

Instilling Knowledge Claims of Personas from 346 Research Articles

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ABSTRACT

Our research goal is to summarize the body of persona knowledge by identifying knowledge claims. This can aid HCI researchers to (a) navigate persona knowledge to form an understanding of what is known about personas quickly, (b) identify central research gaps of what is not known (or said) about personas, and (c) identify claims that are not substantiated with strong empirical evidence and warrant future work. To this end, we use computational and manual techniques to extract 130 knowledge claims based on 9139 sentences from 346 persona articles and analyze whether the existing literature supports these claims. The results, clustered into four groups (“Definition”, “Creation”, “Evaluation”, and “Use”), indicate that claims regarding persona definition are characterized by a higher degree of consensus. In contrast, persona creation and use contain a high proportion of unverified claims. There are few claims concerning evaluation. Empirical research should address unverified claims and develop the ontological understanding on persona evaluation.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI).

KEYWORDS

Personas, knowledge claims, summary, natural language processing

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1 INTRODUCTION

What are personas? How should they be created, evaluated, and used?

These are some of the fundamental questions in persona research, a subsection of human computer interaction (HCI) studies. These questions are essentially rooted in the larger epistemological question of “What is known about personas?” For more than 20 years, HCI researchers have studied and applied personas [23]. Still, there are few literature surveys [35, 83] that collect and synthesize the wealth of knowledge about personas arising from these previous studies.

In this research, we investigate knowledge claims (KCs) about personas, defined here as *factual statements about the nature, purpose, definition, evaluation, or use of personas*. KCs are important for the progress of science [51]. They are useful in many ways: to broadly describe what is known about a phenomenon, field, or domain [102]; and to reveal potential philosophical truisms, i.e., sentences with incomplete truth conditions [75]. In general, KCs indicate statements that “the knower believes to be true yet is debatable as to assess the veracity of the statement”¹. Because KCs may become parts of a belief system [14] (a network of statements that researchers take for granted), the HCI field needs to assess the actual support for these KCs in order for impactful research to progress.

This matter is particularly important for the field of personas. Several authors have suggested that the body of work generated thus far on personas might include several unsubstantiated KCs [21, 61, 71, 77, 85]. In general, such claims can be harmful, as they can mislead researchers to make decisions based on unvalidated knowledge. An example would be to choose the number of personas based on a KC that states “a handful of personas should be created,” (a fictitious quote that nonetheless matches with real claims [100]) while there is no consensus on the “optimal” number of personas [71]. Therefore, awareness of KCs is important for the further evaluation of the body of knowledge in the persona domain.

This awareness can aid HCI researchers to (a) navigate persona knowledge to form an understanding of what is known about personas quickly, (b) identify central research gaps of what is not known (or said) about personas, and (c)

¹<https://medium.com/@amandaposthuma/knowledge-claims-edd58547a920>

be wary of KCs that lack empirical evidence and require future work. To this end, we map the current body of persona knowledge and identify paths forward for researchers and practitioners.

Our methodology follows several steps inspired by the developments in natural language processing (NLP) to automatically process large text corpuses. We use NLP techniques to extract 130 KCs from 346 research articles that either develop personas or discuss personas, and then manually analyze their meanings. Finally, we evaluate the identified KCs in terms of supporting evidence.

2 EARLIER LITERATURE REVIEWS ON PERSONAS

The most comprehensive (and often cited) resources discussing personas from their “start to finish” are textbooks. The seminal textbook by Cooper [23] introduced personas for software developers and designers. The textbook by Pruitt and Adlin [76] discusses the whole lifecycle of personas, from their creation to application. The book by Nielsen [71] achieves a similar goal, summarizing guidelines for persona creation and application. Finally, the book by Mulder and Yaar [68] presents a distinction between qualitative and quantitative personas and discusses various practical aspects of personas.

Undoubtedly, the work presented in these textbooks has been invaluable for the HCI community, however, there is still a dearth of surveys which analyze how personas are presented, understood, and applied in research articles. To the best of our knowledge, there are only a handful of literature reviews [35, 45, 83]. In their work, Goh et al. [35] analyzed 315 persona articles from ACM Digital Library, situating them in the three waves of HCI research. In another survey, Salminen et al. [83], reviewed 49 persona articles that were specifically focused on quantitative persona creation. A survey by Jansen et al. [45] focused on strengths and weaknesses of persona creation approaches, analyzing 74 research articles.

