



# Riding Waves of Change: A Review of Personas Research Landscape Based on the Three Waves of HCI

Chu Hiang Goh, Narayanan Kulathuramaiyer, Tariq Zaman

## ► To cite this version:

Chu Hiang Goh, Narayanan Kulathuramaiyer, Tariq Zaman. Riding Waves of Change: A Review of Personas Research Landscape Based on the Three Waves of HCI. 14th International Conference on Social Implications of Computers in Developing Countries (ICT4D), May 2017, Yogyakarta, Indonesia. pp.605-616, 10.1007/978-3-319-59111-7\_49 . hal-01650073

**HAL Id: hal-01650073**

**<https://inria.hal.science/hal-01650073>**

Submitted on 28 Nov 2017

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# Riding Waves of Change: A Review of Personas Research Landscape Based on the Three Waves of HCI

Goh Chu Hiang <sup>1</sup>, Narayanan Kulathuramaiyer <sup>2</sup>, Tariq Zaman <sup>2</sup>

<sup>1</sup> School of The Arts, Universiti Sains Malaysia, Penang, Malaysia

<sup>2</sup>Institute of Social Informatics and Technological Innovations,  
Universiti Malaysia Sarawak, Kota Samarahan, Malaysia

**Abstract.** With the current growth of personas studies in HCI, we undertook the mapping out of the research approaches done for the past 18 years to provide an overall view on the landscape of personas research. Based on the narrative literature review of published work and paired with the three waves of HCI research development, we identified (1) the publication milestones of personas, (2) established genre of research approaches, and (3) the emerging issues and research trends. By looking at historical development of personas, the studies highlighted some key areas which might be the future trends of personas in the new wave of HCI. These will provide significant insight and direction for future research of personas.

**Keywords:** Personas, HCI, Participatory Design, Cross-Cultural Design

## 1. Introduction

The field of HCI has evolved throughout the years; focus of research has progressed from human factors and usability to user experience and beyond. The use of computer devices shifted from office to the private and public spheres. Technology spreads from the workplace to our homes and everyday lives and has become part of our culture. Through the use of social media, the distinction of designer-user relationship becomes closer and the boundaries between professional designer and novice user are becoming fuzzy. The task of designer and developer as the sole creator for software and web application is no longer a paramount. Interaction between user and designer and the participation of user in the software and web application development process is crucial in the contemporary scene of HCI research and development. The in-depth understanding of the evolution of personas which has become the key user research instrument in User-Centred Design (UCD) is crucial to the HCI research.

This paper presents the literature review of an ongoing research that investigates the use of personas in sustaining local cultural identity. Drawn from the analysis of publications from ACM digital library and paired with Susanne Bødker's [1, 2] Three Waves HCI Challenge and Beyond, we mapped and visualised the landscape of personas studies throughout the years and foresee what lies beyond.

adfa, p. 1, 2011.

## 2. Etymology

The use of the term *persona* has an extraordinary shift if one were to trace it back to the classic origin in Greece [3]. The word is derived from Latin and its original meaning is very close to the idea of mask worn during drama performance and ritual activities. It was later described by the Roman philosopher, Cicero, as the peculiar relation of the individual to the society. In the early years of internet usage, it was referred to as the user's online identity which was distinct from the real-world identity. It was Allan Cooper [4] who gave the contemporary definition of *persona* which referred to as a creative way of constructing the type of person who would use a particular computer application. In a more precise approach, Putnam [5] defined it as an archetypal representation of a group of users with common goals, attitudes and behaviours when interacting with a product. Apparently, the wide spread use of *persona* in user experience design has overlooked the earlier definition of *persona* studies in representing one's online identity.

Personas are one of the most understandable deliverables in the user experience design. Three forms of terms were identified throughout the 315 publications. Namely: *persona* (in its singular form), *personas* (plural form) and *personae* which is the original form of the plural Latin word.

Most user experience designers adopted the plural form of *personas* due to the influence of the analytical work of Carl Jung [6]. The analysis of the 315 publications shows that 85.0% of the publications used the term *personas* to refer to the archetype that referred to the collective character of users, 14.2% used the term *persona*, and 0.32% used *personae*. Nevertheless, the finding leaves room for further debate as the majority publications in ACM are User-Centric research focused.

