtual reality setting, that there is a progression of physical traits in relation to one's core self, where some traits are retained across different avatars and other traits change: a *hierarchy of physical variation (across roles)*.

The notable feature of virtual self-representation compared to physical self-representation is that people can alter all of their physical traits, at will, from one avatar to another across the different roles that they may play. We argue, however, that people do not do this. In particular, when an individual designs multiple avatars to represent him/herself for different roles, the avatar designs tends to be in accordance with a hierarchy of physical variation across roles, as we just discussed. As a result, we propose that people tend to retain more stable traits closely related to their core sense of identity and customize other traits in a purposeful fashion with variations across multiple avatars for different roles they play in virtual worlds. We hypothesize the following:

Hypothesis 4. There is a hierarchy of physical traits across multiple avatars used for different roles: some traits do not change; some show moderate variation; and others vary greatly (see below).



We view traits that do not change as closely tied with a person's core sense of identity or self; we think of these traits as core identity elements. Those traits that are highly variable across different avatars are more peripheral to one's core sense of identity or self. According to this hypothesis, for many people, we would conjecture that the selection of being a human avatar (vs. animal, inanimate object, or a point of light), gender, and race are core identity elements that do not change with the role. Clothing and hair color are highly changeable with various roles. Facial appearance and body features are more in a middle range. For men, facial appearance can change more with the grooming of facial hair, of course. And personal experience while conducting this research suggests that the use of tattoos and facial and body jewelry is becoming more common with avatars (as they are with people nowadays) – although tattoos may be more changeable for avatars than for real

people.

The order of the physical features in the continuum of Hypothesis 4 arises from apparent immutability over a lifetime, due to physiological hard-wiring and long-term socialization. In particular, one might conjecture the following ordering of physical traits (from unwavering to highly changeable): human, gender, race, body-type, eye color, facial appearance, hair, and clothing. We will examine this particular ordering in this paper, but the exact ordering may be open to question, and future research may consider a modified ordering.

In this spirit, Hypothesis 4 (H4) builds on earlier work (Lin & Wang, 2014) that notes that many participants have multiple avatars and their motivations for avatar creation across these multiple avatars include, identity representation, virtual exploration, social navigation, and contextual adaptation. This suggests that people adapt their avatar appearance recognizing the social or virtual context, which is in line with H4 above.

Other research (Schultze, 2014) goes a step further by suggesting, from in-depth interviews with nine Second Life users, that participants tend to represent in their avatars certain stable physical characteristics, such as human shape and sex, to reflect the rational and moral individual. Our proposed hierarchy of physical variation (H4) includes such stable features but also allows that other features may be more changeable to adapt to the social or virtual context.

Furthermore, the presence of certain core traits (highly valued by participants) can account for findings (Castronova, 2004) of how auction prices of avatars are influenced by the physical attributes the avatars possess (within the virtual game EverQuest). This research indicates that avatar sex is a significant predictor of participants' valuation of avatars, whereby male avatars are priced higher than female avatars, even though avatar sex has no impact on performance in the game. Presumably, participants prefer to maintain their own real core characteristics in their persona when choosing an avatar for the game, which is consistent with our proposed hierarchy of physical variation.

Now that we have introduced our four main hypotheses, the next two sections describe two studies that we carried out to test these hypotheses.

3. Study 1: avatar versus real appearances

To examine the first two hypotheses about the difference between people and their primary avatars, we used two corroborative methods: (1) an evaluation by third-party coders of avatar images and photographs of the real people represented by the avatars, and (2) an intercept survey of Second Life (SL) residents about their own perceptions of their avatars. For both methods, we asked the same questions about relative avatar appearance; the only difference is that the avatar-photo comparison data involved third-party assessments of images of avatars and photos, and the intercept survey data involved people's self-reports of their own avatars. We accordingly refer to the intercept survey data as *self-reported data*; we refer to the data about avatar-photo comparisons as *third-party-coded data* (because our coders were not part of Second Life and our questions referred to the avatars and people in the photos in the third person).

3.1. Method 1: avatar-photo comparison

We collected images of 80 avatar-photo pairs from Second Life using a combination of procedures designed to balance various representative sampling considerations. Six examples of avatar-photo pairs that we used are shown in Fig. 1. Details of our procedures for gathering avatar-photo images, final selection of stimuli, and preparation of images are presented in Online Appendix 2. To assess these images, we recruited 167 undergraduates from a major North American university from a subject pool of business students, who served as participants/coders for course credit; their average age was 20.23 years and 73 of these were male. We asked several questions about the avatar-photo pairs using a web-based interface; screenshots of the key questions that we asked appear in Online Appendix 1. The 80 avatar-photo pairs were randomly divided into four groups of 20 avatar-photo pairs. Each of the participants was randomly assigned to assess one of the four groups of 20 avatar-photo pairs. An average of 41.75 participants assessed each of the 80 avatar-photo pairs. We allowed "N.A." responses when participants felt the images did not permit an adequate assessment (as when an image did not contain a full body shot and coders were asked to assess the physical dimension labeled "Body"). Appendix A at the end of this paper contains the link to Online Appendices 1 and 2 which describe the questions that our participants answered and details about our sampling procedure of avatar-photo pairs.

Pretests identified substantial human perceptual heterogeneity in the assessment of avatar attractiveness, which drove the need for > 40 coder assessments per avatar-photo pair. As "beauty is in the eye of the beholder," a slightly increased cell size was required to overcome natural but significant response noise in, for example, coders' reaction to brightly colored hair. Our reason for using 80 avatar-photo pairs was to reflect the range of variation in avatar appearance.

3.2. Method 2: intercept survey

We also conducted a survey of 97 residents (who provided complete responses) of the virtual world Second Life (SL) using an intercept-style recruitment method. After running a small pilot, a reimbursement for survey completion of 150 Linden Dollars (less than US$1) was set as sufficient incentive to recruit subjects; a smaller amount was paid if a participant dropped out early.

To recruit in-world participants, we created and used four field avatars, two male and two female (see Fig. 2). When we set the features of these recruiting avatars, we drew on prior work that suggests that attractiveness and expertise are key factors in designing effective avatars to interact with online consumers – attractiveness influences perceptions of likeability, while the expertise of an avatar can influence perceptions of credibility (Holzwarth et al., 2006). We conducted a pretest to measure SL residents' perceptions of the avatars in terms of credibility, attractiveness, expertise, and likeability (for details see Messinger et al., 2009). The results indicate that all four avatars received high ratings on a 5-point scale for each measure.

We used these avatars to recruit participants over systematically selected representative locations in Second Life, collected evenly over the 24 hour daily cycle (see Online Appendix 3 for detailed descriptions of the procedures for conducting the intercept survey). Survey respondents opened a web-based survey by having their avatar "touch" a stationary board in a survey booth located on Flotsam Beach in SL (to which respondents were directed) or by touching a portable sandwich-board worn by our four survey avatars (see Fig. 4 in Online Appendix 3). The survey began with a consent form and ended with debriefing and Linden dollar payout. The survey questions are shown at the end of Online Appendix 1. (Appendix A gives the link to Online Appendices 1 and 3).

For our sample of 97 completed surveys, the average age of participants in the study was 30.5 years, which together with other demographics we collected, very closely matches the demographics of the overall SL population disseminated by Linden Lab (at the time of the survey), except that we have a somewhat disproportionately high representation from the U.S. (presumably because the solicitation process and survey were conducted in English).

3.3. Results concerning Hypothesis 1

Our first hypothesis is that "People tend to customize the image of their avatars (A) to contain some improvements over, but also (B) to retain similarity to, their real appearance traits." We examine this hypothesis in four ways (Tables 1–4).

