

Supporting Refugees in Every Day Life – Intercultural Design Evaluation of an Application for Local Information

Completed Research Paper

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Abstract

An unprecedented number of refugees have fled to Europe in the last years. When arriving in a new country, refugees need information on topics such as the asylum process, locations of language courses or opening hours of an Arabic speaking physician. However, refugees report an information deficit when arriving in the host countries. We address this information deficit by developing design principles for mobile applications that transmit local information to refugees with different cultural background. We develop a smart phone application that presents complex information in an understandable and intuitive manner to support refugees. To derive design principles, we applied a Design Science Research approach based on a requirements analysis via a survey among refugees. Subsequently, the mobile application's design is iteratively improved based on the results of three user studies with 127 participants of Arabic, African, and Western background. With the improved design, users are faster and more successful in finding the required information. We use these insights to derive design principles for transmitting information to users with different cultural background. This contributes to literature on how IS can support refugees and how findings from Human-Computer-Interaction research can be applied in an intercultural setting.

Keywords: Refugees, Human Computer Interaction, Intercultural Communication, Online Communities, IT Platform, Mobile Application Design

Motivation

Global crises such as civil wars, persecutions, or suppressions led to the highest number of refugees that fled to countries of the European Union since the Second World War. Therefore, solely in Germany over 475,000 refugees applied for asylum in 2015. The points of origin of the refugees are conflict-affected countries in the Middle East such as the Syrian Arab Republic or Afghanistan, and in Africa such as Eritrea or Nigeria (Bundesamt für Migration und Flüchtlinge 2015).

In order to ease the immigration process and to cope with everyday life problems, refugees are dependent on accessing information. However, refugees often lack sufficient and resilient information after arriving in a new environment (Gillespie et al. 2016). Such information would be necessary as it concerns all aspects in daily life – from making an appointment with a local physician, to complying with laws and regulations, to accessing information about culture and society. By depriving refugees of this information, they risk being excluded from daily life and might be pushed to the margins of society (Andrade and Doolin 2016).

Municipalities, which are often supported by local initiatives and volunteers, try to provide refugees with necessary information. While most information is still provided paper-based and orally, some projects start delivering information via digital channels such as mobile applications. These projects face the challenge to communicate information to refugees of different cultural backgrounds through one single application. Research on human-computer interaction (HCI) provides some guidance to design interfaces for different cultural groups. However, these findings are not directly applicable to the quest of disseminating information among refugees. Clear guidelines on the design of such an information application for refugees are missing.

In order to improve the digital transmission of information to refugees, this paper aims at providing design principles for mobile applications in order to display information that is adapted to the different cultures of the refugees. In particular, the principles focus on information visualization, structure, usability, and credibility to provide information in an intuitive way. Within this paper, the following research question is answered: *Which design principles need to be applied to ensure an efficient transmission of information for refugees with different cultural background?*

To answer this question, we first review current literature on information systems (IS) for refugees and human-computer interaction (HCI) in an intercultural context. We then embark on a Design Science Research (DSR) study within the project *INTEGREAT*¹. The *INTEGREAT* project is an initiative that provides an information platform for refugees consisting of a mobile application and a content management system (CMS) as backend (Schreieck et al. 2016a). Municipalities and other information providers can enter information in the backend, which is then displayed in the mobile application. Within the DSR study, we first analyze refugees' information requirements with a qualitative survey. Then, we improve the design of the already existing *INTEGREAT* mobile application within two iterations each featuring a development phase (envisioning and implementation of prototypes) and an intercultural evaluation phase with 90 test persons of Arabic, African and Western background. The evaluations were conducted in four different refugee camps with the help of partner institutions of the *INTEGREAT* project.

The evaluation reveals that the associations of design elements like icons or pictures can vary between diverse cultures. Other elements like typography, content structure, or the general user interface (UI) design are received nearly equal across the considered focus groups. However, a precise adaptation and localization of the presented data needs to be done in order to both transmit information to refugees with different cultural background and to ensure an intuitive usage and understanding of the information. For that reason, we suggest design principles for information visualization, structure, usability, as well as credibility. We discuss how these findings contribute to literature on IS for refugees and intercultural HCI.

Related Work

To cope with everyday life problems in their new environments, refugees depend on accessing sufficient and resilient information (Andrade and Doolin 2016). This section investigates literature related to IS for refugees as well as HCI in an intercultural context. We evaluate in how far extant

¹www.integreat-app.de.

literature contributes to the challenge of efficiently transmitting information for refugees of different cultural background.

