

Picturing It!: The Effect of Image Styles on User Perceptions of Personas

Joni Salminen

Qatar Computing Research Institute,
Hamad Bin Khalifa University; and
Turku School of Economics at the
University of Turku
jsalminen@hbku.edu.qa

Soon-Gyo Jung

Qatar Computing Research
Institution, Hamad Bin Khalifa
University
sjung@hbku.edu.qa

João M. Santos

Instituto Universitário de Lisboa
(ISCTE-IUL)
jmcsm@iscte.pt

Ahmed Mohamed Sayed Kamel

Cairo University
ahmedm.kamel@pharma.cu.edu.eg

Bernard J. Jansen

Qatar Computing Research
Institution, Hamad Bin Khalifa
University
bjansen@hbku.edu.qa

ABSTRACT

Though photographs of real people are typically used to portray personas, there is little research into the potential advantages or disadvantages of using such images, relative to other image styles. We conducted an experiment with 149 participants, testing the effects of six different image styles on user perceptions and personality traits that are attributed to personas by the participants. Results show that perceptions of clarity, completeness, consistency, credibility, and empathy for a persona increase with picture realism. Personas with more realistic pictures are also perceived as more agreeable, open, and emotionally stable, with higher confidence in these assessments. We also find evidence of the uncanny valley effect, with realistic cartoon personas experiencing a decrease in the user perception scores.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Empirical studies in HCI.

KEYWORDS

Persona design, pictures, realism, anthropomorphism

ACM Reference Format:

Joni Salminen, Soon-Gyo Jung, João M. Santos, Ahmed Mohamed Sayed Kamel, and Bernard J. Jansen. 2021. Picturing It!: The Effect of Image Styles on User Perceptions of Personas. In *CHI Conference on Human Factors in Computing Systems (CHI '21), May 08–13, 2021, Yokohama, Japan*. ACM, New York, NY, USA, 16 pages. <https://doi.org/10.1145/3411764.3445360>

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

CHI '21, May 08–13, 2021, Yokohama, Japan

© 2021 Copyright held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-8096-6/21/05...\$15.00

<https://doi.org/10.1145/3411764.3445360>

1 INTRODUCTION

Personas are “fictitious, specific, concrete representations of target users” [4, p. 1]. A persona portrays a group of users who share common characteristics, needs, and goals [49]. While representative of a group of real users, a persona is depicted as one person who embodies the central traits of the group of interest [21].

Most commonly, persona designers give this fictitious person a face and a name, creating a representation known as a persona profile [49]. The picture is considered integral to the persona profile [23, 48]. In fact, the name and picture are the only consistent components of the standard persona set-up [51], as other information may change based on the information needs of persona users. As Adlin and Pruitt [4] point out, “Personas put a face on the user—a memorable, engaging, and actionable image” (p. 11). André et al. [9] argue that the picture of life-like characters attracts the user’s attention, guides the user through the character profile, and conveys additional signals of its personality and emotions. In other words, the picture is essential for evoking the persona as a real and complete person [57].

However, it is not immediately clear if *the picture alone* changes the persona perceptions of the end user. If so, then the picture is a powerful attribute of the persona profile that deserves careful and focused attention during the development of personas. The main *benefit* is that pictures help make the persona more memorable [64], as the user has a human-like visual cue for forming a perception of a person [39]. Moreover, while pictures make personas more lively and appealing [9], they also involve challenges.

The main *challenge* is that using a picture may reinforce users’ stereotypical thinking about the persona [50, 79]. Since a picture, especially a real photograph, tends to be rich in nuanced information, such as skin tone, facial expression, emotion, eye and hair color, apparel such as glasses, potential piercings or tattoos, background, etc., all this information can contribute to stereotypical thinking and reinforce the user’s pre-existing biases regarding gender, age, or ethnicity [39].

Though previous research has discussed these benefits and challenges mostly at a general level [39, 50, 79], there is a notable

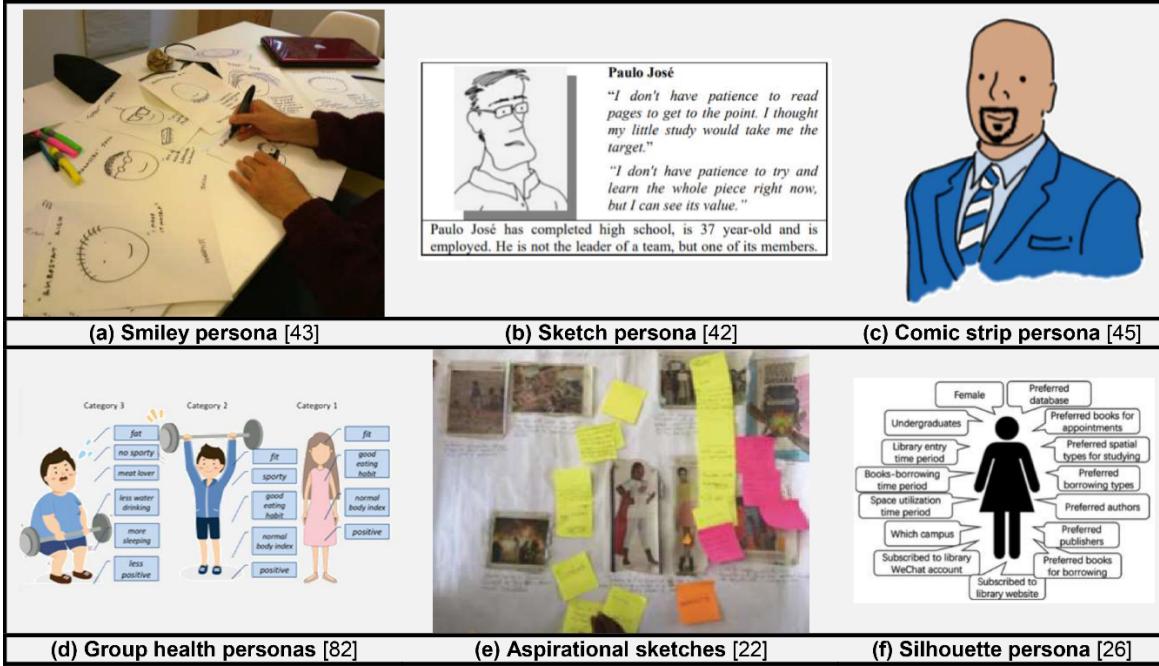


Figure 1: Examples of different cartoon-style personas from the literature. These are generally outliers, as most persona profiles tend to employ realistic photographs.

research gap in terms of what *type or style* pictures persona creators should use in their persona profiles. The proliferation of different graphical styles in the fields of human-computer interaction (HCI) and human-robot interaction (HRI) concerning avatars [1, 74, 75], robots [27, 28, 41, 73], and virtual agents, such as chatbots [15, 32, 76, 85], raises the picture as an important question for persona design, as there are many graphical styles to choose from. It is, therefore, not immediately apparent if real photographs or other pictorial styles would be better suited for creating personas that are credible, empathetic, complete, consistent, and clear, thus complying with the suggested design criteria for holistic personas [11, 13].

In the past, persona developers have mainly used real photographs [39, 62, 70] but also some cartoon-style images [45, 46, 64] in persona profiles (see Figure 1). The findings of Nieters et al. [64] imply that there is a belief among persona creators that “personas are so successful only because they use the faces of real people” (p. 1820). However, the reasoning for the choice of the picture is typically not given, and it appears that most persona developers tend to make the decision randomly [35] based on “hunch” or “what they like” instead of validated knowledge. This issue is exacerbated by the fact that there are very few empirical studies investigating the impact of various persona picture styles on user perceptions.

Therefore, persona developers are left with unanswered questions such as: *Is it better to use realistic or artificial pictures in persona profiles? What type of picture should I attach to the persona? Does the style of picture alter end-user perceptions?* These are some of the questions that motivate our research. Notably, our research question is, **How does the use of different image styles affect**

the user perceptions of personas? We divide this question into the following sub-questions:

- **RQ1:** Does picture realism increase positive user perceptions of personas?
- **RQ2:** How does picture realism influence users’ attribution of personality traits to personas?
- **RQ3:** Is having any picture better than having no picture at all?
- **RQ4:** Is there an uncanny valley effect associated with persona pictures?

To address these questions, we investigate the extent to which the persona picture style (realistic to stylized) affects users’ (N = 149) perceptions of the persona. The level of realism is a crucial design decision that affects the persona’s development effort. From the field, we observe that there are examples of persona systems using both styles: realistic facial photographs (<https://persona.qcri.org>) and cartoon-style pictures (<https://www.socialbakers.com/platform/audience-analysis..>). Therefore, the findings of this research will advance theoretical knowledge in HCI about the effects of different pictorial styles on persona user perceptions. The findings also provide practical guidelines for HCI on how pictures should be implemented in persona templates, which matters for users deploying personas in a number of domains.

2 LITERATURE REVIEW

2.1 Personas and Their Pictures

From a review of the literature, we find that two general approaches – real photos and cartoon-style images – have been used in persona

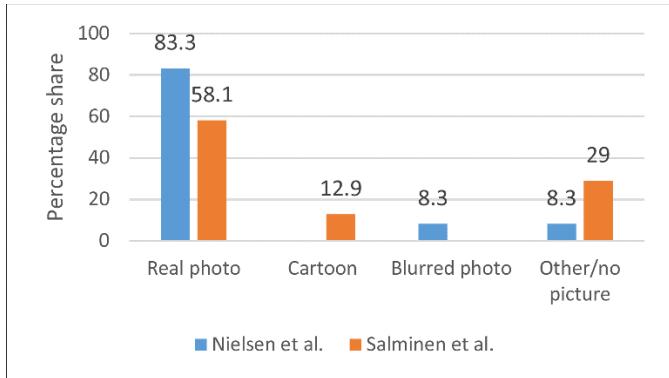


Figure 2: Picture styles from previous reviews of persona profiles. Real photographs appear dominant.

research, which are primarily summarized in two survey articles. In a review of 31 studies, Salminen et al. [67] found that more than half ($n = 18$ studies, 58.1%) had personas with a real facial picture, and only a few studies ($n = 4$, 12.9%) had personas with cartoon pictures. The rest ($n = 9$, 29.0%) had no pictures or used a different visualization (e.g., a dendrogram of user clusters [40]). Nielsen et al. [62] reviewed 47 persona profiles in 12 persona casts, finding that 10 casts (83.3%) used real photos, one used a blurred picture style, and one had no picture at all. Figure 2 summarizes the results from these previous reviews.

Although these reviews suggest that research articles seem to predominantly use real photographs of people, we were able to locate several examples of non-photorealistic graphic styles being used for personas as well [14, 36, 43, 45, 73, 77]. Therefore, alternative picture styles exist, but there is no absolute consensus that the images should be real photographs (or that there should be images at all).

When there is a picture, persona user studies have found that the persona picture does influence user perceptions of the persona [39, 46, 64, 70]. Users process pictures mutually with other persona information, such as quotes, to form narratives, mental models, and interpretations of the personas. For example, users can make inferences about the persona's personality based on the age and race of the person in the picture [70].