While these reviews have been worthwhile and useful, there are still some shortcomings associated with them, the predominant one being not being able to distill KCs which are being made about personas. We address this gap in the literature by collecting a large number ($n=346$) of research articles related to personas and use state-of-the-art NLP techniques combined with manual analysis to systematically extract and analyze phrases that can help us make sense of what is known about personas. Our contribution summarizes the persona body of knowledge, helping those new to personas to understand what is known about personas and those conducting persona studies to identify unverified KCs for future empirical research.

3 METHODOLOGY

Our methodology consists of two main processes, which we describe in the following subsections.

3.1 Computational Processing

We followed ten steps to be able to move our research forward and we describe each of these as follows.

- (1) For the current study, we started with searching Google Scholar for articles mentioning persona development. We

used search terms such as “persona creation”, “persona evaluation”, “persona use”, and “persona is”/“personas are”. We manually reviewed the results to identify **387 articles**, a number that we considered adequately representing the breadth and diversity of persona research. The list of found articles can be viewed in the Supplementary Material (https://www.dropbox.com/sh/71cs4rx80falq5g/AABJRC91Xfb9kfVSD_3sUqvya?dl=0).

- (2) We were able to find full texts for 346 articles out of the 387. These were then downloaded manually.
- (3) All the retrieved articles were manually submitted to an online service (*pdf2text*²) to transform the PDF content into text format that could be computationally manipulated using the Python programming language and various libraries explained in the following steps.
- (4) *DescriptionSentenceDetectorDL*³, a neural network for sentence boundary detection developed in Python, was applied to extract all the sentences from the full-text documents. This step was necessary, so that we could extract sentences as candidate KCs for the manual analysis. We focus on sentence as they are the most granular set of words that is complete, in the sense of a noun, verb, and at least one main clause.
- (5) *Spacy*⁴, an NLP framework, was applied for part-of-speech tagging to tag verbs in the extracted sentences. We considered verbs as important language modalities for extracting sentences that speak of what personas ‘are’, ‘do’, how they are ‘created’, and so on. Again, these sentences *can* contain KCs.
- (6) All the sentences containing a verb and the term ‘persona’ or ‘personas’ were selected. Duplicates were removed. This now resulted in **9139 sentences**. The persona terms were used as filters to drill down to specific sentences that mentioned personas, as these are candidate KCs.
- (7) We further wanted to trim down the 9139 sentences, as this was considered too numerous for manual annotation. To remedy this, we used NLP techniques to eliminate redundant sentences (e.g., “there should be five personas” and “five personas are typically created” refer to the same idea and thus semantically overlap). We used the *Roberta-Large*⁵ transformer model to calculate sentence embeddings [66]. Here, embeddings are 1024-dimensional vectors, so each sentence is represented by 1024 features describing its semantic meaning.
- (8) We applied hierarchical clustering [47], using cosine similarity [67] as a distance function, with the threshold value of 0.5 that was determined by investigating the loss of sentences for increments of the threshold value (see Figure 1). From each cluster, we keep one representative sentence.
- (9) This process yielded **1275 sentences** for manual investigation, representing 14.0% of the total 9139 extracted sentences from the 346 articles. We considered this an acceptable approximation of sentences that refer to personas in the active sense, and they are potential candidates for KCs.

²<http://www.pdf2text.com/>

³https://nlp.johnsnowlabs.com/2020/09/14/sentence_detector_dl_xx.html

⁴<https://spacy.io/>

⁵<https://github.com/UKPLab/sentence-transformers>

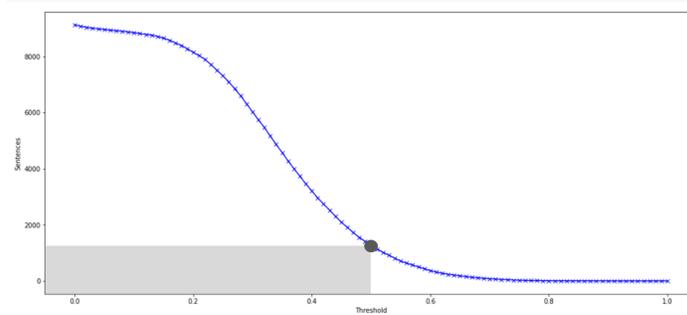


Figure 1: Excluding semantically similar sentences. The x-axis indicates different threshold values of cosine similarity (CS) for clustering. Y-axis indicates the remaining sentences. When CS=0.5, a major portion of the sentences is eliminated, with 1275 sentences remaining for manual evaluation. This was considered as a reasonable trade-off.