IS for Refugees

Refugees are translocated to new and unfamiliar environments in which they differ in language, cultural habits, and life experience (Hannides et al. 2016). In order to resolve resulting everyday life problems and to be open towards a new culture and society, refugees need information. Not being able to access, interpret, and use relevant information, refugees are pushed to the margin of the host country's society (Andrade and Doolin 2016; UN High Commissioner for Refugees 2013). If implemented and governed the right way, IS such as mobile solutions and IT platforms can help to overcome refugees' information deficit (Hein et al. 2016; Schreieck et al. 2016b).

Especially in temporary camps where refugees live on their dangerous way to a safer country, technological aspects often cause a lack of information. Refugees have limited abilities to use cell phones, not resulting from the acquisition of the phones themselves, but rather from accessing a reliable phone network (Wall et al. 2015). In the camps, there is often only a mobile network infrastructure available which is not sufficient and mostly of a stationary kind (Maitland and Xu 2015). However, once they have access to internet either in the camps or as soon as they arrive in their new host country, refugees can use IT for navigating the unfamiliar information environment (Caidi et al. 2010; Lloyd et al. 2013).

Using the Internet or social media can also mediate communicative or expressive activities that connect refugees with a broad range of people and facilitate their participation in IS-enabled social and support networks (Caidi et al. 2010). Individuals increasingly participate in widespread and overlapping social networks also to be part of their old hometown communities (Gifford and Wilding 2013; Urquhart et al. 2009). Regarding the participation in their old communities, however, refugees often suffer from social obstacles that are particularly related to gender. Not married, younger female refugees do not use phones, which is caused by their former lives in their countries of origin. Therefore, women gather information within their surroundings which results in partial, often untrustworthy information (Wall et al. 2015). Otherwise, possessing a mobile phone, but especially exchanging information and digital content around the world, is often associated with a surveillance by the state. Consequently, many refugees are deterred and do not use their phones for that reason (Benítez 2012; Caidi et al. 2010; Hiller and Franz 2004; Wall et al. 2015; Wilding 2012).

In order to get additional insights of challenges and problems refugees face, Fisher et al. (2016) asked young Syrian refugees to create prototypes of visionary devices. These prototypes highlighted that there is an information deficit and underlined further challenges such as the limited access to education. Further challenges concern irrelevant and dangerous information as well as a disrupted social support (Wall et al. 2015).

To face these problems, mobile applications and services as well as design concepts have been established in order to support the refugees and contribute to their social inclusion (Andrade and Doolin 2016). The German applications *Ankommen* (Bundesamt für Migration und Flüchtlinge 2016) and *Welcome App* (Heinrich & Reuter Solutions GmbH 2016) as well as the mobile service *Lantern* from the U.S. disseminate information – of the asylum procedure or to explore and navigate the new environment – to newly arriving refugees (Baranoff et al. 2015). In Italy, migrants use mobile phones to resolve uncertainties of everyday working life. Applying gamification as a motivator in such digital applications can help refugees to form communities, learn the local language and culture and become part of the hosting society (Ngan et al. 2016).

However, IS can be boon and bane for refugees. On the one hand, such technologies can generate impediments to legal status and increase the possibilities for surveillance, whereas on the other hand, refugees obtain a sense of security and wellbeing using IT (Harney 2013). One problem that is still associated with all of these IS solutions is that most refugees suffer from overreliance on information (Maitland and Xu 2015). Especially the dissemination of not trustworthy information using social media leads to increasing misinformation and therefore even strengthens the problem of the information deficit refugees are suffering from (Wall et al. 2015).

Based on that, the main challenge for IS for refugees is to transmit trustworthy information. This challenge is further complicated by the different cultural background of refugees, which needs to be considered when designing solutions that tackle the information deficit. HCI research provides suggestions on the intercultural design of IS artefacts.

HCI research in an intercultural context

The use of smartphone applications is common among refugees. Different applications are used for varying purposes, e.g. to communicate with family members or others, to get information on the new environment, or to access specific data about health issues or regulations (Andrade and Doolin 2016; Talhouk et al. 2016). Ensuring a positive experience for all refugees across different cultures is a huge challenge for HCI research and practice. For example, different directions of reading as well as heterogeneous interpretations of icons need to be considered in the design of applications. Apart from the issue that refugees have different cultural backgrounds and prior knowledge, the mobile application design needs to present information intuitively and in a natural way. Based on that, this section presents the main findings from literature regarding design concepts in an intercultural context.

