International Journal of Human-Computer Studies
Volume 129, September 2019, Pages 64-73

The common player-avatar interaction scale (cPAX): Expansion and cross-language validation

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https://doi.org/10.1016/j.ijhcs.2019.03.003

Highlights

- Player-avatar interactions (PAX) are central to videogaming experiences and effects.
- A PAX metric valid across languages would facilitate cross-cultural comparisons.
- A common solution is developed for English, traditional Chinese, German languages.
- One dimension is validated: anthropomorphic autonomy.
- Three dimensions are refined: relational closeness, critical concern, sense of control.

Abstract

The connection between player and avatar is understood to be central to the experience and effects of massively multiplayer online (MMO) gaming experiences, and these connections emerge from the interplays of both social and ludic characteristics. The comprehensive social/ludic measure of this player-avatar interaction (PAX), however, features some dimensions with theoretical/operational gaps and limited reliability, and is available only in English (despite evidence of potential cultural variations in player-avatar relations). The present study aimed to a) enhance and refine the PAX metric, and b) translate and validate a common metric that bridges English, German, and traditional Chinese languages to facilitate future comparative research. Through exploratory factor analysis of data from MMO players in each of these language-based populations, an improved 15-item common Player Avatar Interaction (cPAX) scale is presented, with

four dimensions: relational closeness, anthropomorphic autonomy, critical concern, and sense of control. The metric is shown to be reliable within and across populations, and construct validity tests show expected associations between scale dimensions and both player-avatar relationship types and senses of human-like relatedness.

Previous Next

The connection between player and avatar is central to the experience and effects of massively multiplayer online (MMO) gaming experiences and is understood to emerge from the interplays of both social and ludic characteristics. Some approaches focus on merging of players' selves with avatars', such as character identification (Klimmt et al., 2009) and wishful identification (cf. Hoffner and Buchanan, 2005). Other approaches examine how avatars' characteristics affect players' self-concept and behavior, such as the Proteus effect (Yee and Bailenson, 2007) and self-presence (Lee, 2004, Ratan, 2013). Yet another approach considers the degree to which the player-avatar relation mirrors a fully realized social relationship. This approach, called player-avatar interaction (PAX; Banks and Bowman, 2016b), situates player-avatar relations along a comprehensive continuum of sociality—from non-social to fully social—and synthesizes key phenomena in other approaches with more recently discovered considerations. Techniques for measuring features of variably social relations, however, face two challenges. First, the comprehensive PAX metric includes dimensions with problematic construct validity and reliability. Second, as is common among measures of player-avatar relations more broadly, the PAX metric is linguistically and culturally siloed, available only in English and developed via intra-cultural data. The present study addresses these challenges by first expanding the existing PAX metric to enhance and refine its sub-dimensions, and then to develop and validate a (to draw from MMO role-playing parlance) "common" version of the expanded scale in English, German, and traditional Chinese. The result is a theoretically copacetic shift from PAX (dimensions: emotional investment, anthropomorphic autonomy, suspension of disbelief, sense of control) to cPAX (parallel dimensions: relational closeness, anthropomorphic autonomy, critical concern, sense of control).

1. Theoretical background

In MMOs—and in videogame play more broadly—avatars are the key vehicle by which players extend their presence and agency into games and influence the form and flow of on-screen game content. They variably convey the player's identity (Van Looy et al., 2012) and/or agency (Eichner, 2014) into the gameworld as players control them. Avatars are thought to influence players, in turn, as these digital bodies and corresponding interface elements communicate to the player social cues (Blascovich, 2002) and ludic feedback such as damage dealt and health points lost (Arsenault, 2005). MMOs, in particular, draw specific attention to the player's avatar, given that they serve as the central manner in which the player visits a persistent and highly social gameworld and the many different elements of that world, such as other players and their avatars (Steinkuehler and Williams, 2006). Because of this centrality, the ways that gamers connect with and perceive their avatars are understood to be central to the experience and effects of gameplay (see Nowak and Fox, 2018, for a review).

Prevailing approaches to player-avatar relations are rooted in a parasocial perspective (e.g., Lewis et al., 2008) in which relations are one-way (players think and feel toward avatars), non-dialectical (players act on avatars, but without reciprocation), and exist in the minds of players (rather than being fully realized social relationships; see Horton and Wohl, 1956). This perspective privileges the dynamic of identification between player and avatar—the multifaceted ways that players see the digital body as reflecting their self-concepts (Downs et al., 2017). Identification mechanisms are associated with different motivations for play (e.g., avatar-based group identification aligns with social motivations; Van Looy et al., 2012), with involvement in the game's story and challenge (Christy and Fox, 2016, Soutter and Hitchens, 2016), and with gameplay enjoyment, especially for noncompetitive games (Trepte and Reinecke, 2010). These identification influences may enhance social- or self-presence—in-game senses *being there* in the game—that in turn may drive loyalty to a given game (Teng, 2017) or creative outputs (Guegan et al., 2016).

More recent perspectives, however, suggest that parasocial approaches reveal only part of the player-avatar relation spectrum—especially in environments (such as MMOs) in which players take an active role in the avatar's creation and action. While identification is well-supported as an important relational mechanism, as important are the ways players view avatars as *differentiated* from the self (Banks, 2015) in the course of variably social player-avatar interactions. Self-differentiation is critical to understanding the dialectic of social relationships (Berscheid and Peplau, 1983), especially the development of empathy and perspective-taking (Bowen, 1978). Specific to games, some players see avatars as fully social agents engaging moral systems, agencies, relationships, and narratives entirely independent of their own, and others still engage a player-avatar relation that is unstable and shifting between identification and differentiation (Banks, 2015). Indeed, social dimensions of player-avatar relations have been associated with prosocial gameplay tendencies as players interact with other players (Bowers, 2018). Taken together, the parasocial and social perspectives offer a more comprehensive and explanatory model of player-avatar relations along a spectrum of sociality —from non-social to parasocial to fully social (Banks and Bowman, 2016a).

2. Measurement of player-avatar interaction dimensions

As this integrated approach frames the player-avatar relation as inherently sociotechnical, it takes into account the interpersonal dimensions of the social perspective along with the interactive media dimensions of the parasocial perspective. The existing metric for player-avatar interaction (PAX; Banks and Bowman, 2016b) features four factors. Emotional investment (EI; social) accounts for ways that players are affectively attached to avatars via its specialness and evoked emotion (love, appreciation, and fear of loss). Perceived anthropomorphic autonomy (AA; social) addresses the ways that players see avatars as existing on their own in a human-like fashion, with independent thoughts, feelings, actions, and existence. Suspension of disbelief (SoD; media) evaluates players' penchants for engaging avatars and their worlds as real, with reverse-coded items for tendencies to find errors, contradictions, or inconsistencies in the avatar's world, game, or story. Finally, sense of control (SoC; media) assesses the degree to which players feels they govern avatars' actions.

While conceptually reflective of the combined parasocial/social approach and largely replicated in studies across multiple game genres (Banks, 2017, Bowman et al., 2016b, Banks et al., 2018, Monroy, 2016), the PAX scale suffers a few challenges. EI and AA are fairly robust factors with six and five items, respectively, and in the noted studies feature alphas consistently above 0.800 and

meaningfully interpretable results supporting construct validity. SoD and SoC, however, require further development. In particular, SoD consists of three items (*I pay attention to errors or contradictions in this avatar's world. / It is important to check for inconsistencies in this avatar's game. / I concentrate on inconsistencies in this avatar's story and the game story.*) that, while largely reliable and offering interpretable measures, do not specifically address the active suspension of disbelief. As first conceptualized by Coleridge (1817/1997), SoD is a willing belief in the unbelievable, or derivatively and in relation to newer media forms it is theorized to emerge as a perception of plausibility or realism (Lombard et al., 2009, Vorderer et al., 2004); the current SoD measure instead focuses on the activation and practice of *disbelief* and the items are reverse-coded. SoC, in turn, is theoretically problematic as scale items do not fully represent the concepts ostensibly measured—it features only two items focusing on a heuristic sense of control (*This avatar does what I want. / I control this avatar.*) that do not account for more comprehensive and nuanced understandings of avatar-control experiences according to perceptions of input and response-feedback (Klimmt et al., 2007) or senses of vicarious agency (Tieri et al., 2015). SoC is also operationally problematic (often with correlation coefficients below the recommended 0.800 mark [Nunnally, 1967], as low as 0.40 [e.g., Banks, 2017, Banks et al., 2018, Monroy, 2016]).

The first aim of this study, then, is to improve the PAX scale by a) further confirming its EI and AA factors, b) improving the construct validity of the SoD and SoC factors by exploring the potential integration of more theoretically consistent items, and c) validating the improved metric's concurrent validity.

3. Player-avatar relation and cross-cultural variation

Although the original PAX metric was developed with an international sample, its use is still limited to studies of English-speaking gamers while extant literature suggests that there may be important differences in how gamers experience avatars and game content across language-based cultural groups. For example, Eastern and Western gamers have been shown to differ in the behavioral and cognitive effects of exposure to violent game content enacted by avatars (Anderson et al., 2010) and in tolerance for self-discrepant avatar appearances (Yoon and Vargas, 2016). Further, gamers from different countries differently assess morally questionable behaviors in game environments (e.g., Jackson et al., 2008).

