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When the Avatar Is First Worn: Trait Feeling and Introversion as Predictors of User Presence in a Novice VTubing Training Protocol

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Abstract

Avatar-mediated streaming has become a distinctive mode of content creation; however, we still lack empirical insight into how novice performers experience avatar embodiment upon their first exposure to VTubing. This study examined whether four continuous psychological type dimensions (Introversion, iNtuition, Feeling, Perceiving) are associated with user presence, measured through the three presence dimensions of the source instrument (property, agency, and change) with privacy examined as a separate exploratory construct, among undergraduate digital media students completing a five-week VTubing training-and-streaming protocol. A quantitative survey embedded in that protocol (n = 120) was analyzed with partial least squares structural equation modeling (PLS-SEM), applying the HTMT criterion for discriminant validity and 5000 bootstrap subsamples. In the exploratory second-order model, Feeling was the strongest correlate ($\beta = 0.442$, $p < 0.001$, $f^2 = 0.282$), followed by Introversion ($\beta = 0.260$, $p = 0.002$) and, negatively, iNtuition ($\beta = -0.236$, $p = 0.009$), while Perceiving was null; together the personality predictors explained 37.3% of the variance in User Presence, and the pattern held after controlling for gender congruence and prior experience. A disaggregated analysis located these associations: Introversion was associated with agency only, iNtuition negatively with property (body ownership) only, and Feeling with property, agency, and privacy. Three of the four predictors were strongly imbalanced in this sample, so pole imbalance is a plausible alternative explanation for the non-significant paths, and all findings are exploratory and correlational. Within these limits, streamer avatar presence appeared dispositionally structured rather than a uniform product of the technology, with affective rather than social orientation as its principal correlate.

Keywords: VTuber; live-streaming; NERIS Type Explorer; psychological type; user presence; PLS-SEM

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1. Introduction

Live-streaming has become a dominant form of mediated social interaction, and within it a distinctive practice has emerged: the streamer performs not on camera but through a rendered avatar animated in real time by face and motion tracking. Unlike conventional

streamers, VTubers present a persistent fictional body while retaining the spontaneity, synchronous chat interaction, and emotional immediacy that define live-streaming as a genre. Interview- and forum-based studies of VTuber audiences show that virtual avatars open performative possibilities unavailable to real-person streamers, and that viewers deliberately preserve the separation between avatar and voice actor rather than trying to collapse it [1,2]. The audience intentionally maintains a fiction that it finds to be beneficial.

This setting is understudied in the context of presence research. Research on avatar embodiment [3] demonstrates that the sensation of inhabiting a virtual body is subdivided into distinct components: the felt location of the self, agency over the body's movement, and proprietorship of the body. Additionally, the illusion persists in the presence of a significant mismatch between the user and avatar. Nevertheless, that research is conditioned upon immersive laboratory environments using avatars assigned to the experimenter and brief exposures. VTubing presents a contrasting case: a self-designed avatar, that is, a designed visual body that serves as the performer's visual self-representation, animated through genuine visuo-motor coupling, viewed on an ordinary screen, and inhabited voluntarily. What embodiment means under first-exposure training and early streaming conditions, rather than under long-term professional inhabitation, is precisely what remains unknown.

The streaming literature offers only limited guidance on this question, because it has largely focused on audiences rather than streamers. Social presence and parasocial interaction, for instance, are typically modelled from viewer surveys [4–6]. There is still a lack of studies on the streamers themselves, the actors who create the avatar's voice and animation, especially among novices learning the craft. This gap matters because avatar presence may not come from the equipment alone. Some people may simply be more inclined than others to step into a persona and feel at home in it, even when the avatar, tracking hardware, and broadcast format are the same. If so, the differences between individual streamers are worth studying, rather than being treated as random noise.

The Myers-Briggs Type Indicator (MBTI) provides a pragmatic approach to this inquiry, but it has significant limitations. The psychometric instrument is subject to debate due to its dichotomous typology, which is not substantiated by the underlying score distributions. Additionally, its test–retest stability is modest, and independent reviews recommend against its routine application [7]. Nevertheless, type language is widely used in self-description and persona design among digital media students and streaming communities. Provided that dimensions are treated as continuous preference-strength scores rather than types, and that instrument limitations are stated explicitly, studying dispositional variation through this vocabulary retains ecological value for an exploratory training-protocol study.

This study used a method called partial least squares structural equation modeling (PLS-SEM [8]), for four reasons. First, presence cannot be measured directly; it must be captured through several survey questions combined. Because some questions capture the idea better than others, PLS-SEM gives more weight to the stronger ones instead of treating every question as equally informative. Second, PLS-SEM works well with a moderate sample size and does not require the data to follow a normal distribution, which suits an early, exploratory study like this one. Third, it estimates all components of presence within a single model, so it is easy to see when a factor affects one component but not another. Fourth, the analysis also determines whether the proposed components are distinct from one another, a criterion that must be satisfied before any relationship in the model can be trusted. One limitation should be stated plainly. PLS-SEM does not correct for measurement error, as it combines survey items into weighted sums rather than true underlying factors, in contrast to covariance-based methods. The weighting of items and the built-in quality tests are the benefits claimed in this study, not error correction.

The study accordingly pursues two objectives:

1. To examine whether personality dimensions, measured as continuous preference-strength scores, are associated with avatar user presence among undergraduate digital media students completing a five-week novice VTubing training-and-streaming protocol. Where such associations exist, the study further identifies which dimensions matter, which components of presence they affect, and how strong those associations are. This study is limited to novice performers in a first-exposure context and does not extend to active professional VTubers.
2. To assess the extent to which the proposed dimensions of VTuber User Presence are empirically distinct from each other in this novice-protocol sample. This evidence is reported regardless of whether it supports the proposed structure, and any higher-order specification is treated as exploratory rather than as definitive validation.

These objectives are addressed in sequence rather than in parallel. The second must be established before the first can be interpreted, because a relationship estimated on a measurement model whose components are not truly distinct cannot be trusted, however strong that relationship may appear.

2. Related Works

This section reviews the literature to establish what is known and what remains unexplored regarding the streamer's side of avatar-mediated streaming. It begins with avatar embodiment, establishing that inhabiting a virtual body is both componential and consequential for the person experiencing it. The focus then shifts to streamer personality, demonstrating that persona is actively authored and maintained through ongoing labor rather than simply displayed. Following this, the role of presence is examined, showing that it is driven by the fidelity of the streamer-avatar link, amplifies both exposure and expression, and relies on privacy as a regulatory dimension. By identifying the specific knowledge gaps within each of these key areas, the synthesis directly informs and introduces the two research questions addressed in this study.

2.1. Avatar Embodiment

Avatar embodiment consists of three interconnected dimensions: body ownership (the degree to which a streamer claims the virtual body as their own), agency (the felt control over its movements), and self-change (the perception that inhabiting the avatar alters one's identity). Validated scales allow these components to be measured independently [3,9]. For novice VTubers at first exposure, this distinction still matters: the avatar is not merely a temporary disguise but a self-representation the performer must begin to inhabit, even before any long-term professional identity has formed. Research on avatar-based self-representation consistently shows that users view their virtual forms as genuine extensions of themselves rather than external tools [10,11].

This integration of self and avatar is an ongoing process rather than an automatic outcome. VTubers actively manage the line between their online persona and offline identity, often exaggerating expressive or gendered traits beyond standard live streaming practices, a balance that requires continuous effort [2]. Consequently, this close connection shapes how streamers experience negative interactions: hostility toward the avatar is often felt as a personal attack, eroding the emotional distance virtual bodies are assumed to provide [12]. Similarly, studies on the Proteus effect show that long-term embodiment can shift a streamer's behavior and self-image toward the traits associated with their avatar [13].