Sobiegalla et al. (2016) propose functional and non-functional design principles for mobile crisis response systems. However, these principles are not adapted to the different cultural backgrounds. Presenting information among refugees with a multi-cultural background may provoke diverse associations (Reinecke and Bernstein 2013). The usage of icons in mobile applications provide, on the one hand, the advantage that they depict information without text (Jandt 2013) but, on the other hand, may provoke varying associations across different cultural groups (Stapelkamp 2013) and therefore need to be chosen carefully. Icons should reflect the user's background and prior knowledge to ensure an appropriate communication of the desired information. This can lead to the use of different icons in order to transmit the same information interculturality (Stapelkamp 2013).

Reinecke and Bernstein (2013) argue in their paper that elements of the interface, like navigation, colors or structure, have to adapt automatically according to the user's cultural background. In contrast to their presented desktop solution, in the case of mobile applications, displays are further limited in space and resolution for what reason also typography needs to adapt to the given circumstances (Cousins 2016; Stapelkamp 2013). Also readability and in particular the direction of reading needs to be adapted. While western cultures read from left to right (LTR), Arabic cultures read from right to left (RTL). Consequently, the whole application UI needs to reflect and adapt the appropriate direction (Khaddam and Vanderdonck 2010).

These findings imply that visualization, structure, and usability are main concepts that need to be adapted for different cultural groups. By adapting the **visualization** of information, a positive user experience is ensured (Lichtlé 2007; Maletzke 1996; Stapelkamp 2013). As refugees reflect different levels of literacy (Hannides et al. 2016) as well as varying cognitive capacities, it should be avoided to display too many elements at once (Butz and Krüger 2013; Krug 2005). Thus, information should be displayed following a strictly hierarchical **structure**. Research further reveals that users basically do not want to think about the functionalities or the representation of content, instead they want to interact with an intuitive interface that does not require further explanation. Otherwise, frustration of the users will be generated (Krug 2005). These user expectations can be met by improving the **usability** of the system – which again can be interpreted differently across cultures.

For refugees, **credibility** has emerged as an additional concept relevant for designing applications. Refugees often do not get the reliable information they need due to a lack of online or mobile connectivity and limited consistent information that they can trust (Hannides et al. 2016). This fact is even strengthened by the overreliance on mobile data, many refugees are suffering from. Without credibility, other design optimizations may not have any effect.

In sum, literature shows that IT is already applied in the context of refugees, however, the information deficit is not yet solved, with challenges in intercultural transmission of information complicating the cause.

Design Science Research Approach

To tackle the issue of an information deficit of refugees, we develop design principles for a mobile application providing information for refugees as part of the *INTEGRATE* project. To do so, we follow the Design Science Research (DSR) approach according to the guidelines of Von Alan et al. (2004). As the DSR approach is often used for the general development of mobile IS applications, it can also be applied to structure the design process of mobile user interfaces (Sonnenberg and Vom Brocke 2012). The DSR development process follows the build-evaluate pattern.

Both of these phases consist of different stages. The **build phase** combines three different aspects: Analyzing the problems and their importance, defining objectives of a solution and finally developing

and implementing this solution. The **evaluation phase** contains three stages as well. First, a suitable context needs to be chosen to demonstrate the solution's capabilities. Second, the actual evaluation can be conducted. Third, the outcomes of the evaluation lead to an adaptation of the design and development stage in the next build-phase. This implies an iterative development process with a continuing overall improvement of the general design concept. The last stage of the evaluation-phase consists of the publication and communication of the research findings in order to contribute to overall research (Sonnenberg and Vom Brocke 2012; Von Alan et al. 2004).

We started the DSR approach by analyzing both an existing early prototype of the *INTEGRATE* mobile application, and the information requirements of refugees using a survey. Among the 37 participating refugees, 4 people had an Arabic, 18 an African and 15 a Western background. On that basis, the build-evaluate process was executed twice in order to improve the design concept of the mobile application iteratively. In the first iteration, we focused on the general design of mobile UI elements such as icons and typography. In order to evaluate the design assumptions of the first iteration, a user test was conducted with 65 test persons each belonging to one of the considered focus groups. 31 of them had an Arabic, 14 an African, and 20 a Western background. The findings from the first iteration led to a second build-evaluate process that focused on a complete design concept for the *INTEGRATE* mobile application to evaluate the structure and hierarchy of the information within the app as well as the overall usability. The 25 participants of this user test composed of 8 refugees with an Arabic, 8 with an African and 9 with a Western background. The evaluation methods and participants' data are summarized in Table 1.