- (10) One of the researchers manually analyzed each of the 1275 sentences to identify if the sentence contained a KC or not. This process is described in the following subsection.

3.2 Manual Processing

The manual annotation process was done using a spreadsheet where we had the 1275 sentences identified earlier as rows to annotate. In a specific column, one of the researchers marked ‘y’ if the sentence contained a KC, and ‘n’ if it did not contain a KC. In another column, the researcher indicated their reasoning for the choice of either excluding or including (unless this was a repeated reason). For each KC, the theme (“Definition”, “Creation”, “Evaluation”, or “Use”) was also recorded. The themes correspond to common activities concerning personas [23].

A KC was defined as a sentence that tells what personas are, how they are created, evaluated, and/or used. For example, “we created five personas” is *not* a knowledge statement, because it describes what was done specifically. In contrast, “five personas are often created” is a knowledge statement because contains a generic claim about personas. Both factual (“personas are. . .”) and normative statements (“personas should be. . .”) were considered as KCs, as both types contribute to the body of persona knowledge.

The initial coding revealed **154 KCs** (12.1% of total), while the remaining 87.9% instances were coded as non-KCs. To verify the reliability of the coding, an interrater agreement analysis was conducted, in which another researcher independently coded a sample of 108 sentences. The analysis revealed substantial agreement (Cohen’s kappa = 0.61, %-agreement = 87.0%). To remedy the disagreements present, the second coder manually reviewed all the samples that the first coder had placed in the ‘yes’ class, to avoid including false positives. The excluded items at this stage (n=31) were discussed case-by-base among the two coders, and the final label was assigned after a mutual consensus was achieved. The exclusions included false positives (n=15) and repetitive claims (n=16). Also, in seven cases, the original sentence included several KCs, e.g., a claim about what personas are and how they are used. In such cases, we divided these into separate KCs. After these steps, we ended up with **130 final KCs**.

These KCs were written into a general form. For example, “As such, personas cannot make absent users have an active role in design.” became “Personas cannot make absent users have an active role in design.” (KC91). The original sentences are available in the Supplementary Material; the remainder of the manuscript focuses on presenting and discussing the general forms of the KCs.

4 RESULTS

Tables 1-4 show the KCs. According to the authors’ assessment, the order of the KCs within a theme is based on ‘more fundamental’ to ‘less fundamental’. Each KC is followed with references that support its status of being verified (consensus) or unverified (non-consensus) based on existing research. In the following tables, each color corresponds to different KCs: (a) green indicates strong evidence or consensus within the literature; (c) yellow indicates unverified claims or those without a consensus; and (c) red indicates a conflict with another KC. Finally, (d) the KCs in **bold** can be used as hypotheses to inspire future work. For example, “Personas are fictional characters.” (KC01) is not a testable proposition, but “A human face is important for decision-makers to empathize with personas.” (KC04) is – a study could incorporate that KC as a hypothesis.

Persona use contains the most KCs (n=49, 37.7%), followed by creation (n=40, 30.8%), and definition (n=33, 25.4%). Evaluation has only a small number of KCs (n=8, 6.2%), most likely reflecting the lack of general guidelines for (or the difficulty of) persona evaluation [21]. Persona use also has the highest ratio of unverified KCs to all KCs (n=33, 67.3%), again followed by creation (n=24, 60.0%), and definition (n=11, 33.3%). Evaluation has one unverified KC. A further examination shows that personas have both claimed benefits (“Personas facilitate a system’s usability testing” (KC103)) and claimed disadvantages (“Personas are not credible but considered ‘made up’.” (KC27)) that have not been substantiated.

Based on the KCs, research agenda for **persona definition** involves primarily the role of physicality in personas (KC03), the importance of human face for empathy (KC04), the requirements of “real data” for personas (given the varied types, e.g., proto-personas and assumption-based personas) (KC18), the role of anchoring for personas (KC19), whether the purpose of personas is to represent typical users (KC07) or the diversity of the user base (KC20) (marked

Table 1: KCs of persona definition. The relatively large share of green cells indicates strong consensus.