In Table 1, we summarize the answers to questions regarding

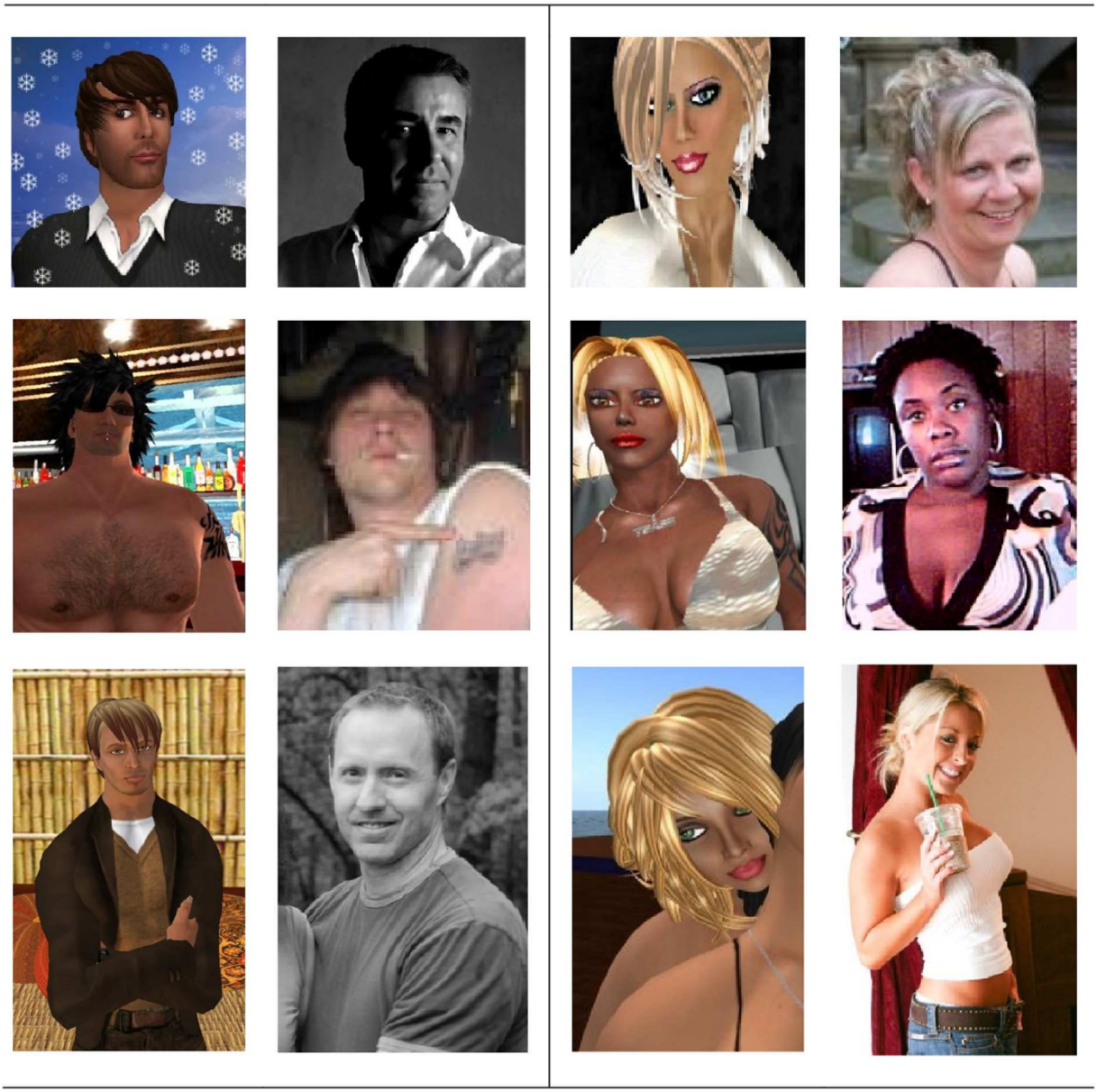


Fig. 1. Examples of avatar-photo pairs.

Fig. 2. Our four field avatars.

Table 1
Attractiveness of avatar versus the real person.

Answers to the questions "*Comparing the image of the avatar and the photo of the associated real person, is the avatar less or more attractive than the real person in the following dimensions?" for the third-party coded data and "Is your avatar less or more attractive than your real self in the following dimensions?" for the self-reported data (1 = avatar less attractive, 4 = same, 7 = avatar more attractive).*

	Third-party-coded					Self-reported[b]				
	Mean	*p*-Value[a]	1–3	4	5–7	Mean	*p*-Value[a]	1–3	4	5–7
Overall	4.82	< **.001**	20%	24%	56%	4.80	< **.001**	10%	34%	55%
Body	4.94	< **.001**	16%	26%	58%	4.72	< **.001**	10%	43%	47%
Face	4.79	< **.001**	21%	24%	55%	NA	NA	NA	NA	NA
Hair	4.73	< **.001**	22%	24%	54%	4.65	< **.001**	13%	34%	53%
Eyes	4.72	< **.001**	20%	29%	51%	4.53	.003	12%	45%	42%
Style of clothes	4.70	< **.001**	22%	28%	50%	4.86	< **.001**	16%	28%	56%

[a] Two tests were calculated. One is a *t*-test that the mean rating is equal to the midpoint 4. A chi-square test with null hypothesis that the proportions of "less attractive" and "more attractive" are equal is also conducted. Of these two tests, we report the *p*-value that is less significant. *p*-values less than .001 are shown in bold.

[b] The means from the self-reported data are not significantly different from those of the third-party-coded data for all five appearance dimensions (at the 0.10 level). This is confirmed by a chi-square test for all five appearance dimensions that shows that the self-reported and third-party data are not significantly different in the proportions of "more attractive" and "less attractive" responses at the 0.10 level. The Cronbach alpha coefficients across the items (excluding "Overall" which is not a separate item) are 0.94 and 0.86 for the third-part-coded and the self-reported data, respectively.

Table 2
Other physical attributes of avatar versus real person.

	(1)	(2)	(3)		
"What is your avatar's age in relation to your own" or "What is the avatar's age in relation to the real person?"					
	"Younger"	"Same"	"Older"	Mean	*p*-Value[a]
Self-reported:	31%	65%	4%	1.73	.008
Third-party-coded:	41%	45%	13%	1.72[b]	< **.001**
"What is your avatar's weight in relation to your own?" or "What is the avatar's weight in relation to the real person?"					
	"Less"	"Same"	"More"	Mean	*p*-Value[a]
Self-reported:	39%	54%	6%	1.67	.001
Third-party-coded:	40%	50%	10%	1.70[b]	< **.001**
"What is your avatar's height in relation to your own" or "What is the avatar's height in relation to the real person?"					
	"Lower"	"Same"	"Higher"	Mean	*p*-Value[a]
Self-reported:	15%	52%	33%	2.18	.084
Third-party-coded:	6%	69%	25%	2.19[b]	< **.001**

[a] Two sets of tests were conducted for each row: (1) *t*-tests that the mean ratings are equal to the midpoint of 2, and (2) chi-square tests of whether the proportion of "Younger"/"Less"/"Lower" (plus half the "Same" category) equals the proportion of "Older"/"More"/"Higher" (plus half the "Same" category). Of these two tests, we report the *p*-value that is less significant.

[b] The means for the third-party-coded data are not significantly different from those of the self-reported data at the 0.1 level. Chi-square tests confirm that the self-reported and third-party-coded data are not significantly different in the proportions of "Younger"/"Less"/"Lower" (plus half the "Same" category) versus "Older"/"More"/"Higher" (plus half the "Same" category).

Table 3
Similarity of the avatar and the real person.