DSR phase	Topic	Evaluation method	# of participants	Background		
				Arab.	Afr.	West.
Initialization	Information requirements	Survey	37	4	18	15
Build-evaluate I	Icon evaluation	User test	65	31	14	20
Build-evaluate II	Design evaluation	User test	25	8	8	9

Table 1. Summary of evaluation methods and participants' data

To perform the evaluations, we visited four different refugee camps in Germany. In all three DSR phases, the test persons further varied in gender, age, and status of approval. Some were underage, unaccompanied refugees, whereas others were accepted refugees who have settled already. Therefore, the user study comes close to a representative excerpt of refugees in Germany.

Results

In this section, we first describe refugees' information requirements when arriving in the host country. We use these results to perform our subsequent design evaluation with information that is relevant for refugees. The design evaluation consists of two build-evaluate phases, with the first focusing on design elements and the second on an overall design concept.

Information Requirements

The results from a survey among 37 refugees show that the process of information procurement is the biggest challenge for refugees as they arrived in Germany. 87% of the surveyed refugees state that they had an information deficit. Only 13% of the test persons were sufficiently informed as they already had contact to persons who already settled in Germany. The lack of information, as well as the foreign German culture were distinct challenges for the refugees. Further problem areas relate to understanding guidelines, rural accommodations with bad infrastructure as well as long waiting times at public institutions.

Our survey shows that the information sources used by refugees can be divided into four categories. The most important information source for refugees are *Local Contact Persons* which has been mentioned by 47 % of the participants. This group comprises also volunteers, contact persons in camps as well as interpreters. The second most important source to gather information is *Family & Friends*, mentioned by 37% of the participants. Other information possibilities encompass *German Classes* (11 %) and the *Internet* (5%).

The survey results also show that *Organizational & Legal Information* is the topic in which the most refugees (33%) are interested in (see Table 2). The second most interesting topic concerns *Education*

& *Profession* with 27% followed by *Accommodation* (16 %) and *Family* (7 %). The topic *Other* comprises local information about cities, doctors, contact persons as well as social welfare benefits and is the third most interesting topic for refugees.

Topic of Interest	% of Test Persons [that mentioned the topic]
Organizational & Legal Information	33
Education & Profession	27
Accommodation	16
Family	7
Other	18

Table 2. Refugees' topics of interest after arriving in the host country

Furthermore, the survey contained questions on the perception of the existing *INTEGREAT* application. 60% of the refugees assess the layout and visualization of information of the *INTEGREAT* application positive. The interviewees describe the structure as clear because it is held simple as well as functional. A point of criticism is the text-heaviness of the application. More pictures or icons would ease the perceived "wall of text". For this reason, the design was enriched with icons in the first build-evaluate phase described in the following section.

Evaluation of Design Elements

In order to ease the intercultural transmission of information using the *INTEGREAT* smartphone application, the results of the survey suggest to use icons for the main and subcategories of the content. We therefore evaluate icons as the first relevant design element. As the information that refugees locally require is very diverse, a categorization into six main categories and multiple sub categories can help to structure and organize the content. The categorization further eases the process of searching for the relevant information. For creating appropriate icons, we designed two alternative icons for each main and sub category. By designing the icons, we reflected the cultural differences and expectations of the focus groups and observations of icon usage in different mobile applications for Western, Arabic and African users.

Afterwards, refugees who participated in the icon evaluation compared both icons for each category in order to identify if the icons represent the information as expected and which of both depicts the information more precisely. By following this approach, cultural differences concerning the associations of each icon can be measured and the considerations and assumptions reviewed. Figure 1 presents the alternative icons for the six main categories. Each icon tries both, to depict the according category in an understandable manner and to adapt to the experience of the intercultural users.