## 3. Methodology

The literature review began with the construction of corpus of papers on personas in HCI by searching in ACM digital library's Full Text Collection. A total of 315 publications from ACM were retrieved as the result of an advanced search setting of keyword *Personas* in both titles and abstracts with the range of publication from year 1998 to 2016 (figure 1). 1998 was a significant year for the contemporary studies of personas as this was the year when Alan Cooper [4] published his ground-breaking book, *The Inmates Are Running The Asylum*. Publications in ACM's digital library were chosen because it is related to the ongoing research which focuses on the formulation of user-centric persona in the domain of HCI. Each publication was examined in the area of abstract, keywords and references. Inclusions and exclusions were made. The whole selection process was guided by four research questions:

- RQ1: Which publications were cited in the reference?
- RQ2: Which wave of the three waves of HCI does it belong to?
- RQ3: What is the research approach carried out?
- RQ4: What are the significant findings of the research?

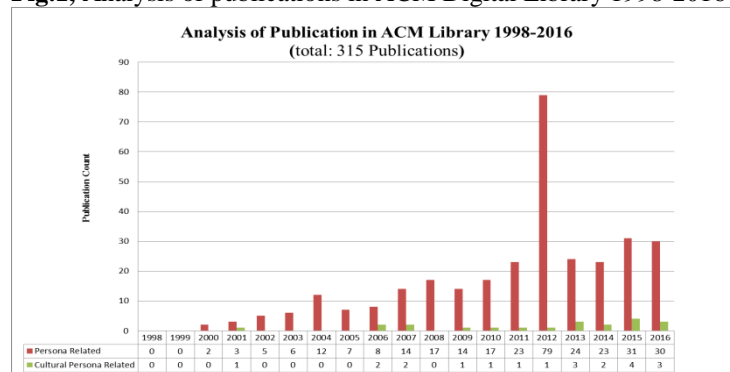
RQ1 led us to more publication findings for publications (such as books and book chapters) which are not in the collection of ACM digital library but have significant impact in the whole landscape development of personas. Publication milestones like Alan Cooper's [4] book *The Inmates Are Running The Asylum* scored the highest citation score amongst the 351 publications. The discovery of other review papers such as Marsden and Haag [7] *Stereotypes and Politics: Reflections on Personas* and Cabrero, Winschiers-Theophilus [8] *A Critique of Personas as representations of "the other" in Cross-Cultural Technology Design* provided resourceful references to reference findings of other related publications (figure 2). RQ2 and RQ3 helped us to analyse and classify the publications according to research approaches and pairing with the three waves of HCI development. This provided as information to visualise the landscape of the research approaches taken in the past years according to the research patterns that emerged.

RQ4 aimed to evaluate and exclude publications which are least significant. Citation counts were used as measurement for publications which are published for more than five years whilst new publications published for less than 5 years were selected based on the reputation of the authors in terms of publications in the field and the significance of the publications to the personas inferred in the three waves HCI development.

The analysis of the key publications indicates that there is a drastic increase in the publications of personas starting from 2007. This shows that the interest in gaining new knowledge in the studies of personas is growing. There was steep rise in 2012 with a record of 79 publications. This was due to a special conference on personas - *13th International Conference on Interacción Persona-Ordenador*. A total of 55 publications related to personas were yielded from that conference. The latest record in 2016 showed that there were 30 publications which is a 400% increase compared to 10 years ago. The research of personas has become a leading method in user experience design and it is gaining momentum every year.

A further filtered search in the existing 315 publications in ACM library with the keyword - *culture* and *cultural* resulted in the increase of cultural related studies of personas. This shows a new variant in personas which focused on local cultural approach and the awareness of the importance of ICT4D has increased.

**Fig.1,** Analysis of publications in ACM Digital Library 1998-2016



**Fig. 2, Citation Counts**

Publication	ACM Citation	ACM Citation
Cooper (1998)	82	2592
Grudin & Pruitt (2002)	69	489
Grudin & Pruitt (2003)	110	608
Norman (2004)	27	39
Nielsen (2004)	41	PhD Thesis
Chapman (2006)	33	112
Adlin & Pruitt (2006)	61	719
Nielsen (2007)	42	16
Bodker (2012)	6	18
Friess (2012)	1	46
Bodker (2013)	1	4
Cabrero (2014)	0	5
Cabrero (2015)	0	8

#### **4. Three Waves of HCI**

Initiated by Bødker [1], the three waves of HCI captured and presented the challenges faced by HCI in the past three decades. Harrison, Tatar [9] postulated an almost similar idea in categorizing the development of HCI into 3 stages. Bødker [1] referred to it as three waves of HCI while Harrison (2007) referred to it as three paradigms of HCI development based on the phenomenological matrix they created. These prove that Bødker [1] was not alone in this effort and both studies capture an almost similar timeframe of the HCI development.