Such cross-population divergence may emerge as a function of cultural norms and/or game content differences. By way of norms, there are regional preferences in game genres and gaming habits. U.S. gamers, for instance, play primarily action/shooter console titles and mobile puzzle/card games (Entertainment Software Association, 2017); Chinese and Korean gamers largely favor regional mobile games (e.g., *Tower of Saviors*) and MMOs (e.g., *Ragnarok Online*; InMobi, 2014); Taiwanese gamers also favor major MMO titles along with globally popular games like *League of Legends*, and *Clash of Clans* (Gamer.com, 2016); German gamers tend to favor strategy games (e.g. *Sid Meier's Civilization V*) more than the other groups of gamers discussed here (IfD Allensbach, 2014). Notably, in these regional reports, all three regions are documented as engaging MMOs, a critical point of comparison for the current study.

Normative differences may extend beyond the games themselves, as some evidence points to regional differences in gaming behavior (Quandt et al., 2014) and nation- or language-based differences in gaming group formation (Eklund, 2015). Other work suggests more homogenous

patterns in gaming behaviors across cultural groups, such as tendencies to build social ties through gaming (Schiano et al., 2011). Game content restrictions may also influence player-avatar relations since localization dynamics may require filtering or altering content according to cultural norms (see Carlson and Corliss, 2011). For example, U.S. and Taiwanese standards require little in terms of content governance while Germany engages one of the strictest censorship programs in Europe (especially concerning violent content and war glorification; Mueller, 2015). Further, Asian MMOs regularly introduce localized game events in celebration of certain holidays. For example, several LINE games (e.g., *Everybody's Marble, LINE Rangers*) in Taiwan introduce localized events or avatars for the Lunar New Year, Dragon Boat, and Mid-Autumn festivals.

Thus, we follow the lead of a growing group of scholars (e.g., De Grove et al., 2017, Kahn et al., 2015, Yoon and Vargas, 2016) who are advancing cross-cultural game studies by translating and validating social scientific measures. Notably, the development of valid cross-cultural measurement tools requires more than a single translation and reliability check. Rather, to establish content equivalence, the process requires initial translations and back-translations by individuals competent in both languages and familiar with the practical and theoretical dimensions of the phenomenon being measured (Cha et al., 2007). Additionally, considerations must be made for construct equivalence—considering the phenomena's relevance and phenomenological equivalence across target cultures—in order to avoid making inappropriate assumptions about the nature of the measurement, especially when understandings of a construct developed or studied primarily within one social context (Douglas and Nijssen, 2003).

The second aim of this study, then, is to a) translate the candidate PAX metric items and develop a common (cross-language) PAX metric in order to facilitate future comparative studies. In particular, we sought to extend the English-language version (primarily targeted to Americans, but accessible to other English-speaking populations) to two geographically, culturally, and linguistically diverse populations that are also understood to differ in their exposure to, preferences for, and attitudes toward videogames: speakers of German (principally Germans, secondarily Austrians) and speakers of traditional Chinese (principally Taiwan Mandarin). These demographics notably correspond with three high-gaming populations. In particular, across the U.S., Taiwan, and Germany, a majority of households are home to regular gamers (Entertainment Software Association 2017, GoodBene 2016, Taipei Times, 2015, Aug. 1), open-world and multiplayer games lead the most popular genres (Dilley, 2017), and they lead their respective regions in per-capita gaming spending (NewZoo, 2016).

4. Method

4.1. Participants

English-, traditional Chinese-, and German-speaking MMO players were recruited via online forums and groups by posting in those languages from the U.S., Taiwan, and Germany. Participants completed an online survey consisting of the expanded scale item pool (described below), and validation and demographic measures. Participants were incented with entry into random drawings for 100 USD/100 Euro/3000 NTD electronic gift certificates (depending on the region of each winner). Notably, since past implementations of the PAX scale report that the metric is reliable but means tend to vary across videogame genres (Bowman et al., 2016), recruitment was limited to

players of MMOs to minimize potential variation in scale fit as a function of the potential genre representation differences.

Recruitment efforts resulted in samples of $N=557$ (English), $N=2274$ (Taiwanese), and $N=1324$ (German). These initial data were scrubbed to remove cases with incomplete data, those not naming a specific avatar for their survey responses, those naming non-player characters (NPCs, which are not controlled by the player), and those naming an avatar from non-MMO games. The resulting samples consisted of $N=281$ (English), $N=532$ (Taiwanese), and $N=648$ (German). Gender proportions varied significantly by language group ($\chi^2(6, N=1461) = 78.44$, $p < .001$), with the traditional Chinese-speaking population less likely to include females and more likely to include non-binary genders than the other two populations; age also differed significantly ($F(2, 1390) = 95.43$, $p < .001$, $\eta_p^2 = 0.12$) with each group distinct from the others—traditional Chinese-speaking was youngest, followed by English-speaking, and German-speaking the oldest. Language groups also differed by current weekly playtime for the identified avatar ($F(2, 1414) = 57.83$, $p < .001$, $\eta_p^2 = 0.08$), with traditional Chinese-speaking gamers playing less each week compared to the other groups (Table 1).

Table 1. Descriptive statistics for language-specific samples.

	English ($N=281$)	**Traditional Chinese ($N=532$)**	**German ($N=648$)**
Gender	Male $n=202$ (71.9%) Female $n=56$ (19.9%) Nonbinary $n=6$ (2.1%) No report $n=17$ (6.1%)	Male $n=367$ (69.0%) Female $n=44$ (8.3%) Nonbinary $n=66$ (12.4%) No report $n=55$ (10.3%)	Male $n=461$ (~71.1%) Female $n=105$ (16.2%) Nonbinary $n=18$ (2.8%) No report $n=64$ (9.9%)
Age	$M=26.9$ years ($SD=8.2$)	$M=25.2$ years ($SD=5.0$)	$M=31.3$ years ($SD=9.0$)
Top games	28 MMOs named. Top: *World of Warcraft* (~68%) *Guild Wars 2* (~6%) *Final Fantasy XIV* (~3%)	43 MMOs named. Top: *World of Warcraft* (~38%) *Maple Story* (~11%) *Ragnarok Online* (~9%)	19 MMOs named. Top: *World of Warcraft* (48%) *Star Wars: Knights of the Old Republic* (~20%) *Elder Scrolls Online* (16%).
Weekly avatar playtime	14.5 h ($SD = 15.5$)	$M=5.7$ h ($SD = 11.5$)	$M=13.0$ h ($SD = 13.6$)

4.2. Procedure and measures

Participants were asked to complete an online survey that began by asking them to name all MMOs they play, then from that list to identify a favorite MMO, and then to name one favorite avatar from that one favorite MMO. This focus on a 'favorite' avatar (rather than most played or most recently played) to (a) mirror the procedure used in the creation of the original PAX metric, and (b) attachment to a character facilitates longer-term opportunities for relational development without necessarily forging identification or differentiation (in line with Teng, 2017). The name of this avatar was then piped into the framing of all following questions to ensure each participant responses were focused on only one named avatar. Participants were then asked to complete the candidate item pool, validation measures, and demographic questions.

The item pool consisted of 10 items per each of the four PAX dimensions; each set contained items from the original scale (Banks and Bowman, 2016b) plus items culled from related literatures. All items were presented in random order as seven-point Likert-style items (where 1=strongly disagree and 7=strongly agree). In particular, Emotional Investment (EI) items comprised six items from the existing PAX scale and four derived from the player-avatar sociality scale EI dimension that was precursor to PAX (see Banks and Bowman, 2016b). Anthropomorphic Autonomy (AA) items included four items from the PAX scale and, similarly, an additional six items from its precursor sociality scale. Suspension of Disbelief (SoD) items included three items from the PAX scale, and an additional four items adapted from Coleridge's (1817/1997) conceptualization of SoD, two items from Vorderer and colleagues' SoD characterization (2004), and one related item from the Temple Presence Inventory characterizing SoD as realism (Lombard et al., 2009). These additional items focus more on the willing suspension of disbelief, thus more faithfully reflecting this construct than the reverse-coded active disbelief as in the original PAX items. Finally, Sense of Control (SoC) items included two from the PAX scale, one from the precursor sociality scale, five adapted from Klimmt and colleagues' metric for assessing control in terms of input and response (2007), and two from Tieri and colleagues' work (2015) framing SoC as vicarious agency. These potential expansion items were chosen as they both faithfully represent the phenomena outlined in the original PAX model and are copacetic with PAX's focus on player-avatar differentiation and sociality (Banks and Bowman, 2016b) rather than the divergent identification/parasociality frameworks.

Construct validation measures were replicated from the original PAX development (Banks and Bowman, 2016b). A one-item heuristic measure evaluated human-like relatedness (HLR; relating to the avatar as they relate to other humans), and a one-item heuristic measure of player-avatar relationship (PAR) type (i.e., object, 'me,' symbiotic, or other orientations; Banks, 2015).

Per the best practices outlined above, the entire survey instrument was translated by the research team into traditional Chinese and German, and then back-translated and pre-tested for readability and face validity by bilingual research assistants familiar with global and regional MMO games.

