"There's Something About Noura": Exploring Think-Aloud Reasonings for Users' Persona Choice in a Design Task

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ABSTRACT

Stakeholders like designers use personas to learn about users. After persona development, stakeholders are usually presented with a persona set. However, there is little research on how stakeholders select a persona from a persona set. A think-aloud analysis with 37 stakeholders who were asked to select a persona for a content design task reveals that persona selection is influenced by comparative, non-comparative, and subjective elements. Persona choice is often made with task compatibility in mind: interests, professions, and education were important contextual factors in our focal task. Storifying is commonly applied by stakeholders, reflecting personas' narrative nature. The persona's picture is often evoked, in addition to nationality and name, though demographics do not play a decisive role. Stakeholders refer to a host of persona attributes when explicating their persona choice. Overall, reasonings for persona choice are multifaceted and individualistic, as we might expect given the information-richness of personas.

KEYWORDS

personas, persona choice, design tasks, user research

1 INTRODUCTION

Personas are realistic but not real people that represent distinct groups (or types) of end-users [11]. Personas seek to inform *stakeholders* (e.g., developers, designers, managers, and others) about users' goals, pain points, and motivations [10, 24, 39, 55]; this is information that designers use in making user-centered design (UCD). The purpose of personas is to keep the focus of designers and content creators on the actual users or audience by presenting a human representation of end-user requirements [1, 11, 16].

Personas have been broadly applied in fields like design, software engineering, journalism and online publishing, privacy and cybersecurity, medical science and health informatics, marketing and advertising, and others [2, 6, 11, 14, 26, 33, 39, 55]. For instance, Microsoft[1] and Spotify[2] use or have used personas for user research. Thus, personas are topical in both research and industry.

Stakeholders use personas to make decisions about users, customers, or other people groups that the personas represent. After personas have been created, a selection of them, referred to as a *persona set* [39] (a 'cast' is also used a synonym for set), is given to stakeholders. But the process of stakeholders using the persona set remains understudied. *What factors contribute to a persona's appeal and captivate stakeholders' attention? What drives stakeholders to prefer one persona over others when presented with many? When faced with a specific task, what influences stakeholders' decision to choose a particular persona to assist them?* These motivational questions inspire the current research.

We may know that designers use personas, somehow, through some processes, but we do not know *why* the designers focus their attention and creative efforts on addressing a specific persona's needs over the other personas available in the same set. Until we understand this choice process in more detail, it is difficult to make progress on related fronts: neither in creating diverse persona sets nor their presentation to designers in persona systems which can contain multiple alternative techniques and interfaces.

The importance of this topic is exacerbated by the surge of *interactive persona systems*—that is, online systems that afford the

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[1] https://techcommunity.microsoft.com/t5/driving-adoption/driving-user-adoption-user-personas-and-user-journey-maps/m-p/82058
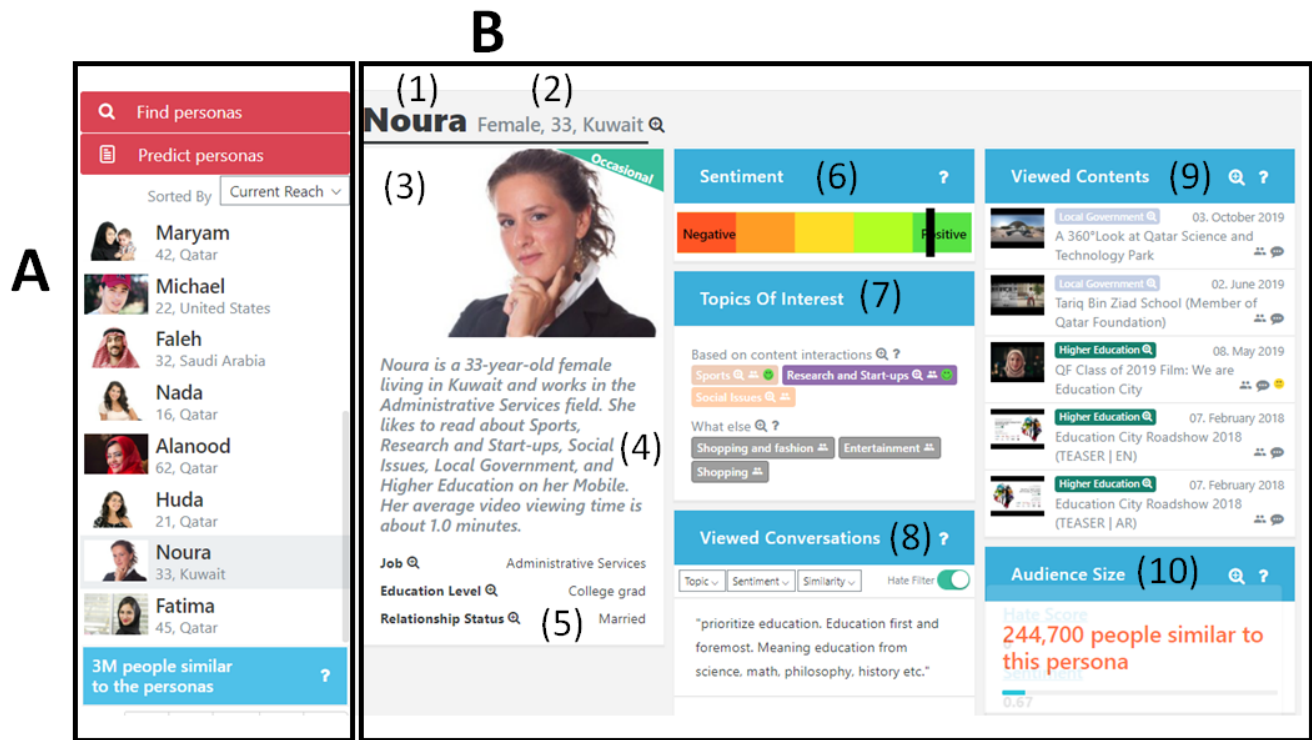[2] https://spotify.design/article/the-story-of-spotify-personas

Figure 1: Screenshot of *Noura* in the persona system. Two central views in the system are the persona listing (indicated by [A]) and the persona profile [B]. By selecting a persona from the persona listing, the system loads the selected persona's profile. Participants were advised to browse the personas freely before choosing one. The full system is available at https://persona.qcri.org/.

flexibility of serving more personas using different UIs (see Figure 1). Thus, the *persona selection problem* now approaches the recommender system problem: which persona (item) should we recommend to a given user? Understanding the process of persona selection thus provides direct utility in designing such systems by providing evidence of stakeholders' thinking process when viewing multiple personas and selecting from them.

The reader may also wonder, "Why does it matter what persona a designer focuses on?". This is a good question, and there is a good answer to it. Let us consider the ideal of creating *inclusive personas* that describe a broad range of user types [8, 22, 23]. This ideal goes into the heart of the persona-creation practice: we want the personas to be reflective of *different* user types; we want them to be varied, non-stereotypical, and not only focused on majority groups.

The principle behind inclusive design with personas [23] is that designers use personas from a wide range of demographics, including marginalized user groups, thus addressing a broader range of needs and user circumstances. When addressing this problem, the studies have thus far focused on creating *more* personas with more diverse attributes [20, 27, 28, 41, 46, 47]. These studies are useful because they increase diversity in the persona set and, therefore, the statistical likelihood of more user types being considered (all else being equal).