Referring to the history of HCI publications, Bødker [1] conjectured the challenges in HCI research which the HCI community has broadened intellectually from its root in engineering research to cognitive science, sociological studies, emotional design as well as social participatory research. It provides appropriate timeline for the quest of mapping the landscape development of personas in this research.

According to Bødker [2], we are currently 10 years beyond the third wave of HCI when she first introduced it in 2006. She established the three waves timeframe: first wave - from the early years of HCI to 1992, second wave – 1992 to 2006 and third wave – 2006 and beyond. The transition of first wave to second wave was discussed by Liam Bannon [10] in his milestone paper *From Human Factors to Human Actor*. The first wave was geared towards cognitive science and human factors. It was model driven and focused on the human being as a subject of rigid research with formal guidelines and systematic texting, and most of the studies were conducted in a closed scientific lab setting.

Bannon [10] observed there was a significant change in the second wave as there was a transition from *human factor* to *human actor* in the HCI research. User studies were carried out from the confined scientific labs to the real-life environment

as anthropology ethnographic research approaches were adopted. Concept of context became important. This signified the beginning of UCD. Theories and research approaches from non-computer science disciplines were applied. Proactive methods, such as a variety of participatory design, prototyping and contextual inquiries, started to emerge in this wave [2, 11].

In the third wave, we observed the flourishing of consumer technology, integration of multiple devices such as desktop, laptop, iPad and mobile. Multiple user experience based situations become apparent when the devices were used in different environment. Ubiquitous computing (or "ubicom") thrived whereby computing is made to appear anytime and everywhere [2]. Research in the third wave challenged the value related to the second wave and embraced experience and meaning-making [12]. User created content, common artifact and shared artifact coursed the boundary between user and designer becomes fuzzy in the realm of social network service (SNS). Scopes of proactive methods such as participatory design as well as the argument of the ability of such method from existing practices to the need of emergent use were broadened.

## **5. Four Research Approaches of Personas**

In the investigation of the common personas research approach practice by researches, we discovered an additional approach which is popular among the researches other than the three which has been posited by Lene Nielsen in 2004. It is Donald Norman [13] Ad-Hoc Personas. The additional ad-hoc personas discovered in our finding showed a significant number of references due to its ad-hoc basis. The four research approaches in chronology are:

- Alan Cooper (1998)– Goal Oriented Personas
- Adlin & Pruitt (2002) – Role Based Personas
- Donald Norman (2004) – Ad-Hoc Personas
- Lene Nielsen (2007)– The Engaging Personas

The goal-oriented persona was the earliest method used by user experience designers and researches based on Cooper's book and his earlier practice in his user experience and strategy firm – Cooper. The approach was strictly goal oriented whereby goals were set in various personas and were differentiated from one another based on their different goals. The approach was popular in the 90's and early 2000.

Norman [13] ad-hoc personas were created in a simple and fast ad-hoc approach which was mainly used as a communication tool to assist quick design decision making. Persona methods comprised ad-hoc assumption to invent personas based on the designer's experience. Role plays and affinity diagramming were involved in the process. Non-data and non-real user involved. Even though the approach may lack scientific validation, it provided a useful agile solution to practicing designers who needed a quick design decision making. The approach was popular among designers from the non HCI domain.

Adlin & Pruitt [14] in their book *Persona Lifecycle: Keeping People in Mind Throughout Product Design* proposed another new approach which was based on the personas' life cycle. It was a role-based approach. Personas were defined by their roles. The similar approach was engaged in another two publications - Grudin and Pruitt [11], Grudin and Pruitt [15]. There were five phases in the persona life cycle. Personas were able to be re-cycled and given new life by updating the user data.