Even though the picture matters, its impact on persona perceptions has not been thoroughly investigated, and the effect of pictures remains largely anecdotal. Of the handful of studies focusing on persona pictures, two apply eye tracking to investigate user reactions. First, Hill et al. [39] found that the use of multiple pictures decreased gender stereotyping without decreasing the engagement with the persona. Second, another user study [70] found that using multiple pictures of the same person in different situations came with the side-effect of confusion, as the end users tend to expect one and not many persona pictures. These two studies – both using real photographs – suggest that the picture affects how users perceive the persona's realism, perceived attitudes, social class, and so on. The persona picture can either reinforce or mitigate pre-existing beliefs depending on the other persona information and on the biases of the user [39].

There are two studies, to our knowledge, that compare persona picture styles. First, Long [46] conducted a user study with nine student teams to investigate the effects of using alternative persona presentation styles and found that photographs were better than illustrations. The study found that the group using personas with real photographs remembered more details ($M = 20.6$) relative to the group using personas with illustrations ($M = 18.4$). However, this difference was not statistically significant. Long [46] mentions explicitly that users of the sketch persona tended to give more vague answers – for example, when asked about the persona's age, they gave an age range of 50–55, whereas the group using the persona with a real picture responded with a more exact age. Moreover, Long argues that using illustrations “can lead to selective consideration of the persona characteristics” (p. 6), increasing the risk of users attributing self-referential information to the persona. Finally, the findings by Long indicate a decreased empathy level for the illustration, as well as a lower recollection of persona details after time [46]. However, the study did not provide statistically significant support for these effects, so even though they are interesting, the findings must be considered anecdotal.

Second, contrary to Long's findings, Nieters et al. [64], in turn, found that action figure pictures increased the memorability of the personas. Interestingly, the decision to use “fake pictures” was met with resistance from the persona users (p. 1820), implying that the use of non-realistic pictures reduces the realism of the persona. However, the findings of Nieters et al.'s study actually indicated that, while the researchers found that participants spent time joking about the action figure personas, “more than two-thirds of the responses were in favor of the action figures [regarding empathy, reputation, and interest]” (p. 1822). Nieters et al. found that the action figure personas build greater confidence about the users than the human faces, while also resulting in better recall. The findings implied that action figures were at least as memorable as real faces and using the action figure style did not decrease the users' ability to empathize with the personas. So, the takeaway from this case study appears to be mixed concerning employing non-realistic pictures.

As those of Long, the findings of Nieters et al. are exploratory in nature. The sample size is small, and statistical evidence was not provided. Neither of the two studies presents statistically significant findings. Therefore, the critical question of the impact of persona pictures remains unresolved. Typically, a decision is made to use either realistic or unrealistic pictures based on the designer's preferences or biases rather than on validated knowledge. To address this gap, we conduct an empirical user study with different persona picture styles. We test various persona picture styles that are crafted using theoretically sound premises. We gradually increase the level of abstraction and evaluate the effects on user perceptions of the personas with each different image style. We conduct detailed statistical analysis to quantify the effects on user perceptions.

2.2 Evidence from Tangential Fields

Evidence in tangential fields (e.g., anthropomorphic agents, avatars, creatures, synthetic actors, non-player characters, and embodied conversational agents [66]) mostly supports *increasing* picture realism for the design goal of like-like characters. However, it is

Table 1: Study hypotheses, measures, and foundational theories. References for the adopted measures are shown – we made minor changes to the original items to suit the study requirements. A 7-point Likert scale was deployed for all the statements (Disagree strongly... Agree strongly).

Hypothesis	Measures	Theory / Concept	
H1 H1a H1b	High picture realism increases the... clarity of the persona. completeness of the persona.	"The information was easy to understand." [72] "The persona had enough information to understand the people it describes." [72]	Person perception [18] Person perception [18]
H1c H1d H1e	consistency of the persona. credibility of the persona. empathy towards the persona.	"The information seemed consistent." [72] "The persona seemed like a real person." [72] "I felt I could understand the persona as a human being." [72]	Person perception [18] Person perception [18] Person perception [18]
H2 H2a H2b	High picture realism increases the... intensity of the personality traits that users attribute to the personas. users' confidence in assessing the persona's personality.	Ten Item Personality Measure (TIPI) [33]	Theory of the mind [8]
H3	Having some picture is better than no picture at all – that is, personas with pictures score higher on perceptions than personas without pictures.	"How confident are you in your answers about the persona's personality?" [44] T-tests on persona perceptions	Anthropomorphism [17]

less agreed upon *until which point* the realism should be increased. Various findings are summarized below.

- McCloud and Manning [52] argue that picture stylization tends to increase user interest and involvement. This is because when people interact with humanized agents, they sustain a constant awareness of their own face, and this mental image is often stylized. Thus, it is easier to identify with a stylized character.
- McDonnell et al. [53] considered eleven types of visual styles of virtual humans ranging from realistic to stylized. Their results showed that cartoon characters were considered highly appealing and were rated as more pleasant and friendly than characters with human appearance.
- Welch et al. [83] reported that pictorial realism increases involvement and the sense of immersion in a virtual environment.
- Nowak and Biocca [65] found that when the virtual human's picture was more unusual and iconic (less anthropomorphic), users experienced more presence than those interacting with agents without a picture or with a highly anthropomorphic picture.
- Investigating the presentation styles of animated pedagogical agents, Adamo-Villani et al. [3] found that the visual style of an animated avatar had an effect on student engagement, with the stylized avatar being perceived more engaging than the realistic one.

Therefore, the evidence appears inconclusive. Persona studies typically deploy realistic photographs, but tangential fields also lend support for the use of other forms of pictorial styles. According to Prendinger and Ishizuka [66], the question of realism vs. stylization is part of an on-going debate in HCI research, one that

"can eventually only be decided empirically with respect to specific application scenarios." (p. 3).

3 HYPOTHESIS DEVELOPMENT

In line with previous research, Table 1 suggests hypotheses concerning the effects of persona picture styles on user perceptions. The underlying notion of the hypotheses is the assumption that the realistic picture will have *mostly positive effects* on user perceptions of the persona, as the persona is intended to be a "real" person. From this construct, we define high picture realism as an accurate representation of a real person in an image. In contrast, low picture realism is an abstract representation evoking a notion of a person.

The essential concepts and theoretical rationale for the hypotheses are clarified in the following.

Justification for H1a-e: *Person perception* is a concept that implies individuals applying the same social norms to personas as they do to humans, suggesting that social psychology concepts are applicable to users' interactions with personas [25] as *persona perceptions* [50]. It is logical to presume that the pictorial style can influence user perceptions. We investigate the following perceptions based on their relevance to personas:

- **clarity** (the persona profile needs to be easy to understand),
- **completeness** (there needs to be adequate information to evaluate the persona),
- **credibility** (the information must appear trustworthy),
- **consistency** (the information should not be conflicting), and
- **empathy** (the user needs to be able to relate to the persona) [72].

Evidence in tangential fields – avatars, virtual agents, synthetic actors, non-player characters, creatures, and embodied conversational agents [66] – mostly supports the use of realistic pictures, as

Table 2: Stylizations' spectrum of realism.

Spectrum of Realism	Stylization	Description
High Realism 	real photo (RP)	full information and human features with no abstraction
	realistic cartoon (RC)	cartoon-like abstraction but still mostly realistic
	human cartoon (HC)	cartoon-like abstraction that represents a person but not in a realistic style
	symbolic cartoon (SC)	cartoon-like abstraction that represents a person with race and gender but has no face or display of emotions
	silhouette (SL)	portrait that indicates gender but with no race or face
	gender-neutral silhouette (GN)	portrait picture that communicates no gender, only that the person is human
Low Realism	no picture (NP)	no picture or no graphical indication of a person

higher pictorial realism is associated with more positive user perceptions [32] [52] [53] [83] [65]. In particular, *anthropomorphism* refers to the degree to which a non-human agent exhibits human attributes [25]. An important notion is that there are degrees of anthropomorphism; a robot, for example, can appear less human-like or more human-like. Typically, varying the degree of humanness of non-human entities is thought to have effects on user perceptions [56]. Therefore, when manipulating the realism of the persona picture, we presume there are *positive* effects on user perceptions: that is, increasing pictorial realism increases perception scores. Essentially, higher scores indicate more positive perceptions that are associated with more meaningful engagement with the persona.

Justification for H2a-b: We expect that picture realism is positively associated with the users' ability to do mental modeling of the persona [34] and, therefore, being able to more *confidently* evaluate the persona's personality. The mental modeling typically attributed to personas is grounded in the theory of the mind [8], according to which individuals are able to attribute mental states – desires, beliefs, emotions, intents, etc. – to oneself and to others. Therefore, “theory of mind is necessary to understand that others have beliefs, desires, intentions, and perspectives that are different from one's own” [84, p. na]. This ability is, according to our expectations, associated with the persona's picture realism.

We also expect that the use of realistic pictures will result in a stronger imprinting of personality traits attributed to the persona, thereby *intensifying* its assessment. Note that in H2a, “intensity” refers to either higher *or* lower scores: a user can think a persona is either very little or very much an extravert, and both of these assessments would be considered intense opinions.

In general, personality traits play a central role in the holistic view of the persona [11, 13] which essentially postulates that personality traits enhance designers' ability to make use of personas by providing a richer profile [10]. This is compatible with Grudin's [34] idea that human personality traits are attributed to personas and Nielsen's [61] concept of rounded personas that contain all the necessary information for wholesome design activities [10]. Anvari et al. [12] find that personas with personality traits are useful for the elicitation of design features and reduce the need for human participation in design activities.

Justification for H3: Having no image tends to result in a lower perception of social presence [65]. Prendinger and Ishizuka [66]

argue that while researchers typically follow the realistic approach when creating virtual humans, it is uncertain if the life-likeness in artificially created characters can best be achieved through realism or stylization. More specifically, there are examples in the literature of personas accompanied by only a text description but no picture [16, 31]. Although the findings in tangential fields seem to generally indicate that a picture (of some type) is desirable, it remains worthwhile to investigate if this holds for personas.

4 METHOD

4.1 Experimental Design

Conceptualization: One way to understand the concept of incremental realism is Milgram's Reality-Virtuality Continuum [55] that aims to encompass the composition and variation of real and virtual entities. The scale extends from completely virtual to completely real. Similarly, Ablanedo et al. [1] propose a continuum of *realistic-simplified-exaggerated-symbolic* for character stylization. We borrow from these two frameworks the idea that there is a *range* of abstraction from less to more realistic for human-like characters. Applying this principle, we constructed a set of visual imagery that incrementally increases the reality of the persona's facial picture.

In human-like character design, pictorial style refers to the degree to which the picture is simplified and reduced [2]. In general, stylization is defined as “the act of representing an object in a non-natural form” [1]. Different levels of stylization include iconic, simple, stylized, and realistic [2]. We applied stylization to make the personas appear less and more realistic in terms of their pictorial style, using six techniques (see Table 2).

Operationalization: We present the participants (discussed below) with personas whose pictures have a varying degree of stylistic representation (see Table 3). Therefore, the experiment has *six* picture styles and *one* non-picture variant for three personas, resulting in $7 \times 3 = 21$ treatments. Each participant sees each of the three personas in one of the seven styles; an individual participant sees three different personas with three different picture styles. For each persona, only the picture is changed according to the tested manipulation – the other persona profile information is the same. For the non-picture treatment, two screen elements (text description and audience size) are shifted upward to avoid an awkward-looking design.