However, while being useful, these studies alone are not sufficient. Even when we were to represent the full scope and scale of demographic (or other) attributes within the persona set, the designer will nonetheless be the one who *decides* how to use the personas in a given set. By force of cognitive necessity, the designer will discard some personas from further consideration, focus on a specific persona over the other available ones, and even focus on specific persona information over others. This is the *free-will paradigm* of using personas, of which the current body of literature knows preciously little (as a side note, we show evidence here from two persona sets that the persona choice is not a random process, so the statistical likelihood of including more personas will not yield an even distribution of different personas being considered for design—this effectively validates the free-will paradigm).

Gaining insights into the factors that influence persona choice can provide valuable information to the HCI community in three key areas:

- **Persona design and development** – By empirically analyzing stakeholders' persona preferences and selection patterns, researchers can identify the specific elements and information within persona profiles that stakeholders prioritize and find most relevant. These insights can directly inform the design and creation of more effective and engaging personas.

- **Persona application and use** – Understanding stakeholders' articulated rationale for selecting a particular persona for a given task can shed light on how individuals perceive and relate to personas in practice. This knowledge can contribute to tools and processes supporting the ways in which people interact with and apply personas in the context of design and problem-solving.
- **Advancing persona theory** – Through a thorough analysis of persona choice, we can lay the groundwork for developing a more robust and encompassing theory of persona-user interaction. Such a theory is currently lacking in the HCI literature, and its establishment would provide a valuable framework for future research and practice in the field.

Moreover, apart from the design of personas, our methods and findings can inform the broader knowledge of the design of interaction systems by supporting:

- **Understanding of user decision-making** to inform the design of interaction systems by highlighting the user's thought process, preferences, and priorities.
- **Enhanced user experience** to inform the design of interfaces, navigation flows, and content presentation to support users' decision-making processes better and facilitate their interactions with the system.
- **Personalization and adaptation** to help designers develop systems that dynamically adjust content, features, and recommendations to meet individual user needs and goals better.
- **Iterative design improvements** to incorporate findings about think-aloud reasonings and iteratively test and refine the system to better align with user expectations and preferences.

Persona choice is a crucial yet understudied aspect of the interaction between personas and the stakeholders who employ them. Despite its potential to provide valuable insights into how stakeholders perceive, relate to, and use personas, this topic has received little attention in the research community. The lack of focus on persona choice has resulted in a limited understanding of the strategies and decision-making processes that stakeholders use when selecting one persona over another. This gap in knowledge hinders our ability to comprehend the dynamics at play when stakeholders engage with personas in the context of design tasks. Without a clear understanding of why stakeholders gravitate towards certain personas, we are left with an incomplete picture of the persona-stakeholder relationship. If we do not fully grasp the factors that influence persona choice, we limit our capacity to design and develop personas that effectively resonate with stakeholders and support their design objectives. Furthermore, without a deeper understanding of the human factors that shape persona preferences, we may miss opportunities to optimize the use of personas in design processes and maximize their impact on design outcomes.

To address this critical research gap, we investigate stakeholders' persona choice; i.e., why they choose a certain persona for a design task. Analyzing the reasons behind stakeholders' persona selections, we can uncover novel insights that contribute to the advancement of persona theory and application. Our methodology is based on analyzing think-aloud recordings that capture stakeholders' thinking process and reasoning for persona choice. These recordings were obtained in a user study in which 37 participants from a non-profit organization selected a persona for whom to design content.

2 LITERATURE REVIEW

2.1 Principles of Persona Theory

Nielsen [39] highlights that personas trump commonly occurring preconceptions about users, thereby supporting user-centered design (UCD). Stemming from Cooper [11], personas are intended to represent real user groups through abstractions (or 'mental models') that summarize key design information. More specifically, one of the traditional premises of personas—and the chief reason why personas have become a viable instrument in UCD [21]—is that personas can help align design with end-users' needs [52]. By *personifying* end-user segments [53], making these segments *come to life*, personas allow designers to imagine a perspective other than their own, helping to overcome self-referential design [35]. The assumption is, therefore, that empathy for end-users is important in design, and that personas are valuable tools in evoking such empathy [36, 52, 57] and perspective taking [39].

Based on prior research, a fundamental component of a successful implementation of persona is related to the users gaining access and establishing *empathy* with the personas [24, 36, 51]. A psychological connection between users and personas opens a gateway for empathy, which is crucial for understanding the users at a deeper level in order to make user-centered design choices in various professional tasks, such as eliciting end-user requirements [17]. Grudin [24] asserts that personas have three tenets tied to the psychological behavior of humans (p. 642): (1) People naturally create and use models of other people; (2) the models of real people transfer to models of fictional people (i.e., to personas), (3) the models of other people include complexity and detail—they are holistic [4, 5], which helps predict the behaviors of others under a number of different circumstances.

While considering individual users may be impractical when making decisions about a user base, using a handful of personas is seen as practical or manageable [28, 39]. The widespread notion of manageability in persona theory can be summarized as follows: *Real information about users is turned into a group of personas through a process of persona development. Then, stakeholders use these personas to learn important details and make decisions based on what they learn.*

2.2 Toward Understanding Persona Choice

Drawing from the theory of *selective attention* [29], choosing which persona to design has far-reaching implications. It essentially sets the course for all subsequent decisions and actions. For instance, the circumstances of a young female in Canada can vary drastically from those of an older male in Africa. Yet, both can belong to the same global audience, e.g., for a social media news channel [3]. Hence, selecting personas serves as a critical decision-making mechanism, signifying the designer's commitment to a particular persona [24].

But "why that persona over others?" The matter is not trivial, because this choice effectively whose interests stakeholders prioritize in their decision-making process. Which personas, among the candidates in a persona set, do they focus their attention on?

A prominent reason why persona choice matters is that a common concern in persona research is that stereotyping and biased thinking may enter into the creation or use of personas and that such bias may further marginalize minority end-user groups [21]. Therefore, stereotyping and bias may prevent empathy with a broad spectrum of real end-users while encouraging solidarity with the mainstream opinion [35, 57]. Wilson et al. [57] suggest that bias and stereotyping in persona research may relate to the unquestioned assumption that personas should explicate end-user's needs and how they will use a product or service. They note that the overemphasis on end-user needs and goals obscures the complexities of real end-user experience and some of the other potential values of personas – especially in applications where personas are used to rally political and social consciousness. In evoking empathy with end-users, they argue, user values – including their "desire for emancipation, philosophies and/or political beliefs, and willingness/capacity to take action" (p. 26) [57] – are more important than the end-user needs. This prioritization is particularly evident when designing products where the concern is not with creating a commercial product but with social justice or sustainability.

Numerous user studies in HCI report that users may form a mental connection with the persona [34–36, 42, 43, 49]. This outcome is visible from the way individuals refer to personas (e.g., "he/she") and the way they express emotions and affections (e.g., "I like her / I'm interested in the same topics as him"). According to this rationale, better (as in more end-user-centric) decisions would be made based on a shared connection that evolves when the user interacts with the persona profile. Therefore, *choice* is an essential aspect of using a persona for decision making.

Nonetheless, the process of persona choice is not well understood, which is why our study investigates this topic. Over the years, multiple studies have investigated persona use, but few or none have focused on persona choice. For example, the prominent studies by Friess [19] and Matthews et al. [37] investigated persona use, but not persona choice. The former studied how personas were mentioned or evoked in real design choices in a company, while the latter focused on stakeholders' perceptions of personas. The use of personas is important but so is the choice process, as the actual usage follows from focusing on a given persona or personas.