Lene Nielsen [16, 17] posited a method which engaged both personas and scenarios in her PhD thesis. The method claimed to be more precise and effective in user personas studies as it was scenario oriented and each persona's differences were based on the task they performed at different time and occasion.

## **6. Mapping of the Landscape of Persona Studies**

Based on the analysis from the popularity of citation references and crossed references in the collected ACM publications, 20 papers were identified and engaged in the mapping of the personas research landscape. Four highly cited papers were selected to signify the changes of waves in the landscape map. As discussed earlier in the three waves of HCI section, based on Bødker [1] Three Waves of HCI, the four publications by Bannon [10], Bødker [1], Harrison, Tatar [9], and Bødker [2] were positioned as publication milestones for each wave of HCI in the left column of the map. Themes were drawn based on the criteria of the three waves as posited by Bødker [2]. These are used as guidelines to identify and justify the personas in the right column of the map (please refer to Appendix). No theme nor papers were identified in the first wave as it was not significant in user personas studies.

These identified themes are:

Second wave:

- Transition from human factor to human actor
- Engagement of other disciplines in research.
- Proactive methods such as participatory design was engaged.

Third wave:

- Embracing user experience and meaning-making by the user.
- Re-examination of the scopes and effectiveness of participatory design.
- The use context and application type broadened and intermixed.

### **6.1 Second Wave**

The emphasis on user centered design in the second wave of HCI provides opportunities in user personas development. Various key developments of personas took place during this period. A total of 7 papers were selected and positioned under the second wave of HCI. These papers were selected based on the popularity in reference citation and a crossed check in both google scholar citation and ACM citation have been carried out to verify the selection. All the publication milestones in the four leading re-

search approaches of personas posited in earlier section were all found here in the second wave. Alan Cooper's [4] book, *The Inmates Are Running The Asylum*, is the leading paper in the area with a score of 2592 in google citation and 27 in ACM citation of the 315 paper analyzed. Cooper's definition of personas remains the most cited definition to date.

Adlin and Pruitt [14]'s book, *Persona Lifecycle: Keeping People in Mind Throughout Product Design*, is the second most cited publication with a score of 719 in google citation and 61 in ACM citation. Together with other two papers, Grudin and Pruitt [11], Grudin and Pruitt [15], it provides popular resource in persona creation methods. Norman (2004) and Nielsen (2004) are the other two publication milestones in defining the four research approaches of personas.

Adlin and Pruitt [14] and Grudin and Pruitt [15] posited the argument of the *personas vs scenario* proposition which seemed in line with the theme of the second wave - transition of human factor to human actor. The pursuit of ethnographical data collection method attempts to imitate human behaviour in the creation of personas. This is demonstrated in the second wave of research trend which attempts to engage other disciplines in persona research.

Grudin and Pruitt [15] showed the attempt to anticipate participatory design in personas and this was highly sorted by other researches with a high google citation count of 489 and ACM citation 69. These show a good acceptance of engaging participatory design in this era.

Chapman and Milham [18] is the sole paper that warned about the pitfall amidst the high popularity of the usage of personas. They argued about the validity of methods employed in personas which led to political conflicts and undermined the ability for researchers to resolve questions with data.

## 6.2 Third Wave

The third wave signified the awareness of user participatory design, and this has created a significant impact in the studies of personas whereby participatory design has become the focus in many major persona research papers. The third wave also indicated that some researchers have started to argue about the effectiveness of user personas in HCI research. This provided a counter-checking effect in the field and it helped in re-evaluating and refining the user study method and further improved the studies in the long run. These adhered to the formulated third theme as mentioned above.

The selection of the 8 publications in this era were merely based on inferring to the significant contribution of the publications adhered to the formulated theme of the third wave. Bødker, Christiansen [19] argued that personas do not support participatory design in her studies of e-government user studies. She warned about the overwhelming popularity of personas where researches overlooked the effective link of created personas and design decision-making in design process. Echoing her argument, Friess [20] conducted a discourse analysis of the decision-making of designers in a top tier design firm which revealed that although the designers dedicate much



efforts in developing and refining personas, personas were relatively low in appearances in the designers' design decision-making. Personas merely served as an effective communication in both findings. Bødker and Nylandsted [21] further posited a new approach in the research of personas by connecting created personas with the underlying technology of an application. This was in line with the theme of the third wave of personas which embraced multiple devices and mixed complex engagements. Marsden and Haag [7] provided an in-depth reflection on personas regarding the benefits and downfalls of persona methods in most of the academic discourse. She warned of the potential stereotyping and the use of personas as political tool in design process which is different from the original motive of design.