KC01	Personas are fictional characters with a name, occupation, age, gender, socio-economic status, interests, stories, and motivations. [23, 71, 76, 77]
KC02	Personas present the image or appearance of the users. [39, 52, 73, 88]
KC03	Personas are presented as real human beings with physical bodies. [81]
KC04	A human face is important for decision-makers to empathize with personas. [12, 52, 73]
KC05	Personas embody specific user groups that become the focus of design. [23, 71, 76, 77]
KC06	Personas represent a group of people. [23, 71, 76, 77]
KC07	Personas embody typical user characteristics of actual or potential user groups of the product under development. [23, 71, 76, 77]
KC08	Personas are based on demographic and behavioral information about users. [23, 43, 46]
KC09	The typical persona is a 1-2-page document containing various user information. [72]
KC10	Personas address “why?” questions about the user. [23, 71, 76, 77]
KC11	Personas rely on individuals’ ability to empathize with fictional characters. [23, 71, 76, 77]
KC12	Personas are descriptive models of a system-to-be users. [23, 71, 76]
KC13	Personas can be defined by three different approaches: purely qualitative, purely quantitative, and mixed qualitative and quantitative. [45, 68]
KC14	Personas are known in the usability and software engineering communities. [35, 40]
KC15	The usefulness of personas in design is based on ideas by Alan Cooper. [71, 76, 77]
KC16	The original approach by Cooper has been criticized by other researchers. [57]
KC17	Cooper’s original interaction design process does not consider personas as part of a participatory approach. [103]
KC18	Personas should be grounded in a strong understanding of real-world users. [77]
KC19	The notion of anchoring helps users recall personas even when the personas are not seen. [30]
KC20	The aim of personas is to represent the diversity of observed motivations, behaviors, and mental models. [90]
KC21	Personas invoke the capability of anticipating another person’s behavior. [23, 36]
KC22	Personas function as a tool for capturing user voices into the design process. [23, 71, 76]
KC23	Persona life goals indicate the user’s purpose for using a system. [38]
KC24	Personas help tailor products for business needs. [50]
KC25	Personas humanize market segments. [28, 84, 97]
KC26	Personas are incoherent compositions of disconnected data. [16, 21]
KC27	Personas are not credible but considered “made up”. [61, 80]
KC28	Data-driven personas represent key data and details about users based on a computational synthesis. [2, 62, 83]
KC29	Practice-based personas support the operationalization of practice-orientation in design projects.
KC30	Assumption-based personas are created based on intuition and assumptions. [31, 42, 60]
KC31	Negative personas are non-users of the product and help communicate who the team is not designing for. [11, 26]
KC32	The served persona is the one who does not use the product but is affected by its use. [82, 94]
KC33	An additional persona is one that is not primary or secondary, whose needs are a combination of the needs of primary and secondary users and is completely satisfied with the functionality of the system. [53, 95]

as conflict in Table 1), the relationship between persona content and system development activities (KC23), personas’ actual usefulness for tailoring products (KC24), consistency of persona information (KC26), trustworthiness of personas in the eye of the users (KC27), and the support personas give for enhancing practice-orientation in design projects (KC29).

The research agenda for **persona creation** includes primarily the real cost of persona projects (KC37), data requirements (KC40-41, KC51), updatability of personas (KC42), the impact of different methods on the resulting personas (KC46), the participation of persona users in the creation process (KC49), studying the actual datasets used for persona creation (KC51), the impact of personal details on persona perceptions (KC52), the optimal degree of specificity of persona information (KC61-64), the relevance of likability of personas (KC66), and the optimal number of personas (KC67-69). Several of these KCs are crucial questions for persona design.

For **persona evaluation**, the critical question concerns whether personas should be tractable to foundational documents (KC77), which would enable the scrutiny of their creation at a detailed level.

For **persona use**, fundamental questions include whether personas are actually used widely in industry (KC82, KC109), whether there are real success stories (KC83), how organizations vary in their adoption of personas (KC84), if personas are well integrated into HCI curricula (KC85) and help students understand user experience concepts (KC86). Other questions relate to formats of persona presentation (KC89), actual value of personas for design decisions (KC93, KC97-100, KC104-105, KC110, KC118-119), communication (KC102), and usability testing (KC103), as well as whether to design for one or many personas (KC95), how decision makers prioritize personas (KC96), and in what ways personas can be misused (KC107). The relationship of personas with other user-centered methods involves several unverified claims (KC123-127), too. There

Table 2: KCs of persona creation. The relatively large share of yellow cells indicates many unverified claims.