Table 3: Experiment characteristics. The treatments are gradually stripping away visual details.

Treatment	The picture communicates ...					
	Face (eyes, mouth)	Emotions	Apparel (e.g., glasses)	Race	Gender	Background
Real photo (RP)	✓	✓	✓	✓	✓	✓
Realistic cartoon (RC)	✓	✓	✓	✓	✓	-
Human-like cartoon (HC)	✓	✓	✓	✓	✓	-
Symbolic cartoon (SC)	-	-	-	✓	✓	-
Silhouette portrait (SL)	-	-	-	-	✓	-
Gender-neutral portrait (GN)	-	-	-	-	-	-
No picture (NP)	-	-	-	-	-	-



Figure 3: Example treatments. All of the twenty-one treatments are shown in full size in the Supplementary Material (https://www.dropbox.com/s/gk9qpd1jvena9xp/Supplementary%20Material_c.zip?dl=0). All of the other information was kept constant except for the picture, which was changed according to the manipulations.

To mitigate the learning effect (participants' behavior changing based on the persona they previously saw), the order of the personas and picture types was random. Furthermore, we built a flow in Qualtrics that ensured each persona-picture type combination received an approximately equal number of participants. Overall, this design (randomized counterbalancing) mitigates learning effects.

4.2 Creation of Treatments

The personas were generated using an automatic persona generation system, reported in [6, 7]. The data used for the persona generation originates from an international news and media channel. The data was collected via the YouTube Analytics API and processed using the persona generation system. Three personas were picked from the generated set of ten personas: one Asian male, one African-American female, and one Caucasian-American male (see Figure 3). These personas were chosen to increase the racial diversity of the tested personas and to allow us to compare if the observed effects were consistent across the personas.

The only changes made to the three chosen personas were the manipulations of the profile image. All other information in the persona profiles was kept constant. By default, the persona system selects a real photograph that is age, gender, and country appropriate. Through searching online photo banks, we secured a set of pictures that corresponded to the baseline photograph and had a

varying degree of realism. We then worked together with a professional photo re-toucher to ensure that the picture versions of a persona had a matching skin tone, hair color and style, and clothing color (see Figure 4), as much as possible.

The **RC** versions were created by a cartoon artist to correspond with the **RP**. The **HC** and **SC** versions were picked from online photo banks to resemble the original photos by gender, age, and ethnicity, and then further edited. These were stylized versions of the persona. As Adamo et al. [2] point out, “a stylized character often presents exaggerated proportions, such as a large head and large eyes, and simplified painted textures” (p. 11). From a design perspective, **HC** and **SC** apply *visual concision*, which is defined as “the reduction of detail through an economy of line and form – while retaining . . . the ‘essence’ of the thing represented” [38] (p. 6).

SL and **GN** represent abstracted, minimal forms. They are symbolic of their visual realization of the persona. A persona typically has a gender and age, but this information can be made more salient or less salient. From **SL**, the gender of the persona can be inferred. From **GN**, it cannot. The **GN** image was included to counter the gendered pictures in other treatments. The picture was selected from the Noun Project (<https://thenounproject.com/search/?q=user>), based on a recommendation on the UX StackExchange discussion forum [81].

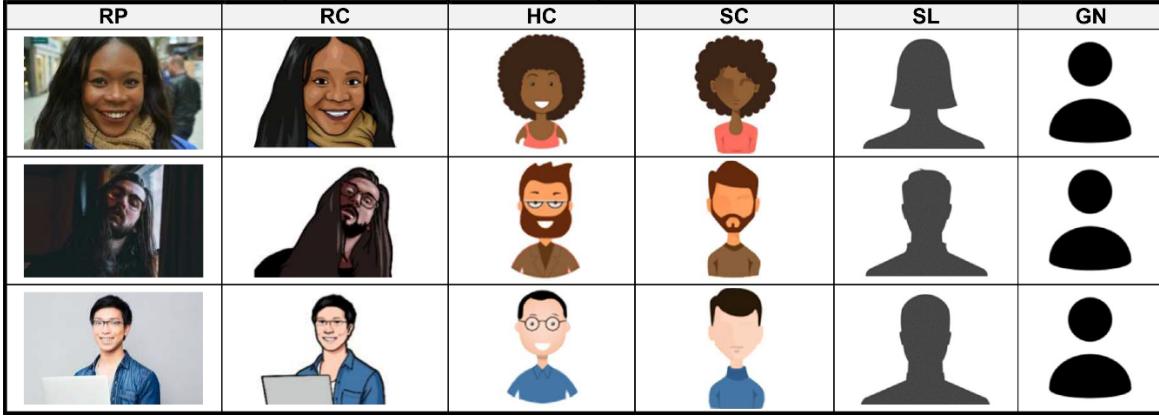


Figure 4: Persona pictures used in the study on Milgram's Virtuality-Reality Continuum [55].

Overall, the treatments represent the persona in varying degrees of human-likeness. Theoretically, the treatments perform gradual abstraction, slowly removing visual cues and information from the persona. **RP** has the most information and the least abstraction. The **RC** loses some of the detail, like photorealism and the background. The **HC** loses some more finesse in facial details. The **SC** loses the face and, with the face, the portrayal of emotions. The **SL** loses race but retains gender. Finally, the **GN** placeholder picture has no gender, indicating only that the person is human.

4.3 Picture Testing and Revising

Before their implementation into the persona profiles, the pictures were pilot-tested among the research team, where feedback was given on their consistency and suitability to the sought-after range of realism. We had three people within the team, all with extensive experience with personas. Since the treatments were mainly the responsibility of one of the researchers, the feedback from the others was considered useful, as they could offer “uncontaminated” perspectives regarding the picture validity. The pilot testing highlighted the interaction among the images’ details and level of realism, in that we could not keep every element the same. As an example, hairstyles in RP lose their ethnic association as realism decreases, and abstraction increases, as does emotional facial expressions. There are similar issues with background and stock photo effects. This pilot testing led to further iterations to improve the match among the different versions of the same persona (e.g., adjustments of skin tone and hair color). In the end, the pilot testing resulted in an acceptable set of treatments for investigating our research objectives. After the satisfactory creation of the images, they were implemented into the persona templates, using image-editing software and leaving all other information intact, apart from the image. Thus, the treatments were ready, and we proceeded to data collection.

4.4 Data Collection

We recruited participants from Prolific, an online survey platform that has been used for data collection in previous persona experiments [68, 71]. Data collection was carried out in July 2020.

We applied several measures to ensure the quality of the responses. First, the approval ratings of the participants needed to be at least 90% for them to be eligible. Second, we inserted six attention checks in unexpected places of the survey (e.g., “Please choose slightly agree”). Third, to ensure that the participants truly comprehended the concept of personas, we devised a persona understanding test, which had three statements: “*Personas are not real people, they are fictitious*” [correct answer: yes]; “*Personas describe a group of people that are similar (e.g., customers, users)*” [yes]; “*Personas are profiles of real people*” [no]. The participants had to answer at least two (out of three) statements correctly to qualify. This was crucial, as we only wanted to include participants who properly understood the concept of personas.

In total, seven participants (2.8%) failed one of the six attention-check questions. We discarded these responses from the data due to validity concerns. We also discarded those participants who did not pass the persona-understanding test ($n = 96$, 38.1%) – i.e., those who failed to answer correctly at least two of the three statements about personas. The remaining 149 participants (59.1%) passed the attention checks and the persona-understanding test and were thus considered eligible for the study. We presume that the discard rate is due to the candidates not properly understanding the concept of persona.

Among the qualified participants, half were female ($n = 74$, 49.7%). The average age of the participants was 32.7 years ($SD = 5.9$). Most of the participants were from the United Kingdom ($n = 101$, 67.8%). Thirty-six (24.2%) were from the United States, and the rest (8.1%) were from various other countries. Fifty-three (35.6%) worked in management positions, 87 (58.4%) identified as workers, and 9 (6.0%) classified their job roles as “other.” Thirty-three (22.1%) indicated that they had previously used personas in their jobs.

The study followed a mixed within-subject 7×3 design, where all participants saw all three personas sequentially, each in different pictorial style, answering statements in between. The survey software (Qualtrics) was used to randomly assign participants to each persona picture type, using the platform’s even-assignment function. This procedure mitigated order effects by ensuring that there was an approximately even number of participants assigned randomly for each treatment.

4.5 Walkthrough of Survey Flow

Introduction: The participants were first introduced to the study. It was made clear that participation was voluntary, and they could withdraw at any time. This was followed by an explanation of the concept of persona (“Personas are fictitious characters that describe a group of real users”). Prior to the persona understanding test, the participants were also shown an example persona with each information element defined as “speech bubbles” (see the Supplementary Material (https://www.dropbox.com/s/gk9qpdljvena9xp/Supplementary%20Material_c.zip?dl=0)).

Persona Understanding Test: It was made clear to the participants that, even though the personas were fictitious, the personas they were about to see were based on real online user data. The participants were then tested for their understanding of the concept of persona. After this, they were asked to review each persona carefully, as they would not be able to return to the persona profile after reviewing it.

(Persona → PPS & TIPI) x 3: After reviewing each persona, the participants filled in two questionnaires. First, for persona perceptions, we deployed the **Persona Perception Scale (PPS)** [72], using the key items from dimensions of Empathy, Completeness, Clarity, Consistency, and Credibility. This scale has been deployed in several previous persona user experiments [68, 69, 71]. The dimensions were chosen based on their compatibility with the hypotheses. Second, for the task of evaluating the persona’s personality, we deployed the **Ten Item Personality Measure (TIPI)**, which is a 10-item scale of the Big Five personality traits [33]. TIPI has been widely deployed in psychological studies, with more than 6,800 citations at the time of the study (Google Scholar). We also chose TIPI because the statements are easy to understand by laymen, and the survey is quick to complete [33], making it suitable for user studies. TIPI has also been used in previous research to operationalize personas’ personality traits [10, 12]. Therefore, the TIPI scale was used due to its commonness and ease of statement completion by non-psychology experts while simultaneously providing valid assessments of personality [33]. The definitions of the Big Five traits are [5]:

- **Agreeable (AGR):** Compassionate, cooperative, generous, helpful, kind, nurturing, sympathetic. These individuals are generally optimistic and trusting of others.
- **Conscientious (CON):** Efficient, hardworking, organized, persevering, responsible, self-disciplined. These individuals tend to be reliable and focused on achieving and planning for the future.
- **Emotionally stable (EMS):** Calm, relaxed, self-confident. Emotionally stable individuals are not moody or tense, and they are not easily tipped into experiencing negative emotions.
- **Extravert (EXT):** Active, amicable, assertive, energetic, enthusiastic, outgoing, talkative. These individuals are friendly and draw inspiration from social situations.
- **Open (OPE):** Artistic, creative, curious, deep, intelligent, imaginative, open-minded, reflective. Open individuals tend to appreciate diverse views, ideas, and experiences.