In a nutshell, the third wave research highlighted certain pitfalls in the studies of personas as outlined below:

- There was a missing link between personas and designers. There was a tendency for designers not to design according to the personas and made design decision based on their own intuition. This problem occurred mostly due to time and financial constraint during design process.
- There was no direct link between data generated personas and the automated design application. (persona vs techsona [21])
- Data generated personas posed a threat in marginalizing minority user groups to fulfill the requirement of majority groups
- Potential bias and stereotyping occurred during the creation of personas as well as design process by designers who had agenda in their design.

## **7. Cultural Personas in Beyond the Third Wave**

Bødker described the HCI development of 10 years after the third wave as a chaos of multiplicity in terms of technology, use situations, methods and concepts [2]. We are in the era of the emergent of diversive communication devices which leads to intermixing of personal, work space, user experiences, common artifacts and meaning making and the fuzziness in professional designer and novice use boundaries. The development of personas and participatory design has no exception. Our analysis revealed that there are multiple dimensions of development in personas beyond the third wave. It is rather early to define it and map it in the research landscape, albeit demonstrating a potential trend of development in various dimensions. As the publications in cultural personas research per se, the development is encouraging.

The ACM digital library publication analysis shows the interest in cultural related personas research starting from 2006 and there is an increase since 2015. Research of the underrepresented cultural group and the micro-culture seems to be an interesting one. Daniel G. Cabrero published a total of five articles in ACM digital library from between 2014 and 2016. This demonstrated the highest publication of an individual author in the review. Cabrero, Winschiers-Theophilus [8], Cabrero [22], Cabrero [23] demonstrated a new dimension in the studies of personas in the third

wave and beyond with rigorous participatory research involving realist emic engagement.

Cabrero [22, 23] conducted his research in rural folks in Namibian whereby participatory design approach was adopted with the involvement of the local in the creation of personas. Sharing his participatory design approach in cultural personas were Zaman and Winschiers-Theophilus [24] where they conducted a community-based co-design personas creation involving semi-nomadic Penan in Borneo Island, Malaysia. The studies focused on digitalizing the Penan sign language – Oroo which are only known by the older generations of the locals whereby co-design with the locals seemed to be the effective method in capturing the tacit indigenous knowledge. The personas formulated were hand-drawn and created by the locals themselves.