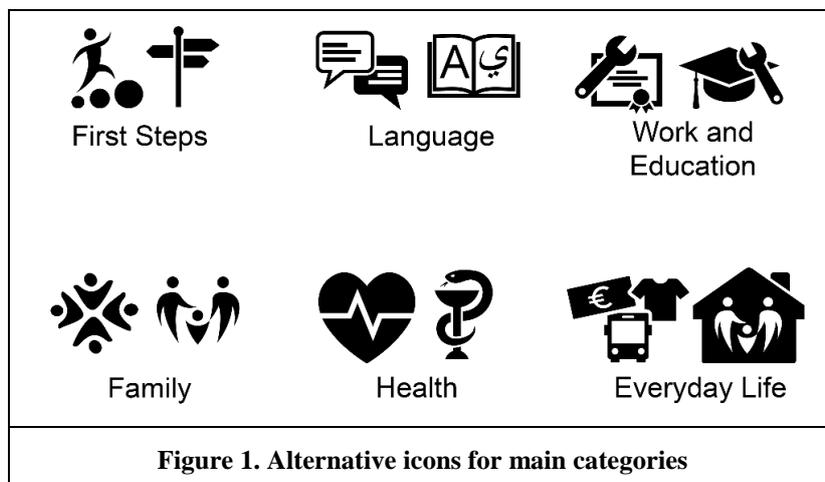


Figure 1. Alternative icons for main categories

In the category *First Steps*, the left icon depicts an abstract person that climbs multiple circles that can be interpreted as staircases. This implies that the person tries to reach a goal and has to overcome

multiple obstacles on its way. The icon on the right, however, depicts a road sign. Road signs provide orientation and help people to find the right way, especially in new environments. As road signs are well known internationally, also in the countries of origin of the people within the focus groups, this icon is able to depict the topics that are presented in the category *First Steps*.

Beside icons, we evaluated further design elements as part of the user interface. As most information of the *INTEGRATE* project is presented in a textual way, the user interface design tries to achieve a pleasant readability. Therefore, as typeface *Google's Roboto* (Google 2016) font is used, a clear sans-serif font that is adapted to the constraints of smartphone screens, as shown in Figure 2 (left).

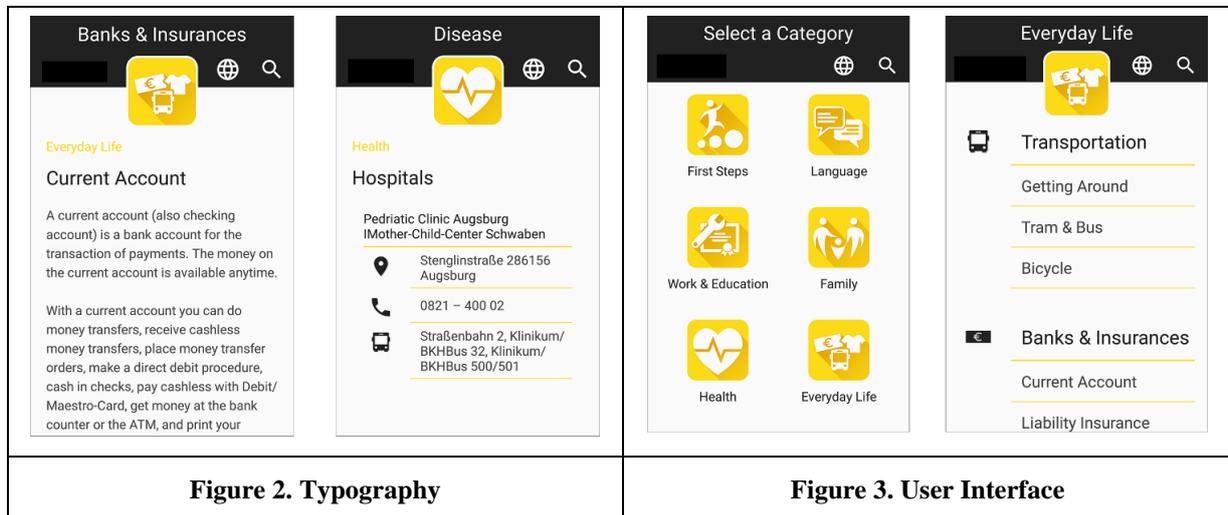


Figure 2. Typography

Figure 3. User Interface

Besides the clear sans-serif font, also the amount of text that is displayed at once was reduced to improve the readability. Therefore, a font size was chosen that allows a maximum of 40 characters per line. In addition, sufficient space between the text lines and enough padding to the edges of the screen were introduced to loosen up the textual content. A further approach to ease reading and avoid the impression of a “wall of text” was to include distinctive icons, as shown in Figure 2 (right). By adding icons for particular contents like addresses or telephone numbers, the overall appearance can be improved and the user can understand intuitively the kind of content that is presented.