Furthermore, avatar embodiment creates unique vulnerabilities. Streamers may face ownership disputes over avatars controlled by corporate entities, or risk identity theft due to the replicability of digital models [14]. These privacy concerns increase as avatar track-

ing becomes more precise [15]. Ultimately, embodiment primarily impacts a streamer's identity, wellbeing, and creative autonomy, rather than serving merely as a tool for audience engagement.

Despite these insights, a practical measurement gap remains. While standard instruments exist to evaluate these components, they were developed in laboratory settings with pre-assigned avatars. It remains unknown how these metrics perform among novice creators who custom-design an avatar and inhabit it during a structured first-exposure training protocol, leaving early-stage variation in embodiment largely unexplored.

2.2. Streamer Personality

Personality serves as a VTuber's most vital asset, functioning as an ongoing performative effort rather than a static trait. Research on identity design shows that a VTuber persona is intentionally constructed before debut, with character traits, backstories, expressive styles, and a visual character design (body form, costume, and style) defined within a creative brief [16]; the designed visual form is therefore part of what the performer later inhabits and experiences as an extension of the self [10,11]. Qualitative evidence from streamer interviews reveals that streamers continually balance this crafted persona with their authentic selves, adjusting the mix over time in response to audience feedback [2]. Although this evidence was gathered from established performers, it implies that even at first exposure the persona is an active construction rather than a fixed trait, so individual dispositions should shape how readily a novice begins to inhabit it.

This negotiation carries an occupational cost. Maintaining a fully separate persona across long and frequent broadcasts proves impractical, so most streamers disclose progressively more of themselves over a career. That resolves the sustainability problem while eroding the separation between character and self. Personality is expressed through channels the streamer actively engineers rather than through the avatar alone, including deliberate modification of vocal characteristics to align the voice with the designed identity [17]. Coherence across these channels matters, because a mismatch between an avatar's implied character and the streamer behind it is registered by audiences as a failure of authenticity [14].

The practical consequences are substantial. Personality compatibility rather than visual appeal converts initial curiosity into durable viewership and community attachment [1,14]. Structural modeling of audience behavior indicates that identification with the virtual persona contributes comparatively little to sustained viewing when set against content professionalism and interaction quality, both of which are expressions of the streamer rather than of the character [18]. Personality also supplies the mechanism through which relational closeness is produced, since disclosure and responsiveness generate the social presence underpinning parasocial attachment and its associated effects [19–21].

The gap in this area is methodological. VTuber research continues to treat personality as a qualitative construct, while proposed typologies in adjacent fields remain heavily debated [22]. Currently, few empirical studies have measured performer personality with standard instruments: the closest examples come from adjacent creative professions such as game development [21], and the VTuber studies reviewed in this section [1,2,14] do not relate such measures to avatar experience in a controlled training setting, leaving the interplay between novice traits, first persona labor, and early embodiment largely unexplored.

2.3. User Presence

In presence research, the construct is defined as the streamer's subjective feeling of existing and acting through a mediated body, as well as being recognized as present

by others. It overlaps with body ownership without being reducible to it: the presence instrument adopted in this study [23] treats property, agency, and change as its three presence dimensions, and related embodiment scales measure the same components [3,9]. A key insight for VTubers is that presence depends on the fidelity of the link between the streamer and the avatar, rather than visual realism alone. High expressive capability, precise motion tracking, and responsive facial articulation are the primary drivers that elevate both the felt sense of presence and the streamer's social credibility [24–26].

This dynamic directly influences how creators operate. Presence maintained through nonverbal channels, such as gestures, body orientation, and timing, allows streamers to communicate effectively and feel co-located with collaborators even without revealing their physical faces [27]. This mechanism explains why VTuber collaborations often feel intimate and cohesive despite the physical separation of the participants [14].

However, heightened presence presents distinct trade-offs. The same mechanisms that make the virtual body feel genuinely inhabited also cause digital intrusions to feel deeply personal, meaning that strong presence intensifies rather than shields against online harassment [12,28]. Consequently, privacy acts as a core regulatory factor of presence. Streamers must continuously calibrate how much of their real-world self is transmitted through the avatar, as higher motion fidelity gradually reduces the anonymity that initially motivated using a virtual body [15,29]. Furthermore, structural evidence indicates that presence does not directly drive audience metrics: identification with the persona plays a minimal role in long-term viewing compared to content quality and interactive engagement [18], though presence expressed through self-disclosure and visual representation does foster relational closeness [19]. Thus, presence functions primarily as a core condition of the streamer experience and expressive capacity rather than a direct driver of viewer retention.

This literature reveals a further gap: although privacy-related intrusion or exposure is often conceptualized alongside presence, it has mainly been studied through qualitative interviews and literature reviews rather than quantitative measurement. The empirical connection to other presence constructs remains unexamined, particularly about whether intrusion is more accurately perceived as a manifestation of presence.

2.4. Research Questions

The limitations across the reviewed literature, as shown in Table 1, together define a modest contribution for this study rather than a definitive validation of professional VTuber embodiment. First, while embodiment research has developed validated instruments, they have rarely been applied to novices who design an avatar and inhabit it during a first-exposure training protocol. Second, personality research in this domain remains largely interpretive, leaving associations between disposition and early avatar experience under-measured. Third, presence research attributes variation primarily to technical fidelity, while conceptualizing privacy-related intrusion without measuring it alongside other dimensions or clarifying whether intrusion is a presence facet or a consequence. Addressing these limitations leads to two research questions framed for a novice undergraduate training context:

RQ1: To what extent do continuous psychological type dimensions relate to user presence among undergraduate participants in a novice VTubing training-and-streaming protocol, and which presence dimensions show these associations?

RQ2: To what extent are the proposed dimensions of VTuber User Presence empirically distinct from each other?

RQ2 is answered first in the analysis, since the structural estimates that answer RQ1 are interpretable only on a measurement model whose components are distinct. The present

study is cross-sectional and correlational, adapts rather than validates its instrument, embeds a quantitative survey in a five-week training protocol with undergraduate digital media students, and does not claim to sample active professional VTuber streamers. The research design and methodology are detailed in the next section.

Table 1. Contribution and limitations of the reviewed literature by theme.

Theme	Method	Contribution	Limitations
Embodiment components and instruments [3,9]	Survey of the field; instrument validation	Defines embodiment as ownership, agency, and self-change, with validated measures.	Developed for short, assigned-avatar VR; not tested with novice self-created avatars in training protocols.
Avatar as extension of the self [10,11]	Qualitative interview and survey in social VR	Shows avatars are experienced as extensions of the self.	Limited to social VR and self-report; lacks quantitative analysis.
Proteus effect and self change [13]	Experimental induction in social VR	Demonstrates embodiment can alter behavior and self-perception.	Based on short-term, assigned-avatar experiments with small samples.
Harassment and the collapse of protective distance [12,28]	Qualitative interview in social VR	Shows avatar-directed harassment is experienced as personal harm.	Social VR only; limited populations; presence and harm not jointly measured.
Ownership and privacy tradeoffs [15,29]	Systematic review and position paper	Identifies privacy, ownership, and impersonation as key embodiment issues.	Conceptual rather than empirical; privacy not integrated with other embodiment dimensions.
VTuber persona design and labour [2,14,16,17]	Interview, observation, and system building	Shows personas evolve from authored identities toward authentic self-expression.	Culturally specific samples; personality not quantitatively measured.
VTuber audience outcomes [1,18–20]	Forum analysis, survey, and SEM	Finds personality compatibility outweighs appearance in audience engagement.	Focuses on audience responses, not streamer experiences.
Presence and expressive fidelity [24–26]	Laboratory experiment and survey of the field	Shows presence depends on motion and expressiveness more than visual realism.	Laboratory setting; streamer differences not examined.
Personality measurement [7,21,22]	Psychometric review and synthesis	Supports continuous personality scores over categorical types.	Review-based only; not applied to novice, avatar-mediated training settings.