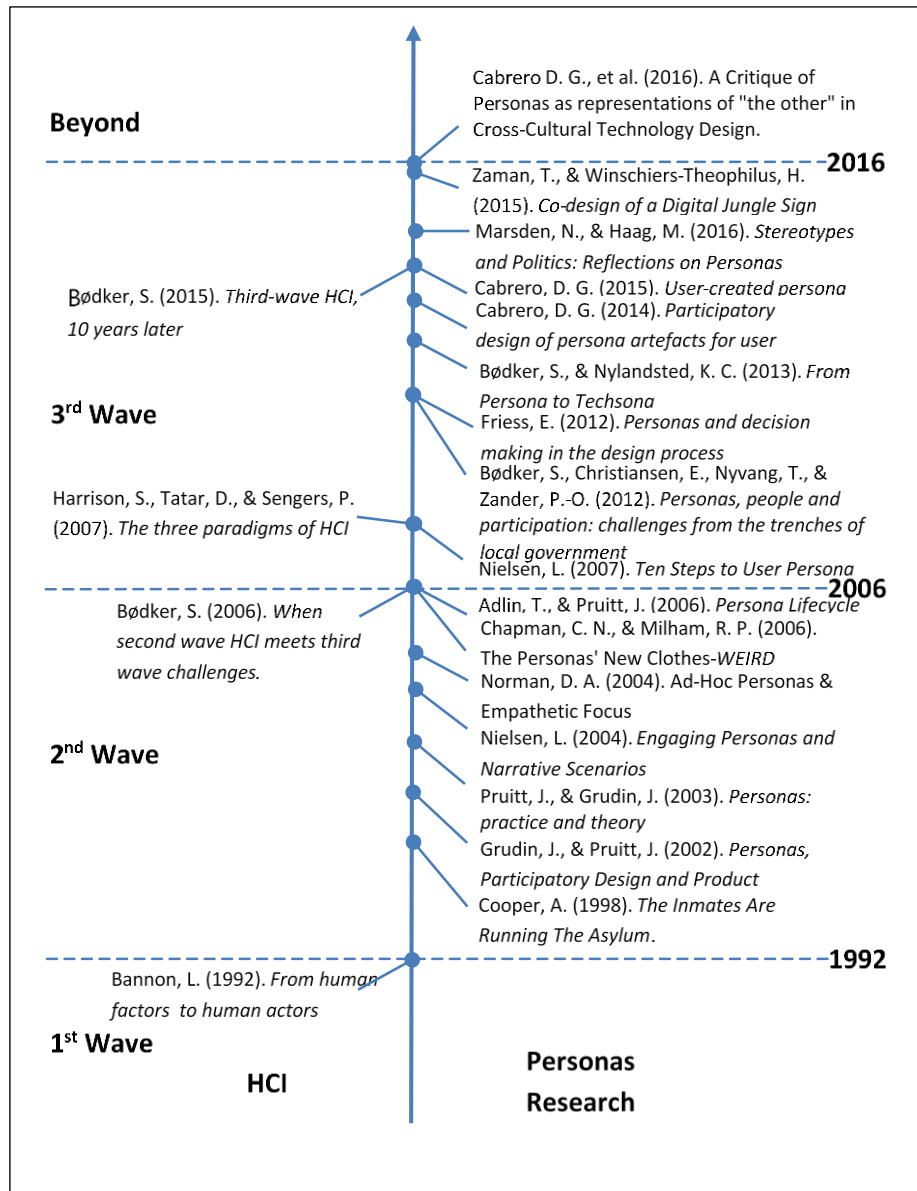
Conducting cultural design studies outside the real insider context could post a risk if culturally designs are flawed as posited by Goh [25]. Under justified and false *pseudo-etic* claims in cultural ‘findings’ represent common problems in cross-cultural design and realist emic engagement approaches carried out by both authors above seemed to be a virtuous solution in capturing and creating local cultural sensitive personas.

Decolonising research methodology has become one of the new agendas beyond the third HCI wave. This demonstrated how indigenous peoples and locals could be involved in research within their own communities and defining their own indigenous knowledge. This echoes with Raewyn Connell’s [26] Southern Theory in decolonising local knowledge. She posited the key contemporary form of southern theory was the use of main stream institution and tools to break free from the Northern hegemony by defining intellectual agendas. The creation of local cultural sensitive personas and the participation of users in the process seem to be the emerging trend in personas studies. Further research in this area to fill the gap and the need to generate new knowledge in this area would be crucial.

## **8. Conclusion**

The studies of personas are becoming a leading method in current user centred studies in information system design. Starting from 1998, there are various researches done and papers published to develop and improve the efficiency of the method and user studies approach. The fundamental methodology influences of leading researches namely - Alan Cooper, Tamar Adlin & John Pruitt, Lene Nielsen are significant insight in many researches. The emerging trend of personas in international users and local cultural contexts is becoming crucial at this present moment and fast becoming a significant method in sustaining local cultural identity and securing the future of ICT4D. Participation design and co-creation of personas seems to be a noble solution in the effort of sustaining local culture and identity.