These definitions were not shown to the participants, as they are not required for assessing the personality traits, which is done

by calculating the score of each trait from the statements posed to the participants. TIPI is usually administered as a form of self-evaluation. However, here we wanted the participants to evaluate the personality of the personas. Therefore, we transformed Gosling’s statement of “I see myself as ...” into “The persona seemed like ...” The scores were processed using the instructions given by Gosling [33] to obtain the final personality ratings.

Background information and End: On average, the participants spent 15.64 minutes to complete the survey ($SD=9.27$). They were financially compensated with a reward of £2.00 per answer, corresponding to an hourly rate of £8.00, roughly equal to the UK hourly minimum wage of £8.21 for those above the age of 25 (statistic from 2019 [80]). Each participant could only participate once, which was ensured by the IP filtering function of Qualtrics.

4.6 Data Processing and Analysis

The responses were exported from the data collection platform. For the analysis, the dataset was transposed so that each observation consisted of an interaction between a participant and a persona. As such, each participant yielded three observations. For each observation, the following variables were created: *Treatment*, indicating which treatment was assigned to that interaction; *Persona*, indicating which persona was assigned to that interaction; and *Picture realism*, the participant-rated realism of the persona’s picture. Variables indicating the participant’s *Gender* and *Age* were also created. Two additional variables were created – *Emotion*, a dichotomous dummy indicating whether the persona expressed emotion or not, and *First Impression*, which denoted whether the user’s first impression of the persona was positive, negative, or neutral.

The hypotheses were tested using General Linear Modelling (GLM) [54] unless otherwise mentioned. GLM is a linear-regression based model where multiple predictors are included, using a combination of fixed factors and continuous variables (covariates), and multiple response variables are also included. Gender, Treatment, and Persona were included in the model as fixed factors coded as dummy variables, while Age and Picture realism were entered as covariates [37]. For Gender, the reference category was “Male”; for Treatment, it was “No Picture”; and for Persona, “Chris” was used.

5 RESULTS

5.1 RQ1: Does Picture Realism Increase Positive User Perceptions of Personas?

For this research question, we tested the hypotheses of realism’s positive impact on persona perceptions. H1a – H1e were all supported (see the Supplementary Material (https://www.dropbox.com/s/gk9qpdljvena9xp/Supplementary%20Material_c.zip?dl=0) for full statistical results). Figure 5 shows the perception scores for the different treatments. After controlling for gender, age, treatment assignment, and persona assignment, the evidence indicates support for H1.

H1a is fully supported; High picture realism increases the clarity of the persona ($B = 0.121$, $p < 0.001$).

H1b is fully supported; High picture realism increases the completeness of the persona ($B = 0.213$, $p < 0.001$).

H1c is fully supported; High picture realism increases the consistency of the persona ($B = 0.130$, $p < 0.001$).

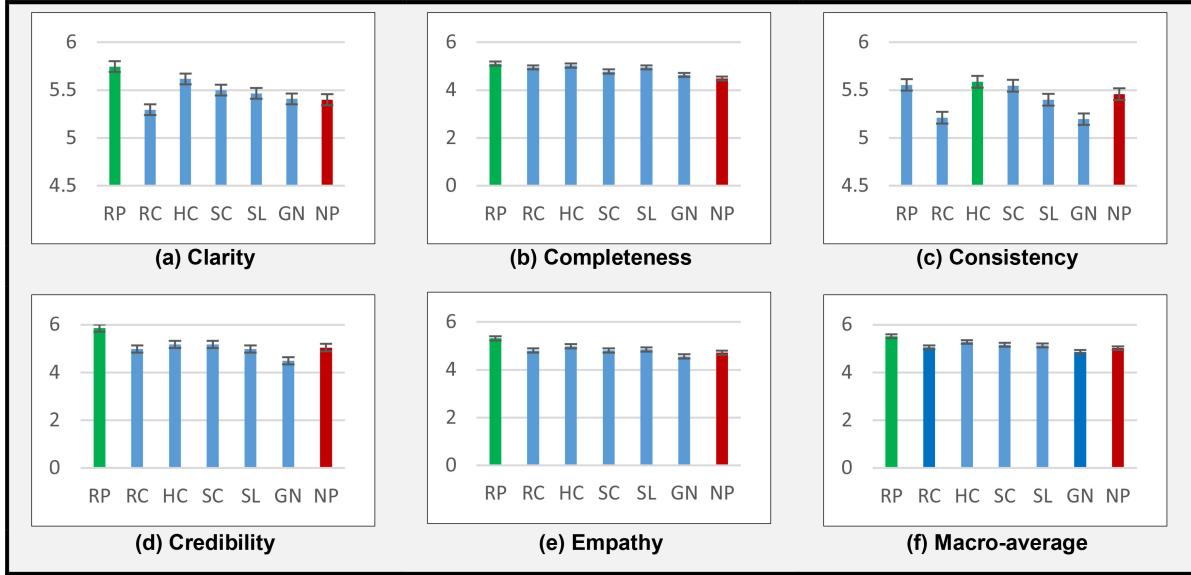


Figure 5: Perception Scores for different treatments. The Y-axis indicates the score. Non-photo treatment is highlighted in red, the highest value in green. Error bars indicate standard errors. The scores indicate that the best picture style for most perceptions is Real Picture (four highest scores), followed by Human-Like Cartoon (one highest score).

Ashley							Chris							Agung									
	RP	RC	HC	SC	SL	GN	NP		RP	RC	HC	SC	SL	GN	NP		RP	RC	HC	SC	SL	GN	NP
EXT	4.96	5.14	4.98	5.05	4.80	5.02	4.78		4.68	5.60	4.76	4.85	4.50	4.66	4.78		3.98	4.43	3.93	4.19	4.50	4.28	3.92
AGR	4.65	4.55	4.45	4.03	3.91	4.19	3.88		3.18	3.28	3.64	3.60	3.50	3.27	3.46		4.29	3.75	4.19	3.96	3.95	2.94	3.72
CON	5.11	5.24	5.07	4.48	4.61	4.62	4.53		3.68	4.08	4.66	4.95	4.67	4.41	4.58		5.57	5.03	4.74	4.96	5.28	4.28	4.52
EMS	4.46	4.64	4.16	3.95	3.98	3.69	3.80		4.18	4.35	4.28	4.30	4.31	4.09	4.40		4.76	4.33	4.55	4.29	4.25	3.33	3.70
OPE	4.78	4.88	4.73	4.65	4.61	4.76	4.10		4.68	4.70	4.56	4.80	4.11	4.02	4.22		4.71	4.20	4.19	4.31	4.63	3.94	3.88

Figure 6: Personality ratings given by the participants to the personas. Green indicates a higher, red a lower mean score.

H1d is fully supported; High picture realism increases the credibility of the persona ($B = 0.313$, $p < 0.001$).

H1e is fully supported; High picture realism increases users' empathy toward the persona ($B = 0.307$, $p < 0.001$).

5.2 RQ2: How Does Picture Realism Influence Users' Attribution of Personality Traits to Personas?

To address this question, we investigate the Big Five personality traits attributed to the personas by the participants. The personality ratings (see Figure 6) yield interesting findings about how users rate the personality of personas and how their personality trait attribution is influenced by the pictures. The results indicate, for example, that Agung is generally perceived as less extraverted. Chris is generally perceived as less agreeable and conscientious. The emotional stability and openness of Agung drastically decrease when removing a picture that shows race and gender.

Statistically significant effects were calculated based on the average standardized scores (z-scores), where the baseline of zero represents the average score for the given personality trait in the

whole data – we consider this as the norm for comparison [78]. Calculations show that Agung's agreeableness ($Z = -0.64$, $t(142) = -2.77$, $p = 0.042$), conscientiousness ($Z = -0.6$, $t(142) = -2.72$, $p = 0.026$), and emotional stability ($Z = -0.71$, $t(142) = -3.17$, $p = 0.013$) were significantly lower with GN compared to the overall population average.

In turn, Agung's conscientiousness was significantly higher when the RP style was used ($Z = 0.63$) compared to the overall average of the population, $t(142) = 3.08$, $p = 0.017$. For Chris, extraversion was significantly higher with RC style compared to the overall average of the population ($Z = 0.69$, $t(142) = 3.16$, $p = 0.013$), and conscientiousness was significantly lower with RP ($Z = -0.68$, $t(142) = -3.07$, $p = 0.018$). None of the differences for Ashley were significant. Figure 7 shows the personality rating deviations for each persona.

Overall, significant and positive effects were found regarding high picture realism and perceptions of agreeableness ($B = 0.109$, $p < 0.001$), emotional stability ($B = 0.069$, $p < 0.001$), and openness ($B = 0.103$, $p < 0.001$), but no statistically significant effect was found for extraversion ($B = -0.027$, $p = 0.308$) or conscientiousness ($B =$

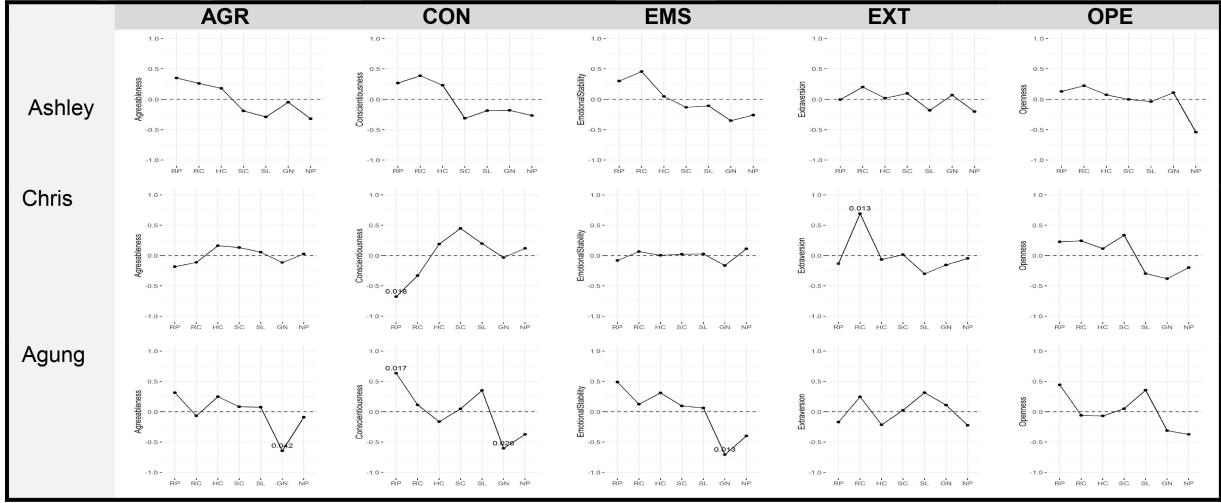


Figure 7: Big Five personality traits across picture styles. Points represent the persona-adjusted average z-scores. The zero value represents the overall population average. Labels represent p values after correction for false discovery rate. Only p values < 0.05 are shown. Full-size graphs are provided in Supplementary Material (https://www.dropbox.com/s/gk9qpd1jvena9xp/Supplementary%20Material_c.zip?dl=0).