5. Results

The responses from all three data sets were subjected to multi-group exploratory structural equation modeling (ESEM) using maximum likelihood estimation with oblique geomin rotation (see Marsh et al., 2009). Oblique rotations are necessary to account for the theoretical and empirical correlations among PAX dimensions (Banks and Bowman, 2016b). The main advantage of ESEM over confirmatory factor analysis (CFA), which is typically used to *a priori* verify factor structures was in freely estimating cross-loadings for all items on all factors for use as criteria for identifying

poorly performing items. Cross-loading was deemed likely for two reasons related to expanding PAX to an improved, cross-language scale: (a) by adding 25 items to the original 15-item PAX scale to bolster smaller-than-optimal and theoretically problematic factors, new cross-loadings were likely to emerge and (b) it was unknown *a priori* how translated items would function across language groups. Because of the importance that new metric has a high degree of discriminant validity among its dimensions, geomin rotation was used for its ability to more accurately estimate cross-loadings than other oblique rotation strategies (Aksoy, 2017, Asparouhov and Muthén, 2009). Given the substantial empirical and theoretical support of PAX's four-dimensional structure (as outlined above), four-factor models were estimated.

To develop a common metric across all three language groups, items were iteratively removed from the pool in three rounds: 1) dropping 13 items with primary standardized loadings less than 0.50 in any language group, 2) dropping nine items with primary standardized loadings greater than 0.60 or cross-loadings less than 0.25 in any language group, and 3) dropping three items with primary standardized loadings greater than 0.60 or cross-loadings less than 0.25 in any language group. After three iterations, 15 items were retained, with a factor structure largely in line with the original PAX metric. For brevity, only primary factor loadings for the final model are presented in Table 2, with complete pattern matrices (including cross-loadings) reported in Supplemental Materials (Section 1).[1]

Table 2. Geomin-rotated ESEM factor structure by language sub-sample (presented in English, for interpretation; see Appendix A for translations).

cPAX factor	English	Traditional Chinese	German
Relational closeness (formerly EI)†			
I feel very close to this avatar.	0.841	0.824	0.775
I am emotionally invested in this avatar.	0.815	0.791	0.632
I have a meaningful connection with this avatar.	0.894	0.880	0.914
This avatar and I have a close relationship.	0.770	0.915	0.877
Anthropomorphic Autonomy			
This avatar has its own thoughts and ideas.*	0.987	0.920	0.972
This avatar has its own feelings.*	1.009	0.926	0.945
This avatar is autonomous and acts on its own.*	0.734	0.920	0.771
This avatar has its own sense of right and wrong.	0.735	0.787	0.74
Critical concern (formerly SoD Recoded)†			
I pay attention to errors or contradictions in this avatar's world.*	0.832	0.784	0.806
It is important to check for inconsistencies in this avatar's game.*	0.958	0.919	0.944

cPAX factor	English	Traditional Chinese	German
I concentrate on inconsistencies in this avatar's story.*	0.622	0.835	0.851
Sense of control			
This avatar responds to my inputs as I expect.	0.828	0.818	0.732
My commands have a visible impact on this avatar's actions.	0.804	0.871	0.841
I affect this avatar directly.	0.874	0.906	0.883
I am in charge of what this avatar does.	0.886	0.854	0.807

Note. Loadings are standardized factor loadings. Use of oblique rotations does allow for loadings to be greater than 1.00, as factors are interpreted as standardized regression coefficients rather than correlations.

* Item was in the original PAX scale.

† The EI factor is reinterpreted here as 'Relational Closeness' and the reverse-coded SoD factor is reinterpreted here as the forward-coded 'Critical Concern' measure in the final version of cPAX, as explained in the following section.

Although the hypothesis of exact model was tentatively rejected, other global fit indices suggested that the model had acceptable global fit, χ^2 (153) = 513.69, $p < .001$ (χ^2 contributions from English sample = 117.34, traditional Chinese = 257.06, German = 139.29), RMSEA = 0.070 (90% CI: 0.063, 0.076), CFI = 0.979, TLI = 0.958; SRMR = 0.015. See Table 3 for all model fit statistics.

Table 3. Model fit statistics for multiple-group cPAX models.

Model type (Marsh et al., 2009)	BIC	χ^2	*df*	RMSEA	90%LB	90%UB	CFI	TLI	SRMR
ESEM	66,212	513.69	153	.070	.063	.076	.979	.958	.015
CFA	66,161	869.25	252	.071	.066	.076	.965	.956	.044
ESEM Model 2	66,198	861.56	241	.073	.068	.078	.965	.954	.054
EwC Model 2 (P FL)	66,058	639.12	221	.062	.057	.068	.976	.966	.036
EwC Model 5 (P FL)	66,268	939.23	243	.077	.072	.082	.960	.948	.051
EwC Model 5 (P FL, P INT)	66,056	694.64	235	.063	.058	.069	.974	.965	.039
EwC Model 7 (P FL, P INT)	66,416	1178.2	265	.084	.079	.089	.948	.938	.068

Model type (Marsh et al., 2009)	BIC	χ^2	*df*	RMSEA	90%LB	90%UB	CFI	TLI	SRMR
EwC Model 7 (P FL, P INT, P Unq)	66,038	738.54	250	.063	.058	.069	.972	.965	.042
EwC Model 8 (P FL, P INT, FV)	66,105	776.84	243	.067	.062	.072	.970	.961	.112
EwC Model 8 (P FL, P INT, P FV)	66,050	709.07	240	.063	.058	.069	.973	.965	.060
EwC Model 8 (P FL, P INT, P FV, FCV)	66,060	768.12	252	.065	.060	.070	.971	.963	.085
EwC Model 8 (P FL, P INT, P FV, P FCV)	**66,024**	**720.40**	**249**	**.062**	**.057**	**.068**	**.973**	**.966**	**.067**
Final model validation tests									
EwC Model 8 (final) with HLR	71,670	757.61	282	.059	.054	.064	.973	.966	.064
EwC Model 8 (final) on PAR	64,286	836.86	348	.054	.050	.059	.973	.965	.048

Note. Model marked in bold was the best-fitting model solution, retained for all further analyses. Model labels (e.g., Model 2) correspond to Marsh et al. (2009) taxonomy of measurement invariance for exploratory structural equation modeling (ESEM), see p. 443. Customizations to each default model are indicated in parentheses. The following abbreviations are used: CFA = confirmatory factor analysis; EwC = ESEM-within-CFA; P FL = partial invariant factor loadings; P INT = invariant item intercepts; P Unq = partial invariant item uniquenesses; P FV = partial invariant factor variances; FCV = invariant factor covariances; P FCV = partial invariant factor covariances; HLR = human-like relatedness; PAR = player-avatar relationship. Statistics reported in this table include: RMSEA = root mean squared error of approximation; LB = 90% lower confidence interval; UB = 90% upper confidence interval CFI = comparative fit index; TLI = Tucker-Lewis Index; SRMR = standardized root mean square residual. All χ^2 $p < .0001$. Models are explained in detail in supplemental materials: https://osf.io/8 gcsr/.

Inspecting the residual inter-item correlations for each group revealed several potential sources of minor local model misfit (i.e., correlation residuals ≥ 0.1 and standardized correlation residuals > 1.96): five for the English sample ($M = 0.157$, range = 0.117–0.235), three for the traditional Chinese sample (0.118, 0.149, 0.167), and five for the German sample ($M = 0.161$, range = 0.104–0.281). Further inspection of the text of the items with residual correlations suggested that these residuals may have been due to within-factor item pairs with similar concepts (e.g., within the Relational Closeness factor, two items addressed notions of relational closeness and two dealt with meaningfulness). To avoid over-fitting, post-hoc correlations among indicator residuals were not added to the model.

The plausibility that any remaining factor cross loadings were not substantially different from zero was investigated by comparing the final ESEM model to a model in which all cross-loadings were constrained to zero (i.e., a CFA model). The results of a chi-square model comparison indicated that the model without cross-loadings had significantly worse overall fit than the original ESEM model, $\Delta\chi^2 = 355.563$, $\Delta df = 99$, $p < .001$ (see Table 4). In other words, despite items' overall weak cross-

loadings, these were substantial enough to materially influence the statistical model. Thus, the ESEM model was retained for subsequent analyses.

Table 4. Dimension means, reliability, and normality for the common player-avatar Interaction Scale (cPAX).

	English	Traditional Chinese	German
	M **(*SD*) – αskewness/kurtosis (SE)**	***M*** **(*SD*) – αskewness/kurtosis (SE)**	***M*** **(*SD*) – αskewness/kurtosis (SE)**
Relational closeness	4.43 (1.62) –0.90 –0.35 (0.15)/–0.66 (0.29)	5.22 (1.31) –0.92 –0.49 (0.15)/–0.26 (0.29)	3.72 (1.61) –0.89 0.05 (0.15)/–0.771 (0.29)
Anthro. autonomy	2.20 (1.60) –0.93 1.13 (0.15)/0.03 (2.9)	3.75 (1.83) –0.95 0.10 (0.15)/–1.04 (0.29)	2.69 (1.86) –0.90 0.82 (0.15)/–0.60 (0.29)
Critical concern	3.37 (1.73) –0.87 0.03 (0.15)/–1.09 (0.29)	4.91 (1.44) –0.90 –0.85 (1.5)/0.45 (0.29)	3.52 (1.83) –0.92 –0.01 (0.15)/–1.20 (0.29)
Sense of control	6.53 (0.85) –0.91 –3.04 (0.15)/12.97 (0.29)	5.96 (1.19) –0.93 –1.78 (0.15)/4.25 (0.29)	6.26 (0.89) –0.84 –1.79 (0.15)/4.77 (0.29)

Note: Values in this table are calculated based on composite values for interpretability (rather than latent values, as reported in other portions of this analysis).