3 METHODOLOGY

3.1 Research Site and Participants

The data for this study was collected from a non-profit organization that promotes crucial initiatives in research, education, and public health. This organization was selected due to its orientation to use personas in real decision-making. The organization employs personas for two primary purposes: to (a) better understand its online audience, and (b) strategically plan online content creation.

The participants were recruited by members of the organization asking for volunteers. As mentioned, the study was conducted at the organizational workplace.

The study involved 37 participants, comprising 10 females (27%) and 27 males. The participants' average age was 32.9 years (SD = 6.9). The participants' job roles reflected the diverse roles involved in creating end-user experiences in large organizations. These positions included content specialists, copywriters, engineers, data analysts, editors, project managers, researchers, social media managers, and software developers. The participant pool thus represents a cross-section of individuals with varied backgrounds and expertise.

The participants had a varying level of knowledge about personas, with the majority having conceptual experience (71%, n = 26), meaning they were familiar with the concept of personas but had not used them in practice. Slightly less than a third of the participants (27%, n = 10) had some practical experience, having applied personas before, albeit infrequently. Only one participant (3%, n = 1) had extensive experience, regularly using personas in their job. To ensure adequate level of understanding, all participants were explained what personas are and how they are used.

3.2 Persona Creation

The personas were generated using an interactive persona system reported and validated in previous work [2, 3, 32]. Previous persona experiments have applied this system [44, 48, 50], mainly because it (a) offers a standardized method of generating personas from authentic end-user data, (b) enables stakeholders to directly interact with the personas using a web browser, and (c) logs stakeholders' interactions with personas in the system logs.

The persona generation system generated two persona sets (**PS**), with a number of personas predefined by us. **PS1** contained 5 personas, and (**PS2**) contained 15 personas and thus had more demographic diversity than **PS1** (see Table 1 and Figures 2 and 3 for details[3]). The persona system generated both sets from YouTube Analytics statistics depicting the organization's YouTube audience. Besides varying the set size hyperparameter, which afforded different personas for the two sessions each participant had, no other manipulations to the personas or the sets were made.

Both sets were generated from the focal organization's YouTube channel data retrieved via the *YouTube Analytics API*[4] with the channel owner's permission and in accordance with the platform's terms of service. The data was based on 1.5M views—aggregated by demographic groups containing age group, gender, and country—on 125 videos. The persona generation method [2, 3, 32] outputs personas with a (1) name, (2) demographics (age, gender, country), (3) picture, (4) text description, (5) sociographics (job, marital status, education), (6) sentiment, (7) topics of interest, (8) quotes, (9) most viewed content, and (10) the number of people the persona represents.

3.3 Task Design

The task involved promoting the organization as a workplace to a specific persona. Each participant was informed that a persona is a fictitious person representing a real user segment, and that the personas provided to the participants were based on the organization's

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[3]Screenshots from the system showing the full persona profiles are available in the online supplementary material.
[4]https://developers.google.com/youtube/analytics

actual audience data from their YouTube channel, representing different audience segments.

In their task, the participant was asked to use the information provided in the persona to promote the organization. This was done by the participant creating a targeted message that they think resonates with the persona and effectively promotes the organization as an attractive workplace for individuals similar to that persona. The task was designed in collaboration with the organization to ensure it is realistic and portrays an authentic use case of personas in the organization's context. More broadly, this task mirrors a common social media content design activity, where content is tailored to a specific target audience. The organization recommended using this task in the study, as they considered it a natural fit for their intended application of personas. Consequently, the task represents an authentic use case of personas within an organizational setting, reflecting how personas are employed to inform and guide content creation efforts aimed at specific user segments.

3.4 Data Collection

In the study, each participant had two sessions completing an identical task, but with a different set of personas. Through this, we could collect more data on persona choice. According to the within-subjects design, we counterbalanced the order of the persona sets so that the participants were randomly assigned to either first see the **PS1** and then the **PS2**, or the other way around.

For each session, we welcomed the participant, provided the participant with the consent form, and explained the study's purpose. There were two stations, each with identical workstations and screens; the workstations were used for data collection of interaction with the persona system. For each station, there was one moderator. Each moderator followed identical study scripts, so all participants experienced a similar procedure for the study.

Following the welcoming, the participants used the interactive persona system to explore the available personas and eventually select one that best suited the given task. The participants could freely interact with the system, including switching from one persona to another and perusing the personas' information, including topics of interest, social media quotes, and so on. Figure 1 shows a screenshot of the system.

We used the concurrent think-aloud method [18], encouraging the participants to explain aloud what they were doing and why. We only spoke to a participant when they stopped voicing their thinking to not interfere with the task completion. We did not opt for complete non-obstruction, since we specifically wanted to learn about the participants' reasoning while carrying out the task. We recorded the participants' voices, and the recordings were later transcribed to text for analysis by professional human transcribers.

For an exploratory data analysis, we logged the visits to the persona profiles that are based on the mouse-tracking data logged using *Persona Analytics*, a user tracking system developed for the interactive persona system [31, 45]. The persona choices were obtained from the survey responses given by the participants after each persona usage session.

Table 1: Persona characteristics.

	PS1 (less diverse)	PS2 (more diverse)
Mean age (SD)	34.2 (8.5)	32.9 (11.7)
Min age	25	16
Max age	38	62
Female ratio	20.0 %	53.3 %
Unique countries	2	4

(a) Jafar   (b) Ghada

(c) Bassam   (d) Faisal

(e) Osamah

Figure 2: The images in PS1. Two personas were most frequently selected by the participants: Jafar (a) and Bassam (c). To view the complete information associated with each persona, please refer to the screenshots provided in the Supplementary Material.

3.5 Think-Aloud Transcription and Analysis

All recordings were manually transcribed by three professional transcribers that were recruited from Upwork, a freelancing platform. There were approximately 25 hours of audio (M = 40, SD = 10 minutes). This included 141,495 words, corresponding to 138 pages of transcribed text (in MS Word with an 11-point font size and line spacing of 1.08). In other words, this corpus provides a rich dataset dealing with cognitive aspects of the persona selection process, based on utterances that verbalize the users' thinking.

We performed qualitative analysis on the think aloud (TA) transcripts [18] from the experiment. The TA transcripts were a combination of concurrent and retrospective reports [15] wherein the participants were encouraged to speak during the task concurrently and answered questions about the task and their choices retrospectively after the completion. The participants were also thinking aloud while completing the post-session surveys, and several insightful comments were obtained during this period. The lead author solicited research questions from all authors and ran a sample of the transcripts through a dialectical process, which entails *"a recursive, iterative process in developing the codes and increasing [the] understanding of the phenomenon"* [56] to generate a codebook used to analyze all transcripts. The other authors commented on the codes based on (a) their relevance to personas, and (b) their relevance to *in situ* observations (i.e., comparing to notes taken from the actual experiment). Ultimately, the codes were aggregated