0.049, $p = 0.079$). As such, H2a is partially supported, as three out of five personality traits increase with picture realism. Thus, high picture realism increases the intensity of personality attribution for agreeableness, emotional stability, and openness. These traits increase with picture realism, but conscientiousness and extraversion do not. Moreover, the results show that picture realism is positively associated with the users' confidence in assessing the persona's personality ($B = 0.080$, $p < 0.001$). Thus, H2b is fully supported: Picture realism increases the users' confidence in assessing the persona's personality.

5.3 RQ3: Is Having Any Picture Better than Having No Picture at All?

This RQ, and the associated H3, was addressed using t-tests, where we compared the means of all the picture treatments against the means of the non-picture treatments and expected the picture treatments to score higher than non-picture treatments. We chose to compare the means of all picture variations to the non-picture variation because of the question formulation ('any picture' implies that a comparison against the means of all is suitable). Although the scores for personas with pictures were generally higher, the results show that there is no significant difference among the means of picture versus non-picture treatments for neither *clarity* ($M = 5.50$ vs. $M = 5.44$, respectively), $t(445) = -0.38$, $p = 0.702$; *completeness* ($M = 4.89$ vs. $M = 4.59$), $t(445) = -1.76$, $p = 0.079$; *consistency* ($M = 5.42$ vs. $M = 5.49$), $t(445) = 0.47$, $p = 0.641$; *credibility* ($M = 5.11$ vs. $M = 5.01$), $t(445) = -0.52$, $p = 0.605$; nor *empathy* ($M = 4.89$ vs. $M = 4.73$), $t(445) = -0.84$, $p = 0.400$.

When comparing personas with RP to personas with no picture, the results show significant differences for completeness ($t(131) = 2.640$, $p < 0.01$; $M = 5.11$ vs. $M = 4.49$, respectively), credibility ($t(131) = 4.262$, $p < 0.001$; $M = 5.86$ vs. 5.04), and empathy ($t(131) = 2.545$, $p < 0.05$; $M = 5.32$ vs. $M = 4.71$), but not for *clarity* ($t(131) =$

1.822, $p = 0.071$; $M = 5.75$ vs. $M = 5.40$) or *consistency* ($t(131) = 0.563$, $p = 0.575$; $M = 5.56$ vs. $M = 5.46$). Additionally, when comparing personas with RC to personas with no picture, the results show no significant differences for any of the persona perceptions.

Therefore, H3 is not supported: Having some picture is not better than no picture at all – personas with *any* picture do not have higher perception scores than personas without pictures, but only real pictures show statistically significant changes in the user perceptions.

5.4 RQ4: Is There an Uncanny Valley Effect Associated with Persona Pictures?

Mori introduced the concept of the uncanny valley in 1970 [56] after observing that as the appearances of robots became more human-like, they appeared more appealing – but as the robots became very close to being realistic, people found the small imperfections in them disturbing. In design, the uncanny valley is often considered as the hypothesized relationship between an entity's resemblance to a human being (realism) and the users' emotional responses to the entity.

Aligned with this notion, Figure 8a illustrates a non-linear trend on the macro-average of all persona perception scores. The perception scores generally increase (from right to left), but before RP, there is a noticeable drop taking place at RC. RC aims to mimic the texture and facial details of RP while not being a real photograph. As the uncanny valley hypothesis suggests, pictures that get "too close" to reality without being real are not considered optimal for user perceptions.

Another indication of the uncanny valley effect is the exception of SC from the pattern observed in Figure 8b, where SC (cartoon without a face) is considered as less realistic than SL (the mere silhouette picture). Spearman's correlation coefficient quantitatively shows the non-linearity between the rank of the picture

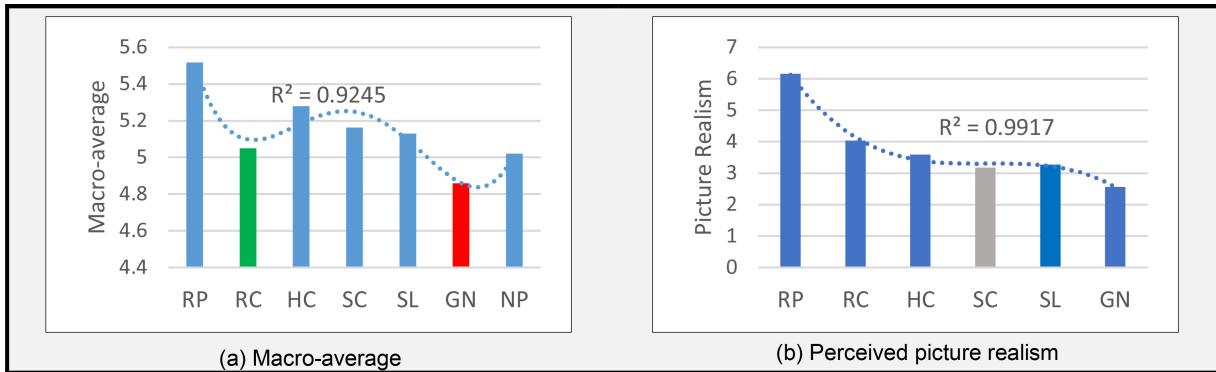


Figure 8: Uncanny valley of persona pictures. (a) The macro average (i.e., the aggregated mean score across all tested perceptions) increases going from the right (less realistic) to the left (more realistic) but shows a sudden drop for RC (green bar), which is the realistic cartoon picture. Also, interestingly, the GN picture (red bar) scores lower on the perceptions than having no picture at all. (b) Another sign of uncanny valley is observed in the sense that SL (grey bar), which adds detail such as clothes, hair, and race (but not a face), is perceived as less realistic than the mere silhouette profile picture.

realism and the rank of the perceptions (macro-average), which is $\rho = 0.600$ (i.e., a strong but not perfect relationship).

5.5 Qualitative Analysis of the Open Answers

The data for the qualitative analysis was from a free form question the participants were asked after seeing the persona (“Describe your first impression of the persona.”). These answers were stored in a spreadsheet. All the open answers ($n = 447$) were read by one of the researchers to identify mentions of pictures or appearance. Twenty-two (4.9%) responses included such mentions. We did not specifically organize the answers to themes. Instead, we reflected their meaning, on one hand, for the obtained quantitative results and, on the other hand, for our previous knowledge on persona perceptions (e.g., stereotyping [79] and stock photo effect [68]). This was followed by writing up the obtained insights and giving supportive quotations.

Only a small fraction of the open answers ($n = 22$, 4.9%) referred to the persona’s picture when asked to describe their first impression of the persona. This is interesting because even though the picture had statistically significant effects on the perception of the personas, the participants rarely made a vocal note of that. Thus, it appears the picture’s effect is either subconscious or at least not articulated as the most influential information when asked. It is possible that some participants did not want to appear “superficial,” judging the persona based on the picture, even though their quantitative evaluations were affected by the picture. Most commonly, the participants referred to the persona’s quotes and interests as the basis of forming their first impression. Those that referred to pictures did seem to assert some stereotypes based on the pictures. These stereotypes were attributed to the persona’s political stance:

- “Picture was first thing I saw, and impression was a **liberal working in IT/engineering** or a philosopher who is anti-war. This was reinforced by the info/blurb though surprised they worked in production field [sic]” (Comment 393 on Chris-RP, emphasis by us).

- “Seeing this personas profile describes the persona as a **warm liberal person**. That was my first impression.” (Comment 411 on Chris-SC, emphasis by us)

In the case of Agung, where the picture presented a person with glasses and a computer, some comments considered the persona as “geeky”:

- “The persona seems a passionate character that like [sic] matters arising from political crisis and also **seems nerdy**.” (Comment 268 on Agung-RP, emphasis by us)
- “geeky” (Comment 266 on Agung-RP)

In contrast, the picture of Chris, although also having glasses, was interpreted very differently. One participant described Chris as a “typical Silicon Valley kind of guy” (Comment 400 on Chris-SC), while another participant inferred, “My first impression on [sic] the persona was towards the negative. I saw it/him as someone who was most likely a drug addict, college dropout and some few criminal records [sic]” (Comment 397 on Chris-RC). Chris was also described as looking like a “difficult person” (Comment 300 on Chris-RC). These are examples of the end users of the personas projecting their own biases on the personas. We intentionally included Chris to avoid the issue of the “stock photo” effect [68]. However, some of the participants may have reacted negatively to Chris’s long hair and facial expression. Additionally, a couple of participants were disturbed by the lack of realism in the non-gendered pictures of Chris:

- “No picture so straight away don’t think of them as very ‘human [sic].’” (Comment 385 on Chris-GN)
- “A little mysterious, would have been better if there was a profile picture. Their views seem generally normal and not too outrageous.” (Comment 392 on Chris-GN)

Finally, one comment referred to the pictorial style:

- “Her profile picture was cartoon-like, so that made her a little hard to relate to. She seemed interesting, although some of her quotes didn’t make a lot of sense (without the context).” (Comment 83 on Ashley-RC)

Table 4: Evidence for the hypotheses. ✓ = Fully Supported (bolded).

Hypothesis	Result
H1a Picture realism increases the clarity of the persona.	✓
H1b Picture realism increases the completeness of the persona.	✓
H1c Picture realism increases the consistency of the persona.	✓
H1d Picture realism increases the credibility of the persona.	✓
H1e Picture realism increases the users' empathy towards the persona.	✓
H2a Picture realism increases the intensity of the personality traits that users attribute to the personas.	partially supported
H2b Picture realism increases the users' confidence in assessing the persona's personality.	✓
H3 Having some picture is better than no picture at all – that is, personas with pictures score higher on most perceptions than personas without pictures.	not supported

Table 5: Effect sizes (η^2 = partial eta-squared), darker color indicates stronger effect. The effect sizes for persona perceptions tend to be medium or large, whereas those for confidence and personality ratings are small. This implies that the picture type had a stronger effect on persona perceptions than on the personality ratings.

Construct	η^2	Interpretation
PPS		
Clarity	.039	MEDIUM
Completeness	.087	MEDIUM
Consistency	.047	SMALL
Credibility	.23	LARGE
Empathy	.16	LARGE
TIPI		
Extraversion	.001	SMALL
Agreeableness	.027	SMALL
Conscientiousness	.011	SMALL
Emotional	.029	SMALL
Openness	.039	SMALL
CONFIDENCE		
Confidence	.04	SMALL
NOTE: Thresholds used: small = .01; medium = .06; large = .14 [29]		

5.6 Summary of the Results

Table 4 summarizes the results. The full results of the General Linear Models with fixed factors (coded as dummies), covariates, and standard errors are shown in the Supplementary Material (https://www.dropbox.com/s/gk9qpdi1jvena9xp/Supplementary%20Material_c.zip?dl=0). Effect sizes are shown in Table 5

6 DISCUSSION

6.1 Theoretical Implications

Given that the oft-mentioned justification for personas is the generation of empathy [24, 63], the fact that less realistic images have large effects on credibility and empathy seems a critical advantage

of using realistic photographs. Also, the important perceptions of clarity and completeness had medium-sized effects. Therefore, the persona perceptions are more strongly affected by the type of picture than personality attribution. So, while a rupture from authentic imagery does not necessarily remove the view of the persona as a *real person*, it does substantially decrease the perceptions of clarity, completeness, consistency, credibility, and empathy – concepts that can be regarded as design goals for rounded personas [72].