"Is your avatar similar to or different from your real self in the following dimensions" or "Is the avatar similar to or different from the real person in the following dimensions?"

(1 = very different, 7 = very similar).

	Self-reported[a]				Third-party-coded			
	Mean	1–3	4	5–7	Mean	1–3	4	5–7
Overall	4.54	22%	25%	53%	3.33	59%	12%	29%
Age	5.22	13%	16%	70%	3.79	48%	15%	37%
Weight	4.82	16%	22%	62%	3.78	48%	16%	36%
Height	4.52	28%	21%	52%	4.15	37%	21%	42%
Body	NA	NA	NA	NA	3.47	56%	13%	31%
Face	NA	NA	NA	NA	3.22	60%	11%	28%
Hair	4.43	29%	20%	52%	3.10	62%	11%	27%
Eye color	4.85	23%	14%	63%	3.70	47%	17%	36%
Style of clothes	4.65	24%	16%	60%	3.02	64%	12%	24%

[a] The means of the self-reported data are significantly higher than those of third-party-coded data for all traits at the 0.001 level (except for Height, which is significantly different at $p = .064$). Chi-square tests confirm that the self-reported data have a significantly higher proportion of traits perceived to be "similar" to their real selves (5, 6, 7, and half of 4) than the third-party-coded data at the 0.001 level (except for Height, which is significant at $p = .062$). The Cronbach alpha coefficients across the items (excluding "Overall") are 0.83 and 0.91 for the self-reported and third-part-coded data, respectively.

attractiveness of avatars relative to the associated real persons on a number of dimensions. The third-party-coded data (for the avatar-photo comparison method) are referenced in the left side of the table. We showed our coders an avatar image and a photo of the associated real person (left vs. right placement was randomized) and asked, "Is the avatar less or more attractive than the real person in the following dimensions?" We calculated the mean score (over the 41.75 coders, on average, for each of these dimensions) for each of the 80 photo-avatar pairs. For each dimension of avatar appearance, we calculated a single mean score over all the 80 photo-avatar pairs, which we report in first column of Table 1. *t*-Tests were performed to compare the mean on each dimension with the midpoint of 4 (which is labeled as "same" attractiveness). The results demonstrate that the means are significantly > 4. As non-parametric corroboration, we also performed chi-square tests as follows. We grouped together all answers coded 1-through-3, 4, and 5-through-7, and provide a frequency distribution over all the 3340 evaluations (80 avatar-photo pairs × 41.75 coders/pair). For each dimension, we calculated a chi-square test with null hypothesis that the proportion that replied that the avatar was "more attractive" than the real person (coded 5, 6, 7, plus half of those coded 4) was equal to the proportion that replied that the avatar was "less attractive" than the real person (coded 1, 2, 3, plus half of those coded 4). To be conservative, we report in Table 1 the less significant *p*-value from the *t*-test and the corresponding chi-square test.

We obtained similar results from the intercept survey of 97 Second Life residents, summarized on the right side of Table 1 (under the heading of "self-reported" data). When asked "Is your avatar less or more attractive than your real self in the following dimensions?" the participants gave mean responses which were nearly the same as third-party-coded data for their avatars' Body, Hair, Eyes, Style of Clothes and Overall (the intercept survey, which was conducted first

Table 4
Overall relationship between the avatar and the real person.
"Overall, would you say that your primary avatar is (check one):" or "Overall, would you say that the avatar is (check one):"

	Self-reported	Third-party-coded	Answer
(1)	14%	7%	As close to your real self [as the real person] as can be made.
(2)	23%	16%	Generally recognizable as your real self [as the real person].
(3)	34%	26%	A mix of similar and unrecognizable features to your real self [to the real person].
(4)	24%	30%	Mostly not recognizable as your real self [the real person].
(5)	5%	20%	As far from your real self [the real person] as can be made.

	Mean	*p*-Value[a]
Self-reported[b]	2.82	< .001
Third-party-coded[c]	3.40	< .001

[a] *t*-Test of the hypothesis of 1 ("same").
[b] For the self-reported data we cannot reject the hypothesis that there is an equal proportion of "recognizable" and "unrecognizable" responses using a chi-squared test ($p = .63$). This is based on grouping as "recognizable" the count of responses with (1) or (2) and half of the responses for (3); and as "unrecognizable" the count of responses with (4) or (5) and half of the responses for (3).
[c] The mean of the third-party-coded data is greater than that of the self-reported data at the 0.001 level. This is confirmed by a chi-square test, which indicates that the third-party-coded data have a significantly higher proportion of "not recognizable" avatars at the 0.001 level than is recorded in the self-reported data.

chronologically, did not ask about avatar face). As with the avatar-photo comparison method, the means from the intercept survey method are significantly > 4, and this is confirmed by chi-square tests indicating that the proportion of subjects who report their avatar is "more attractive" is greater than the proportion of subjects who report that their avatar is "less attractive" on each dimension.

The Cronbach alpha coefficients for these two datasets are both in the good (above 0.80) to excellent (above 0.90) range. We note that we are not explicitly engaged in scale development; however, these coefficient estimates provide evidence of internal consistency among the items.[2]

Table 1 provides support for Hypothesis 1(A) that Second Life participants (in the judgment of objective third parties as well as in their own judgment) tend to customize the image of their avatars "to contain some improvements over … their real appearance traits." The answers on average indicate that people create avatars that are somewhat more attractive in body, face, hair, eyes, style of clothes, and overall (all means are significantly > 4). We also note a substantial proportion of answers equal to 4, which evidences a motive of self-verification (in support of Hypothesis 1(B)).

We next consider questions for age, weight, and height (see Table 2). For the self-reported data, when respondents were asked about avatar age in relation to their own, the modal response was "Same" but many more people answered "Younger" than "Older." In particular, 65% of the participants selected "Same," which reflects a motive for self-verification in customizing the image of avatars to retain similarity with the participants' real appearance traits. But, if we assign a value of 1 for "Younger," 2 for "Same," and 3 for "Older," then the average response is 1.73, which is significantly < 2 ("Same"). This is confirmed with a chi-square test that rejects that the proportion of "Younger" equals the proportion of "Older" at a 0.001 level. For the third-party-coded data, we get a very similar mean response (a general pattern confirmed with chi-square tests). We also note that the third-party-coded data indicate more equal proportions corresponding to self-verification and self-enhancement, since nearly the same percentages choose "Younger" (41%) as "Same" (45%).

When we asked about avatar weight relative to subjects' own real weight, the modal response for the self-reported data was "Same," but more people answered "Less" than "More." We might interpret this result as indicating that 54% reflected a motive for self-verification, and 39% indicate a motive for self-enhancement. The average response (assigning 1-to-3 coding) is 1.67, which is significantly < 2 ("same"). This is corroborated by a chi-square test which indicates that there is a higher proportion of "Less" than that of "More." These results are closely reinforced by the third-party-coded data where the average response (assigning a 1-to-3 coding) was 1.70 (which is not significantly different from the average of the self-reported data of 1.67, as is also confirmed by a chi-square test).

When we asked about avatar height relative to own height, the modal response for the self-reported data was again "Same," and more people answered "Higher" than "Lower." The average response (assigning 1-to-3 coding) was 2.18, which is only marginally > 2 ("Same"). We interpret the result as indicating that 52% reflect a motive for self-verification, and 33% reflect a motive for self-enhancement. The results for this case are a bit more ambiguous because, while men may prefer to be taller, women may not. Perhaps the data indicate more about individual differences in people's satisfaction with their real height than about a motive for self-enhancement. (The third-party-coded data have an average response of 2.19, which is statistically indistinguishable from that of the self-reported data.)