3. Materials and Methods

3.1. Research Design

This study adopts a structured field trial design in which a quantitative survey is embedded in a five-week VTubing training-and-streaming protocol. The analytic design is correlational rather than experimental: there is no manipulated treatment contrast, and the objective is to explain variance in a latent second-order construct, User Presence, as a function of four exogenous predictors representing psychological type. Open-ended questionnaires and focus-group discussions collected in Session 4 were read narratively

only as contextual information, to check whether participants' own accounts were broadly consistent with the quantitative results; they were not coded or thematically analyzed, no qualitative results are reported, and the term triangulation is not claimed. The formal PLS-SEM modelling is based solely on the Session-4 PACP survey. Because the aim is prediction and variance explanation rather than confirmation of a covariance structure, and because the model contains a hierarchical component with heterogeneous indicator counts, variance-based structural equation modeling (PLS-SEM) was selected over covariance-based SEM.

One property of the method should be stated plainly at the outset. PLS-SEM combines survey items into weighted composites rather than into common factors, so it does not correct for measurement error in the way covariance-based estimation does. The advantages claimed for this study are the weighting of unequal indicators, the capacity to estimate a hierarchical construct alongside its dimensions, and the integrated measurement diagnostics reported in the results.

3.2. Conceptual Framework and Hypotheses

Figure 1 presents the conceptual framework. Four exogenous constructs are hypothesized to be associated with User Presence, which is modelled as a reflective-reflective hierarchical component model (HCM) manifested through the three presence dimensions defined in the source instrument [23]: property (PROP), agency (AGEN), and change (CHNG). Because that instrument examines privacy separately and reports its correlations with the three presence factors, privacy (PRIV) is modelled in this study as a separate exploratory construct, predicted by the same four exogenous constructs, rather than as a dimension of User Presence. The hypotheses follow from the reviewed literature. Introversion is expected to be positively associated with presence because avatar mediation removes the streamer's physical body from view, a compensation expected to benefit streamers who draw energy from internal rather than external sources [2,14]. iNtuition is expected to be negatively associated with presence because inhabiting a virtual body is partly a perceptual achievement resting on concrete correspondence between one's own movement and the avatar's [24–26]. Feeling is expected to be positively associated with presence because the qualitative literature describes VTuber performance as sustained affective projection [2]. Perceiving is examined only as an exploratory, symmetry-checking expectation with a tentatively positive direction, on the grounds that openness to unstructured experience might ease adoption of a persona; it is labelled H4 for consistency of presentation but is effectively a research question rather than a theoretically committed hypothesis. Because the higher-order construct is itself exploratory, all four hypotheses are tested as exploratory directional expectations rather than as confirmatory hypotheses.

H1. *Introversion (I) is positively associated with User Presence.*

H2. *iNtuition (N) is negatively associated with User Presence.*

H3. *Feeling (F) is positively associated with User Presence.*

H4. *Perceiving (P) is positively associated with User Presence.*

3.3. Sample and Data Collection

A purposive sampling technique was applied under non-probabilistic sampling to recruit undergraduate digital media and technology students who completed a five-week novice VTubing training-and-streaming protocol. Inclusion criteria required that participants were aged 18 years or older, completed the protocol (avatar authoring with Live2D or

VRoid, real-time tracking setup, practice stream, and a minimum 15 min peer live-stream), and provided informed consent. Prior professional VTuber streaming experience was not an inclusion criterion; the sample is therefore a novice/first-exposure cohort rather than a population of active professional VTuber streamers. Data were obtained from 120 complete responses; all enrolled participants completed the five-week protocol, with no attrition. Sample adequacy met both the ten-times rule, which requires 40 cases because at most four predictors point at any construct [8], and the inverse square-root method of Kock and Hadaya [30]. Participation was voluntary, with no academic credit or financial compensation; although some participants were students in a program associated with the research team, enrolment and the trial were kept administratively separate from course grading, and non-participation carried no penalty. The study received ethical approval (WUEC-25-063-01) as one component of a broader project on avatar design and identity in virtual environments; no personally identifying information was collected, and all demographic data are reported only in aggregate.

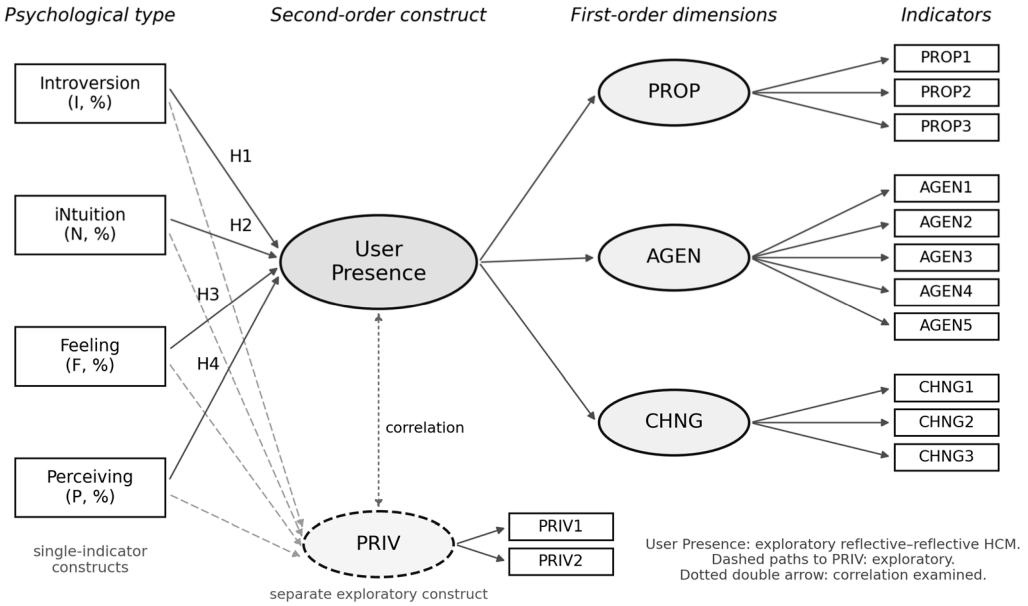


Figure 1. Conceptual framework. Rectangles denote observed variables and ellipses denote latent constructs. User Presence is specified as an exploratory reflective-reflective hierarchical component model with the three presence dimensions of the source instrument [23]; privacy is a separate exploratory construct (dashed paths).

The protocol was a five-week, four-session structured field trial conducted under authentic, non-laboratory conditions after informed consent. In Session 1 (one week), participants received standardized software training and then authored and calibrated their own VTuber avatar with full creative freedom, to maximize self-identification (Figure 2). Session 2 (one week) standardized the technical setup in VTube Studio and OBS and included a five-minute practice stream to reduce technical anxiety. In Session 3 (two weeks), each participant delivered at least one open-ended live-stream of at least fifteen minutes to a peer audience of at least ten classmates, with active interaction and explicit narration of activities (Figure 3); we note that this is a supervised, peer-facing task of limited duration and is not equivalent to sustained, public-facing professional streaming. In Session 4 (one week), the quantitative PACP survey used in this analysis was administered. Open-ended questionnaires and focus-group discussions were also collected; they were read narratively to check whether participants' own accounts were consistent with the

quantitative results (used only as background context and not reported as findings) and were not subjected to formal thematic coding.