This four-factor model will be referred to as the *common* Player-Avatar Interaction Scale (cPAX). Descriptives are presented in Table 4, factor correlations in Table 5, and factor interpretations are provided in the next section.

Table 5. cPAX factor correlations.

Dimension	**1**	**2**	**3**
	English		
1. Relational Closeness			
2. Anthro. autonomy	0.391***		
3. Critical concern	–0.306***	–0.457***	
4. Sense of control	0.125*	–0.176**	0.006
	Traditional Chinese		
2. Anthro. autonomy	0.385***		

Dimension	1	2	3
3. Critical concern	–0.364***	–0.322***	
4. Sense of control	0.221***	–0.279***	-0.045
	German		
2. Anthro. autonomy	0.426***		
3. Critical concern	–0.382***	–0.516***	
4. Sense of control	0.037	–0.103**	–0.053

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Finally, in order to compare (a) means of cPAX dimensions and (b) relationships of cPAX dimensions with validation measures among groups, it was first necessary to demonstrate a degree of measurement invariance, i.e., that items measured the same thing in the same way in all language groups (Marsh et al., 2009). Following the recommendations of Marsh et al., (2009), successively more restrictive models were estimate and compared. Models were selected by comparing several global fit statistics, in particular the sample-size adjusted BIC and the recommendations of Cheung and Rensvold (2000) and Cheng (2007) to retain the more parsimonious nested model if CFI decreased by no more than 0.01 and RMSEA increased by no more than 0.015 (see Table 3 and Supplemental Materials, Section 2). (See Supplemental Materials for full multiple group invariance analyses, model comparison details, and procedures for estimating partially invariant models.) Because of substantial non-invariance in item uniqueness (model M7p, see Supplemental Materials, Section 2), comparisons of manifest means of composites between language groups should not be made. However, given the comparatively limited partial invariance in item loadings and intercepts as well as factor variances and covariances, comparisons of latent means and structural regression coefficients can be made, acknowledging that such comparisons may exhibit minor bias.

Because of the substantial degree of measurement invariance of cPAX among the three language groups, comparisons of latent means among language groups are minimally confounded by differences in responding among groups. Thus, differences among language groups can be attributed to differences in underlying cPAX constructs rather than to measurement artifacts (see Table 6).

Table 6. Comparisons of latent means of cPAX dimensions across language groups.

	English	Traditional Chinese		German	
Dimension	***M***	***M***	***SE***	***M***	***SE***
Relational closeness	0.000	0.518	0.08	–0.378	0.08
Anthropomorphic autonomy	0.000_a	0.854	0.08	0.204_a	0.07
Sense of control	0.000	–0.619	0.08	–0.321	0.07
Critical concern	0.000_b	0.628	0.08	0.079_b	0.08

Note. Latent factor means for the English sample were fixed to 0 to identify the model, and thus have no standard errors. Means without shared subscripts are statistically significantly different, $p < .0001$. English versus traditional Chinese and English versus German comparisons: p-values are from parameter estimates for factor means, because these parameters estimate their difference from reference group (English). Traditional Chinese versus German comparisons: p-values are from Wald test of parameter equivalence ($df = 1$). $_a$ $p = .005$; $_b$ $p = 0.318$.

5.1. Interpreting dimensions of the common player-avatar interaction scale (cPAX)

In interpreting the final, 15-item cPAX solution (Table 2), it is appropriate to address shifts in scale dimensions from the original PAX metric. One aim of this study was confirmation of the robust factors (AA and EI) and the improvement of the problematic factors (SoD and SoC). Three of four original AA items were retained, replacing a previous item (the avatar having its own life when the player logs out) with one denoting a "sense of right and wrong," in line with evidence suggesting that more social orientations toward avatars include seeing the avatar as having moral agency (Banks, 2015). However, all EI items were displaced by items from the PAX-precursor sociality scale (Banks and Bowman, 2016b) denoting heuristic feelings of closeness, investment, connectedness, and relatedness. Following, that factor is renamed "Relational Closeness" (RC), defined here as *a disposition toward the avatar as a function of emotional attachment* (see Collins and Feeney, 2004) and perception of relational *interdependence* (see Rusbult et al., 2004).

Rather than the expected shift toward items more faithfully representing suspension of disbelief as perceived plausibility, realism, or willing engagement of the unbelievable, all three original SoD items were retained: attention to contradiction in the world, to inconsistency in the game, and to inconsistency in the avatar's story. Given that the more faithful indicators of SoD do not appear to coalesce as a core mechanism in player-avatar relations, it is interpreted that the former reverse-coded factor was mis-identified. Although SoD could, in fact, be key to PAX variations, extant scholarship suggests that people are often unwilling to explicitly articulate a willing belief in fictional or technological agents (see Banks, 2019) despite implicit signaling of social cognition (see Hofmann et al., 2005). We argue this dimension is, instead, better characterized (without reverse-coding) as "Critical Concern" (CC). CC is defined here as *the degree to which players attend to and evaluate the internal coherence and consistency of the avatar's situation in the gameworld*, with higher scores on this dimension signaling higher levels of critical evaluation. Despite the shift in label, this critical evaluation is commensurable with (though a conceptual inverse of) suspension of disbelief and so is copacetic with the overall model since (in parallel with past research; Banks and Bowman, 2016b) players are more likely to be critical of the avatar's game, environment, and story when the gameworld is engaged as a socially rich, believable space.

Previous SoC items were entirely displaced by pool items indicating sense of control as the link between inputs and observed effects or outputs (adapted from Klimmt et al., 2007). These items represent a more nuanced approach to the mechanism underlying a sense of control (input response, visible impacts and effects, being in charge) compared to the original PAX metric's more heuristic indicators of control.

5.2. Construct validity

To advance validation of the cPAX metric, the scale was subjected to the same construct validation procedures as the original PAX scale: correspondence with player-avatar relationship type and sense of human-like relatedness (Banks and Bowman, 2016b). Given that PAX differs as a function of player-avatar relationship (PAR) types—avatar as Object, Me, Symbiote, or Other (Banks and Bowman, 2016b)—we would expect cPAX to vary similarly, noting the potential for cross-cultural variation and for the SoC measure to vary given the dramatic changes to that dimension's items. It can be expected that Object and/or Me relationships would have the lowest RC means; Other relationships would have the highest and Object relationships would have the lowest AA means; Object and/or Me relationships would feature the highest SoC means; Object relationships would have the lowest and Symbiote and/or Other relationships would have the highest CC means.

Latent variable regressions were conducted to compare latent means across PAR types within language-specific samples (Table 7) with the subsample of participants who responded to the PAR question (n=1435). Means and mean differences generally followed the expected patterns within each language group. For RC, those indicating Object relationships reported lowest and Symbiote reported highest, although Symbiote was not statistically significantly different from Me and Other in most groups. For AA, Object reported the lowest scores and Other reported highest, although in the English and traditional Chinese language groups Other and Symbiote were not statistically significantly different. For SoC, Me reported highest (with Other not significantly different) and Other reported lowest in the traditional Chinese and German groups, while means were statistically significantly different in the English group. For CC, however, Object reported highest and Other or Symbiote reported lowest, suggesting that measured concern is for the consistency and coherence of the avatar's functioning within the game as a ludic system rather than as a narrative world with social actors.

Table 7. Latent means of cPAX dimensions by player-avatar relation type.

Language group / cPAX dimension	**Object**	**Me**	**Symbiote**	**Other**	R^2	p
English	n=129	n=77	n=51	n=17		
Relational closeness	–0.797	**0.103$_a$**	**0.478$_a$**	**0.217$_a$**	0.223	<0.001
Anthropomorphic autonomy	–0.964	–0.563	**0.554$_a$**	**0.974$_a$**	0.306	<0.001
Sense of control	0.028$_a$	0.283$_a$	0.101$_a$	–0.411$_a$	0.027	0.177
Critical concern	**0.730**	–0.008$_a$	–0.411$_a$	–0.310$_a$	0.186	<0.001

Language group / cPAX dimension	Object	Me	Symbiote	Other	R^2	*p*
Traditional Chinese	*n*=116	*n*=162	*n*=170	*n*=81		
Relational closeness	–0.288	**0.622$_a$**	**0.663$_a$**	0.071	0.188	<0.001
Anthropomorphic autonomy	–0.076	0.294	**0.948$_a$**	**1.099$_a$**	0.169	<0.001
Sense of control	–0.566$_a$	**–0.046**	–0.484$_a$	–1.671	0.184	<0.001
Critical concern	**–0.021**	–0.473$_a$	-0.611$_a$	–0.554$_a$	0.073	0.002
German	*n*=370	*n*=104	*n*=138	*n*=20		
Relational closeness	–1.122	**–0.168$_a$**	**0.160$_a$**	**0.326$_a$**	0.255	<0.001
Anthropomorphic autonomy	–0.611	–0.135	0.585	**1.857**	0.269	<0.001
Sense of control	–0.275$_a$	**0.085$_b$**	–0.167$_{ab}$	–1.180	0.045	0.009
Critical concern	**0.665**	0.111$_a$	–0.115$_a$	–0.984	0.146	<0.001

Note. Within rows, means without shared subscripts differ at $p < .01$. Largest means are bolded.