Moreover, the small-to-medium effect sizes (see Table 5) for TIPI scores indicate that, even though the increase in the perception scores is statistically significant, in most cases, the effect is not large. This implies that, although realistic photographs are beneficial, users can attribute personality traits to personas with less realistic pictures as well. One interpretation for this is, according to the theory of the mind [8], the exercise of mental modeling that the users carry out. A less realistic character can become a part of “mental role-play,” where the requirement of realism is relaxed [38]. Users’ understanding of personas as fictitious characters [58] may thus mitigate the effect of pictures on personality attribution.

Furthermore, the lack of support for H3 (pictures vs. non-pictures) is surprising and highlights the importance of high realism – not just any picture improves the persona perceptions. When the users are shown personas with less realistic pictures, they need to infer the personality from the textual information, such as the persona’s quotes and topics of interest. Therefore, it appears that users can adjust to the lack of pictures to some degree, which implies that the image is a beneficial but not absolutely necessary part of the persona profile. That being said, the perceptions the users form about personas are stronger when including a more realistic picture, applying to both the perceptions of personas and the personality traits attributed to them. The findings, thus, imply that even for domains (e.g., e-health [47]) in which the picture tends to be considered as secondary information relative to “more serious” persona attributes, considering the type of picture may be worthwhile given its general impact on persona perceptions and personality attribution.

The results also indicate that there is an “uncanny valley” effect associated with the realism of persona pictures. Previously, Nieters et al. [64] alluded to the possibility of persona pictures having an uncanny valley effect: “Some members of UXD team ... suggested that developers would not possess empathy for very human-like figures

to the same extent they could possess with photos of humans” (p. 1820). However, Nieters et al. [64] did not test this effect in the study, and, as such, our findings provide evidence of uncanny valley in the context of persona pictures. Somewhat related to the uncanny valley, our results also suggest that users might find realistic pictures *too informative*. This is because the realistic pictures may have too much room for (negative) stereotyping and unnecessary (random) details. For example, one participant called Chris-RC a “drug addict,” and the laptop of Agung-RP may have caused people to refer to him as a “geek,” or it may be related to Asians being stereotyped as nerdy in the US. With cartoons, it is easier to abstract away from peripherals, backgrounds, and other information that may direct the persona users’ attention to irrelevant details.

Interestingly, the open answers suggest that stereotyping seems to be involved in both RP and HC. Perhaps this is because HC still contains a clear element of race. Only when deducting all signs that could be interpreted in a stereotypical way (i.e., beyond SC), we did not find any stereotypical interpretations in the open answers. This implies a trade-off between increasing realism and decreasing stereotypical thinking: *designers can have one but perhaps not the other*. The key, we believe, is to strike a balance between providing a persona character that people can relate to while limiting extraneous visual cues that can be interpreted in ways that do not correspond with the persona’s “essence”. While finding neutral pictures of real people may cause the persona to be boring or bland, using cartoon-style pictures may not have the same effect, as users expect cartoon pictures to be less detailed than photorealistic pictures of real people [38]. For implementation, this may require the use of photographic professionals to smooth out these extraneous elements from persona images.

6.2 Design Considerations

Our results imply that different pictorial styles “maximize” different user perceptions. Particularly, using real pictures increases the persona’s clarity, completeness, credibility, and empathy – perceptions that can be considered design goals [72]. Consistency, also a design goal for personas [72], is maximized with HC. In general, the differences between RP and HC are the smallest. Therefore, it appears safe to say that *either RP or HC is a good choice for the design of persona profiles*. RC appears to be “too realistic,” without being a real photo (i.e., the uncanny valley effect), so RC may not be a good implementation choice.

Ultimately, persona developers will have to determine when to increase and decrease picture realism, based on their design objectives, for which we provide some guidelines for the HCI community.

When to increase picture realism: When persona developers want to maximize the chances of a persona being perceived as *Credible, Clear, Complete, and Empathetic*, they should opt for the use of real pictures. In general, real pictures are a safe bet for persona profile design.

When to decrease picture realism: At times, there may be good reasons for decreasing picture realism during the design of a persona. A developer may choose to reduce or eliminate human features from a persona if the persona needs to appear more *Consistent*, in which case the human cartoon style is optimal. Persona creators may also want to abstract away from information that may

evoke stereotypical interpretations of the persona. With the use of detailed pictures, the persona may be perceived as real but not in the way that the developer intended it as the biases of end users may be projected on the persona. Figure 9 illustrates the implementation of realistic pictures and cartoon-style pictures in different persona systems.

6.3 Future Research Directions

Several interesting directions for future research exist.

First, in Nieters et al. [64], the design team poses an interesting question: “*Do persona pictures need to stand out or should they fit with social norms to be accepted?*” (paraphrased, p. 1819). We find this a fascinating question and one that our present research did not address. More research is needed on the social meanings that users associate with realistic pictures and whether or not there are other design techniques to control unforeseen consequences besides abstraction.

Second, interestingly, our manual coding revealed that the first-impression answers mentioning the picture or appearances of the persona constituted a small fraction (less than 5%). So, even though the effect of the picture was statistically significant for most perceptions, this is rarely mentioned when asked about. Therefore, there is a discrepancy between what information participants report influences their impression of the persona, and what the evidence suggests. We surmise that either the effect is not consciously recognized by the users or not disclosed due to reasons of social desirability (e.g., the participant not wanting to seem “superficial” by mentioning that appearances influenced their judgment of the persona) (cf. [30]).

Third, the “true” value of the persona picture could possibly be teased out through behavioral data collection. For example, an eye-tracking methodology could be deployed to test how the picture types garner attention from the users – the expectation, based on our results, is that users might focus on the picture to form their first impression of the persona, even though they would spend more time interacting with other information [39].

Fourth, cultural aspects have been identified as important antecedents in persona use and interpretation [19, 20, 59, 60]. Therefore, it would be interesting to inspect (a) how imagery with culturally loaded meanings is interpreted when varying the level of picture realism, and (b) how the cultural origins of the persona users affect their acceptance and perceptions of less and more realistic persona pictures. The participants in our study originated from WEIRD countries (“Western, educated, industrialized, rich and democratic”), but inspecting non-WEIRD cultures would be worthwhile [19].

Fifth, previous research has identified various templates/designs for personas [62, 67]. It would be interesting to see if the template (e.g., the screen-size ratio of text to pictures or the picture’s placement relative to other elements) affects the results.

Sixth, the application scenario may affect the interpretation and requirement of realism. For example, entertainment and infotainment contexts [66] may be more compatible with cartoon style personas than (more “serious”) business contexts (cf. [64]). Future research should investigate the influence of the specific application scenario on users’ requirements for the picture realism.

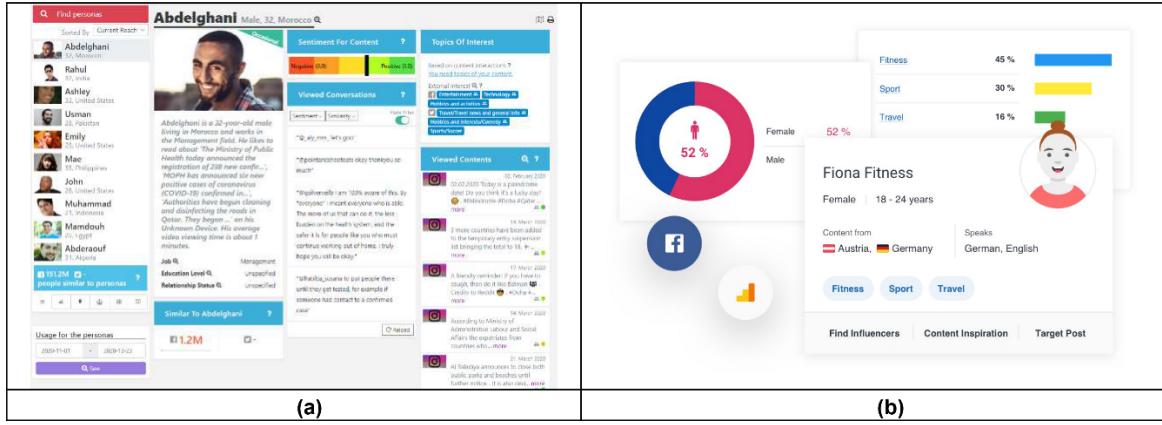


Figure 9: (a) Example of a persona system using realistic pictures (<https://persona.qcri.org>). (b) Example of a persona system using cartoon-like pictures (<https://www.socialbakers.com>).

Seventh, and finally, in a study of avatar stylization, Ablanedo et al. [1] suggest that designers consider the task for determining the desired level of realism. In our case, the task was about evaluating the persona's personality, which may be considered a judgmental task. That is, future research would do well by investigating tasks that more explicitly require empathetic user understanding, as the scores given to the personas might differ according to the type of task.

7 CONCLUSION

One-hundred-and-forty-nine participants evaluated three personas with different pictorial styles. High picture realism increased the participants' perceived clarity, completeness, consistency, credibility, and empathy for the persona. In addition, personas with more realistic pictures were perceived as more agreeable, open, and emotionally stable, with an increased confidence in these personality ratings. As the pictures became less realistic, the persona perceptions were affected negatively. The open answers suggested stereotypical labeling was more common with more realistic pictures. Although the use of abstract images may help mask stereotypical features in persona pictures, this comes at the cost of decreasing the positive persona perceptions and personality traits that users attribute to personas.