In order to transmit the according information intuitively, the general UI design was envisioned as clear, clean and structured. As described in the *Related Work* section, a well-organized UI improves the user experience (UX) and leads to less user frustration.

The UI concepts that include the design elements for the first build-evaluate iteration are presented in Figure 3. A *Toolbar* at the top of the interface provides user orientation by both explaining the according content and displaying the actions, the users can perform. In addition, appropriate icons depict the most important functionalities like the possibility to search.

The *Content Area* underneath the toolbar depicts the content of the according screen. We strived for a clean and clear structure, in order to present the actual content in an intuitive manner. Therefore, only the most important information is shown along with appropriate icons that depict the according content in an understandable way.

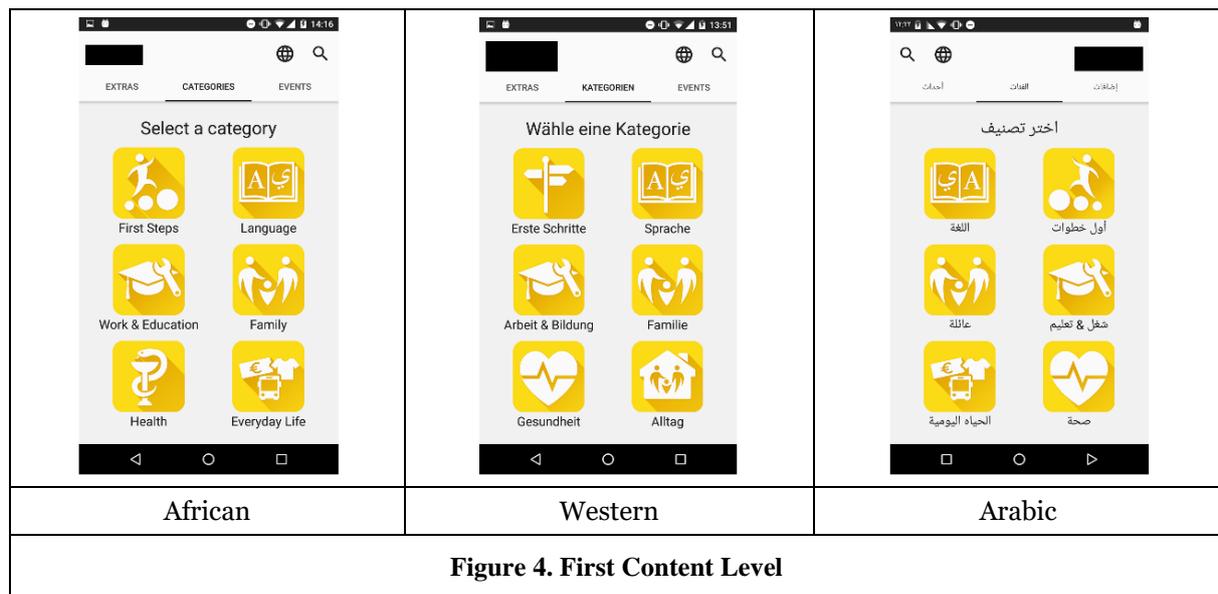
To ease the evaluation process and the analysis, a dedicated evaluation application was implemented that allowed the test users to execute the evaluation within a mobile smartphone application. The evaluation was split into three parts. During the first part, the user could specify individual data like gender, age and country of origin. The second part covered the evaluation of icons, whereby the user could choose the icon which represents the according category most precisely in his or her opinion. If none of both icons was suitable, the user could also decide to choose no icon at all. The third and last part was the evaluation of further design elements. Here, the user could evaluate the design approach of the evaluation application against the design approach of the current *INTEGRATE* smartphone application and choose the UI that seems more suitable.

The icon evaluation process revealed that in only 40% of all cases, all cultural groups preferred the same icon for the respective category. This implies that in 60% of all cases, the association of the according icon was diverse between the cultural groups. For example, the icon for *Everyday Life* information was chosen differently from Westerners as from Arabs and Africans.