Additionally, cPAX dimensions would be expected to be specifically correlated with a sense of human-like relatedness (HLR) as a sense of connecting with the avatar as one would connect with other humans. It can be expected that HLR would be positively correlated with RC and AA, but with no relationship or a negative relationship with SoC and (given the finding above) either no relationship or a negative relationship with CC (cf. Banks and Bowman, 2016b). Partial correlations estimated based on the final model (Table 3) with the subsample of participants who responded to this question (*n*=1255) follow these patterns, with HLR positively correlated with RC and AA in all groups, negatively correlating with CC in all groups, and not statistically significantly correlating with SoC in any group (Table 8).

Table 8. Partial covariances and correlations between cPAX dimensions and human-like relatedness by language group.

	English		Traditional Chinese		German	
Factor	**Covar.**	***r***	**Covar.**	***r***	**Covar.**	***r***
Relational closeness	1.419***	0.516***	0.902***	0.413***	1.505***	0.575***
Anthropomorphic autonomy	1.096***	0.398***	0.673***	0.262***	1.012***	0.386***
Critical concern	–1.090***	–0.396***	–0.531***	–0.259***	–0.663***	–0.253***
Sense of control	0.136	0.049	0.250	0.083	–0.194	–0.074

*** $p < .001$.

Given adherence to expected patterns in HLR and cross-PAR differences, evidence supports cPAX as a construct-valid measure of the player-avatar interaction within and across a multi-language sample of MMO gamers.

6. Discussion

This study accomplished the improvement of a previous measure of player-avatar interaction (PAX; Banks and Bowman, 2016b) by addressing its theoretical and measurement shortcomings, and by translating and validating the metric (cPAX, or common player-avatar interaction scale) across language groups with heavy-gaming populations. Specifically, this new measure a) refines the emotional investment dimension through the lens of relational closeness (RC), b) confirms Anthropomorphic Autonomy (AA) dimension, c) clarifies that Critical Concern (CC; as the careful critique of the avatar's gameworld situation) is a more precise characterization of items previously interpreted as suspension of disbelief, and d) improves the sense of control (SoC) dimension by shifting from heuristic to input/output-oriented items.

6.1. cPAX across language groups

The cPAX metric demonstrated partial measurement invariance, which may be somewhat expected given known cultural differences in relational orientations (e.g., Mesman et al., 2016), humanization of non-humans (e.g., Salem et al., 2014), and motivations and expectations for play (Lee and Wohn, 2012). In other words, the different cultures are known to differently experience connections with both humans and non-humans, where avatars may represent an intersection of those ontological domains (Banks, 2015). That partial measurement invariance was observed with cPAX suggests that even with culture-specific variance in how players might interact with avatars within our focal language groups, comparisons of cPAX dimensions between language groups are still relevant indicators of observed differences in those dimensions (rather than measurement artifacts). These comparisons are offered below.

Perhaps most notably, traditional Chinese-speaking gamers reported markedly higher scores for RC, AA, and CC—and slightly lower SoC scores—compared to the English- and German-speaking groups. It is possible that the higher perceptions of human-likeness, closeness, and concern for consistency may be driven by regional gaming preferences, as Taiwanese gamers reported favoring a wide range of MMOs that emphasize rich narratives in which avatars are distinctive in appearance and personality, which may encourage players to perceive them as more human-like (cf. Bowman et al., 2016). In contrast, English-speaking participants (the majority of which were American) reported slightly higher SoC scores and slightly lower AA and CC scores, while German-speaking gamers reported RC scores lower than the other two groups.

Altogether, these differences are interpreted to suggest that orientations toward avatars could be explained by known cultural differences. Broadly, as Taiwanese gamers may take a more social orientation toward avatars (high closeness, humanization, and concern), Americans a middling social orientation (leaning toward control), and Germans a less social orientation (lower closeness), in line with Taiwan's more collectivist and U.S.'s more individualistic norms (Hofstede et al., 1991), and Germans' cultural tendency to minimize socioemotional behaviors (Lehmann-Willenbrock et al., 2014). It is interesting to speculate as to the ways that these differences in orientations toward avatars could manifest in meaningful differences in how those gaming

populations engage MMOs, in general. For instance, that traditional Chinese-speaking gamers appear to adopt a more social and narrative orientation toward avatars aligns with key gaming gratifications found for Taiwanese gamers—action, companionship, and friendship (Hsieh, 2018)—while Western populations are also motivated by challenge and escape gratifications (Yee, 2006). That English-speaking gamers had higher scores for sense of control over avatars aligns with evidence of North Americans' tendency toward competition and completionism gameplay priorities, compared to Eastern gamers (Kahn et al., 2015), suggesting that strong feelings of governance over a game character may be driven by motivations to excel in game tasks. Further, that German-speaking gamers had low relational closeness aligns with indications that German users (along with other geographically defined populations) prefer digital characters that reflect their own culture (Endrass et al., 2013)—games named in the study included characters of both U.S.-centric and Eastern aesthetics, but none that are specifically German. Thus, it is possible that there could be cultural population-level tendencies toward player-avatar orientations in MMOs, depending on the degree to which cultural backgrounds are (not) reflected.

Following, it may be that language-group differences in orientations toward avatars could follow cultural tendencies in orientations toward social others, more broadly. This interpretation is supported in extant literature arguing for the natural treatment of media according to human norms when the medium or its content deliver sufficiently anthropomorphic cues (Reeves and Nass, 1996) such that one's human-relational traits may be transferred to avatar relations. Notably, however, the demographics represented in the sub-samples may also have influenced these patterns. Regarding emotional investment, although the high RC scores among Taiwanese gamers do not align with literature suggesting a cultural aversion to displaying self-focused emotions in social situations (Argyle et al., 1986), this study's sample may not engage traditional norms as it trended young and highly educated. In tandem, the older (and perhaps more traditional; Joeckel et al., 2013) German sample reported the lowest RC scores, consistent with the archetypical socioemotional conservativism.

6.2. Limitations and future research

The present study was inherently limited in that participants were recruited from gaming-interest fora such that the sample may feature idiosyncrasies characteristic of those who frequent such online spaces. While we cannot make claims that these gamers represent all gamers, the sampling procedure overcomes geographically bound convenience samples while also tapping communities who regularly engage online gaming—notable given the social nature of such games (Steinkuehler and Williams, 2006). Additional work is needed to conduct confirmatory factor validations of the cPAX metric, to validate the scale across various gaming demographics and formats given that past scholarship suggests PAX varies by genre (Bowman et al., 2016). Future research should also explore the aforementioned cultural differences to consider the ways that culture-variant player-avatar interaction may influence gameplay experiences and to parcel out potential cultural and ludic influences on player-avatar relations. Also notable are cultural differences that might exist irrespective of video games but instead, relevant to the survey methodology employed in the current study—for example American students have been shown to report more extreme responses when answering survey questions than Taiwanese students (Chen et al., 1995), thus each language-group mean may be a function of tendencies toward survey responses in general.

7. Conclusion

The 15-item cPAX scale offers valid metric for assessing player-avatar interaction through mechanisms of relational closeness, anthropomorphic autonomy, critical concern, and sense of control. In comparison to previous instruments, it offers improved theoretical consistency and statistical robustness of factors. The metric bridges linguistic and cultural differences to effectively assess player-avatar interaction and is useful in its predictions of variables relevant to the merged parasocial/social relational spectrum. Thus, the cPAX scale is promising in its potential to advance a more comprehensive understanding of how player-avatar interaction emerges from and influences gameplay motivations, experiences, and effects.

Acknowledgements

All authors contributed equally to this manuscript and share first authorship: JB designed the study and collected U.S. data; JHL and DP completed translations and led data collection in Taiwan and Germany, respectively; NDB and JAW conducted analyses. The authors gratefully acknowledge the assistance of Yu-Fan Chen and Cheng-Yi Liu in the Chinese-language translation and validation. A portion of this work was supported by Ministry of Science and Technology, R.O.C. grant #103-2628-H-009-002-SS4.