Table 2, thus, provides support for both Hypothesis 1(A) and (B). Not only do a high proportion of respondents pick "Same" for each of the three questions in both data sets; but a substantial number of respondents reflect a motive for self-enhancement. This provides evidence of the interplay and balance between the two motives discussed in the hypothesis development section.

In principle, it would be desirable to simply ask people whether "you are happy with various aspects of your physical self and are merely reflecting these aspects in your avatar" (self-verification), or "to what extent did you adjust your avatar in order to enhance your own real-world image in the virtual world?" (self-enhancement). These are somewhat sensitive topics for respondents, however, and respondents might not be willing to give straight answers to avoid sounding either arrogant or weak. A less intrusive way to approach the balance that people strike between self-verification and enhancement is to re-ask the questions in Tables 1 and 2 slightly differently. We accordingly asked people "Is your avatar similar to or different from your real-self in the following dimensions?" (see Table 3).

The self-reported data show that the majority of respondents indicated that their avatars were similar to their real selves (between 5 and 7) for all the physical dimensions shown in Table 3. This provides support for Hypothesis 1(B) that participants tend to customize the image of their avatars "to retain similarity to their real appearance traits." The extent to which answers are given in the "different" range (between 1 and 3, or equal to 4), however, also reinforces the presence of a motivation beyond simple self-verification when creating their

[2] We thank a reviewer for suggesting this. We also find this true for Tables 3 and 8.

avatars. By comparison, third-party-coded data manifest a greater tendency of seeing avatars as different from the corresponding persons than do people in self-reports about their own avatars. The means from the third-party data are smaller than those of the self-reported data at the 0.001 level for the "Overall" question and for all dimensions in Table 3 except "Height" (which coders may have had difficulty judging from the photos). This is borne out in chi-square tests.

Said differently, subjective assessments appear to give greater weight to similarities (perhaps because individuals know their own intentions), and objective third-party coders appear to give greater weight to differences (because these people, unaware of intentions, may find unintended differences more prominent). That is, we have support for Hypothesis 1(B) (that people tend to customize the image of their avatars to retain similarity with their real appearance traits) from the self-reported data, but not from the third-party-coded data.

Our last way of assessing the balance between self-verification versus self-enhancement is to put the question directly to respondents. For the self-reported data, we asked people how close their primary avatar is to their real self (see Table 4 below for the five possible answers). We find that 23% see their avatars as "generally recognizable as their real selves," and 14% see their avatars as being "as close as possible as can be made." In principle, both of these answers are supportive of self-verification, but these two percentages together still sum to < 50%. In addition, comparing the mean (2.82) with the midpoint of 3 using a *t*-test, we cannot reject the null hypothesis that respondents make their avatars "a mix of similar and unrecognizable features to your real self" ($t = -1.56$). This suggests that neither self-verification nor self-enhancement is the only motivation underlying avatar construction.

As with the previous question, third-party observers (in the avatar-photo comparison method) see avatars as less recognizable as their associated real persons. The mean (3.40) is greater than the mean for the self-reported data at 0.001 level, and this is confirmed at the 0.001 level with a chi-square test. In addition, the mean for the third-party-coded data is also > 3 at the 0.001 level ("a mix" $t = 4.88$).

Taken together, Tables 1 through 4 support the two parts of Hypothesis 1 (H1) as follows:

	Support for	Effect/motivation	Data set
Table 1	H1(A)	Self-enhancement	Both[a]
Table 2	H1(A) & H1(B)	Mix of both	Both[a]
Table 3	H1(B)	Self-verification	Self-reported[a]
Table 4	H1(A) & H1(B)	Mix of both	Both[a]

[a] Subjective (self-reported) and objective (third-party-coded) data.

Overall, we interpret these results as evidence that people are motivated by a blend of self-verification and self-enhancement when they represent themselves with avatars. Third-party observers may not fully appreciate this blend, however, and tend to give greater weight to self-enhancement.

3.4. Results concerning Hypothesis 2

We now turn to examine our second hypothesis that people enhance on their weak traits and do not enhance on traits that they perceive as already strong. Using third-party-coded data, we investigate the relationship between the benchmark assessments of attribute attractiveness of the real person (in Questions 5 and 6 of Online Appendix 1) and the measure of an avatar's attribute attractiveness relative to the associated attribute of the real person (Questions 1 and 2 of Online Appendix 1, which are summarized in the third-party-coded results of Tables 1 and 2). We test this in a linear model and show the estimates in Table 5.

It is instructive to interpret these results. We begin with the equation for Age, where the dependent variable comes from Table 2 (and is coded as 1 = Younger; 2 = Same; and 3 = Older) and the independent variable comes from Online Appendix 1, Question 6. Examination reveals that when the real person is 20, 32, or 43, for example, the estimated equation will predict 2.02 ("Same"), 1.49 (50/50 chance of "Younger" or "Same"), or 1.01 ("Younger"), respectively. That is, at an age of 20 for this estimated relationship, the model predicts that a person will use an avatar of the same age as the real person. On the other hand, a person who is 43 is predicted to make an avatar that is "Younger." And, of people aged 32, half are predicted to pick "Younger" and half, to pick "Same." This is indeed an estimated form of "compensatory self-enhancement" and confirms Hypothesis 2 for the variable Age. Similar interpretations apply for Height and Weight. (For these two regressions, the independent variables come from Online Appendix 1, Question 5. For the independent variable of Weight, less is preferred, and reverse coding is used.)

Table 5
Regression tests for compensatory self-enhancement theory.

Relative avatar attribute	=	α (*t*-Stat)	+	β (*t*-Stat)	Real attribute	R^2	DOF
Avatar's relative Age	=	2.9 (21.4)	+	−0.044 (−9.785)	*Real Age*	0.46	112
Avatar's relative Overall Attractiveness	=	6.8 (20.3)	+	−0.48 (−6.23)	*Real Attractiveness Overall*	0.26	112
Avatar's relative Weight	=	1.2 (7.3)	+	0.12 (3.59)	*Attractiveness of Real Weight*	0.10	112
Avatar's relative Height	=	2.7 (19.8)	+	−0.12 (−4.42)	*Attractiveness of Real Height*	0.15	111
Avatar's relative Body Attractiveness	=	6.8 (21.1)	+	−0.39 (−5.73)	*Attractiveness of Real Body*	0.23	109
Avatar's relative Face Attractiveness	=	6.4 (19.8)	+	−0.45 (−5.90)	*Attractiveness of Real Face*	0.24	111
Avatar's relative Hair Attractiveness	=	6.1 (18.0)	+	−0.38 (−4.88)	*Attractiveness of Real Hair*	0.18	111
Avatar's relative Eyes Attractiveness	=	5.7 (13.6)	+	−0.30 (−3.36)	*Attractiveness of Real Eye*	0.09	108
Avatar's relative Clothing Style Attractiveness	=	6.3 (16.6)	+	−0.42 (−4.75)	*Attractiveness of Real Style of Clothing*	0.17	109

Now, for the Overall Attractiveness trait, the dependent variable comes from Table 1 (coded as 1 = Avatar Less Attractive, 4 = Same, 7 = Avatar More Attractive) and the independent variable comes from Online Appendix 1, Question 5 (coded as 1 = Very Unattractive; 4 = Neutral; 7 = Very Attractive). For the Overall Attractiveness equation, when the real person is "Very Unattractive" (1), "Neutral" (4), or "Very Attractive" (7), the estimated equation will predict 6.32 ("Avatar is More Attractive"), 4.88 (somewhat above "Same"), or 3.44 (somewhat below "Same"), respectively. That is, this model predicts that a very unattractive person will compensate and is predicted to make his or her avatar quite a bit more attractive. Again, this is an estimated form of "compensatory self-enhancement" for this type of data. Similar interpretations apply for Body, Face, Hair, Eyes, and Clothing Style.