KC34	Persona creation is not a trivial task. [23, 71, 76, 77]
KC35	Creating personas is typically not cheap, easy, or quick. [23, 71, 76]
KC36	Persona creation requires significant effort. [23, 68, 71, 76]
KC37	An average persona project costs about 47,000 US dollars. [27]
KC38	Persona creation aims at extracting the most important information from the analyzed user data. [23, 68, 71, 77]
KC39	A persona should not describe everyone. [23, 71, 76]
KC40	Personas are often not based on first-hand customer data. [62]
KC41	Personas should be based on real data. [23, 77]
KC42	Personas should be regularly updated. [44, 48]
KC43	The user data that the personas are created from changes over time. [44, 48]
KC44	Persona creation has three basic steps: data collection, user segmentation, and persona write-up. [68, 71]
KC45	There is no standard method to develop personas. [45, 68, 71]
KC46	Different persona creation methods have different outcomes. [54]
KC47	Persona creation has historically involved the use of ethnographic, survey, and focus group methods. [45, 77]
KC48	Ethnography can be applied to develop personas. [15, 77, 101]
KC49	The team using the personas should participate in their creation. [38]
KC50	The first step in developing a persona is to determine the sampling of the users. [10]
KC51	Personas are often based on small data that lacks statistical significance. [21]
KC52	Personal details make personas appear trustworthy and alive. [30]
KC53	Users' needs are essential information in personas. [32]
KC54	Persona creators prioritize user needs. [38]
KC55	A photo facilitates the persona creation process. [1]
KC56	Persona pictures can play a crucial role in representation of gendered assumptions and stereotypes. [39, 88]
KC57	Personas that are created stereotypical can have negative effects on the design process. [57, 59, 104]
KC58	Personas can contain a description of how the persona moves through his or her day. [23, 71]
KC59	"Goals" in the persona profile describe both the overarching goals of the persona and the persona's specific goals where a technical tool might be of help. [8, 9, 23]
KC60	Where user characteristics are in conflict, multiple personas can be developed to account for diversity in the users. [99]
KC61	Personas should contain specific and precise information. [87]
KC62	It is more important to be specific than accurate when creating personas. [34]
KC63	It is more difficult to ignore a detailed persona than aggregated user data. [19]
KC64	A persona should not include too many details to exclude users that it represents. [20]
KC65	Fictional details in a persona are included to increase communication and commitment to the character. [23, 71]
KC66	Personas should be likable. [86, 89]
KC67	Keeping the number of personas small is advisable. [23]
KC68	The number of personas should be between three and seven. [15]
KC69	Creating less than ten personas can result in underrepresentation of user groups. [58]
KC70	Persona creation process is explicitly data-driven compared to other more anecdotal approaches. [37]
KC71	Latent Semantic Analysis is the first step in the evolution of personas into a more broadly applicable design method. [65]
KC72	Analyzing variable interactions is important when creating quantitative personas. [22]
KC73	Personas can lead to a systematic underrepresentation of groups that are underrepresented in the user data, since attributes that exist in small numbers get lost in a quantified approach. [58]

is also a conflict (see Table 4) between KC90 that argues that personas can act as stand-ins for real users and KC91-92 that argue that personas should not replace users' active participation in a design process.

5 DISCUSSION

Overall, the findings indicate that several foundational KCs have not been empirically verified. The frequency of KCs indicates a high emphasis on persona use and a low emphasis on persona

evaluation. This mirrors the fact that evaluation is considered as a difficult theme in persona research [20, 21, 89].

Researchers and practitioners can be more trusting of the KCs marked in green in Tables 1-4, as these are considered strong claims in the persona body of knowledge. Yellow and red claims should be approached with more caution, as they contain claims that should be verified through empirical research or are conflicting.

Our research peps several questions that warrant further analysis:

- (1) Are some of the "fundamental truths" that researchers and

Table 3: KCs of persona evaluation. The relatively small number of claims indicates general lack of attention.

KC74	Personas may not accurately match the user data. [2]
KC75	It is difficult to verify that a persona accurately reflects user data. [21, 40, 84]
KC76	It is not clear if personas even can be evaluated for accuracy. [21]
KC77	Personas should be linked to foundational documents, including the user study data backing up the persona. [61]
KC78	Flexibility of personas is both a strength and a weakness. [33, 45]
KC79	Different users interpret a persona in different ways. [57, 104]
KC80	The fact that personas are presented as real people makes them prone to stereotyping. [57, 104]
KC81	Personas need to be refreshed and updated to ensure they accurately reflect user needs. [44, 48]

practitioners hold true of personas true at all?; (2) Do the claimed persona benefits hold in empirical studies? If yes, under which circumstances?; and (3) What is the relationship between personas and other user research methods? The bolded claims (n=71) in Tables 1-4 can either be used as hypotheses *per se* or modified to become hypotheses for future research.