Evaluation of the Design Concept

In this section, the second build-evaluate iteration of the DSR method is described. The focus was set on completely elaborated user interfaces that featured all functionalities of the current *INTEGRATE* smartphone application. Insights and findings of the first iteration were included. Again, a dedicated evaluation application was implemented to conduct user tests.

Figure 4 presents the user interfaces for each cultural group of the first content level, which enables the user to select one of the main categories. As the first iteration revealed that the association of icons can differ across the considered focus groups, this design concept adapts the icon sets to the according cultural groups. Therefore, Figure 4 shows from left to right the icon set for the African, Western and Arabic culture. As the comparison shows, not all icons are different across the cultural groups. The categories *Language*, *Work & Education*, as well as *Family* can be tagged with the same icons across all cultural groups. This implies that for the *INTEGRATE* smartphone application three out of six icons need to be adapted according to the focus groups.



Besides the localization of the icon sets, the general design principle could be drawn from the first evaluation. A common UI design concept was presented to all considered focus groups accordingly, shown in Figure 5. The design concept should follow common design principles within the area of mobile UI design. Using a very clean and structured style provides clear orientation without the disturbance of *Visual Noise*.

Besides the clean list displaying the different topics, the application is also adapted to the directions of reading. Here, the concept of mirroring is applied as shown in Figure 5. The mirrored UI is suitable for languages with a RTL direction of reading.

In order to be able to measure a difference between the design concept implemented in the evaluation application and the current *INTEGRATE* prototype app, an A/B comparison was chosen. Test users needed to locate three different pieces of information within both applications (e.g. “What should you do when you lose the debit card of your current bank account?”). By measuring the duration users needed to locate the three pieces of information and the number of clicks they performed, we could identify differences in terms of user experience. To even out the learning effect, we randomized whether users started the test with the old or the new application.

The evaluation reveals that the new design concept provides a clearly measurable advantage in terms of UX and general usability. As shown in Figure 6 (top), only between 56% and 72% of the test persons could accomplish the tasks using the current *INTEGRATE* prototype app (Integreat_old), all test persons handled the tasks successfully using the evaluation application with the new design concept (Integreat_new). Especially people with an Arabic background had difficulties to find the desired information with the old version. For example, only 25% of the Arabic test persons were able to complete two or three out of the three tasks. This result indicates that the prototype application has a worse UX for RTL direction of reading.

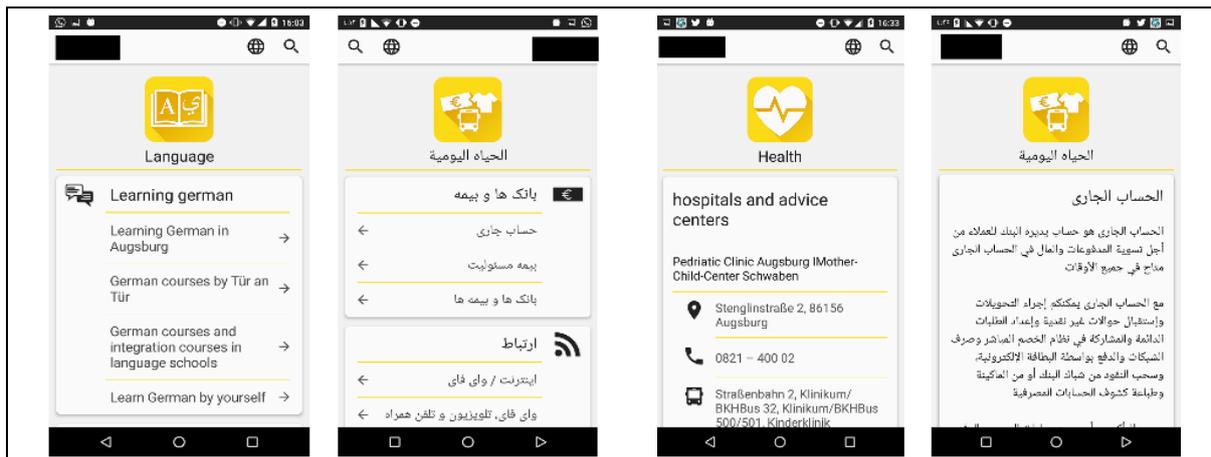


Figure 5. Second and Third Content Level in English and Arabic

Apart from advantages in accomplishing the tasks, the new design concept further enabled the users to find the information more quickly (Figure 6, bottom). Task 1 and 2 were accomplished significantly faster with the new design. Only task 3 was completed more slowly with the new *INTEGRATE* application. The reason is, that the strict hierarchical clustering of information moved this piece of information one level down in the new design concept.