REFERENCES

- [1] Jennie Ablanedo, Elaine Fairchild, Tami Griffith, and Christopher Rodeheffer. 2018. Is This Person Real? Avatar Stylization and Its Influence on Human Perception in a Counseling Training Environment. In *International Conference on Virtual, Augmented and Mixed Reality*, Springer, 279–289.
- [2] Nicoletta Adamo, Hazar N. Dib, and Nicholas J. Villani. 2019. Animated Agents' Facial Emotions: Does the Agent Design Make a Difference? In *International Conference on Augmented Reality, Virtual Reality and Computer Graphics*, Springer, 10–25.
- [3] Nicoletta Adamo-Villani, Jason Lestina, and Saikiran Anasingaraju. 2015. Does Character's Visual Style Affect Viewer's Perception of Signing Avatars? In *Second International Conference on E-Learning, E-Education, and Online Training*, Springer, 1–8.
- [4] Tamara Adlin and John Pruitt. 2010. *The Essential Persona Lifecycle: Your Guide to Building and Using Personas* (1st ed.). Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.
- [5] Basant Agarwal. 2014. Personality detection from text: A Review. *International Journal of Computer System* 1, 1 (2014).
- [6] Jisun An, Haewoon Kwak, Soon-gyo Jung, Joni Salminen, and Bernard J. Jansen. 2018. Customer segmentation using online platforms: isolating behavioral and demographic segments for persona creation via aggregated user data. *Soc. Netw. Anal. Min.* 8, 1 (December 2018), 54. DOI: <https://doi.org/10.1007/s13278-018-0531-0>
- [7] Jisun An, Haewoon Kwak, Joni Salminen, Soon-gyo Jung, and Bernard J. Jansen. 2018. Imaginary People Representing Real Numbers: Generating Personas from Online Social Media Data. *ACM Transactions on the Web (TWEB)* 12, 4 (2018), Article No. 27. DOI: <https://doi.org/10.1145/3265986>
- [8] John R. Anderson, Daniel Bothell, Michael D. Byrne, Scott Douglass, Christian Lebiere, and Yulin Qin. 2004. An integrated theory of the mind. *Psychological review* 111, 4 (2004), 1036.
- [9] Elisabeth André, Thomas Rist, and Jochen Müller. 1998. WebPersona: a lifelike presentation agent for the World-Wide Web. *Knowledge-Based Systems* 11, 1 (September 1998), 25–36. DOI: [https://doi.org/10.1016/S0950-7051\(98\)00057-4](https://doi.org/10.1016/S0950-7051(98)00057-4)
- [10] Farshid Anvari and Deborah Richards. 2016. A Method to Identify Talented Aspiring Designers in Use of Personas with Personality. In *Evaluation of Novel Approaches to Software Engineering*, Leszek A. Maciaszek and Joaquim Filipe (eds.). Springer International Publishing, Cham, 40–61. DOI: https://doi.org/10.1007/978-3-319-30243-0_3
- [11] Farshid Anvari, Deborah Richards, Michael Hitchens, and Muhammad Ali Babar. 2015. Effectiveness of Persona with Personality Traits on Conceptual Design. In *Proceedings of the 37th International Conference on Software Engineering - Volume 2 (ICSE '15)*, IEEE Press, Piscataway, NJ, USA, 263–272. Retrieved July 11, 2018 from <http://dl.acm.org/citation.cfm?id=2819009.2819048>
- [12] Farshid Anvari, Deborah Richards, Michael Hitchens, Muhammad Ali Babar, Hien Minh Thi Tran, and Peter Busch. 2017. An empirical investigation of the influence of persons with personality traits on conceptual design. *Journal of Systems and Software* 134, (December 2017), 324–339. DOI: <https://doi.org/10.1016/j.jss.2017.09.020>
- [13] Farshid Anvari and Hien Minh Tri Tran. 2013. Persona ontology for user centred design professionals. In *The ICIME 4th International Conference on Information Management and Evaluation*, Ho Chi Minh City, Vietnam, 35–44.
- [14] M. Aoyama. 2005. Persona-and-scenarios based requirements engineering for software embedded in digital consumer products. In *Proceedings of the 13th IEEE International Conference on Requirements Engineering (RE'05)*, Washington, DC, USA, 85–94. DOI: <https://doi.org/10.1109/RE.2005.50>
- [15] Theo Araujo. 2018. Living up to the chatbot hype: The influence of anthropomorphic design cues and communicative agency framing on conversational agent and company perceptions. *Computers in Human Behavior* 85, (August 2018), 183–189. DOI: <https://doi.org/10.1016/j.chb.2018.03.051>
- [16] David Bamman, Brendan O'Connor, and Noah A Smith. 2013. Learning Latent Personas of Film Characters. In *Proceedings of the 51st Annual Meeting of the Association for Computational Linguistics*, Sofia, Bulgaria, 10.
- [17] Björn Bengtsson, Judee K. Burgoon, Carl Cederberg, Joseph Bonito, and Magnus Lundeberg. 1999. The impact of anthropomorphic interfaces on influence understanding, and credibility. In *Proceedings of the 32nd Annual Hawaii International Conference on Systems Sciences*. 1999. *HICSS-32. Abstracts and CD-ROM of Full Papers*, IEEE, 15-pp.
- [18] Aline W. de Borst and Beatrice de Gelder. 2015. Is it the real deal? Perception of virtual characters versus humans: an affective cognitive neuroscience perspective. *Frontiers in psychology* 6, (2015), 576.

- [19] Daniel G. Cabrero. 2014. Participatory design of persona artefacts for user experience in non-WEIRD cultures. In *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium papers, and Keynote abstracts-Volume 2*, 247–250.
- [20] Daniel G. Cabrero, Heike Winschiers-Theophilus, and José Abdelnour-Nocera. 2016. A Critique of Personas As Representations of “the Other” in Cross-Cultural Technology Design. In *Proceedings of the First African Conference on Human Computer Interaction (AfriCHI’16)*, ACM, Nairobi, Kenya, 149–154. DOI: <https://doi.org/10.1145/2998581.2998595>
- [21] Daniel G. Cabrero, Heike Winschiers-Theophilus, Jose Abdelnour-Nocera, and Gereon Koch Kapuire. 2016. A hermeneutic inquiry into user-created personas in different Namibian locales. In *Proceedings of the 14th Participatory Design Conference: Full papers-Volume 1*, 101–110.
- [22] Daniel G. Cabrero, Heike Winschiers-Theophilus, and Hedvig Mendonca. 2015. User-created personas—a micro-cultural lens into informal settlement’s youth life. In *IFIP Working Conference on Human Work Interaction Design*, Springer, 57–70.
- [23] Yen-ning Chang, Youn-kyung Lim, and Erik Stoltzman. 2008. Personas: From Theory to Practices. In *Proceedings of the 5th Nordic Conference on Human-computer Interaction: Building Bridges (NordiCHI ’08)*, ACM, New York, NY, USA, 439–442. DOI: <https://doi.org/10.1145/1463160.1463214>
- [24] Alan Cooper. 1999. *The Inmates Are Running the Asylum: Why High Tech Products Drive Us Crazy and How to Restore the Sanity* (1 edition ed.). Sams - Pearson Education, Indianapolis, IN.
- [25] Ewart J. De Visser, Samuel S. Monfort, Ryan McKendrick, Melissa AB Smith, Patrick E. McKnight, Frank Krueger, and Raja Parasuraman. 2016. Almost human: Anthropomorphism increases trust resilience in cognitive agents. *Journal of Experimental Psychology: Applied* 22, 3 (2016), 331.
- [26] Lan Du and Ziqi Wang. 2018. Research on the Annual Reading Report of Academic Libraries Based on Personas. *Open Journal of Social Sciences* 6, 10 (October 2018), 95–105. DOI: <https://doi.org/10.4236/jss.2018.610009>
- [27] Brian R. Duffy. 2003. Anthropomorphism and the social robot. *Robotics and autonomous systems* 42, 3–4 (2003), 177–190.
- [28] Autumn Edwards, Chad Edwards, Patric R. Spence, Christina Harris, and Andrew Gambino. 2016. Robots in the classroom: Differences in students’ perceptions of credibility and learning between “teacher as robot” and “robot as teacher.” *Computers in Human Behavior* 65, (December 2016), 627–634. DOI: <https://doi.org/10.1016/j.chb.2016.06.005>
- [29] Andy Fields. 2005. Discovering statistics using SPSS. *Beverly Hills: Sage Publications* 541, (2005).
- [30] Robert J. Fisher. 1993. Social desirability bias and the validity of indirect questioning. *Journal of Consumer Research* 20, 2 (1993), 303–315. DOI: <https://doi.org/10.1086/209351>
- [31] Denae Ford, Thomas Zimmermann, Christian Bird, and Nachiappan Nagapapan. 2017. Characterizing Software Engineering Work with Personas Based on Knowledge Worker Actions. In *Proceedings of the 11th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM ’17)*, IEEE Press, Piscataway, NJ, USA, 394–403. DOI: <https://doi.org/10.1109/ESEM.2017.54>
- [32] Eun Go and S. Shyam Sundar. 2019. Humanizing Chatbots: The effects of visual, identity and conversational cues on humanness perceptions. *Computers in Human Behavior* (January 2019). DOI: <https://doi.org/10.1016/j.chb.2019.01.020>
- [33] Samuel D. Gosling, Peter J. Rentfrow, and William B. Swann. 2003. A very brief measure of the Big-Five personality domains. *Journal of Research in personality* 37, 6 (2003), 504–528.
- [34] Jonathan Grudin. 2006. Why Personas Work: The Psychological Evidence. In *The Persona Lifecycle*, John Pruitt and Tamara Adlin (eds.), Elsevier, 642–663. DOI: <https://doi.org/10.1016/B978-012566251-2/50013-7>
- [35] Frank Y. Guo, Sanjay Shamsadasani, and Bruce Randall. 2011. Creating Effective Personas for Product Design Insights from a Case Study. In *Internationalization, Design and Global Development* (Lecture Notes in Computer Science), Springer, Berlin, Heidelberg, 37–46. DOI: https://doi.org/10.1007/978-3-642-21660-2_5
- [36] Penny Hagen and David Gravina. 2006. Sharing through Artefacts: client-user centred design. *The object of interaction: the role of artefacts in interaction design* (2006), 13.
- [37] Joseph F Hair, William C Black, Barry J Babin, and Ralph E Anderson. 2014. *Multivariate data analysis*. Pearson Education Limited, Essex.
- [38] Jillian G. Hamilton. 2009. Identifying with an avatar: a multidisciplinary perspective. In *Proceedings of the Cumulus Conference: 38° South: Hemispheric Shifts Across Learning, Teaching and Research*, Swinburne University of Technology and and RMIT University.
- [39] Charles G. Hill, Maren Haag, Alannah Oleson, Chris Mendez, Nicola Marsden, Anita Sarma, and Margaret Burnett. 2017. Gender-Inclusiveness Personas vs. Stereotyping: Can We Have it Both Ways? In *Proceedings of the 2017 CHI Conference*, ACM Press, Denver, Colorado, USA, 6658–6671. DOI: <https://doi.org/10.1145/3025453.3025609>
- [40] Richard J. Holden, Anand Kulanthaivel, Saptarshi Purkayastha, Kathryn M. Goggins, and Sunil Kripalani. 2017. Know thy eHealth user: Development of biopsychosocial personas from a study of older adults with heart failure. *International Journal of Medical Informatics* 108, (December 2017), 158–167. DOI: <https://doi.org/10.1016/j.ijmedinf.2017.10.006>
- [41] Thomas Holz, Mauro Dragone, and Gregory MP O’Hare. 2009. Where robots and virtual agents meet. *International Journal of Social Robotics* 1, 1 (2009), 83–93.
- [42] Plinio Thomaz Aquino Junior and Lucia Vilela Leite Filgueiras. 2005. User modeling with personas. In *Proceedings of the 2005 Latin American conference on Human-Computer Interaction*, ACM, 277–282.
- [43] Justin Larner. 2014. Value-led personas: a methodology to promote sustainable user-centered design? *Working paper* (2014). Retrieved from <https://eprints.lancs.ac.uk/id/eprint/76219/>
- [44] Susan Laschinger, Jennifer Medves, Cheryl Pulling, Dr Robert McGraw, Brett Waytuck, Margaret B. Harrison, and Kasey Gambeta. 2008. Effectiveness of simulation on health profession students’ knowledge, skills, confidence and satisfaction. *International Journal of Evidence-Based Healthcare* 6, 3 (2008), 278–302.
- [45] Makayla M. Lewis and Lizzie Coles-Kemp. 2014. Who says personas can’t dance?: the use of comic strips to design information security personas. In *Proceedings of the extended abstracts of the 32nd annual ACM conference on Human factors in computing systems - CHI EA ’14*, ACM Press, Toronto, Ontario, Canada, 2485–2490. DOI: <https://doi.org/10.1145/2559206.2581323>
- [46] Frank Long. 2009. Real or imaginary: The effectiveness of using personas in product design. In *Proceedings of the Irish Ergonomics Society Annual Conference*, Irish Ergonomics Society Dublin.
- [47] Yuhan Luo, Peiyi Liu, and Eun Kyung Choe. 2019. Co-Designing Food Trackers with Dietitians: Identifying Design Opportunities for Food Tracker Customization. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI ’19*, ACM Press, Glasgow, Scotland UK, 1–13. DOI: <https://doi.org/10.1145/3290605.3300822>
- [48] Jiao Ma and Cindy LeRouge. 2007. Introducing User Profiles and Personas into Information Systems Development. *AMCIS 2007 Proceedings* (December 2007). Retrieved from <http://aisel.aisnet.org/amcis2007/237>
- [49] Maness, J. M., Miaskiewicz, T., and Sumner, T. 2008. Using personas to understand the needs and goals of institutional repository users. *D-Lib Magazine* 14, 9/10 (2008), 1082–9873.
- [50] Nicola Marsden and Maren Haag. 2016. Stereotypes and Politics: Reflections on Personas. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI ’16)*, ACM, San Jose, USA, 4017–4031. DOI: <https://doi.org/10.1145/2858036.2858151>
- [51] Tara Matthews, Tejinder Judge, and Steve Whittaker. 2012. How Do Designers and User Experience Professionals Actually Perceive and Use Personas? In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI ’12)*, ACM, Austin, Texas, USA, 1219–1228. DOI: <https://doi.org/10.1145/2207676.2208573>
- [52] Scott McCloud and A. D. Manning. 1998. Understanding comics: The invisible art. *IEEE Transactions on Professional Communications* 41, 1 (1998), 66–69.
- [53] Rachel McDonnell, Sophie Jörg, Joanna McHugh, Fiona Newell, and Carol O’Sullivan. 2008. Evaluating the emotional content of human motions on real and virtual characters. In *Proceedings of the 5th symposium on Applied perception in graphics and visualization*, 67–74.
- [54] Keith A McNeil, Isadore Newman, and Francis J Kelly. 1996. *Testing research hypotheses with the general linear model*. SIU Press.
- [55] Paul Milgram, Haruo Takemura, Akira Utsumi, and Fumio Kishino. 1995. Augmented reality: A class of displays on the reality-virtuality continuum. In *Tele-manipulator and telepresence technologies*, International Society for Optics and Photonics, 282–292.
- [56] Masahiro Mori. 1970. *Bukimi no tani* [the uncanny valley]. *Energy* 7, (1970), 33–35.
- [57] Lene Nielsen. 2002. From User to Character: An Investigation into User-descriptions in Scenarios. In *Proceedings of the 4th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques (DIS ’02)*, ACM, London, England, 99–104. DOI: <https://doi.org/10.1145/778712.778729>
- [58] Lene Nielsen. 2004. Engaging personas and narrative scenarios. PhD Thesis. Samfundslitteratur Copenhagen, Denmark. Retrieved from <http://personas.dk/wp-content/samlet-udgave-til-load.pdf>
- [59] Lene Nielsen. 2010. Personas in Cross-Cultural Projects. In *Human Work Interaction Design: Usability in Social, Cultural and Organizational Contexts*, Dinesh Katre, Rikke Orngreen, Pradeep Yammiyavar and Torkil Clemmensen (eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 76–82. DOI: https://doi.org/10.1007/978-3-642-11762-6_7
- [60] Lene Nielsen. 2019. Going Global—International Personas. In *Personas - User Focused Design*, Lene Nielsen (ed.). Springer, London, 123–133. DOI: https://doi.org/10.1007/978-1-4471-7427-1_7
- [61] Lene Nielsen. 2019. *Personas - User Focused Design* (2nd ed. 2019 edition ed.). Springer, New York, NY, USA.
- [62] Lene Nielsen, Kira Storgaard Hansen, Jan Stage, and Jane Billestrup. 2015. A Template for Design Personas: Analysis of 47 Persona Descriptions from Danish Industries and Organizations. *International Journal of Sociotechnology and Knowledge Development* 7, 1 (January 2015), 45–61. DOI: <https://doi.org/10.4018/ijskd.2015010104>
- [63] Lene Nielsen and Kira Storgaard Hansen. 2014. Personas is applicable: a study on the use of personas in Denmark. In *Proceedings of the SIGCHI Conference on*