Indeed, all nine β coefficients in this table are significant at the 0.001 level and in the expected direction (i.e., negative, except for the coefficient on Attractiveness of Real Weight, due to the reverse coding in this case). In addition, the R-squared statistics for the Age and Overall equations are high (given that these are one-variable regressions). This illustrates the idea of compensatory self-enhancement (Hull, 1943; Kaplan, 1975) at the level of individual attributes, and constitutes support for Hypothesis 2.

Table 6
Sample question.
"Please rate your behavior on the following dimensions in Second Life and in real life:"

	Introvert				Extrovert	
In Second Life	1	2	3	4	5	NA
In real life	1	2	3	4	5	NA

3.5. Results concerning Hypothesis 3

We now turn to Hypothesis 3 that states that "(A) the use of an avatar more attractive than a person's actual appearance will induce confidence and extroversion. (B) But the increase will be greater when the person exhibited low confidence and extroversion in the real world to start with." We are asking whether avatar appearance affects behavioral traits and behavioral intentions in virtual worlds. In the intercept survey, we obtained information on retrospective self-reported perceptions of behavior of Second Life residents using questions of the form shown in Table 6.

We asked such questions for the following five behavioral traits: Introvert(1)/Extrovert(5); Reserved(1)/Loud(5); Risk Averse(1)/Risk Taking(5); Shy(1)/Outgoing(5); Superficial(1)/Thoughtful(5).

Table 7 reports estimated linear models that describe the impact on perceived behavioral traits in Second Life (such as "Extraversion") of both (a) the associated behavioral traits in real life and (b) our measure of overall avatar attractiveness (described earlier in Table 1).

The dependent variables in Table 7 consist of the measures of the self-reported virtual-world behavioral traits obtained from questions of the form of Table 6 (in the row labeled "In Second Life"), standardized to have zero mean and standard deviation of 1. The first independent variable in each of these regressions consists of the (standardized) measures of real-world behavioral traits obtained from questions of the form of Table 6 (in the row labeled "In Real Life"). The second independent variable in each of these regressions is the (standardized) measure from the in-world intercept survey of Avatar Attractiveness Overall reported in Table 1. Table 7 also includes the product of these two independent variables as an interaction effect, and the demographic variables Age (standardized) and Sex (which equals 1 for females and 0 for males).

If Hypothesis 3(A) is true, we should find a positive main effect associated with avatar attractiveness. If Hypothesis 3(B) holds, we should find a negative coefficient for the interaction term – so that a person with a lower level of the trait in the real world will show a greater increase due to attractiveness. (We also expect a positive main effect associated with the behavioral trait in real life.)

Our main result is that the coefficients on (i.e., the main effect for) avatar attractiveness are indeed positive and significantly different from zero (at the 0.05 level) in the first three regressions. Thus, using a more attractive avatar leads to reported behavioral traits in Second Life that are more extroverted, loud, and risk-taking, which provides some support for Hypothesis 3(A). We also find a positive main effect associated with the behavioral trait in real life, indicating that in-world and real-life behavioral traits are closely linked. The interaction terms, however, while with the expected sign, are not significant. So we do not find support for Hypothesis 3(B).

Although not significant, these terms add to model fit. To understand the model, we consider the following example (for a 30 year old female). If we condition on a value for "Extroversion" in real life of 1, then it can be shown that the effect of increasing Avatar Attractiveness from 1 to 7 leads to an increase in the prediction of "Extroversion" in Second Life from 1.27 to 2.78: more than double. (We make this calculation using the values in Table 7 for the column labeled "Extrovert," using the standardized values throughout.) By comparison, if we instead condition on a value for "Extroversion" in real life of 5, then increasing Avatar Attractiveness from 1 to 7 can be shown to increase "Extroversion" in Second Life from 4.37 to 4.59, which is a smaller percentage increase. Whereas both cases predict an increase, the impact of a more attractive avatar is greater in the former case than in the latter. The other equations yield similar interpretations.

4. Study 2: casual versus business avatars

People take various roles in different aspects of life ("casual me," "professional me," "me as a parent," etc.), and most of us are increasingly engaging in online interaction with other parties in various roles in our work and leisure activities. There now exist different venues for projecting online representations of oneself in professional contexts (e.g., on a business or university webpage, in Twitter, and in LinkedIn) and leisure contexts (e.g., in Facebook and in online dating sites). We explore this general issue in the specific context of virtual worlds by asking the following questions: What are points of difference between multiple avatars individuals created for different roles or identities that they take in virtual worlds? And how can we characterize and understand the differences? This is a natural extension of the previous study, which asked how people made their primary avatars different from themselves. Now we focus on the extent and nature of differences that

Table 7
Regression of virtual world behavior on real life behavior and avatar attractiveness.[c]

	Dependent variable: behavioral trait in Second Life (*t*-stats)				
	Extrovert	Loud	Risk taking	Outgoing	Thoughtful
Behavioral trait in real life[a]	**0.61**	**0.64**	**0.28**	**0.60**	**0.70**
	(7.23)	(8.16)	(2.96)	(7.11)	(8.81)
Avatar attractiveness	**0.18**	**0.19**	**0.26**	0.13	0.02
	(2.08)	(2.35)	(2.64)	(1.47)	(0.28)
BTRL:AA[b]	−0.08	−0.06	−0.10	−0.11	−0.07
	(−0.92)	(−0.75)	(−1.08)	(−1.36)	(−0.99)
Age	−0.001	−0.04	0.20	−0.06	0.08
	(−0.013)	(−0.48)	(1.98)	(−0.65)	(1.05)
Sex	−0.003	0.03	−0.04	0.04	−0.06
	(0.030)	(0.30)	−0.28	(0.04)	(−0.56)
R-squared	0.41	0.46	0.21	0.41	0.48
Res. std. err.	0.79	0.75	0.91	0.79	0.75

[a] If the dependent variable is Extrovert [in Second Life], the independent variable is the behavioral trait of Extrovert [in real life], and similarly for the other four columns.
[b] *BTRL:AA* is the product of the variables in the first and second rows.
[c] Significance at the 0.05 level is indicated in bold. All variables (BTSL, BTRL, AA, Age) are standardized, except for Sex, which equals 1 for females and 0 for males. The same model with intercepts yields almost no change in the coefficients, R-squared, and insignificant intercepts, so the intercepts were left out.

Fig. 3. Examples of business and casual avatars.

people tend to use for two particular virtual identities for avatars: casual versus business or professional.

4.1. Sample and measurement

We asked business students in an undergraduate retailing course in a major university in North America to evaluate three retail stores in the virtual world Second Life and to create two avatars, casual and business, to represent themselves in this virtual world as they explored various 3D virtual retail environments. Avatar creation is necessary because Second Life is an avatar-mediated environment. Students were given a tutorial about Second Life and avatar creation. Students were instructed that they had the option of making their casual and business avatars as similar to or as different from each other as they liked. Students also filled out a questionnaire about their avatars and their motivations when designing these avatars.

We included only those avatars made by students who spent more than 30 min in creating their casual avatars and at least another 30 min in creating their business avatars (avatars from 19 students were excluded using this criterion). Our sample, thus, consists of avatars of 38 students, who spent a median time of 1.5 h in creating a casual avatar (inter-quartile range from 1 to 3 h) and 1 h in creating a business avatar (inter-quartile range from 1 to 2 h). We refer to the responses of these 38 students to the questionnaire about the avatars they created as the *self-reported* data. Of these 38 students, consent was obtained from 23 students (11 men and 12 women) to allow third-party reviewers to assess their casual and business avatars, and compare these with each other and with their own personal photograph. As examples, six avatar-pairs are shown in Fig. 3.