(a) Naif

(b) Rami

(c) Sami

(d) Rajab

(e) Imran

(f) Cambell

(g) Jameela

(h) Maryam

(i) Michael

(j) Faleh

(k) Nada

(l) Alanood

(m) Huda

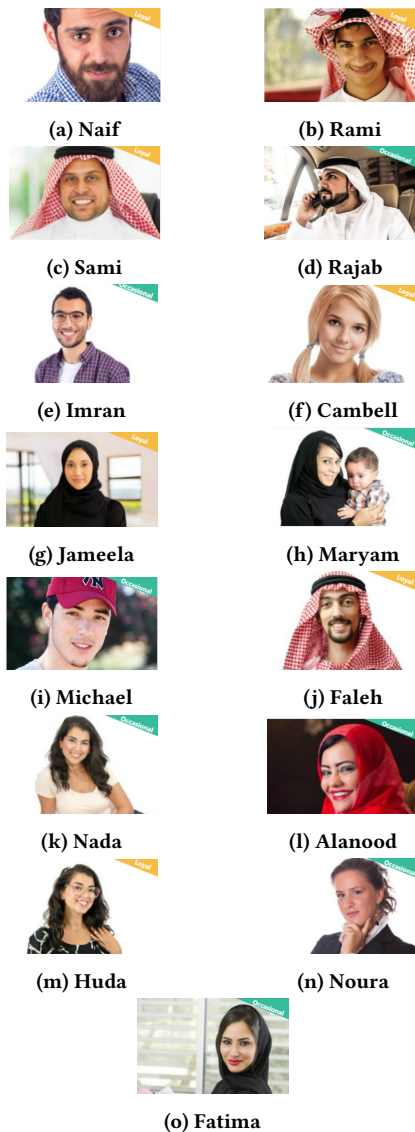**(n) Noura**

(o) Fatima

Figure 3: The images of personas in PS2. Except Sami (c) and Alanood (l), all personas were selected by at least one participant during the study. Among the chosen personas, Imran (e) was most frequently selected. To access the complete profiles of each persona, please consult the Supplementary Material.

into recurring sub-themes, and sub-themes were aggregated into emerging themes through an inductive thematic analysis [7].

Coding helped us to convert the TA transcripts into meaningful data units, which were examined through frequency, word count, and sentiment analysis. For sentiment analysis, we mobilize the *AFINN Sentiment Lexicon* by [38] that rates English words between -5 (most negative) and 5 (most positive), along with multipliers and diminishers, in order to create comparative sentiment scores between sentences.

4 RESULTS

4.1 Exploratory Analysis Results

The participants could name the persona they chose in 82.4% of the task completions. In the rest of the completions, they generally referred to the persona (e.g., "the young woman"). In this analysis, we only include 82.4% of the completions (n = 61) where the participants could name the persona, and we can thus operationalize the persona's age, gender, and country.

The overall engagement with the system increased with the number of personas, with 55.6% more profile visits for 15 personas (n = 985) than for 5 personas (n = 633). However, there are fewer visits per persona, with 15 personas (M = 65.7) having more visits than 5 personas (M = 126.6), Z = -2.97, p = .003. This represents a 48.1% decrease.

In other words, even though the total number of visits per persona more than doubles, the number of visits per persona nearly halves. This simply means the participants use more personas when given the chance but they do not linearly increase their attention to viewing each persona but instead make fewer comparisons (recall that a visit indicates the participant switching from one persona to the other in the system UI).

We also tested if the persona visit frequency was associated with the persona's age, gender, or country of origin. We grouped the countries into "Qatar" and "Others" due to the large prevalence of Qatari personas (which stemmed from the nature of the dataset from which the personas were created).

A slight negative correlation between age and the number of visits was observed (r = -0.148), but it was not statistically significant (p = 0.522). However, a statistically significant difference in the number of visits between gender was found using the Mann-Whitney U test. On average, males (M = 91.33, SD = 36.33) had more visits than females (M = 58.00, SD = 28.27), U = 86.0, p = .025.

When comparing the visits to personas from Qatar with other countries, even though the average number of visits for personas from Qatar was higher (M = 82.60, SD = 41.27) compared to those from other countries (M = 63.17, SD = 15.26), the Mann-Whitney U test indicated no statistically significant difference, U = 50.5, p = .697.

So, these results suggest a significant association between gender and the number of visits but no significant association between the country group and the number of visits.

The chi-square tests indicated that there was no significant association between participant gender and the chosen persona gender, $\chi^2(1, N = 61) = 0.196$, p = .658, whereas a significant association was observed between the persona number and the chosen persona gender, $\chi^2(1, N = 61) = 9.178$, p = .002.

In other words, the participants did not systematically prefer personas whose gender matched that of the participant. However, they selected a male persona much more frequently when using the five-persona set (83.9%

We leave further quantitative testing to other work; in accordance with our RQs, the remainder of this work focuses on reporting the think-aloud analysis.

4.2 Think-Aloud Findings

The analysis yielded three main themes: (1) reasons for choosing a persona; (2) ways of linking the personas with the task; and (3) reasons for focusing on or examining certain persona features, along with their sub-themes. We accordingly map these themes and sub-themes to our research questions (see Table 2).

4.3 Reasons for Choosing a Persona

This theme has four sub-themes: (1) comparative (see Table 3); (2) non-comparative; (3) subjective; and (4) focused.

4.3.1 Comparative. These codes are used when participants compare multiple personas based on various criteria. We grouped the criteria that were mentioned frequently. The personas were compared dominantly on interests (23.2%), nationality (15.5%), gender (12.9%), and age (12.3%). The least mentioned comparative criteria were comments (4.5%), audience size (5.2%), images (5.8%), average viewing time, and most viewed content (9%). Some of these results were surprising, especially when each code was compared with the space (in terms of pixel size) the criteria occupied on the persona profile screen (see Figure 4). Audience size had the richest units regarding the average word count ($\bar{x}$ = 30.38). Sentiments were strong when comparing images ($\bar{x}$ = 0.123) and interests ($\bar{x}$ = 0.1084).

Interests, Professions, and Education: A persona is presented with six topics of interest: three with the title "based on content interactions" and three with the title "what else." Additionally, the "job" and "education level" information given for the persona coincides with discussions around interests. Some examples of these units are: *"yeah, they all seem to be very interested in government and social issues"* (B07); *"so, this is the first different one, I think [...] he's focused on higher education and undergraduate education [and] I think this was different"* (A13); *"I think there were multiple personas that were interested in working in [...] social and community services"* (B22); *"Imran [persona] stood out because of his interest in education [and] that wasn't something similar to a lot of others"* (A09); and *"you know, most of them seem to come from similar professional backgrounds in terms of community service, that type of stuff, and then also lots of similarities related to the kind of things that they're interested in reading about or pages that they're visiting"* (A15).

Nationality, Names, and Languages: Nationality was the second biggest comparison criterion for personas. This was an interesting result, as **PS1** consists of four personas from Qatar and one from Saudi Arabia, making it less likely to initiate comparisons. In contrast, **PS2** was comparatively more diverse, with 10 from Qatar, 2 from Kuwait, 2 from the United States, and 1 from Saudi Arabia. Some examples of comparison units were: *"you can sort if [...] they are family or something... or they are Qataris or from Europe"* (B03); *"so, four out of these five are living into Qatar [...] I have to choose... four of them again from the dress, they all look like locals"* (B02); *"I'm going to start with Saudi Arabia because this is the only one who's different from the rest of them"* (A09); *"so, here they are all Middle Eastern"* (B19); and *"I'm trying to see outside of Qatar and Saudi, international audiences, but I guess that option isn't there"* (B11).