Figure 2. Representative sample of custom-designed VTuber avatars (Live2D or VRoid Studio) authored by trial participants during Session 1. Images are participant-authored avatar screenshots/composites included with informed consent for publication.

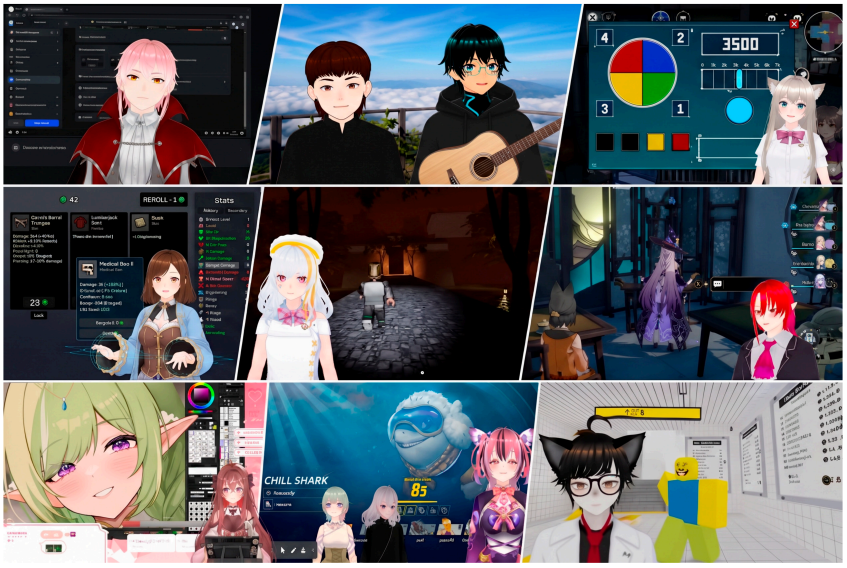


Figure 3. Example of an active live−streaming session showing real−time avatar tracking, OBS broadcast compositing, and live peer−audience interaction via chat overlay. Images are participant session screenshots included with informed consent.

3.4. Measures

Psychological type was measured with the 16Personalities online instrument [31], which administers the NERIS Type Explorer: a proprietary, trait-based questionnaire that reports each preference dimension as a continuous percentage score and that draws on both Jungian type theory and Big Five-related content while remaining a distinct instrument from the MBTI. The instrument reports five facets (Mind, Energy, Nature, Tactics, and Identity); the present study uses four of these five outputs, the Introversion, iNtuition, Feeling, and Perceiving scores, and does not analyze the fifth, the Assertive-Turbulent Identity facet. Introversion, iNtuition, Feeling, and Perceiving were each captured by a single continuous score from 0 to 100 that is oriented toward its named pole, so that a value above 50 indicates the named pole (for example, an Introversion score above 50 denotes the introverted side) and higher values denote a stronger preference for that pole; each dimension is therefore specified as a single-indicator construct with the loading fixed at 1.00. Scores were retained as continuous variables in the structural model rather than dichotomized into types, consistent with evidence that the underlying distributions are continuous and that dichotomization discards variance [7].

Direct psychometric evidence for the NERIS Type Explorer is limited but not absent: a confirmatory factor analysis of the scale supports its five-facet structure, including the Assertive-Turbulent Identity facet [32]; the present study draws on four of these five facets, and this is the basis for treating the four continuous scores as trait indicators in the present analysis. Evidence from the MBTI is related but not interchangeable, because NERIS is a separate instrument, so it is cited only as indirect background: MBTI-type scores show generally strong reliability [33]; the original Myers instrument and the MBTI Manual document the type scales [34,35]; and the dimensions converge with four of the Big Five factors [36], which is relevant because NERIS incorporates Big Five content. Because the analysis models continuous scores and never assigns discrete types, it also avoids the objection to using the MBTI categorically [7]. All personality conclusions are nonetheless treated as exploratory.

The three presence dimensions were measured with items adapted from the avatar presence and preference questionnaire [23], which was developed for participants embodying an avatar rather than observing one; item wording was adjusted only to refer to the participant's own streaming avatar rather than to an experimentally assigned one. The two privacy items were written for this study, informed by the privacy construct examined in [23] rather than taken from its item set, which is a further reason for treating privacy as a separate construct. All items were measured on five-point Likert scales from 1 (strongly disagree) to 5 (strongly agree). The retained item, PRIV1 (worded 'I feel that protecting my avatar's privacy is essential for preserving my personal boundaries'), is positively worded toward privacy protection, so a higher score indicates a stronger belief that protecting the avatar's privacy matters. Full item statements are given in Table 2. The questionnaire as administered, in Thai and in English, is provided in the Supplementary Materials (File S1).

3.5. Analytical Procedure

The two-stage approach was used for the hierarchical component model. In Stage 1, the first-order constructs (PROP, AGEN, CHNG, and the separate PRIV construct) were estimated together with the exogenous constructs, and the resulting latent variable scores were saved. In Stage 2, the three presence scores (PROP, AGEN, and CHNG) served as the indicators of the second-order User Presence construct, and the structural paths H1 to H4 were estimated; PRIV was retained as a separate endogenous construct predicted by the four exogenous constructs, and its correlation with User Presence was examined. Inference used bootstrapping with 5000 subsamples, no sign changes, and percentile confidence

intervals. All models were estimated with the SEMinR package (version 2.6.0) in R (version 4.3.3) [37], using the factorial inner weighting scheme; *p*-values are empirical two-tailed bootstrap *p*-values, and f^2 is computed by re-estimating each model without the predictor concerned. Predictive relevance was assessed with PLSpredict [38], implemented in the predict_pls() function of the same SEMinR package with the direct antecedent approach (10 folds, 10 repetitions), yielding Q^2predict for each endogenous construct and indicator and a comparison with a linear-model benchmark. A single inferential standard is applied throughout: two-tailed tests at $\alpha = 0.05$, supported by 95% bootstrap confidence intervals. Because the higher-order construct is exploratory, H1 to H4 are treated as exploratory tests of directional expectations, with H4 closer to a research question (Section 3.2); the sixteen disaggregated paths reported with the results are likewise exploratory, and because they form a larger family of tests, this multiplicity is acknowledged and no individual path is over-interpreted. Two robustness checks were added. First, the Stage 2 model was re-estimated with gender congruence and prior experience with the metaverse or avatar-related platforms as control variables. Gender congruence was coded 1 when a participant who selected female or male embodied an avatar of the same gender presentation and 0 otherwise; the seven participants who selected LGBTQ+ or prefer not to disclose could not be classified and were excluded from this check (n = 113). Because the experience item includes a non-ordinal option (not sure), prior experience was entered as dummy variables for never, use regularly, and not sure, with used occasionally as the reference category. Second, a sensitivity analysis re-estimated the structural model with alternative sets of first-order dimensions.

Table 2. Research instrument: constructs, item codes, and item statements.

Construct	Code	Item Statement or Measurement
Introversion	I	Percentage preference strength on the Introversion-Extraversion dimension
iNtuition	N	Percentage preference strength on the iNtuition-Sensing dimension
Feeling	F	Percentage preference strength on the Feeling-Thinking dimension
Perceiving	P	Percentage preference strength on the Perceiving-Judging dimension
Property	PROP1	I felt like the avatar's outfit was my own outfit.
	PROP2	The avatar felt like a real human character.
	PROP3	I had the feeling that the avatar belonged to me.
Agency	AGEN1	The movements of the avatar seemed to be my own movements.
	AGEN2	I enjoyed controlling the movements of the avatar.
	AGEN3	I have felt comfortable using the avatar.
	AGEN4	I felt as if I was causing the movement of the avatar.
	AGEN5	The movements of the avatar were synchronous with my own movements.
Change	CHNG1	I had the illusion of owning a different body from my own.
	CHNG2	I felt the need to check if my body really still looked like what I had in mind.
	CHNG3	I felt as if the form or appearance of my body had changed.
Privacy	PRIV1	I feel that protecting my avatar's privacy is essential for preserving my personal boundaries.
	PRIV2	I feel that I can accept it if this avatar is shared. (deleted post hoc; see Section 4.1)

To identify in which dimensions the associations are concentrated, a disaggregated specification was also estimated in which the three presence dimensions and PRIV were modelled as separate endogenous constructs rather than as manifestations of a single higher-order construct. This is reported in Section 4 and is treated throughout as a diagnostic complement to the hypothesized model rather than as a competing specification.