We created an online questionnaire of the same form as in Online Appendix 1 to compare the casual versus business avatars of a single person, and we recruited participants in an undergraduate subject pool at a major North American university to serve as third-party coders. Each of the 23 pairs of casual-professional avatars stimuli was assessed

Table 8
Similarity of casual and business avatars.
"Is your casual avatar similar to or different from your business avatar in the following dimensions?" or "Is the casual avatar similar to or different from the business avatar in the following dimensions?" (1 = very different, 7 = very similar).

	Self-reported[b]				Third-party-coded[d]
	Mean[a]	Different	Similar	*p*-Value[b]	Mean[c]
Body	5.32	9	28	0.002	4.38
Eye color	4.76	14.5	22.5	0.189	4.36
Face	4.43	17	20	0.622	3.70
Hair	3.86	19	18	0.869	3.35
Style of clothes	2.81	28	9	0.002	2.59
Overall	4.37	12.5	22.5	0.091	3.45

[a] The significance between various dimensions is as follow: Body & Face: $p = .061$; Body & Hair: $p = .005$; Body & Clothes: $p < .0001$; Eye Color & Hair: $p = .101$; Eye Color & Style of Clothes: $p < .0001$; Face and Clothes: $p = .001$; Hair & Clothes: $p = .037$.

[b] Chi-square test that the "Similar" (5, 6, 7 and half of 4) and "Different" (1, 2, 3, and half of 4) cells have equal probability (of 0.5).

[c] The significance between the dimensions is as follows: Eye & Hair: $p = .032$, Eye & Clothes: $p < .0001$; Face & Clothes: $p = .005$; Hair & Clothes: $p = .068$.

[d] Using a t-test, the third-party means are significantly smaller than the self-reported means for the following traits: Overall ($p = .032$) and Body ($p = .018$). The Cronbach alpha coefficients across the items (excluding "Overall") are 0.88 and 0.92 for the self-reported and third-part-coded data, respectively.

on average by 42.9 students in our subject pool. We refer to this as our *third-party-coded* data. Our goal is to use the third-party-coded and the self-reported data to explore the pattern of difference between multiple avatars for various purposes and identities. This will allow us to examine Hypothesis 4.

4.2. Results concerning Hypothesis 4

We begin by summarizing some categorical outcomes for the set of 23 avatar-pairs in the third-party-coded sample. All but one of the 46 avatars (2 roles × 23 pairs) had exclusively human features – the one exception being a casual avatar with large wings and head-spikes instead of hair. Similarly, all but one of the 46 avatars was the same gender as the corresponding person; and, in particular, one (Asian) man provided a female (Asian) casual avatar. All but three of the 46 avatars retained the same race as the corresponding person; of the exceptions, one Caucasian women made her casual and business avatars both African-American, and one Asian woman made her casual avatar a (blond) Caucasian. Taken together, the facts summarized in this paragraph indicate that there are traits that do not change for most people across multiple avatars, which is consistent with Hypothesis 4.

We turn to our data about perceived differences in other physical dimensions, as summarized in Table 8 for the self-reported data (38 participants) and the third-party-coded data (23 avatars pairs × 42.9 coders/avatar pairs). We focus on the question, "Is your casual avatar similar to or different from your business avatar in the following dimensions?" We find that across casual-business avatar pairs, Body was the most similar (mean value on a seven point scale of 5.32 and 4.38, respectively for self-reported and third-party-coded data, where 7 = very similar and 1 = very different); Eye Color and Face were next, followed by Hair. Style of Clothing exhibited the greatest differences across casual-business avatar pairs (2.81 and 2.59, respectively).

Starting with the self-reported data, proceeding from the top to the bottom of this list, Body is not significantly different from Eye Color, but it is progressively more significantly different for Face, Hair, and Style of Clothes. Eye Color is not significantly different from Face, but is progressively more significantly different for Hair and Style of Clothes. And so on.

We also summarize the frequency distribution of answers of "similar" (that were coded as 5, 6, 7, and half of those coded as 4) and of "different" (coded as 1, 2, 3, and half of those coded as 4), and we perform a chi-square test of whether the "Similar" and "Different" cells have equal probability. We find that Body has a significantly higher number of "Similar" replies, and that Style of Clothes has a significantly higher number of "Different" replies. This suggests three tiers of physical attributes, those very similar across the causal-business roles (as with Body), those in the intermediate range, and those very different across the two roles (as with Style of Clothing). This provides support for Hypothesis 4.

Next, we corroborate this finding with the third-party-coded data. We observe that the ordering in the third-party-coded data matches the ordering of the self-reported data, which provides further support for Hypothesis 4. We further observe that the mean physical dimensions are smaller for the third-party-coded data than for the self-reported data, and, in particular, "Body" and "Overall" are significantly smaller at the 0.05 level.

We now summarize other findings of Study 2. While not directly connected with Hypothesis 4, these results provide background about how people relate to avatars with different roles.

First, in reply to the question, in the self-reported data, "Is your real self closer to your business or casual avatar?" 54% participants answered "Casual Avatar", and 46% answered "Business Avatar." We, thus, see variation in the avatar-role participants most identify with.

Second, we find that neither the casual nor the business avatar was systematically more attractive in our data. We asked the question, "Is the [your] casual avatar less or more attractive than the [your] business avatar in the following dimensions?" In chi-square tests, we found no significant differences (even at the 0.10 level) in the proportion of responses that find the "causal avatar more attractive" versus "business avatar more attractive" for all the six items discussed in Table 1 (Overall, Body, Face, Hair, Eyes, and Style of Clothes), in both third-party-coded and self-reported data. In *t*-tests, we confirmed that the mean response is never significantly different from 4 ("Same") on a 7-point scale at the 0.10 level for the six dimensions of Table 1.

Third, we find that the casual avatar is systematically perceived to be younger than the business avatar. In particular, we asked participants for the self-reported data (and coders for the third-party coded data) the following question (analogous to Table 2): "What is your (the) casual avatar's age in relation to your (the) business avatar's age? Younger (1); same (2); older (3)". For the self-reported data, 26.3% of the respondents reported they made their casual avatars look younger than their business avatars, and none reported older. For both the third-party-coded and self-reported data, the mean responses were 1.62 and 1.74, both of which are significantly lower than 2 = same ($t = -5.60$, $p < .001$ and $t = -3.64$, $p < .001$, respectively). In light of Hypothesis 4, we could view age as less closely tied to participant's core sense of identity and more alterable for the desired role.

Lastly, we find that generally the casual-business avatar pairs are perceived to be "a mix of similar and unrecognizable features to each other." In particular, we asked a question (which is a scale analogous to Table 4) asking "Overall, would you say that your (the) casual and business avatars are (check one): As close to each other as can be made (1); generally recognizable as the same (2); a mix of similar and unrecognizable features to each other (3); mostly not recognizable as each other (4); as far from each other as can be made (5)." The mean of this question is 2.79 for the self-reported data and 3.20 for the third-party-coded data. We cannot reject that these two means are significantly different from 3. This question sums up all the results relating to this second study – the casual-business avatar pairs have some traits in common and some traits that are different; this is observed by third-parties and in self-reports.

Overall, this study provides evidence that people make somewhat different-looking avatars for different roles. As in real life, there is great within-person variation in clothes and hair; but in virtual worlds there is also variation in facial appearance, eye color, and body type – and

very infrequent variation in race, gender, or humanity. But, although there are substantial dissimilarities in avatar physical dimensions, there is no significant difference in attractiveness across the casual and business avatars (for individual traits and overall). One systematic difference is that students make their business avatars look older. Generally, the data offer support for what we refer to as a *hierarchy of physical variation across online roles* – and further development and study of such a hierarchy seems warranted.