Gender and Marital Status: Gender was an important factor in drawing participants' attention, especially the single female persona (20%) in the 5-persona treatment was easily distinguishable from the other personas. Examples: *"The woman is distinct because she*

was just the only one" (B22); *"we will just skip the lady for now just to look at how this compares to the other man just to see if the only difference is age or if they're similar in terms of interests."* (A01). In contrast, in the 15-persona treatment, there were 8 females (53.3%). For example: *"So, you have more females here, which is interesting. The previous one had only one female in five."* (B01). Not surprisingly, gender also coincided with comparisons around marital status such as: *"Ok, so... maybe, we can like to put a single mother"* (A04) or *"I mean, I think two of them are married, and the rest of them are single [...] I can tell they're bachelors"* (B15).

Age: Comparisons based on age focus on rough categories like young versus old or 20s versus 30s. Age has been offered as a physical attribute that is perceived to steer behaviors. Comparison units based on age reflected some of the general bias against age-related attitudes: *"Why did you choose this persona? Young, stable mind, because once you enter 30s it's like you become a more stable thinker than you are actually in your 20s. In your 20s you're still struggling between what you want and what you're doing."* (A14); *"The difference between ages is really strong. If you target teenagers who are 15 to 25 years old, it's totally different than targeting people who are from 45 to 55."* (B10); *"This is a persona that I really don't know, but the range of age [has] more [propensity] to set new things... I don't know how to explain it."* (B08).

Average Viewing Time and Most Viewed Content: Viewing time is presented as a single sentence in the persona's short bio. Despite that, it did not stay as obscure in the participants' discussions. Surprisingly, the most viewed content, which has a more prominent and visible UI element on the screen, was not as frequently mentioned as average viewing time with its much smaller screen space. Examples are: *"the fifth persona that lives in Saudi Arabia actually has less, has shorter time, like, 0.9 minutes, so this is interesting"* (B12) and *"Campbell [persona], I will tell you why [...] because she has a view of 1.6 minutes, which is actually higher than anyone till now"* (A14).

Images: Although images are arbitrary selections chosen to illustrate the represented persona segment, they result in sentimentally strong responses from the participants (the strongest among all codes). The image is the least data-driven of all the components of a persona. Previous studies suggest that the images in virtual social profiles and online avatars are the primary elements that cause trust and empathy in digital communication [12, 13]. In the TAs, talking about images resulted in positive responses such as *"I like his picture here, he has a Falcon, that's unique..."* (B01) and *"also, like I want to say that his photo was authentic like it looks like it's an actual person as opposed to the other ones that I felt like these are not real people"* (A10).

Audience Size and Loyalty: Audience size is information presented in bigger and red font on the bottom right of the screen with the text "[X] people similar to this persona." Although it constructs the reach potential of the persona, it was surprisingly underused for comparative purposes (only 5.8%). It is also one of the least sentimentally poor codes. Some examples are: *"I thought that Jafar [persona] is not very big, but it turns out that that's the biggest audience that we have this time"* (B14) and *"let's see the audience size, so, this is now I guess from the highest ones"* (B19). The poor sentiments may be resulting from the fact that audience sizes were generally small for most personas. In the **PS1**, the audience sizes changed

Table 2: Themes and sub-themes of TA analysis. Sentiments were calculated using AFINN Sentiment Lexicon [38].

Theme (% to Total)	Sub-Theme	Explanation	Frequency (% to Theme Total)	Word Count $\bar{x}$	AFINN Sentiment $\bar{x}$
Reasons for choosing or focusing on a persona (55.8%)	Comparative	Comparing as a strategy	155 (43.9%)	17.22	0.082
	Non-comparative	Mobilizing given information	121 (34.3%)	28	0.1085
	Subjective	Storifying as a strategy	69 (19.5%)	23.47	0.1366
	Focus	Elimination as a strategy	8 (2.3%)	17	0.0421
Ways of linking the personas with the task (20.7%)	Target Group	Defining target group as a strategy	72 (55%)	26.99	0.1054
	Message	Focusing on message as a strategy	27 (20.6%)	37.41	0.1058
	Design	Dissecting persona UI	13 (9.9%)	29.69	0.0946
	Platform	Understanding the platform as a strategy	11 (8.4%)	27.45	0.0853
	Diversity	Information diversity	8 (6.1%)	27.63	0.1224
Focusing on / examining a certain persona feature (23.5%)	Features	Unpacking given information	138 (92.6%)	19.28	0.0988
	Completeness	Integrity of information presentation	11 (7.4%)	26.45	0.0942

Table 3: Coding for the comparative sub-theme. Sentiments were calculated using AFINN Sentiment Lexicon [38].

Sub-Theme	Code	Frequency (% to Sub-Theme Total)	Word Count $\bar{x}$	AFINN Sentiment $\bar{x}$
Comparative	Interests (32), Professions (3), and Education (1)	36 (23.2%)	22.97	0.1084
	Nationality (21), Names (2), and Languages (1)	24 (15.5%)	19.79	0.0478
	Gender (16) and Marital Status (4)	20 (12.9%)	25.45	0.0969
	Differentiation (19)	19 (12.3%)	20.63	0.0762
	Age (18)	18 (11.6%)	27.44	0.0826
	Average Viewing Time (12) and Most Viewed Content (2)	14 (9.0%)	24.57	0.0584
	Images (9)	9 (5.8%)	24.22	0.123
	Audience Size (7) and Loyalty (1)	8 (5.2%)	30.38	0.049
	Comments (4) and Sentiments (3)	7 (4.5%)	23.57	0.0955

between 5,900 and 45,000 ($\bar{x}$ = 21,340). The difference was much higher in the **PS2**, with the smallest being 3,800 and the highest being 1,700,000 ($\bar{x}$ = 200,887).

Comments and Sentiments: Comments (seen on the screen as "viewed conversations") and sentiments (seen on the screen as a colorful bar) had the least mentions when comparing personas. This is surprising since sentiments and comments form a full middle column on the screen, with the sentiments bar especially colorful and conspicuous. An explanation might lie in the fact that the participants did not instantly grasp the meaning of the information. This was indicated in units such as *"this one is the same comment, you know, Rajab [persona] and Imran they are showing exactly the same"* (B19) and *"they had very similar sentiments; the difference in sentiments were difficult to appreciate..."* (B08).

Differentiation: Finally, 12.3% of the units were comments about the diversity of the personas. In most cases, the participants were critical of the overlapping information and were drawn to the persona that "stood out" whether it was the best persona for the task at hand or not. Some critical comments were: *"so now I'm just reading all of the descriptions, but honestly, almost none of them seemed different"* (A13); *"so, I'm looking at the list of personas, and I'm trying to, sort of, distinguish the difference between them"* (A03); and *"they just seemed very similar in a lot of ways, so, I just wasn't sure of how to choose or differentiate between the personas"* (A15).

In light of too much similarity, the strategy employed by the participants was to look for a persona that stood out the most from the others. This strategy becomes apparent in units like *"I guess I'm trying to find something that's a bit different"* (A01); *"because there seemed to be so many similarities between most of the people,*

so somehow it appealed to me when someone seemed to have a little bit of difference because then I could tell them apart from the others" (B07); and *"I think, to me like the thing that stuck to me because it was the only difference [...]"* (A02). This is a surprising result, as this strategy does not guarantee finding a persona that has a good fit with the task at hand. However, the participants felt forced to seek uniqueness when met with too much similarity.

4.3.2 Non-comparative. These are comments that discuss how certain characteristics of personas played a role in their selection without comparing them with other personas. This sub-theme has the same codes to the comparative sub-theme (see Table 4).