Many claims may appear trivial (e.g., “Personas provide design inspiration.” (KC104)) and it is, therefore, tempting to accept them without critical thought. However, doing so is detrimental to the scientific progress of persona research, as it may lead to perpetuation of truisms. When presented with plausibly sounding knowledge claims, the question persona advocates need to ask is, “It may seem so, but is it really so?”.

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Table 4: KCs of persona use. The relatively high number of bolded items indicates there is a lot of room for experimental work in research concerning persona use.

KC82	Personas are used extensively in both industry and research. [19]
KC83	Several companies have adopted personas successfully. [98]
KC84	There is variation in how organizations encourage persona adoption within a team. [98]
KC85	The persona method is taught widely at many university courses on HCI. [38]
KC86	The user-experience design/usability concept of personas can help students understand such factors. [96]
KC87	Personas have been used in HCI studies for more than ten years. [71]
KC88	After their creation, personas do not receive much attention. [34, 79]
KC89	Persona is typically represented by a sheet on the wall. [74]
KC90	Personas act as stand-ins for real users when real users are not easily reachable. [38]
KC91	Personas cannot make absent users have an active role in design. [16]
KC92	Personas should not replace the active involvement of users and other stakeholders in product development. [25]
KC93	Personas help the design team consider specific user characteristics when making design decisions. [56]
KC94	Personas are used to represent the end-users and their relation with the problem and context at hand. [23, 93]
KC95	A system should be designed for one primary persona whose needs are considered predominantly. [55]
KC96	Personas are prioritized differently during their use. [38]
KC97	Personas help the design team stay focused on aspects that will satisfy key target users.
KC98	Personas facilitate designing for a target user. [13]
KC99	Personas help avoid self-referential design. [52, 57, 64]
KC100	A persona is an effective means of reducing misunderstandings that occur between product developers and intended user groups. [92]
KC101	Personas help explain to users why a system works for them. [38]
KC102	Personas enable quick communication of user information within teams. [69]
KC103	Personas facilitate a system's usability testing. [69]
KC104	Personas provide design inspiration. [18]
KC105	Personas force designers to consider social and political aspects of design that otherwise may go unexamined. [17]
KC106	Using the persona method risks reproducing gender stereotypes. [39, 58]
KC107	Personas can be used to justify design decisions after the fact. [79]
KC108	Personas can be used to uncover potential gaps between user needs and system capabilities.
KC109	Personas are used in system development. [2]
KC110	Personas provide additional information to get a holistic view of users for requirements engineering. [9]
KC111	Personas can aid the validation of software by reviewing the needs and requirements of personas against the behavior of the software system. [91]
KC112	Personas can be used for identifying what features not to develop. [54]
KC113	Personas enable new designs that otherwise would not have been created. [4]
KC114	Personas have benefits compared to data analytics. [46, 84, 85]
KC115	Personas can be used for the comparison of user segments. [3, 63, 78]
KC116	In Human-Robot Interaction, personas can help define the initial social skills and features needed during interaction. [29]
KC117	Holistic personas contain information for remembering, understanding, applying, and analyzing users. [4–7]
KC118	Personas help identify security risks that may otherwise not have been considered. [50]
KC119	Personas may be more effective for communication than for design activities. [61]
KC120	Personas that are not linked to foundational documents can still be useful communication tools.
KC121	The rhetorical function of personas has not been studied extensively. [81]
KC122	Personas do not replace other user-centered design activities. [23, 71, 77]
KC123	Personas complement objective user studies. [41]
KC124	Personas should be accompanied by other user-centered methods. [24]
KC125	Personas help designers focus on the complexity of the actual use situation. [16]
KC126	Personas are an alternative to user roles. [49]
KC127	Personas are often used with scenarios. [17]
KC128	Personas can be used for modeling user strategies under different situations. [23, 36]
KC129	Personas should be used during the entire user-centered design process. [76]
KC130	The usefulness of personas relies on storytelling and narratives. [70]

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