5. Discussion and conclusions

This paper shows that, when designing their avatars, people balance the motives of self-enhancement and self-verification. In Study 1, people customize their avatars with moderate enhancements, but bearing similarity to their real selves. This conclusion is distinct from past work that argues that people create idealized versions of themselves. And the particular form of self-enhancement that we find is compensatory self-enhancement (Hull, 1943; Kaplan, 1975), whereby the physical traits enhanced in avatars tend to be those traits in real life that people are less satisfied with. One caveat is that subjective perceptions of the similarity of one's avatar to one's self in self-reports tend to be greater than objective perceptions of third parties. Furthermore, Study 1 also demonstrates that changing one's online appearance can influence online behavioral traits. In particular, people tend to be more extroverted, risk-taking, and loud in virtual worlds as a result of designing and using more attractive avatars relative to their true selves. In Study 2, we find evidence that, across multiple avatars used for different roles, people maintain consistency for physical traits, such as gender and race, that appear to express more fundamental aspects of their identity, but vary more on other peripheral traits, such as hair, style of clothing, and face. This finding provides support for our proposed hierarchy of physical variation across online roles and can be considered as another manifestation of people balancing the motives of self-verification and (purposeful) self-enhancement.

More generally, our findings speak to Belk's (2013) conception of the extended self in a digital world. Our studies are relevant to Belk's discussion of digital reembodiment of the self, the relationship between behavior in the digital world and the real world, and that people may have multiple forms of themselves in digital environments. All our findings provide evidence in a particular virtual environment of consistency of self-representation in terms of avatar appearance and behavior. These findings address Belk's (2013) argument, in the digital realm, that "there is no singular core self" (p. 483). While we agree that there is variation online due to selective enhancements and adaptation to social context, we find that people often retain many of their core identity elements (such as human form, race, and gender) and real-world physical features. Even the self-reports on behavioral traits indicate a close relationship between real-world behavior and in-world behavior (albeit with amplification of some in-world behavioral traits for more attractive avatars).

5.1. Implications

Turning to practical implications of this research, as new uses of avatar-mediated environments arise, it is important to understand how people set the appearance of their avatars in relation to themselves. There are a number of implications of the ideas of the current paper for society and business, a selection of which we describe below.

5.1.1. Avatar standards

Our results can help provide guidance for a universal avatar standard that would be portable across platforms. Reflecting our hypotheses H1 and H2, avatars would be composed of a blend of realistic and enhanced features. Inputs could include two or more pictures or drawings, together with parameter specifications for standard trait descriptors. Reflecting H4, some core features would not be easily changeable, while peripheral features could be readily varied according to the desired context (business, casual, gaming, etc.). The features could be mixed and matched or the user could create preset avatar versions (casual-evening, business-day-use, beach-ready, etc.) that could be selected. The avatars could be rendered in multiple forms, selected from a menu, including 2D or 3D, and photorealistic, stylized, or cartoon formats. The essential feature is that a file would exist that is portable across social media and game platforms. There might be an optional companion file that includes standard accessories common in games. The idea of a universal avatar standard has appeared on discussion boards in the last couple of years, but as yet has not gotten much traction. The current paper provides support for the idea.

What already exist are Bitmojis, a personalized emoji or cartoon avatar of a person that can be used with Facebook, Facebook Messenger, Gmail, Snapchat, Slack and other social media environments. Bitmojis were created by the company Bitstrips, which was acquired in 2016 by Snapchat. "The Bitmoji mobile app has grown 3986% in the past year among adults aged 18 and older" (Puzier & Norton, 2017; also see Silbert, 2018).

As a supplement or alternate to this idea, electronic gaming and virtual world platforms could offer increased customizability of their avatars as part of their business models. These platforms might start with a standard avatar, possibly from a universal standard. Then platforms could charge a premium for greater customizability (to some extent some games already offer similarly-motivated add-ons). As background, gaming is already a big business: the "top 25 public companies by game revenues generated a combined $94.1 billion in 2017, an increase of +29% compared to 2016" (Wijman, 2018). Indeed, this is larger than the movie industry, where the "global box office revenue is forecast to increase from about 38 billion U.S. dollars in 2016 to nearly 50 billion U.S. dollars in 2020" (Statista, 2018). Gaming involves major companies (see Geoshen, 2018 and Morris, 2018) including Tencent/Riot Games (e.g., developer of League of Legends), Sony Interactive (Shadow of the Colossus), Microsoft Studios (Halo), Activision Blizzard (Call of Duty, World of Warcraft), Electronic Arts (FIFA), Ninteno (Mario), Take-Two Interactive (Grand Theft Auto V), and Zynga (FarmVille).

5.1.2. Norms of communications

The current paper also has implications for understanding new norms of communications. Avatars and visual representations have already transcended virtual worlds and gaming environments to move to social media such as Facebook, Instagram, Snapchat, and Twitter, as well as to online communication forms such as Skype, webpages, and email. Emoticons are standard, but these can be personalized, as we noted in the previous section. This personalization may assist with employees building a personal brand on platforms such as LinkedIn, and can be used in business cards, personalized stationary, and in avatars intended for remote meetings. In entertainment, the use of avatars is commonplace in digitized animated movies for children and adults (as made by Disney, Pixar, Dreamworks, etc.).

New norms are even extending to digitized models, like Shadu.

> "Shudu has been called "the world's first digital supermodel," and the obsessive fawning … her lifelike features provoke suggests she won't be the last. She arrives at a time in which Instagram, Snapchat filters and photo-editing apps that rely on artificial intelligence have blurred the lines between reality and fantasy, turning ordinary people into paintings or delicately featured digital avatars who preen for 'likes.'"
>
> (Holley, 2018)

Accompanying these changes are new norms of social interaction, where people come to expect progressively more perfect digital self-presentations. Indeed, there are now filters for webcams that enhance our digital images in real time, in the same way that photos can be edited after the fact. This could apply to social contexts such as how we

represent ourselves on online dating sites, and also in our business and personal webpages. We have come to expect makeup for improving the appearance of actors and other celebrities; we may increasingly be evidencing similar expectations toward private individuals (including males). For future digital self-representations, the current paper suggests that people will balance their "core self" with enhancements.

From a very different perspective, which may be relevant at this juncture, experimenting with avatars provides an avenue for people to explore variations in self-presentation that they might not (yet) feel comfortable with in the physical world. This can involve something as small as a beard or a tattoo, or something as central as gender.

5.1.3. Applications for business

The current paper has applications for virtual teams, salespeople, customer service agents, avatar representatives in traditional advertising, branding, logos, webpages, product packages, and product placement in games, and movies. In particular, the findings of the current research help business understand the psychological principles that guide individual's avatar customization. Furthermore, our findings provide guidance for businesses in terms of interpreting avatar appearance as a cue about people's behavioral traits.

In virtual teams, enterprise virtual media can be a first way to meet someone digitally, followed up by real interactions. As noted by Cummings and Dennis (2018) in this context, the "virtual first impressions matter." At the same time, when these teams meet in the future, a contradiction between people's enhanced self and the actual self may hinder trust and positive dynamics that may have developed. As these authors (Cummings & Dennis, 2018, p. 699) note,

> Trust is a judgment made by individuals about their willingness to be vulnerable to the actions of others (Robert, Denis, & Hung, 2009). When trust is low, problems occur including poor decision making, conflict, and misunderstandings, all leading to poor performance (Haikkinen, 2004). Identification is the degree to which individuals see themselves as one with another person or a group of people (Nahapiet & Ghoshal, 1998). Evidence suggests that the existence of salient identification may increase information exchange and cooperation.
>
> (Lewicki & Bunker, 1996)

This suggests the desirability of retaining an authentic core self-representation, together with a modicum of enhancements to add to professionalism. This provides a further reason for selecting an avatar that balances self-validation and self-enhancement, as per hypotheses H1 and H2. The same argument can be made for virtual salespeople and customer service agents who may wish to use an avatar.