The personas were selected primarily based on their interests (24%) and nationality (14.9%), which mirrors the comparative sub-theme. However, this is followed by comments and sentiments (13.2%), audience size (13.2%), and gender and marital status (12.4%). The least mentioned comparative criteria were average viewing time (3.3%), images (7.4%), and age (11.6%).

These results extend our understanding of the data when matched with the comparative units. Age and gender are mobilized when comparing the personas but appear less when discussing a specific persona. On the other hand, the personas were compared the least according to their audience size and comments, yet when a persona is being scrutinized while isolated from the others, this information came up more. Interests and nationality were strong in comparing personas and talking about single personas.

Discussions around audience size contained, once more, the richest units in terms of the average word count ($\bar{x}$ = 33.06). Sentiments are generally strong in the non-comparative units, with most of them being over the 0.1 band. Almost all cases present an apparent
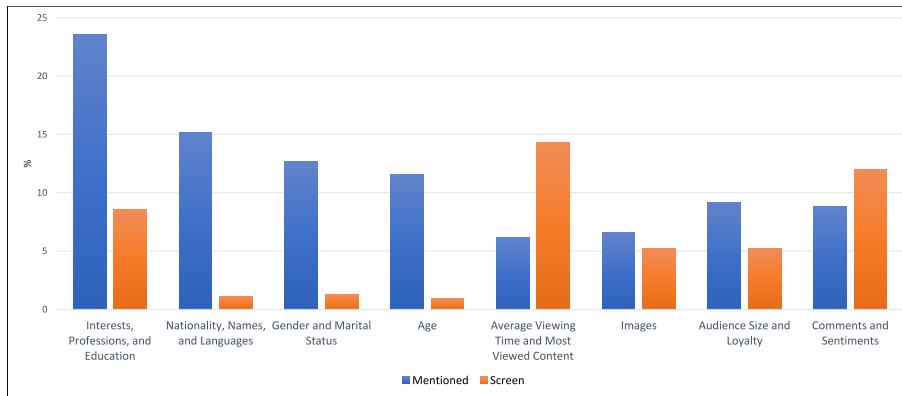
Figure 4: Percentage of persona information mentioned by the participants (based on code frequency) versus the percentage of the space the information occupies on the persona profile screen (based on a 1280 x 930 pixel screenshot). The rank of the information in terms of pixel-size in the UI correlates negatively with the rank of the mentioned information (Spearman ρ = -0.503), meaning that, though some information occupies very little space in the persona profile (e.g., age, gender, nationality, etc.) it is mentioned heavily by the participants. These contrast with some information that occupies the bigger portions of the screen (e.g., comments, most viewed content, etc.) but is not frequently referred to by the users.

Table 4: Coding for the non-comparative sub-theme. Sentiments were calculated using AFINN Sentiment Lexicon [38].

Sub-Theme	Code	Frequency (% to Sub-Theme Total)	Word Count $\bar{x}$	AFINN Sentiment $\bar{x}$
Non-Comparative	Interests (23), Professions (2), and Education (4)	29 (24%)	28.52	0.1195
	Nationality (14), Names (1), and Languages (3)	18 (14.9%)	31.11	0.107
	Comments (7) and Sentiments (9)	16 (13.2%)	27.31	0.1302
	Audience Size (16) and Loyalty (0)	16 (13.2%)	33.06	0.0662
	Gender (7) and Marital Status (8)	15 (12.4%)	29.6	0.0908
	Age (14)	14 (11.6%)	20.36	0.1179
	Images (9)	9 (7.4%)	21.56	0.1285
	Average Viewing Time (3) and Most Viewed Content (1)	4 (3.3%)	32.5	0.1082

reason why (or why not) a persona was selected in relation to the content provided in the persona profile.

Results from screen-size comparison (see Figure 5) are similar to comparative units.

4.3.3 Subjective. Units coded as "subjective" are comments where participants discuss personal reasons for choosing a persona (see Table 5). These reasons may be related to on-screen information for the persona (such as identification with the persona) or may be based on totally non-existing information that is fabricated by the participants. The sentiment scores of these units are typically very high (all but one higher than 0.1, with one higher than 0.2), which indicates that participants evoke positive subjective experiences, stories, or similarities to understand personas.

Storifying: Frequently, when explaining why they are choosing a persona, participants would fabricate speculative narratives about the personas that are loosely based on the information on the screen. This has also been a pervasive phenomenon in previous persona research. For example, Grudin and Pruitt [25] write about the users' ability to make inferences from partial knowledge. These speculative narratives might be about personality (e.g., *"she is curious and shoppy"* A01; *"are we working the adventure; because he's... he wants that"* A07; *"he's really dedicated, he's hard working"* B15;

etc.), behaviors (e.g., *"I expect him, you know, to donate"* A02; *"[...] because he tried to be funny"* A07; etc.), or perceptions (e.g., *"[...] he was like a little bit, you know, more mature and kind of understand things from a different perspective"* A08; *"he looked like a wise person"* B01; etc.).

Experience: Occasionally, participants would liken a persona to a real person(s) in their lives and judge the persona based on their experiences with this real person(s). Some examples are: *"that sounds like my brother"* (A04) and *"I felt like I can relate to him, like he might be someone I know, like a couple of my friends are having the same issues working and taking care of kids"* (A10).

Similarities: In another pervasive phenomenon, participants liken certain characteristics of personas to themselves in order to make a decision. This is most apparent in similar interests (e.g., *"[I chose this persona because] I have a unique interest in sports, stood out more than others"* A01; *"[...] I might be the similar person to this guy, but in a different aspect, like, not for entrepreneurship or social services but for something else"* A14; *"I'm looking for a persona who also likes to have, like, who is engaged in community services because I am working in community services as well, so we could have same interests"* B09; etc.), age (e.g., *"this persona is close to my age group"* A02; *"I think I would select... Jafar, I guess because he's close to my*
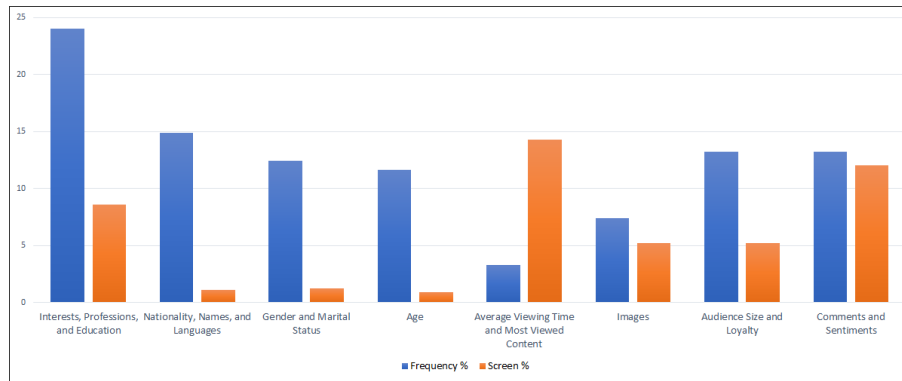
Figure 5: A comparison of the percentage of code segments in the interviews versus the percentage of the space they occupy on the persona profile screen (based on a 1280x930 pixel screenshot) for the non-comparative units. Compared to Figure 4, *Comments* code becomes more even.

Table 5: Coding for the subjective sub-theme.