- Human Factors in Computing Systems*, ACM, Toronto, Ontario, Canada, 1665–1674.
- [64] James E. Nieters, Subbarao Ivaturi, and Iftikhar Ahmed. 2007. Making personas memorable. In *CHI '07 extended abstracts on Human factors in computing systems - CHI '07*, ACM Press, San Jose, CA, USA, 1817. DOI: <https://doi.org/10.1145/1240866.1240905>
 - [65] Kristine L. Nowak and Frank Biocca. 2003. The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators & Virtual Environments* 12, 5 (2003), 481–494.
 - [66] Helmut Prendinger and Mitsuru Ishizuka. 2004. Introducing the cast for social computing: Life-like characters. In *Life-Like Characters*. Springer, 3–16.
 - [67] Joni Salminen, Kathleen Guan, Lene Nielsen, Soon-gyo Jung, Shammur Absar Chowdhury, and Bernard J. Jansen. 2020. A Template for Data-Driven Personas: Analyzing 31 Quantitatively Oriented Persona Profiles. In *In the Proceedings of the 22nd International Conference on Human-Computer Interaction (HCI'20)*, Copenhagen, Denmark.
 - [68] Joni Salminen, Soon-gyo Jung, João M. Santos, and Bernard J. Jansen. 2019. Does a Smile Matter if the Person Is Not Real?: The Effect of a Smile and Stock Photos on Persona Perceptions. *International Journal of Human-Computer Interaction* 0, 0 (September 2019), 1–23. DOI: <https://doi.org/10.1080/10447318.2019.1664068>
 - [69] Joni Salminen, Ying-Hsang Liu, Sercan Sengün, João M. Santos, Soon-gyo Jung, and Bernard J. Jansen. 2020. The Effect of Numerical and Textual Information on Visual Engagement and Perceptions of AI-Driven Persona Interfaces. In *IUI '20: Proceedings of the 25th International Conference on Intelligent User Interfaces*, ACM, Cagliari, Italy, 357–368. DOI: <https://doi.org/10.1145/3377325.3377492>
 - [70] Joni Salminen, Lene Nielsen, Soon-gyo Jung, Jisun An, Haewoon Kwak, and Bernard J. Jansen. 2018. "Is More Better?": Impact of Multiple Photos on Perception of Persona Profiles. In *Proceedings of ACM CHI Conference on Human Factors in Computing Systems (CHI2018)*, ACM, Montréal, Canada. DOI: <https://doi.org/10.1145/3173574.3173891>
 - [71] Joni Salminen, João M. Santos, Soon-gyo Jung, Motahhare Eslami, and Bernard J. Jansen. 2019. Persona Transparency: Analyzing the Impact of Explanations on Perceptions of Data-Driven Personas. *International Journal of Human-Computer Interaction* 0, 0 (November 2019), 1–13. DOI: <https://doi.org/10.1080/10447318.2019.1688946>
 - [72] Joni Salminen, João M. Santos, Haewoon Kwak, Jisun An, Soon-gyo Jung, and Bernard J. Jansen. 2020. Persona Perception Scale: Development and Exploratory Validation of an Instrument for Evaluating Individuals' Perceptions of Personas. *International Journal of Human-Computer Studies* 141, (April 2020), 102437. DOI: <https://doi.org/10.1016/j.ijhcs.2020.102437>
 - [73] Thiago Freitas dos Santos, Danilo Gouveia de Castro, Andrey Araujo Masiero, and Plínio Thomaz Aquino Junior. 2014. Behavioral persona for human-robot interaction: a study based on pet robot. In *International Conference on Human-Computer Interaction*, Springer, 687–696.
 - [74] Sercan Sengün. 2014. A semiotic reading of digital avatars and their role of uncertainty reduction in digital communication. *Journal of Media Critiques* 1, Special (2014), 149–162.
 - [75] Sercan Sengün. 2015. Why do I fall for the elf, when I am no orc myself? The implications of virtual avatars in digital communication. *Comunicação e Sociedade* 27, (2015), 181–193.
 - [76] Michal Shmueli-Scheuer, Tommy Sandbank, David Konopnicki, and Ora Peled Nakash. 2018. Exploring the universe of egregious conversations in chatbots. In *Proceedings of the 23rd International Conference on Intelligent User Interfaces Companion*, ACM, 16.
 - [77] Gavin Sim, Abhishek Shrivastava, Matthew Horton, Simran Agarwal, Pampa Sai Haasini, Chandini Sushma Kondeti, and Lorna McKnight. 2019. Child-Generated Personas to Aid Design Across Cultures. In *Human-Computer Interaction – INTERACT 2019 (Lecture Notes in Computer Science)*, Springer International Publishing, Cham, 112–131. DOI: https://doi.org/10.1007/978-3-030-29387-1_7
 - [78] Martin N. Stienen, Felix Scholtes, Robin Samuel, Alexander Weil, Astrid Weyerbrock, and Werner Surbeck. 2018. Different but similar: personality traits of surgeons and internists—results of a cross-sectional observational study. *BMJ open* 8, 7 (2018), e021310.
 - [79] Phil Turner and Susan Turner. 2011. Is stereotyping inevitable when designing with personas? *Design studies* 32, 1 (2011), 30–44.
 - [80] UK Government. 2019. LPC welcomes acceptance of its 2019 minimum wage rate recommendations. GOV.UK. Retrieved August 12, 2020 from <https://www.gov.uk/government/news/lpc-welcomes-acceptance-of-its-2019-minimum-wage-rate-recommendations>
 - [81] UX Stack Exchange. 2014. Gender neutral photos for users who don't yet have a profile picture. *User Experience Stack Exchange*. Retrieved August 12, 2020 from <https://ux.stackexchange.com/questions/58102/gender-neutral-photos-for-users-who-dont-yet-have-a-profile-picture>
 - [82] L. Wang, L. Li, H. Cai, L. Xu, B. Xu, and L. Jiang. 2018. Analysis of Regional Group Health Persona Based on Image Recognition. In *2018 Sixth International Conference on Enterprise Systems (ES)*, 166–171. DOI: <https://doi.org/10.1109/ES.2018.00033>
 - [83] Robert B. Welch, Theodore T. Blackmon, Andrew Liu, Barbara A. Mellers, and Lawrence W. Stark. 1996. The effects of pictorial realism, delay of visual feedback, and observer interactivity on the subjective sense of presence. *Presence: Teleoperators & Virtual Environments* 5, 3 (1996), 263–273.
 - [84] WikiMili. 2020. Collective intelligence. Retrieved from https://wikimili.com/en/Collective_intelligence
 - [85] Michelli X. Zhou, Wenxi Chen, Ziang Xiao, Huahai Yang, Tracy Chi, and Ransom Williams. 2019. Getting virtually personal: chatbots who actively listen to you and infer your personality. In *Proceedings of the 24th International Conference on Intelligent User Interfaces: Companion*, ACM, 123–124.