For virtual service delivery (including business-to-business services, retailing, government services, and advertising/communication services), and virtual market research (gathering survey data and conducting focus groups in particular virtual worlds or targeting specific demographics within these worlds), one should consciously set the appearance of a virtual moderator to relate to, but appear credible with, group participants. In online settings, there has already been work that considers the use of avatars, with particular appearance types, to enhance consumer's perceived self-congruity with a brand (Aguirre-Rodriguez, Bóveda-Lambie, & Miniard, 2015). Generally, marketers and service employees need to understand how their digital self-presentation will influence interaction with others and also how to interpret the appearance of their customers, as well as nuances such as digital gestures.

With regards to avatar-spokespersons in virtual worlds, these can provide product information and permit consumers' multimodal interactions and thereby lead to more positive product attitude, deeper product involvement, and an enhanced online shopping experience (Jin & Bolebruch, 2009). It would be desirable to check whether the principles of the current paper carry over. It would also be desirable to check the effect of the use of digital images in traditional advertising, logos, webpages, on product packages and in-world product placement in games and movies.

5.1.4. Applications for education

For education, the current paper also suggests that people will use avatars that balance self-verification and self-enhancement. It is critical to properly set expectations about avatar appearance and to accurately gauge the behavior of participants in the virtual environment (Jarmon, Traphagan, Mayrath, & Trivedi, 2009). In this context, an avatar's appearance may provide clues about a student's learning motivations. As with work groups, the principles of individuals being comfortable with their representations and feeling and being perceived by others as genuine is critical. This is particularly true if the education occurs both online and in the real world for the same groups, so as to avoid dissonance or confusion if the avatar and real person are too dissimilar. At the same time, some enhancement is likely to appear professional and can enhance group interactions.

There are specific areas of application for training, which can avoid the anxiety of public speaking for shy individuals. In this case, people can deal with the anxiety in learning by disassociating and using different-looking avatars from their reals selves (as noted by Aymerich-Franch, Kizilcec, & Bailenson, 2014). Furthermore, our study amplifies the implications of these studies which indicate that people experience social events more positively when their avatars are improved versions of themselves (as with our hypothesis H3).

> Lastly, there is evidence that older adults prefer photorealistic avatars (Puri, Baker, Hoang, & Zuffi, 2017), which makes the users feel more safe and thereby encourages interaction. These authors note "[t]he potential strengths of avatars for elderly users in terms of omitting physical limitations and enabling virtual travel through various real life scenarios…" (p. 504).

5.1.5. Other applications and implications

There are many other applications of virtual worlds in business and various disciplines. Several of these are reviewed in Messinger et al. (2009), covering marketing, market research, advertising, public relations, retail and ecommerce, service delivery, and other business areas, including management information systems, organizational issues, industrial engineering, and customer relationship management, as well as to applications for the social sciences, library science, legal issues and privacy, arts and humanities, and sexuality. We direct readers to that paper, but we emphasize that correctly interpreting how users construct their avatars is foundational for a careful deployment in these various applications.

The above discussion describes direct applications of the results of the current paper to avatar-mediated environments – with elaboration from related research and some conjecture. But the ideas of the current paper may also be extendable to other forms of online self-representation or even real self-representation. For example, the principal of balancing self-enhancement and self-verification may apply to the use of online media such as Twitter or online discussion boards (in which one must choose a name and, occasionally, a 2D avatar). And the idea of a hierarchy of physical variation across (online) roles may apply to people's presentation of their casual and business selves in such social media as Facebook versus LinkedIn. In addition, an influence on economic outcomes may arise in online auction sites that permit various forms of self-representation of buyers and sellers (for example, representing a party as an individual or as a business, perhaps working with a charity, or even represented by an avatar).

The current paper discusses self-representation with an avatar, but one could also consider self-representation through material possessions or associations in various contexts. Thus, the choice of a car, a house, club membership, or even membership in a particular place of worship might reflect a balance between self-enhancement and self-verification. The self-verification motive, for example, might suggest

discrete presentation of luxury products. And judicious incorporation of youthful features in automobiles might be desirable for middle-aged customers. Indeed, a brand may be like an avatar representing a company's product. These are conjectures – and much has been written on these ideas before, but the hypotheses of this paper provide a lens for viewing such possibilities in future research.

5.2. Limitations

We acknowledge limitations of our data, including possible self-selection bias when people post photos of themselves with their avatars, reliance on self-reports, and relatively small sample size for some of our results. Although we have endeavored to address these issues by including parallel methods (e.g., third-party-coded and self-reported data; parametric and non-parametric analysis), we think it would be desirable to confirm our results across other datasets and to study behavior of people in other kinds of environments that differ from the open-objective environment of Second Life (such as World of Warcraft). A central question for future research is whether the evidence we find in the virtual world Second Life carries over to the larger extant virtual realm, including popular social media and online communities.

5.3. Future research

We think several extensions of the current research are of interest. To better understand behavior in virtual worlds, it is desirable to study how often and for what reasons people change the appearance of their avatars. It would also be desirable to conduct Netnographic research (Kozinets, 2002) on social expectations and rationale for avatar appearance and behavior in different virtual environments. And, when a person is less similar to his or her avatar, then perhaps in-world behavior will adhere less to real-world social norms. This extends past work (Yee, Bailenson, Urbanek, Chang, & Merget, 2007) which considers the similarity of social norms in-world and in the real world, as relates to interpersonal distance and eye gaze transfer, moderated by gender. Or, alternately, it would be interesting to study instances of how emergent or learned in-world behavior may carry over to influence a person's real-world behavior. Along these lines, there has already been study of effects on general behavior (McLeod, Liu, & Axline, 2014), behavior in work-groups (Lohle & Terrell, 2014), and proclivities toward real exercise (Song, Kim, & Lee, 2014). In addition, we think it would be desirable to study virtual appearance effects in negotiation settings.

It might also be interesting to use variation in avatar realizations as a diagnostic tool for uncovering identity issues or problems that people may be experiencing, building on Higgins' (1987) social discrepancy theory. In a clinical setting, a patient could be asked to create one or more avatars, and analysts could examine discrepancies between the appearance of the person and the person's avatar, or between various different avatar realizations.

From yet a different perspective, there is an opportunity to explore issues of identity formation, development, and reinforcement in virtual worlds, and other online spaces that use similar visual avatars. This is an interesting context because previous theories about how a person "constructs" his or her identity can be directly tested in this environment. Moreover, the world is becoming digital, and therefore traditional models of personality and identity will likely morph into this digital domain. The goal of such future research would include testing pre-existing ideas about identity in a new domain and in ways not previously available. But it could go further to explore new potentialities of and phenomena in the digital realm related to group dynamics and social relations.

Appendix A. Supplementary information

Supplementary information about this article (in particular, Online Appendices 1, 2, and 3) can be found online at https://doi.org/10.1016/j.jbusres.2018.12.020. Online Appendix 1 describes key questionaire elements (a) for the avatar-photo comparison study, assessed by third-party coders (undergraduates from a subject pool) and (b) for the the self-reported in-world intercept survey. Online Appendix 2 describes our detailed procedures for photo-comparison method, including (a) sampling methods used, (b) selection and preparation of images, and (c) details of the three sub-samples. Online Appendix 3 describes detailed procedures for the intercept-survey method.

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