3.6. Evaluation Criteria

The measurement model was assessed against the following criteria: indicator loadings of at least 0.708, Cronbach's alpha and composite reliability of at least 0.70 and no greater

than 0.95, average variance extracted (AVE) of at least 0.50, and HTMT below 0.90 [39,40]. HTMT was adopted as the primary criterion for discriminant validity in preference to the Fornell-Larcker comparison [41], which has been shown to lack sensitivity to discriminant validity failures under conditions common in composite models.

The structural model was assessed against variance inflation factors below 5.0, bootstrapped significance of path coefficients, the coefficient of determination (R^2), the effect size f^2 interpreted as 0.02 small, 0.15 medium, and 0.35 large [42], and Q^2predict > 0. Consistent with the variance-based paradigm, no covariance-based fit indices are reported, as χ^2, CFI, and RMSEA are not applicable to PLS-SEM.

4. Results

The sample comprised 120 undergraduate digital media and technology students aged 18–23 (M = 20.1, SD = 0.7) who completed the five-week novice VTubing protocol. Participants answered a single self-description item whose response options were female (n = 60), male (n = 53), LGBTQ+ (n = 6), and prefer not to disclose (n = 1); these counts sum to the full sample and are reported exactly as administered. Because this select-one item combined gender identity with an LGBTQ+ self-identification, gender and sexual orientation cannot be separated post hoc, a limitation of the demographic instrument noted in Section 5.5. Most reported only occasional prior use of the metaverse or avatar-related platforms (80.0%) and 1 to 5 h of weekly use of such platforms, including viewing avatar-based streams (50.0%), which does not constitute professional VTuber status. For avatars, 60% were female-presenting and 40% male-presenting, in styles led by Fantasy (35%) and Casual (29.2%), then Kemonomimi (15%), Traditional (11.7%), and Cyberpunk (9.2%).

For description only, the sample skewed toward Introversion (81.7%, n = 98), Sensing (90.8%, n = 109), and Perceiving (82.5%, n = 99), with Feeling (54.2%, n = 65) edging out Thinking (45.8%, n = 55); the commonest labels were ISFP (n = 51), ISTP (n = 28), ESTP (n = 13), ISTJ (n = 6), ISFJ (n = 5), INFJ (n = 3), and other (n = 14). These categories characterize the sample but are not used in estimation; the model instead treats each dimension as a continuous preference score, reported next.

The continuous predictors were Introversion (M = 63.0, SD = 16.2, range 10–97), iNtuition (M = 36.1, SD = 14.5, range 5–86), Feeling (M = 51.4, SD = 17.5, range 4–100), and Perceiving (M = 58.2, SD = 15.7, range 8–94). Two features matter. Because each score is oriented so that values above 50 fall on the named pole (in this case, iNtuition) and values below 50 fall on its opposite (Sensing), the iNtuition mean of 36.1 places most participants on the Sensing side: 109 of 120 (90.8%) scored below 50, leaving 11 cases on the iNtuition pole. Feeling, by contrast, is the most balanced dimension. This asymmetry around the 50-point threshold underlies the pole-imbalance caveat (Section 5.5) and should be borne in mind when reading the non-significant paths for the more skewed dimensions.

4.1. Assessment of the First-Order Reflective Measurement Models

The initial estimation retained all 13 endogenous indicators. Three constructs met all criteria, but the two-item privacy construct did not. PRIV2 loaded at only 0.591, Cronbach's alpha for PRIV was 0.299, and, critically, the HTMT ratio between AGEN and PRIV reached 1.028, a clear violation of the 0.90 threshold indicating that the two constructs were not empirically distinct. The two privacy items did not form a usable scale. PRIV2 was reverse-keyed relative to PRIV1, and the two-item measure did not behave as intended: the inter-item correlation was weak (r = 0.18), and reverse-scoring PRIV2 did not repair reliability but drove the alpha negative, so the two items are unreliable under either scoring. The wording of the reverse-keyed item was, in hindsight, a construction weakness.

Diagnostic inspection showed that PRIV2 was the source of the overlap. Its removal reduced the AGEN–PRIV latent correlation from 0.443 to 0.259 while leaving the association between PRIV and Feeling essentially unchanged, moving from 0.487 to 0.491. PRIV2 was therefore deleted post hoc and the model re-estimated. Because deletion left PRIV with a single indicator (PRIV1), PRIV is treated as an exploratory single-indicator construct in the final model; single-indicator measurement precludes reliability and HTMT assessment and qualifies all PRIV-related conclusions. Following the source instrument [23], PRIV is therefore analysed as a separate exploratory construct rather than as a dimension of User Presence (Sections 3.2 and 4.2). Table 3 reports the final measurement results.

Table 3. Reflective measurement model, final solution.

Construct	Indicator	Loading	α	CR	AVE
PROP	PROP1	0.824	0.723	0.826	0.616
	PROP2	0.641			
	PROP3	0.871			
AGEN	AGEN1	0.683	0.816	0.871	0.576
	AGEN2	0.783			
	AGEN3	0.721			
	AGEN4	0.814			
	AGEN5	0.786			
CHNG	CHNG1	0.789	0.675	0.819	0.601
	CHNG2	0.779			
	CHNG3	0.757			
PRIV	PRIV1	1.000	n/a	n/a	n/a
I, N, F, P	single item	1.000	n/a	n/a	n/a

Note: PRIV2 deleted post hoc after HTMT(AGEN, PRIV) = 1.028; PRIV retained as an exploratory single-indicator measure of perceived privacy concern (PRIV1); n/a denotes not applicable for single-indicator constructs.

All composite reliabilities exceed 0.70 and all AVE values exceed 0.50, establishing internal consistency and convergent validity. Two indicators, PROP2 at 0.641 and AGEN1 at 0.683, fall marginally below the 0.708 guideline but were retained because their blocks already satisfy AVE and CR and deletion would not raise AVE materially, which is the accepted practice for loadings in the 0.40 to 0.708 band [39]. The alpha for CHNG of 0.675 is slightly below 0.70, but its composite reliability of 0.819, the preferred PLS-SEM statistic, is satisfactory.

Discriminant validity among the multi-indicator constructs was confirmed by HTMT. All computable ratios fall below the conservative 0.85 threshold. Because PRIV is now measured by one indicator, its HTMT ratios cannot be calculated; discriminant validity for PRIV is therefore argued on content grounds and supported by its moderate latent correlations of 0.259 with AGEN, 0.347 with CHNG, and 0.359 with PROP, a point revisited as a limitation in Section 5.5. The full HTMT matrix, indicator loadings and cross-loadings, item-level descriptive statistics, the construct reliability and validity coefficients, and the latent-variable correlation matrix are reported in the Supplementary Materials (Tables S1–S5); the highest HTMT ratio is 0.734 (PROP and AGEN), all ratios stay below the 0.85 threshold, and every indicator loads most strongly on its own construct.