Appendix A. cPAX scale item pool for english, traditional Chinese, and German

English	Chinese	German	Source
Emotional Investment - Investing in the entity on an emotional level (strong tie)			
This avatar is very special to me.	這角色對我來說很特別	Dieser Avatar bedeutet mir sehr viel.	PAX
I don't really care about this avatar. (R)	我不太在乎這個角色	Dieser Avatar ist mir eigentlich egal.	PAX
I have no emotional connection to this avatar. (R)	我與這角色沒有情感上的連結	Ich habe keine emotionale Bindung an diesen Avatar.	PAX
I would be heartbroken if I lost this avatar.	若我失去這角色我會感到心碎	Ich wäre todunglücklich, wenn ich diesen Avatar verlieren würde.	PAX
I appreciate this avatar.	我欣賞這個角色	Ich schätze diesen Avatar.	PAX
I love this avatar.	我愛這角色	Ich liebe diesen Avatar.	PAX
I feel very close to this avatar.	我對於這個角色感到非常親近	Ich fühle mich diesem Avatar eng verbunden.	PAR sociality
I am emotionally invested in this avatar.	我對於這個角色投入很多情感	Ich lasse mich gefühlsmäßig auf diesen Avatar ein.	PAR sociality
I have a meaningful connection with this avatar.	我與這個角色的連結很有意義	Ich habe eine bedeutsame Verbindung mit diesem Avatar.	PAR sociality
This avatar and I have a close relationship.	我和這個角色的關係很緊密	Dieser Avatar und ich haben ein enges Verhältnis.	PAR sociality

Anthropomorphic Autonomy - Perception of functional and moral human-likeness			
This avatar has its own thoughts and ideas.	這個角色擁有自己的想法與思考	Dieser Avatar hat seine eigenen Gedanken und Ideen.	PAX
This avatar has its own feelings.	這個角色有自己的感覺	Dieser Avatar hat seine eigenen Gefühle.	PAX
This avatar is autonomous and acts on its own.	這個角色自主性高且憑己意行動	Dieser Avatar ist autonom und handelt selbständig.	PAX
When I log out of the game, this avatar has its own life.	當我登出遊戲後這遊戲角色會繼續他自己的生活	Wenn ich das Spiel verlasse, hat dieser Avatar sein eigenes Leben.	PAX
This avatar and I play the game together.	是我跟這個角色一起玩這個遊戲	Dieser Avatar und ich spielen das Spiel gemeinsam.	PAR sociality
This avatar has its own sense of right and wrong.	這個角色能自己判斷是非	Dieser Avatar hat seine eigene Auffassung von richtig oder falsch.	PAR sociality
This avatar is like a human being.	這個角色栩栩如生就像是一個人	Dieser Avatar ist wie ein menschliches Wesen.	PAR sociality
This avatar is a completely separate being.	這個角色是一個完全不一樣的個體	Dieser Avatar ist ein vollkommen eigenständiges Wesen.	PAR sociality
This avatar doesn't exist without me. (R)	沒有我這個角色不會存在	Dieser Avatar existiert nicht ohne mich.	PAR sociality
This avatar has its own, distinct personality.	這個角色擁有屬於自己,與眾不同的個性	Dieser Avatar hat eine eigene, einzigartige Persönlichkeit.	PAR sociality
Suspension of Disbelief - Intentional/purposeful engagement in avatar as real			
I pay attention to errors or contradictions in this avatar's world. (R)	我會關注遊戲世界中任何矛盾或錯誤的地方	Ich achte auf Fehler und Widersprüche in der Welt dieses Avatars.	PAX
It is important to check for inconsistencies in this avatar's game. (R)	檢查角色在遊戲中不一致的內容很重要	Es ist wichtig, das Spiel dieses Avatars auf Unstimmigkeiten zu prüfen.	PAX
I concentrate on inconsistencies in this avatar's story. (R)	我專注在角色故事及遊戲故事中有任何不一致的地方.	Ich konzentriere mich auf Unstimmigkeiten in der Geschichte dieses Avatars.	PAX
When thinking about this avatar, I like to believe the unbelievable.	當我想起這個角色時我想要盡可能的去相信不可信之處	Wenn ich an diesen Avatar denke, glaube ich gern an das Unglaubliche.	Coleridge
I like to think that this avatar could exist in the “real world.”	我想要相信這個角色可以在這真實世界中存在	Mir gefällt der Gedanke, dass dieser Avatar in der „realen Welt“ existieren könnte.	Coleridge
Playing with this avatar is more	如果我相信這個遊戲的	Mit diesem Avatar zu spielen ist	Coleridge

enjoyable if I allow myself to believe in the fantasy of the game.	故事及幻想我會更享受使用這個角色去遊玩	unterhaltsamer, wenn ich mir selbst erlaube, an die Fantasiewelt im Spiel zu glauben.	
The things this avatar does happen a lot like the way they might in the real world.	這個角色的行為跟這世界上的行為運作非常相似	Die Dinge, die dieser Avatar tut, passieren so ähnlich wie in der realen Welt.	TPI
I sometimes think about whether or not this avatar's story is plausible. (R)	我有時候思考這個角色的故事是否合理	Ich denke manchmal darüber nach, ob die Geschichte dieses Avatars plausibel ist.	MEC-SPQ
I often criticize whether the things this avatar does in the game are realistic. (R)	我常常批評這角色在遊戲中的行為是否具有真實性	Ich kritisiere oft den Realismus der Dinge, die dieser Avatar im Spiel tut.	MEC-SPQ
I choose to believe that this avatar is real.	我選擇相信這個角色是真實的	Ich habe mich dafür entschieden zu glauben, dass dieser Avatar echt ist.	Coleridge
Control - sense of governance and authority over the avatar's actions			
This avatar does what I want.	這角色照我想要的方式行動	Dieser Avatar tut, was ich will.	PAX
I control this avatar.	我控制了這角色	Ich kontrolliere diesen Avatar.	PAX
This avatar responds to my inputs as I expect.	這角色按照我的預期回應我的輸入指令	Dieser Avatar reagiert auf meine Eingaben, wie ich es erwarte.	Perceived Control (adapted)
My commands have a visible impact on this avatar's actions.	我的指令對於這個角色的行為有可見的影響	Meine Befehle wirken sich sichtbar auf die Handlungen dieses Avatars aus.	Perceived Control (adapted)
I affect this avatar directly.	我直接影響這個角色	Ich beeinflusse diesen Avatar direkt.	Perceived Control (adapted)
I am in charge of what this avatar does.	我是主要管理這個角色行為的人	Ich bestimme, was dieser Avatar tut.	Perceived Control (adapted)
It is difficult to control this avatar's actions. (R)	很難控制這個角色的行動	Es ist schwer, die Handlungen dieses Avatars zu kontrollieren.	Perceived Control (adapted)
This avatar obeys my will.	這個角色服從我的命令	Dieser Avatar gehorcht meinem Willen.	Vicarious Agency (adapted)
I feel like this avatar is an extension of my own actions.	我覺得這個角色是我自身行為的延伸	Es kommt mir so vor, als wäre dieser Avatar eine Erweiterung meiner eigenen Handlungen.	Vicarious Agency (adapted)

This avatar is a tool to carry out my wishes.	這個角色是實行我想法的工具	Dieser Avatar ist ein Werkzeug, um meine Wünsche auszuführen.	PAR sociality

Source references: PAX and PAR Sociality (Banks and Bowman, 2016b); Coleridge (concepts pulled from Coleridge 1817/1997); TPI (Lombard et al., 2009); MEC-SPQ (Vorderer et al., 2004); Perceived Control (Klimmt et al., 2007); Vicarious Agency (Tieri et al., (2015).

Recommended articles Citing articles (0)

References

Aksoy, 2017 S.C. Aksoy
A Comparison of Geomin Versus Target Rotation Criteria in Exploratory Factor Analysis With Correlated Factors and Large and Complex Pattern Matrices (Doctoral Dissertation)
University of Miami, Coral Gables, Florida (2017)
Retrieved from
http://scholarlyrepository.miami.edu/oa_dissertations/1941
Google Scholar

Anderson et al., 2010 C.A. Anderson, A. Shibuya, N. Ihori, E.L. Swing, B.J. Bushman, Sakamoto, ..., M. Saleem
Violent video game effects on aggression, empathy, and prosocial behavior in eastern and western countries: a meta-analytic review
Psychol. Bull., 136 (2) (2010), p. 151, 10.1037/a0018251
CrossRef View Record in Scopus Google Scholar

Argyle et al., 1986 M. Argyle, M. Henderson, M.H. Bond, Y. Iizuka, A. Contarello
Cross-cultural variations in relationship rules
Int. J. Psychol., 21 (1986), pp. 287-315, 10.1080/00207598608247591
CrossRef View Record in Scopus Google Scholar

Arsenault, 2005 D. Arsenault
Dark waters: spotlight on immersion
Dans GAMEON-NA North America 2005 International Conference Proceedings, Ghent, Eurosis (2005), pp. 50-52
Available at
https://papyrus.bib.umontreal.ca/xmlui/bitstream/handle/1866/13052/2005_Dark_Waters_Spotlight_on_Immersion.pdf
View Record in Scopus Google Scholar

Asparouhov and Muthén, 2009 T. Asparouhov, B. Muthén
Exploratory structural equation modeling
Struct. Equ. Model., 16 (2009), pp. 397-438, 10.1080/10705510903008204
CrossRef View Record in Scopus Google Scholar

Banks, 2015 J. Banks

Object, me, symbiote, other: a social typology of player-avatar relationships
First Monday, 20 (2) (2015), 10.5210/fm.v20i2
0-0
Google Scholar

Banks, 2017 J. Banks
Of beard physics and worldness: the (non-)effect of enhanced anthropomorphism on player-avatar relations
Psychol. Pop. Media Cult., 6 (4) (2017), pp. 381-393, 10.1037/ppm0000104
CrossRef View Record in Scopus Google Scholar

Banks, 2019, May J. Banks
Theory of mind in social robots: replications of five classic (human) tests
Paper presented at the annual conference of the International Communication Association, Washington, D.C. (2019, May)
Google Scholar

Banks and Bowman, 2016a J. Banks, N.D. Bowman
Avatars are (sometimes) people too: linguistic indicators of parasocial and social ties in player-avatar relationships
New Media Soc., 18 (7) (2016), pp. 1257-1276, 10.1177/1461444814554898
CrossRef View Record in Scopus Google Scholar