Sub-Theme	Code	Frequency (% to Sub-Theme Total)	Word Count $\bar{x}$	AFINN Sentiment $\bar{x}$
Subjective	Storifying	31 (45%)	21.87	0.208
	Similarity: Interests (10), Professions (1), and Education (1)	12 (17.4%)	27.83	0.1273
	Similarity: Age	9 (13%)	23.44	0.0289
	Experience	6 (8.7%)	26.5	0.1711
	Similarity: Gender (5) and Marital Status (1)	6 (8.7%)	23.83	0.1334
	Similarity: General	3 (4.3%)	15.33	0.1821
	Similarity: Nationality (2), Names (0), and Languages (0)	2 (2.9%)	25.5	0.1053

age" A04; *"also, my first inclination is to go towards someone who's close to my age range"* A15; etc.), and gender (e.g., *"well, I think I'll go with Ghada. [...] since I'm a woman like her"* B09; etc.). Also, some general similarities (e.g., *"Amir [persona], 40, male, single, that's interesting [...] probably that's going to be my future"* B22; etc.) and similar nationalities were weaker but existing selection criteria.

4.3.4 Focused. This is the idea of concentrating on a single persona quickly while abandoning the others. This sub-theme contains a frequency of n=8 units with an average word count of $\bar{x}$ = 17 and an average AFINN sentiment score of $\bar{x}$ = 0.0421. Since the task was timed, a few participants ended up using most of their time with a single persona without needing to check the others in detail. Previous studies underline the importance of first impressions in digital profiles and agents [54]. We surmise that these participants picked a persona based on rough first impressions and chose to stick with it rather than comparing it with others. Some examples are: *"I think when I read the first one, I was concentrating on like a single persona, so I didn't compare it with the others"* (A02) and *"oh, I was only focusing on one person"* (B09).

4.4 Ways of Linking the Personas with the Task

This theme has five sub-themes: (1) target group; (2) message; (3) design; (4) platform; and (5) diversity.

4.4.1 Target Group. We used this code when participants defined a target group based on the task at hand and discussed whether

a persona was within their target group or not. This sub-theme has a frequency of n=72 units with an average word count of $\bar{x}$ = 26.99 and an average AFINN sentiment score of $\bar{x}$ = 0.1054. This sub-theme has the highest unit frequency, accounting for 55% of the units in this main theme.

Defining a target group was considered a part of marketing activities. Out of 25 participants who had units in this sub-theme, 21 were either marketers or researchers who might be accepted as having experience with target groups. Target groups were defined through age (e.g., *"old and age-wise, I don't think that Bassam or Faisal [personas] should... can be our focus group or our target audience"* B13; *"I feel that 21 [...] there's a direction to hire younger people and the organization"* A10; etc.), gender (e.g., *"she seems like she belongs to the target audience of [the organization] and [the organization] actually is looking for aspiring men and women, but especially women"* B12; etc.), interests (e.g., *"I don't think he is one of our target audiences because he works in the sales field, which for a non-profit organization... yeah, it's not relevant..."* B13; etc.), and nationality (*"I think it's going to be harder to sell [the organization] to him cause he's in a different country"* A09).

Some target group definitions were based on reaching new audiences and not so much on immediate relevance to the task. These participants took the initiative of specifying expanded target groups without prompt. For example, A13 mentions selecting an international persona because *"there was a very big potential audience and*

the US, which we haven't tapped yet"; B11 explains making an unorthodox persona choice because *"this person might not be that interested in visiting [the organization's channel], but I want to make him interested in visiting [the organization's channel]."*

4.4.2 Message. Since the task involved writing a marketing message to the selected persona, participants occasionally discussed how their messages and persona choices were related. This sub-theme has n=20 units with an average word count of $\bar{x}$ = 37.41 and an average AFINN sentiment score of $\bar{x}$ = 0.1058. This sub-theme has the highest average word count, which indicates that it sparked the most detailed discussions. Some examples are:

- *"Oh, he has kids, and he's interested in like, maybe, it would be nice to tell him that, for example, there's a place for your kids here or like this can be a place for the whole family. That's how we can attract him because he wants to find places for his children to read in Arabic, and he seems religious."* (A10)
- *"So maybe, because I noticed that she's very interested in an NGO, nonprofit and everything. So maybe, I want to engage her by letting her know that we have the local community, we are a foundation, and let's try to work together."* (A11)
- *"Especially since also these example personas that we looked at its young people [...] who are interested in these type of topics at community development and, of course, you know, you'd think that they're willing, they want to be able to do something for the betterment or development of their country."* (A15)
- *"If she looks for the video that shows that we have promoted this event... It could be like gift titles for research event or a hackathon, or where these kind of things... that can be promoted."* (B03)

4.4.3 Design. These units are comments on how the design of personas could have been different to make their task easier. This sub-theme has n=13 units with an average word count of $\bar{x}$ = 29.69 and an average AFINN sentiment score of $\bar{x}$ = 0.0946. We will mobilize these codes to iterate our persona system further.

4.4.4 Platform. Some participants considered the social media platform whose data was used for the persona creation (YouTube) when discussing personas. This sub-theme has n=11 units with an average word count of $\bar{x}$ = 27.45 and an average AFINN sentiment score of $\bar{x}$ = 0.0853. The participants used their own knowledge, perceptions, and biases about the platforms rather than any actual data. Some examples are: *"so, as far as I know, YouTube is more using that target audience, the younger the better"* (A11) and *"[the selected persona] is also one of YouTube's primary recipients of the content, they have a larger attention span over YouTube"* (B18).

4.4.5 Diversity. Six participants voiced concerns about the lack of diversity in the personas for the task. This sub-theme has n=8 units with an average word count of $\bar{x}$ = 27.63 and an average AFINN sentiment score of $\bar{x}$ = 0.1224. The high sentiment score of this sub-theme conflicts with its content; however, this may be an inconclusive analysis due to the low number of units. Some examples are: *"I'm not really sure about that [I understood personas as people] just cause they were very similar to each other, and so, I felt like I was talking to the same people"* (A09); *"they [personas] weren't*

as unique as people are" (A13); and *"for the [organization's] website, we really like to have them very diverse"* (B14).

4.5 Examining a Certain Persona Feature

This theme has two sub-themes: (1) features and (2) completeness, with the features sub-theme accounting for 92.6% of the total units.

4.5.1 Features. This large sub-theme entails participants' comments about the personas' features. Note that this sub-theme differs from the non-comparative sub-theme mentioned before, wherein the participants explain why they chose a persona based on certain features. Here, the participants either mention the features of the personas decoupled from the intention of choosing that specific persona or discuss the functions and meanings of the features themselves. This sub-theme has the same codes as the previously mentioned comparative and non-comparative sub-themes (see Table 6).

The leading units for this sub-theme are images (n=28, 20.3%), nationality and names (n=24, 17.4%), audience size (n=21, 15.2%), and comments and sentiments (n=20, 14.5%). These results lead us to believe that when examining a persona while mentally isolated from other alternative personas, participants take the time to scrutinize and talk about those features the most. The sentiment scores were generally higher than or close to 0.1. Although the average viewing time and most viewed content created the least number of units (n=5, 3.6%), they also sparked the richest conversation with an average word count of $\bar{x}$ = 28.4.

4.5.2 Completeness. This smaller sub-theme is formed of comments about how the features of a persona come together (or not) to present a complete and coherent picture. This sub-theme does not have specific codes and contains a frequency of n=11 units with an average word count of $\bar{x}$ = 26.45 and an average AFINN sentiment score of $\bar{x}$ = 0.0942. Consistency and completeness have been pervasive issues around the construction of personas [9, 39, 51]. As a result, when features do not come together consistently or present contradicting information, the participants voice their confusion. The high sentiment score of this sub-theme also conflicts with its content; however, this may have again been an inconclusive analysis due to the low number of units. Some examples are: *"the negatives, their dislikes are very important, because the only thing I saw was positive"* (B17) and *"with respect to that particular task, they seem complete, but when it's framed more like what do they have for breakfast, you know, it's not complete"* (A01).