4.2. Assessment of the Second-Order Construct

User Presence was then estimated as a reflective-reflective second-order construct using the two-stage approach [43], with the three presence dimensions of the source instrument as its indicators. Table 4 reports their loadings on the higher-order construct; all

three load significantly (each $p < 0.001$). PROP (0.850) and AGEN (0.901) are the strongest manifestations, whereas CHNG is weak (0.518); the second-order CR (0.811) and AVE (0.601) meet their thresholds, while Cronbach's α (0.664) is slightly below 0.70. Property is retained because the source instrument [23] defines it as one of its three presence dimensions. The specification is nonetheless treated as exploratory rather than confirmatory, given the weak change dimension. PRIV, analysed separately, correlates moderately with User Presence (r = 0.386) and with each presence dimension (0.259 to 0.359), consistent with a related but distinct construct, as in the source instrument.

Table 4. Second-order construct, User Presence (Stage 2).

Dimension	Loading	t	Weight	Verdict
PROP	0.850	17.57	0.485	Supported
AGEN	0.901	41.43	0.527	Supported
CHNG	0.518	3.88	0.218	Marginal

Note: CR = 0.811; AVE = 0.601; Cronbach's α = 0.664. PRIV is analysed as a separate construct and is not an indicator of User Presence.

Collinearity among the four exogenous constructs was negligible: variance inflation factors (VIF) were 1.058 (Introversion), 1.033 (iNtuition), 1.039 (Feeling), and 1.073 (Perceiving), well below the threshold of 5.0. Low VIFs indicate that the structural estimates are not distorted by predictor collinearity; they do not rule out common method variance. Because the predictor and outcome measures share a single source and a single measurement occasion, common method variance cannot be excluded, and this is stated as a limitation in Section 5.5.

4.3. Structural Model and Hypothesis Testing

The structural model was estimated with 5000 bootstrap subsamples. Table 5 reports the tests of H1 to H4, and Table 6 reports explanatory and predictive power. In the specified second-order model, the four personality predictors explain 37.3% of the variance in User Presence ($R^2 = 0.373$), an associational figure for this model specification, not a claim that personality explains 37.3% after controlling for technology. Q^2predict is positive for PROP (0.273), AGEN (0.240), and PRIV (0.163), indicating predictive relevance for these constructs; for CHNG it is slightly below zero (−0.004), so predictive relevance is not claimed for this dimension. At the indicator level, PLS predictions had a lower out-of-sample error than the linear-model benchmark for 9 of the 11 multi-item indicators (Table S8).

H3 is supported: Feeling shows the strongest association ($\beta = 0.442$, $p < 0.001$, $f^2 = 0.282$, medium) and accounts for the bulk of the explained variance. H1 is supported with a small effect ($\beta = 0.260$, $p = 0.002$, $f^2 = 0.084$). H2 is also supported: iNtuition is negatively associated with User Presence ($\beta = -0.236$, $p = 0.009$, $f^2 = 0.087$), and its 95% confidence interval excludes zero. Because only 11 participants scored on the iNtuition pole (Sensing = 90.8%, n = 109), this result rests on a strongly imbalanced distribution around the 50-point threshold and is interpreted cautiously. H4 is not supported: Perceiving has effectively zero association with User Presence ($\beta = 0.018$, $p = 0.831$); given the extreme imbalance on several dichotomized poles, H4 is not described as decisively rejected. Figure 4 summarizes the final structural model.

Table 5. Structural model results for H1 to H4 (second-order model with PROP, AGEN, and CHNG); 5000 bootstrap subsamples.

Hypothesis	β	SE	t	*p*-Value	95% CI	f^2	Decision
H1: I → User Presence (+)	0.260	0.075	3.469	0.002 **	[0.104, 0.400]	0.084	Supported
H2: N → User Presence (−)	−0.236	0.083	−2.825	0.009 **	[−0.396, −0.070]	0.087	Supported
H3: F → User Presence (+)	0.442	0.059	7.450	<0.001 ***	[0.326, 0.558]	0.282	Supported
H4: P → User Presence (+)	0.018	0.095	0.192	0.831	[−0.166, 0.206]	0.004	Not supported

Note: Statistical significance ** $p < 0.01$, *** $p < 0.001$.

Table 6. Explanatory power (R^2) and predictive relevance (Q^2predict).

Endogenous Construct	R^2	Adjusted R^2	Interpretation	Q^2predict
User Presence (second order)	0.373	0.352	Moderate	n/a
PROP	0.316	0.292	Moderate	0.273
AGEN	0.327	0.304	Moderate	0.240
CHNG	0.097	0.066	Weak	−0.004
PRIV (separate construct)	0.256	0.230	Weak to moderate	0.163

Note: n/a denotes not applicable; Q^2predict is not computed for the second-order User Presence construct because, in the two-stage approach, it is measured by the latent variable scores of PROP, AGEN, and CHNG, for which Q^2predict is reported separately.

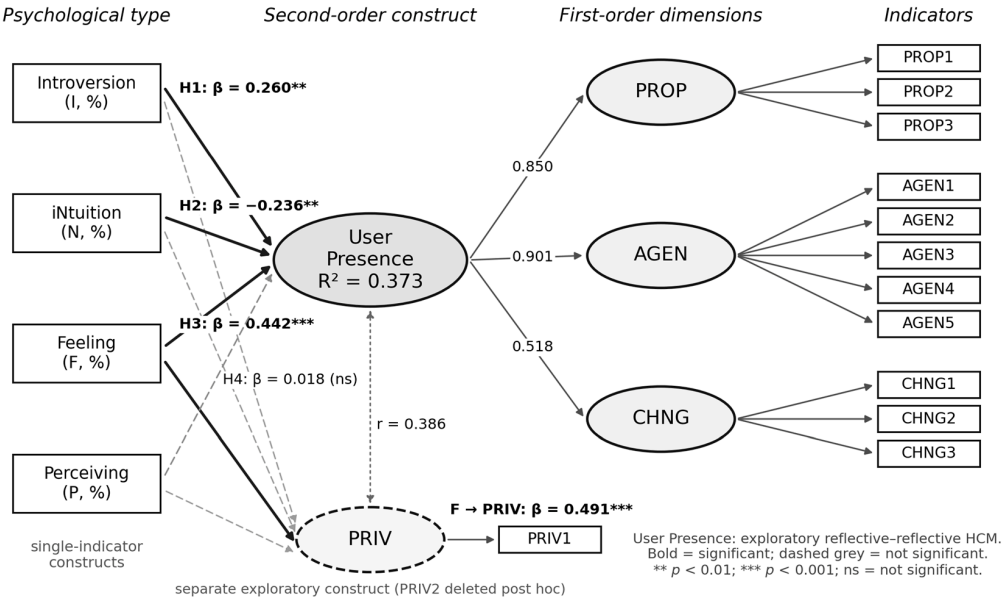


Figure 4. Structural model results. Values on the predictor paths are standardized coefficients for H1 to H4 (Table 5); values on the second-order paths are the loadings of the first-order dimensions (Table 4). R^2 refers to the exploratory second-order User Presence construct. PRIV, a separate exploratory construct measured by PRIV1 after the post hoc deletion of PRIV2 (Section 4.1), is shown with its significant path from Feeling (Table 7) and its correlation with User Presence (r), drawn as a dotted double-headed arrow to indicate a non-directional association rather than a hypothesized path.

Table 7. Disaggregated structural paths.