Banks and Bowman, 2016b J. Banks, N.D. Bowman
Emotion, anthropomorphism, realism, control: validation of a merged metric for player–avatar interaction (PAX)
Comput. Hum. Behav., 54 (2016), pp. 215-223, 10.1016/j.chb.2015.07.030
Article Download PDF View Record in Scopus Google Scholar

Banks et al., 2018 J. Banks, N.D. Bowman, J.A. Wasserman
A bard in the hand: the role of materiality in player-character relationships
Imagin. Cognit. Personal., 38 (2) (2018), pp. 61-81, 10.1177/0276236617748130
View Record in Scopus Google Scholar

Bersheid and Peplau, 1983 E. Bersheid, L.A. Peplau
The emerging science of relationships
Close Relationships, W. H. Freeman & Company, New York (1983), pp. 1-19
Google Scholar

Blascovich, 2002 J. Blascovich
Social influence within immersive virtual environments
R.S. Schoeder (Ed.), The Social Life of Avatars, Springer, London (2002), pp. 127-145
CrossRef Google Scholar

Bowen, 1978 M. Bowen
Family Therapy in Clinical Practice
Aronson, New York (1978)
Google Scholar

Bowers, 2018 S. Bowers
The Effects of Avatar Appearance and Player-Avatar Interaction on Prosocial and Antisocial Gameplay: A Large Scale Field Test
(Master's thesis)
California State University, Fullerton (2018)
Google Scholar

Bowman et al., 2016a N.D. Bowman, M.B. Oliver, R. Rogers, B.I. Sherrick, J. Woolley, M-Y. Chung
"In control or in their shoes": how character attachment differentially influences video game enjoyment and appreciation
J. Gaming Virtual Worlds, 8 (1) (2016), pp. 83-99, 10.1386/jgvw.8.1.83_1
CrossRef View Record in Scopus Google Scholar

Bowman et al., 2016b N. Bowman, J. Banks, E. Downs
The duo is in the details: game genre differences in player-avatar relations
AoIR Sel. Pap. Internet Res., 6 (2016)
http://spir.aoir.org/index.php/spir/article/view/1402
Google Scholar

Carlson and Corliss, 2011 R. Carlson, J. Corliss
Imagined commodities: video game localization and mythologies of cultural difference
Games Cult., 6 (1) (2011), pp. 61-82
1555412010377322
CrossRef View Record in Scopus Google Scholar

Cha et al., 2007 E.-S. Cha, K.H. Kim, J.A. Erlen
Translation of scales in cross-cultural research: issues and techniques
J. Adv. Nurs., 58 (4) (2007), pp. 386-395, 10.1111/j.1365-2648.2007.04242
CrossRef View Record in Scopus Google Scholar

Chen et al., 1995 C. Chen, S.-Y. Lee, H.W. Stevenson
Response style and cross-cultural comparisons of rating scales among East Asian and North American students
Psychol. Sci., 6 (3) (1995), pp. 170-175
CrossRef View Record in Scopus Google Scholar

Cheng, 2007, September P. Cheng
Waiting for something to happen: narratives, interactivity and agency and the video game cut-scene
Situated Play: Proceedings of DiGRA 2007 Conference (2007), pp. 15-24
September
View Record in Scopus Google Scholar

Cheung and Rensvold, 2000 G.W. Cheung, R.B. Rensvold
Assessing extreme and acquiescence response sets in cross-cultural research using structural equations modeling
J. Cross-Cult. Psychol., 31 (2) (2000), pp. 187-212, 10.1177/0022022100031002003
CrossRef View Record in Scopus Google Scholar

Christy and Fox, 2016 K.R. Christy, J. Fox
Transportability and presence as predictors of avatar identification within narrative video games
Cyberpsychol. Behav. Soc. Netw., 19 (4) (2016), pp. 283-287
CrossRef View Record in Scopus Google Scholar

Coleridge, 1817 S.T. Coleridge
Biographia Literaria
N. Leask (Ed.), J.M. Dent., London (1817)
Google Scholar

Collins and Feeney, 2004 N.L. Collins, B.C. Feeney
An Attachment Theory perspective on closeness and intimacy
D.J. Mashek, A. Aron (Eds.), Handbook of Closeness and Intimacy, Lawrence Erlbaum, Mahwah, NJ (2004), pp. 163-188
CrossRef View Record in Scopus Google Scholar

De Grove et al., 2017 F. De Grove, J. Breuer, V. Chen, T. Quandt, R. Ratan, J. Van Looy
Validating the Digital Games Motivation Scale for comparative research between countries
Commun. Res. Rep., 34 (1) (2017), pp. 37-47, 10.1080/08824096.2016.1250070
CrossRef View Record in Scopus Google Scholar

Dilley, 2017, June 19 Dilley, J. (2017). The most popular video games in the world. , June 19
CableTV. Retrieved from: https://www.cabletv.com/blog/popular-video-games-world-map.
Google Scholar

Douglas and Nijssen, 2003 S.P. Douglas, E.J. Nijssen
On the use of "borrowed" scales in cross-national research: a cautionary note
Int. Mark. Rev., 20 (6) (2003), pp. 621-642, 10.1108/02651330310505222
CrossRef Google Scholar

Downs et al., 2017 E. Downs, N.D. Bowman, J. Banks
A polythetic model of player-avatar identification: synthesizing multiple mechanisms
Psychol. Pop. Media Cult. (2017), 10.1037/ppm0000170
Google Scholar

Eichner, 2014 S. Eichner
Levels and points of agency
Agency and Media reception: Experiencing Video Games, Film, and Television, Springer Fachmedien Wiesbaden, Wiesbaden (2014), pp. 163-174
Agency and Media Reception
CrossRef View Record in Scopus Google Scholar

Eklund, 2015 L. Eklund
Bridging the online/offline divide: the example of digital gaming
Comput. Hum. Behav., 53 (2015), pp. 527-535, 10.1016/j.chb.2014.06.018
Article Download PDF View Record in Scopus Google Scholar

Endrass et al., 2013 B. Endrass, E. André, M. Rehm, Y. Nakano
Investigating culture-related aspects of behavior for virtual characters
Auton. Agents Multi-Agent Syst., 27 (2013), pp. 277-304, 10.1007/s10458-012-9218-5
CrossRef View Record in Scopus Google Scholar

Entertainment Software Association 2017 Entertainment Software Association (2017). Essential facts about the computer and video game industry. Available from: http://www.theesa.com/wp-content/uploads/2017/09/EF2017_Design_FinalDigital.pdf.
Google Scholar

Gamer.com 2016 Gamer.com (2016). Ranking of popular game discussion boards. Available from https://www.gamer.com.tw/.
Google Scholar

GoodBene 2016 GoodBene. (2016). Taiwan has ranked as the top fourth of worldwide mobile game revenue chart. Available from http://www.goodbene.com/?p=802.
Google Scholar

Guegan et al., 2016 J. Guegan, S. Buisine, F. Mantelet, N. Maranzana, F. Segonds
Avatar-mediated creativity: when embodying inventors makes engineers more creative
Comput. Hum. Behav., 61 (2016), pp. 165-175
Article Download PDF View Record in Scopus Google Scholar

Hoffner and Buchanan, 2005 C. Hoffner, M. Buchanan
Young adults' wishful identification with television characters: the role of perceived similarity and character attributes
Media Psychol., 7 (4) (2005), pp. 325-351, 10.1207/S1532785XMEP0704_2
View Record in Scopus Google Scholar

Hofmann et al., 2005 W. Hofmann, B. Gawronski, T. Gschwendner, H. Le, M. Schmitt
A meta-analysis on the correlation between the Implicit Association Test and explicit self-report measures
Personal. Soc. Psychol. Bull., 31 (10) (2005), pp. 1369-1385
CrossRef View Record in Scopus Google Scholar

Hofstede et al., 1991 G. Hofstede, G.J. Hofstede, M. Minkov
Cultures and Organizations: Software of the Mind, 2, McGraw-Hill, London (1991)

Horton and Wohl, 1956 D. Horton, Richard Wohl
Mass communication and para-social interaction: observations on intimacy at a distance
Psychiatry, 19 (3) (1956), pp. 215-229, 10.1080/00332747.1956.11023049
CrossRef View Record in Scopus Google Scholar

Hsieh, 2018 P.-J. Hsieh
Main psychometric factors of video game gratificatino among Taiwan adolescents: a pilot study
Q. Zhang (Ed.), Pacific Rim Objective Measurement Symposium 2016 Conference Proceedings, Singapore, Springer (2018), 10.1007/978-981-10-8138-5_9

Google Scholar

IfD Allensbach 2014 IfD Allensbach
Allensbacher Computer- und Technik-Analyse 2014
ACTA, Allensbach, Germany (2014)
[report]
Google Scholar

InMobi 2014 InMobi (2014). Mobile gaming cross-market analysis (first edition, Q1 2014). Available from: http://www.inmobi.com/ui/pdfs/Mobile_Gaming_Cross-Market_Analysis_(First_Edition).pdf.
Google Scholar

Jackson et al., 2008 L.A. Jackson, Y. Zhao, W. Qiu, A. Kolenic III, H.E. Fitzgerald, R. Harold, A. Von Eye
Cultural differences in morality in the real and virtual worlds: a comparison of Chinese and US youth
CyberPsychol. Behav., 11 (3) (2008), pp. 279-286
CrossRef View Record in Scopus Google Scholar