5 DISCUSSION

5.1 Implications for Persona Theory

The analysis of think-aloud transcripts revealed that participants use a variety of comparative and non-comparative criteria to select personas, notably focusing on interests, nationality, gender, and age. This supports the theory of personas in HCI by demonstrating their practical utility in identifying target user segments using human-centric information [11, 39, 40]. The results also imply that participants did not adhere to a single optimal method for processing information; rather, multiple cognitive strategies are employed with personas based on the task context and available information. Participants demonstrated complex decision-making

Table 6: Coding for the features sub-theme. Sentiments were calculated using AFINN Sentiment Lexicon [38].

Sub-Theme	Code	Frequency (% to Sub-Theme Total)	Word Count $\bar{x}$	AFINN Sentiment $\bar{x}$
Features	Images	28 (20.3%)	17.5	0.0896
	Nationality (10), Names (14), and Languages (0)	24 (17.4%)	12.58	0.0385
	Audience Size (19) and Loyalty (2)	21 (15.2%)	20	0.0914
	Comments (14) and Sentiments (6)	20 (14.5%)	18.05	0.1142
	Interests (14), Professions (3), and Education (1)	18 (13%)	23.11	0.1251
	Age	15 (10.9%)	15.27	0.1148
	Gender (5) and Marital Status (2)	7 (5.1%)	19.29	0.1065
	Average Viewing Time (3) and Most Viewed Content (2)	5 (3.6%)	28.4	0.11

processes when selecting the persona, often focusing on finding a match or fit between the task (and thus the goal of the organization) and the given persona. They did not simply choose the persona based on straightforward criteria but applied a thorough examination that included both comparisons among multiple personas and individual assessments. This suggests that persona choice is affected by both rational analysis and intuitive judgment, which is aligned with the theory of personas as a UCD tool [25, 39].

In our focal organization's task, important contextual factors that influence persona choice include interests, professions, and education, though people relied on multiple persona characteristics in their choice process. The apparent focus on personas' multidimensional characteristics also supports the theoretical notion of personas mitigating self-referential bias [11, 39]. Indeed, the participants rarely mentioned their own preferences but were rather focused on taking the perspective of the personas, trying to make sense of the person behind the persona and ultimately figuring out the compatibility with the task. However, there were some indications similarity-seeking in this process (*"I feel I share him the interest in volunteering and giving to the community"* (A02)), though often this seemed to be part of the sense-making process in which the participants were trying to understand the persona as a person. Participants frequently engaged in storifying, a common sense-making strategy that reflects the narrative nature of personas [39]. This involves creating stories or narratives around the personas to better understand and relate to them.

In addition to the persona's interests, profession, and education, participants often refer to the persona's picture, nationality, and name when explaining their choice. This suggests that demographic factors still play a role in persona selection, although they may not be the decisive factors. The variety of persona attributes mentioned by participants when describing their reasoning indicates that the choice is based on a range of considerations. There is no single dominant pattern in the persona choice process, but given the psychological rationale presented by Grudin [24] as the foundation of why personas work, we should not necessarily expect one either. In contrast, the reasonings behind persona choice are multifaceted and individualistic. This is not surprising given the rich information ("roundedness", as Nielsen calls it [39]) provided in persona profiles, which allows stakeholders to consider various aspects of the persona when making their selection. The complexity of the decision-making process emphasizes the importance of designing personas that are comprehensive and give stakeholders enough room to make informed choices based on their specific needs and contexts.

5.2 Design and System Implications

Based on our findings, designers can improve the use of think-aloud protocols in developing a set of personas that align with users' preferences, needs, and decision-making processes. Insights from our study can inform the design of the interaction system's interface and presentation elements to support users, better and our findings also reinforce the need to involve usability testing and iterative design refinements in such systems. Our findings highlight that a digital persona presentation's visual and interaction design affect the decision-making process. From this perspective, the ways in which the features of a persona are presented can become as important as the content of those features. Designers working to create a digital interface to showcase and interact with personas can operationalize our findings, which are outlined below.

Specifically, we suggest enhancements for persona systems by incorporating features that enable users to compare personas, clearly highlighting their similarities and differences directly. Such a feature would streamline the persona selection process, making it more user-friendly for stakeholders. Additionally, introducing functionality to rank or filter personas based on various comparative criteria, such as age, nationality, and interests, would expedite the selection process. This approach is particularly efficient in scenarios with numerous personas, as it eliminates the need for time-consuming, manual comparisons of each persona individually.

Additionally, the design of persona profiles could be further optimized by de-emphasizing elements that have little impact on persona selection. This result is also echoed in [58] wherein the researchers identified and dropped irrelevant persona features, as well as in [30] wherein persona feature choices were pre-limited in a persona design exercise. In our study, which analyzed social media data such as YouTube videos, the less relevant features were average view time and most viewed content. Instead, the design should focus on accentuating more influential aspects, like interests. This approach not only streamlines the selection process but also ensures that key information is more prominent and accessible to users, thereby enhancing the overall effectiveness and usability of persona systems.

5.3 Limitations and Directions for Future Work

The findings suggest that both the diversity and the number of personas play a role in users' persona selection process. However,

the current analysis does not provide a clear distinction between the individual effects of these two factors. Some participants explicitly mentioned the number of personas when interacting with the system. Although a more detailed analysis is left for future research, these exploratory findings indicate that diversity and the number of personas are related. As a result, persona creators can potentially promote more inclusive design outcomes by increasing both the number and diversity of personas. The rationale behind this is that when designers choose from a more diverse set of personas, they are more likely to consider the needs and preferences of a wider range of user groups, assuming all other factors remain constant. Future work ought to investigate the effect of set size on the persona choice process.

Even though we mobilized an automated data-driven persona creation methodology, the underlying functionalities, data structures, and algorithms should not be bereft of such examinations of traditional personas in terms of representing the diversity of the user population. We propose that an important future research direction is to investigate how self-centric bias, self-referential design, and empathy play out for personas generated automatically from data instead of by designers through manual methodologies. Nonetheless, the *medium* of serving the personas—whether system, paper, or something else—could itself affect the choice process, which requires further investigation.

The study design had some limitations in terms of testing the order effects. An optimal approach would involve presenting the personas in a randomized order to multiple participants and assessing whether the probabilities of choosing each persona remain consistent regardless of their position. However, these limitations stem from two main factors. Firstly, the sample size was limited, making it challenging to recruit a sufficient number of participants to meet the sample size requirements for complex experimental designs. Secondly, the data-driven persona system used in the study displays the personas in a fixed order for all users by default, which may have influenced the participants' choices.

Addressing the limitations, future work could involve using a larger sample size and randomly assigning participants to different persona orders. By doing so, researchers can better isolate the impact of order effects on persona selection and draw more definitive conclusions about the factors influencing users' choices. Such controlled studies form an important part of the research agenda toward understanding persona choice. Finally, we surmise that comparing the persona choice process to a standard segment (i.e., nameless and faceless marketing segments) choice process could teach us more about the psychological relationship between personas and stakeholders, especially relative to "target groups" and "user segments" that are highly dominant in industry. Therefore, a lot remains to be studied!

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