Path	β	t	*p*-Value	95% CI	f^2	Effect Size
I → PROP	0.080	1.045	0.317	[−0.080, 0.222]	0.014	negligible
N → PROP	−0.258	−2.977	0.005 **	[−0.425, −0.085]	0.064	small
F → PROP	0.465	7.869	<0.001 ***	[0.351, 0.584]	0.305	medium

Table 7. *Cont.*

Path	β	t	*p*-Value	95% CI	f^2	Effect Size
P → PROP	0.032	0.344	0.730	[−0.154, 0.213]	−0.004	negligible
I → AGEN	0.343	3.954	<0.001 ***	[0.173, 0.505]	0.160	medium
N → AGEN	−0.188	−1.884	0.067	[−0.375, 0.019]	0.049	small
F → AGEN	0.325	4.920	<0.001 ***	[0.200, 0.458]	0.140	small
P → AGEN	0.065	0.727	0.430	[−0.104, 0.248]	0.006	negligible
I → CHNG	0.188	1.840	0.065	[−0.012, 0.384]	0.037	small
N → CHNG	−0.053	−0.518	0.624	[−0.248, 0.153]	0.004	negligible
F → CHNG	0.208	1.896	0.075	[−0.022, 0.415]	0.036	small
P → CHNG	−0.145	−1.064	0.291	[−0.381, 0.158]	0.022	small
I → PRIV	0.039	0.563	0.623	[−0.099, 0.169]	0.002	negligible
N → PRIV	0.108	1.281	0.176	[−0.054, 0.277]	0.015	negligible
F → PRIV	0.491	6.021	<0.001 ***	[0.322, 0.640]	0.311	medium
P → PRIV	−0.042	−0.404	0.728	[−0.241, 0.171]	0.002	negligible

Note: Statistical significance ** $p < 0.01$, *** $p < 0.001$. The final column reports Cohen f^2 effect-size labels (negligible < 0.02; small ≥ 0.02; medium ≥ 0.15; large ≥ 0.35); f^2 is obtained by re-estimating the model without the predictor, and small negative values are read as zero. Bootstrapped 95% confidence intervals (5000 subsamples) that exclude zero indicate significance at the two-tailed 0.05 level.

Two robustness checks were run on this model. First, with gender congruence and prior experience added as control variables (n = 113), no control was significant (gender congruence β = 0.095, $p = 0.279$; no experience category differed from occasional use, all $p \geq 0.190$), and the pattern of H1 to H4 was unchanged (Introversion β = 0.262, $p = 0.001$; iNtuition β = −0.222, $p = 0.019$; Feeling β = 0.490, $p < 0.001$; Perceiving β = 0.021, $p = 0.828$; Table S7). Second, a sensitivity analysis re-estimated the model with alternative sets of first-order dimensions (Table S6). H1, H3, and H4 held in every specification, including one based on PROP and AGEN alone. H2 was significant whenever PRIV was excluded from the higher-order construct (PROP, AGEN, and CHNG: β = −0.236, $p = 0.009$; PROP and AGEN: β = −0.247, $p = 0.008$) but not when PRIV was included (the earlier specification that also included PRIV: β = −0.167, $p = 0.070$; PROP, AGEN, and PRIV: β = −0.173, $p = 0.076$), because iNtuition relates positively, although not significantly, to PRIV (Table 7). The H2 result therefore depends on how User Presence is specified and is reported with that qualification.

4.4. Disaggregated Analysis

Because the second-order model reports each predictor as a single coefficient on User Presence, a disaggregated specification was estimated in which the three presence dimensions and PRIV were modelled as separate endogenous constructs, again with 5000 subsamples. This identifies in which dimensions each association is concentrated. Results are reported in Table 7.

Three patterns emerge. First, Feeling is the strongest correlate across the model, significant for PROP, AGEN, and the separate PRIV construct, and strongest for PROP and PRIV; its association with CHNG is not significant. Second, the association of Introversion is concentrated in AGEN, since its paths to the other dimensions are non-significant. Third, the negative association of iNtuition is concentrated in PROP and does not generalize to the other dimensions. Perceiving is non-significant on every dimension, consistent with the non-support of H4 under the caveats about pole imbalance noted above.

5. Discussion

5.1. Answers to the Research Questions

RQ1 asked whether continuous-type dimensions are associated with avatar user presence in this novice protocol, and if so, which dimensions are associated with which components. Within this first-exposure sample the answer is affirmative but not generalizable to professional streamers. Feeling is the strongest correlate of the exploratory User Presence construct ($\beta = 0.442$, medium) and Introversion a secondary one ($\beta = 0.260$, small); iNtuition is negatively associated with it ($\beta = -0.236$, small) in the three-dimension specification, and Perceiving is null. The disaggregated analysis reveals a division of labor the aggregate coefficients conceal: Feeling is associated with property and agency and, outside the higher-order construct, with PRIV; Introversion only with agency; and iNtuition only, and negatively, with property. Presence in this sample is therefore dispositionally structured and dimension-specific rather than uniform, though the imbalance around the 50-point threshold on Sensing (90.8%) and other poles remains an alternative explanation for the non-significant paths and a reason for caution about the iNtuition result.

RQ2 asked how far the proposed dimensions are empirically distinct. The answer is conditional. Property, agency, and change are distinct by HTMT, but Privacy was not distinct from agency as first specified (HTMT = 1.028), was reduced post hoc to a single indicator, and, following the source instrument [23], is now analysed as a separate construct rather than as a dimension of User Presence. The higher-order specification is thus exploratory, not a definitive validation, and because the measurement answer constrains the structural one, RQ2 was resolved before RQ1.

5.2. Feeling as the Principal Correlate

Feeling is the clearest result: the only predictor significant across most of the model, carrying the bulk of the explained variance. Because embodiment research attributes presence to perceptual and motor conditions, motion correspondence and expressive range [3,9,24–26] that the training protocol holds roughly constant, what remains to explain variation is the participant. Inhabiting a persona at first exposure appears to involve sustained affective projection rather than a purely perceptual event, consistent with accounts of deliberate emotional overacting to offset the reduced non-verbal channel [2]. This prominence may also reflect the pole imbalance on the other dimensions (especially Sensing = 90.8%). Because each participant designed the avatar they inhabited, this affective investment may extend to the designed visual body itself; however, features of visual character design were not measured in this study, so this link remains a hypothesis to be tested with inter-rater-coded design attributes.

The privacy result should be read in the same exploratory spirit. Because the retained item PRIV1 is worded toward privacy protection, the coefficient of $\beta = 0.491$ for F $\rightarrow$ PRIV indicates that participants higher in Feeling report a stronger attitude that protecting the avatar's privacy matters. This is an evaluative stance toward the avatar rather than an experience of intrusion, so it is better connected to accounts of how users weigh the disclosure and ownership of their virtual identities [15,29] than to studies of harassment. Read alongside the property (body ownership) result, it is consistent with a single underlying process, in which the more fully a novice experiences the avatar as their own, the more its privacy is felt to be worth protecting; consistent with the source instrument [23], privacy is therefore treated as related to, but separate from, User Presence ($r = 0.386$), and whether it is a consequence of presence cannot be settled by a single-item, post hoc measure. The association is confined to a novice training-protocol sample and should not be read as evidence about professional VTuber streamers.

5.3. Introversion and the Agency Pathway

Introversion supports H1 at the aggregate level, but the disaggregated analysis shows the association is not general. Introversion is associated with agency with a medium effect size ($\beta = 0.343$, $f^2 = 0.160$) and nothing else. This is the pattern a compensation account anticipates: for more introverted novices, the avatar may function as an instrument of expression that responds to intention without requiring on-camera appearance. Agency, the sense that the avatar acts as the participant wills, is precisely the component such participants would be expected to value, giving quantitative form to qualitative observations that performers differ in how sustainably they can hold a persona apart from themselves [2,14]. Reporting only the aggregate coefficient of 0.260 would have implied a broad effect that the data do not support, which is a central reason the disaggregated model was estimated.