Joeckel et al., 2013 S. Joeckel, N.D. Bowman, L. Dogruel
The influence of adolescents' moral salience on actions and entertainment experience in interactive media
J. Child. Media, 7 (4) (2013), pp. 480-506
CrossRef View Record in Scopus Google Scholar

Kahn et al., 2015 A.S. Kahn, C. Shen, L. Lu, R.A. Ratan, S. Coary, J. Hou, ..., D. Williams
The Trojan Player Typology: a cross-genre, cross-cultural, behaviorally validated scale of video game play motivations
Comput. Hum. Behav., 49 (2015), pp. 354-361, 10.1016/j.chb.2015.03.018
Article Download PDF View Record in Scopus Google Scholar

Klimmt et al., 2007 C. Klimmt, T. Hartmann, A. Frey
Effectance and control as determinants of video game enjoyment
Cyberpsychol. Behav., 10 (6) (2007), pp. 845-848
CrossRef Google Scholar

Klimmt et al., 2009 C. Klimmt, D. Hefner, P. Vorderer
The video game experience as "true" identification: a theory of enjoyable alterations of players' self-perception
Commun. Theory, 19 (4) (2009), pp. 351-373
Google Scholar

Lee, 2004 K.M. Lee
Presence, explicated
Commun. Theory, 14 (1) (2004), pp. 27-50
View Record in Scopus Google Scholar

Lee and Wohn, 2012 Y.H. Lee, D.Y. Wohn

Are there cultural differences in how we play? Examining cultural effects on playing social network games

Comput. Hum. Behav., 28 (4) (2012), pp. 1307-1314, 10.1016/j.chb.2012.02.014

Article Download PDF View Record in Scopus Google Scholar

Lehmann-Willenbrock et al., 2014 N Lehmann-Willenbrock, J.A. Allen, A.L. Meinecke

Observing culture: differences in U.S.-American and German team meeting behaviors

Group Processes Intergroup Relat., 17 (2) (2014), pp. 252-271, 10.1177/1368430213497066

CrossRef View Record in Scopus Google Scholar

Lewis et al., 2008 M.L. Lewis, R. Weber, N.D. Bowman

"They may be pixels, but they're MY pixels": developing a metric of character attachment in role-playing video games

CyberPsychol. Behav., 11 (4) (2008), pp. 515-518, 10.1089/cpb.2007.0137

CrossRef View Record in Scopus Google Scholar

Lombard et al., 2009 M. Lombard, T.B. Ditton, L. Weinstein

Measuring presence: the Temple Presence Inventory

Proceedings of the 12th Annual International Workshop on Presence (2009), pp. 1-15

Available from

http://astro.temple.edu/~tuc16417/papers/Lombard_et_al.pdf

View Record in Scopus Google Scholar

Marsh et al., 2009 H.W. Marsh, B. Muthén, T. Asparouhov, O. Lüdtke, A. Robitzsch, A.J.S. Morin, U. Trautwein

Exploratory structural equation modeling, integrating CFA and EFA: application to students' evaluations of university teaching

Struct. Equ. Model., 16 (3) (2009), pp. 439-476, 10.1080/10705510903008220

View Record in Scopus Google Scholar

Mesman et al., 2016 J. Mesman, M.H. van IJzendoorn, A. Sagi-Schwartz

Cross-cultural patterns of attachment: universal and contextual dimensions

J. Cassidy, P.R. Shaver (Eds.), Handbook of Attachment: Theory, Research, and Clinical Applications, Guilford, New York (2016), pp. 790-815

Google Scholar

Monroy, 2016 J. Monroy

Affecting Racial Bias Via Perspective-Taking in a Virtual Environment

The Ohio State University, Columbus, OH (2016)

Google Scholar

Mueller, 2015 H. Mueller

The Censorship of German Video Games: The Effects of National Sensitivity to Violence in Entertainment Content

University of Oregon, Eugene, Oregon (2015)

Google Scholar

NewZoo, 2016 NewZoo (2016). Global games market report: aAn overview of trends and insights. Available from: https://newzoo.com/solutions/revenues-projections/global-games-market-report/.
Google Scholar

Nowak and Fox, 2018 K.L. Nowak, J. Fox
Avatars and computer-mediated communication: a review of the definitions, uses, and effects of digital representations
Rev. Commun. Res., 6 (2018), pp. 30-53
View Record in Scopus Google Scholar

Nunnally, 1967 J.C. Nunnally
Psychometric Theory
McGraw-Hill, New York (1967)
Google Scholar

Quandt et al., 2014 T. Quandt, V. Chen, F. Mäyrä, J. Van Looy
(Multiplayer) gaming around the globe? A comparison of gamer surveys in four countries
Multi-player: The social Aspects of Digital Gaming Gaming, Routledge, London (2014), pp. 23-46
View Record in Scopus Google Scholar

Ratan, 2013 R. Ratan
Self-presence, explicated: body, emotion, and identity extension into the virtual self
Handbook of Research on Technoself: Identity in a Technological Society, IGI Global, Hershey, PA (2013), pp. 322-336
CrossRef Google Scholar

Reeves and Nass, 1996 B. Reeves, C.I. Nass
The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places
Cambridge University Press, New York (1996)
Google Scholar

Rusbult et al., 2004 C.E. Rusbult, M. Kumashiro, M.K. Coolsen, J.L. Kirchner
Interdependence, closeness, and relationships
D.J. Mashek, A. Aron (Eds.), Interdependence, closeness, and relationships, Handbook of Closeness and Intimacy (2004), pp. 137-162
Google Scholar

Salem et al., 2014, March M. Salem, M. Ziadee, M. Sakr
Marhaba, how may I help you?: effects of politeness and culture on robot acceptance and anthropomorphization
Proceedings of the 2014 ACM/IEEE international conference on Human-robot interaction, New York, ACM (2014, March), pp. 74-81
CrossRef View Record in Scopus Google Scholar

Schiano et al., 2011, June D.J. Schiano, B. Nardi, T. Debeauvais, N. Ducheneaut, N. Yee

A new look at World of Warcraft's social landscape
Proceedings of the 6th International Conference on Foundations of Digital Games, ACM (2011), pp. 174-179
CrossRef View Record in Scopus Google Scholar

Soutter and Hitchens, 2016 A.R.B. Soutter, M. Hitchens
The relationship between character identification and flow state within video games
Comput. Hum. Behav., 55 (2016), pp. 1030-1038
Article Download PDF View Record in Scopus Google Scholar

Steinkuehler and Williams, 2006 C.A. Steinkuehler, D. Williams
Where everybody knows your (screen) name: online games as "Third Places"
J. Comput.-Med. Commun., 11 (4) (2006), pp. 885-909, 10.1111/j.1083-6101.2006.00300.x
CrossRef View Record in Scopus Google Scholar

Taipei Times, 2015, Aug. 1 Taipei Times (2015, Aug. 1). Video games central to Taiwanese life, survey shows. Available from: http://www.taipeitimes.com/News/taiwan/archives/2015/08/01/2003624403.
Google Scholar

Teng, 2017 C.I. Teng
Impact of avatar identification on online gamer loyalty: perspectives of social identity and social capital theories
Int. J. Inf. Manag., 37 (6) (2017), pp. 601-610
Article Download PDF View Record in Scopus Google Scholar

Tieri et al., 2015 G. Tieri, E. Tidoni, S.M. Aglioti
Mere observation of body discontinuity affects perceived ownership and vicarious agency over a virtual hand
Exp. Brain Res., 233 (4) (2015), pp. 1247-1259, 10.1007/s00221-015-4202-3
CrossRef View Record in Scopus Google Scholar

Trepte and Reinecke, 2010 S. Trepte, L. Reinecke
Avatar creation and video game enjoyment
J. Media Psychol., 22 (2010), pp. 171-184, 10.1027/1864-1105/a000022
CrossRef View Record in Scopus Google Scholar

van Looy et al., 2012 J. van Looy, C. Courtois, M. De Vocht, L. De Marez
Player identification in online games: validation of a scale for measuring identification in MMOGs
Media Psychol., 15 (2) (2012), pp. 197-221, 10.1080/15213269.2012.674917
CrossRef View Record in Scopus Google Scholar

Vorderer et al., 2004 P. Vorderer, W. Wirth, F.R. Gouveia, F. Biocca, T. Saari, F. Jäncke, ..., P. Jäncke
Report to the European Community, Project Presence
(2004)
MEC (IST-2001-37661)Available from
http://academic.csuohio.edu/kneuendorf/frames/MECFull.pdf

Google Scholar

Yee, 2006 N. Yee
Motivations for play in online games
CyberPsychol. Behav., 9 (6) (2006), pp. 772-775
CrossRef View Record in Scopus Google Scholar

Yee and Bailenson, 2007 N. Yee, J. Bailenson
The Proteus effect: the effect of transformed self-representation on behavior
Hum. Commun. Res., 33 (3) (2007), pp. 271-290, 10.1111/j.1468-2958.2007.00299.x
CrossRef View Record in Scopus Google Scholar

Yoon and Vargas, 2016 G. Yoon, P.T. Vargas
I see myself through my avatar: evidence from East Asia and North America for acculturated effects on virtual representation preference
Asiascape, 3 (1–2) (2016), pp. 79-96, 10.1163/22142312-12340049
CrossRef View Record in Scopus Google Scholar

1 All supplemental materials can be accessed at this anonymous OSF space: https://osf.io/8gcsr/

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