## Appendix- Personas Research Review Landscape



## References

1. Bødker, S., *When second wave HCI meets third wave challenges*, in *Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles*. 2006, ACM: Oslo, Norway. p. 1-8.
2. Bødker, S., *Third-wave HCI, 10 years later---participation and sharing*. interactions, 2015. **22**(5): p. 24-31.
3. Marshall, P.D. and K. Barbour, *Making Intellectual Room for Persona Studies: a New Consciousness and a Shifted Perspective*. Persona Studies, 2015. **1**(1).
4. Cooper, A., *The Inmates Are Running The Asylum*. 1998, Indianapolis: Sams Publication.
5. Putnam, C., B. Kolko, and S. Wood, *Communicating about users in ICTD: leveraging HCI personas*, in *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development*. 2012, ACM: Atlanta, Georgia, USA. p. 338-349.
6. Jung, C., *Psychological Types. The Collected Works of C.G. Jung*. . Vol. 6. 1991, London: Routledge.
7. Marsden, N. and M. Haag, *Stereotypes and Politics: Reflections on Personas*, in *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. 2016, ACM: Santa Clara, California, USA. p. 4017-4031.
8. Cabrero, D.G., H. Winschiers-Theophilus, and J. Abdelnour-Nocera, *A Critique of Personas as representations of "the other" in Cross-Cultural Technology Design*, in *Proceedings of the First African Conference on Human Computer Interaction*. 2016, ACM: Nairobi, Kenya. p. 149-154.
9. Harrison, S., D. Tatar, and P. Sengers, *The three paradigms of HCI*. alt. chi, 2007.
10. Bannon, L., *From human factors to human actors: the role of psychology and human-computer interaction studies in system design*, in *Design at work*. 1992, L. Erlbaum Associates Inc. p. 25-44.
11. Grudin, J. and J. Pruitt. *Personas, Participatory Design and Product Development: An Infrastructure for Engagement*. in *Proceedings of the Participatory Design Conference*. 2002. Malmö, Sweden.
12. McCarthy, J. and P. Wright, *Technology as Experience*. 2004, Cambridge, MA: MIT Press.
13. Norman, D.A. *Ad-Hoc Personas & Empathetic Focus*. 2004 [28 October 2016]; Available from: [http://www.jnd.org/dn.mss/personas\\_empath.html](http://www.jnd.org/dn.mss/personas_empath.html).
14. Adlin, T. and J. Pruitt, *Persona Lifecycle : Keeping People in Mind Throughout Product Design*. 2006, Burlington, MA, USA: Morgan Kaufmann.
15. Grudin, J. and J. Pruitt, *Personas: practice and theory*, in *Proceedings of the 2003 conference on Designing for user experiences* %@ 1-58113-728-1. 2003, ACM: San Francisco, California. p. 1-15.
16. Nielsen, L., *Ten Steps to User Persona By Dr. Lene Nielsen*. 2007.
17. Nielsen, L., *Engaging Personas and Narrative Scenarios*. PhD Series. Vol. 17. 2004, Copenhagen Samfundslitteratur.

18. Chapman, C.N. and R.P. Milham, *The Personas' New Clothes: Methodological and Practical Arguments against a Popular Method*. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 2006. **50**(5): p. 634-636.
19. Bødker, S., et al., *Personas, people and participation: challenges from the trenches of local government*, in *Proceedings of the 12th Participatory Design Conference: Research Papers - Volume 1*. 2012, ACM: Roskilde, Denmark. p. 91-100.
20. Friess, E., *Personas and decision making in the design process: an ethnographic case study*, in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* %@ 978-1-4503-1015-4. 2012, ACM: Austin, Texas, USA. p. 1209-1218.
21. Bødker, S. and K.C. Nylandsted, *From Persona to Techsona*, in *Human-Computer Interaction – INTERACT 2013: 14th IFIP TC 13 International Conference, Cape Town, South Africa, September 2-6, 2013, Proceedings, Part IV*, P. Kotzé, et al., Editors. 2013, Springer Berlin Heidelberg: Berlin, Heidelberg. p. 342-349.
22. Cabrero, D.G., *Participatory design of persona artefacts for user eXperience in non-WEIRD cultures*, in *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium papers, and Keynote abstracts - Volume 2*. 2014, ACM: Windhoek, Namibia. p. 247-250.
23. Cabrero, D.G., *User-created persona: Namibian rural Otjiherero speakers*, in *Proceedings of the 33rd Annual International Conference on the Design of Communication* %@ 978-1-4503-3648-2. 2015, ACM: Limerick, Ireland. p. 1-6.
24. Zaman, T. and H. Winschiers-Theophilus. *Co-design of a Digital Jungle Sign Language Application*. in *Proceedings of the 15th IFIP TC 13 International Conference (INTERACT'15)*. 2015.
25. Goh, C.H., *Cross-Cultural Web Design Study: Designers' Challenging Task in Developing Country*. Asia Pacific Journal of Contemporary Education and Communication Technology 2016. **2**(1): p. 190-199.
26. Connell, R. *Decolonising Knowledge, Democratising Curriculum*. 2016 [cited 2006 18 December 2016]; Available from: <http://www.raewynconnell.net/2016/10/decolonising-curriculum.html>.