The contrast with Feeling is informative. Feeling is associated with presence broadly, with the association concentrated in the affective and proprioceptive components, whereas the association of Introversion is narrow and concentrated in the instrumental component. The two dispositions are therefore associated with different components of avatar presence, one emotional and one functional.

5.4. Implications

Within a novice training protocol where technical setup is roughly standardized, the study relocates part of the explanation of user presence from apparatus to person. Embodiment and presence research has established which technological conditions produce the illusion [3,9,24–26]; the present results indicate that when those conditions are held roughly fixed, personality variables in the specified model are associated with 37.3% of the variance in the higher-order construct (associational R^2, not after controlling for technology). The contribution is modest and context-bound: quantitative, performer-side associations in a first-exposure undergraduate sample where only qualitative accounts of professional streamers previously dominated.

The value of estimating both the aggregate and disaggregated models is itself a methodological implication. The aggregate model answers the hypotheses efficiently, but its results mislead if read alone: the supported association of Introversion is confined to one component, and the negative association of iNtuition is concentrated in property and depends on whether privacy is included in the construct. Higher-order specifications are attractive for parsimony, and this case shows what parsimony conceals.

Practically, the findings may inform persona-design pedagogy and trainee wellbeing in digital media programs. If property (body ownership) and privacy valuation concentrate among novices with a particular affective orientation, instructors cannot assume that a given avatar and tracking setup will feel the same to everyone. Self-assessment at the persona design stage [16] may be a more productive educational intervention than adjusting the technology alone. The privacy finding also bears on wellbeing, since those who report inhabiting the avatar most fully also place greater value on protecting its privacy [15,29]. Extension to agencies or professional streamers requires new samples.

5.5. Limitations

- PRIV is a single indicator construct after the post hoc deletion of PRIV2, so its reliability cannot be assessed, its HTMT ratios are not computable, and measurement error is assumed away; it is analysed as a separate construct, following the source instrument, and whether it is a consequence of presence remains unresolved. Future work should develop a multi-item scale that separates disclosure from intrusion, balances item direction, and tests HTMT before structural interpretation.

- The second-order alpha of 0.664 falls slightly below 0.70 and CHNG loads weakly, so the hierarchical specification is defensible only as an exploratory specification and is not claimed as definitive validation of a three-dimensional structure.
- CHNG is weakly explained, loads weakest on User Presence, and returns a Q^2predict below zero, raising the question of whether it belongs in the higher-order construct as currently operationalized, although the sensitivity analysis shows that the structural conclusions do not depend on it (Table S6).
- The four exogenous constructs are single-item measures whose reliability cannot be assessed; measurement error in them may bias the path coefficients in either direction, so the reported effects should not be assumed to be conservative.
- The design is a structured field trial using a single-source, single-occasion quantitative survey, so all relationships are associational, causal language is unwarranted, and common method variance cannot be excluded. Low VIF rules out predictor collinearity but does not rule out common method variance.
- PLS-SEM maximizes explained variance and provides no global test of model fit, so a moderate R^2 does not establish that the structure is correct.
- The H2 result rests on only 11 participants on the iNtuition pole and on the specification of User Presence (Table S6), so it should be treated as tentative, and replication with a larger, better-balanced sample is warranted.
- Gender congruence and prior experience did not alter the results when added as controls (Table S7), but avatar type and tracking fidelity were not modelled and could confound the reported associations; they should enter replication. Because the sample comprises undergraduate novices completing a training protocol, it supports no inference to active professional VTuber streamers or to those who have left streaming. Dichotomized personality poles are severely imbalanced (e.g., Sensing = 90.8%, n = 109), so pole imbalance, that is, asymmetry around the 50-point threshold, is a credible alternative explanation for the null H4 result, for the fragility of the H2 result, and for the relative prominence of Feeling. Because the predictors are continuous 0 to 100 scores that span broad ranges, this imbalance is not by itself evidence of range restriction, which would require comparison with an appropriate reference distribution.
- The demographic instrument recorded gender and LGBTQ+ self-identification within a single select-one item, so gender identity and sexual orientation could not be reported separately; future studies should measure them as distinct items.

5.6. Future Research

Three directions follow. First, the privacy construct should be redesigned as a multi-item scale that measures disclosure and intrusion separately and with consistent item direction, since a single item cannot support a reflective construct. Second, whether Change belongs in the higher-order construct should be reconsidered, given its weak loading, weak explanation, and Q^2predict below zero. Third, and most importantly, the dispositional model should be replicated with (a) a sample drawn from an actual streaming population with documented tenure and sampling designed to ensure balance on all four personality dimensions; (b) an established, validated personality inventory such as the BFI-2 [44] administered alongside the type scores, so that convergence or divergence becomes a finding and reliance on the contested type instrument is reduced; (c) gender identity measured separately from sexual orientation, so that gender congruence can be tested for all participants; and (d) a longitudinal design with a pre-registered analysis plan, so that how presence develops as a streamer grows into a persona can be examined directly.

6. Conclusions

This study asked whether avatar presence in a first VTuber streaming experience is dispositionally structured or uniform, and the evidence, within clear limits, pointed to the former. Modelling presence as a higher-order construct of property, agency, and change, Feeling was the dominant correlate and Introversion a secondary one, iNtuition was negatively associated with presence, and Perceiving was null, together accounting for 37.3% of the variance in the specified model; the pattern held after controlling for gender congruence and prior experience. A disaggregated analysis indicated dimension-specific associations: Feeling with property, agency, and the separate privacy construct, Introversion with agency alone, and the negative association of iNtuition with property alone. These associations are correlational and were estimated on a strongly imbalanced sample of novice student streamers, so pole imbalance and the post hoc privacy repair qualify them, the iNtuition result also depends on how presence is specified, and the 37.3% figure describes variance within the specified model rather than the association of disposition net of technology. With those qualifications, inhabiting an avatar did not appear to be a uniform product of the tracking setup and persona but varied with the performer, with affective rather than social orientation as its principal correlate. These dimension-specific associations are exploratory and remain to be confirmed on independent, better-balanced samples. The contribution is therefore an exploratory, performer-side, first-exposure account, together with a transparent demonstration of where a higher-order model of presence holds and where it conceals dimension-specific effects. Because the avatars were participant-designed visual bodies, the account also points to a research direction at the intersection of visual character design, avatar embodiment, and user presence, which future work can test directly.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/informatics13100170/s1, Table S1: Descriptive statistics for the four personality predictors (0 to 100 scale); Table S2: Descriptive statistics for the presence and privacy indicators (5-point scale); Table S3: Indicator loadings and cross-loadings (Stage 1); Table S4: Heterotrait–monotrait (HTMT) ratios among the multi-indicator constructs; Table S5: Latent variable correlation matrix (Stage 1); Table S6: Sensitivity analysis: structural paths under alternative sets of first-order dimensions; Table S7: Main model with gender congruence and prior experience as control variables (n = 113); Table S8: PLSpredict results at the indicator level (10 folds, 10 repetitions); File S1: Questionnaire as administered (Thai and English).

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Informed Consent Statement: Informed consent was obtained from all participants. Consent explicitly covered participation, the collection of optional demographic information, and the publication of anonymized participant-authored avatar images and streaming screenshots (Figures 2 and 3); no participant is identifiable from the published images. Persona names shown within participant-authored avatar images are self-selected fictional character names and are not linked to any participant's real identity.

Data Availability Statement: The data, analysis tables, and questionnaire supporting the findings of this study are openly available at https://github.com/chaowanan/Supplementary-Materials (accessed on 1 October 2026).

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Conflicts of Interest: The authors declare no conflicts of interest.

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