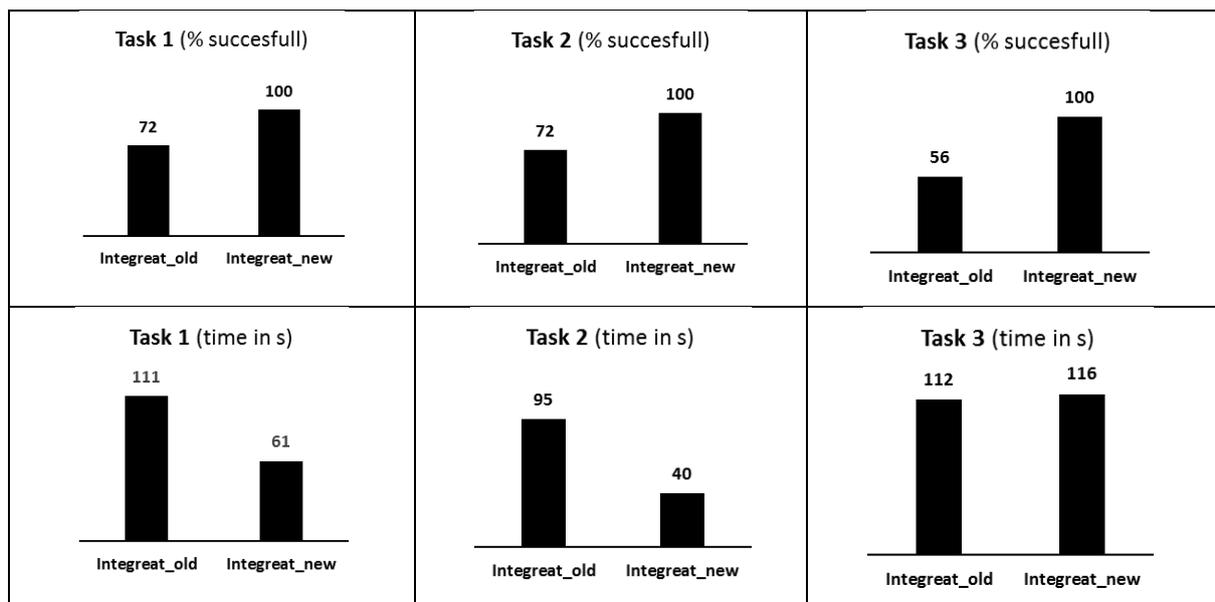


Figure 6. Successful task accomplishment (top) and average task time (bottom)

Discussion

In this paper, we developed and evaluated an intercultural design concept for the *INTEGRATE* smartphone application, which provides the possibility to communicate local information to refugees in an intuitive way. Based on these results, we derive design principles for an information application for refugees and mobile applications for users with different cultural background in general. We further discuss how this work contributes to current literature in IS for refugees and HCI research.

The user studies revealed that for each of the considered focus groups an independent set of icons is necessary in order to communicate the same information. These icon sets do not differ completely, as three out of six icons for the main categories can be displayed equally across all focus groups. This implies that visual elements like icons or pictures need to be chosen carefully as well as their associations for the users need to be examined on a case-by-case basis. As *INTEGRATE* is designed for an intercultural audience, it needs to adapt to diverse directions of reading (Khaddam and

Vanderdonckt 2010). It is especially important in the context of RTL languages, otherwise, usability and UX will suffer and user frustration will rise (Krug 2005). From these findings, we deduct design principles that aim at supporting other projects that need to communicate information to users with different cultural background. These principles are presented in Table 3.

Design Principles	Visualization	Text	Maximum of 40 characters per line
			Sans-serif font
			Left-To-Right and Right-To-Left compatibility
		Icons	Usage only in combination with a textual description
			Validation of icons across cultures
	Structure	Hierarchical clustering of information	
		3-Click-Rule	
	Usability	Offline capability	
		Usage of common interaction possibilities	
	Credibility	Usage of disclaimer	

Table 3. UX design principles for transmitting information in an intercultural context

Adapting the **visualization** of information is essential to ensure a positive user experience in an intercultural context (Lichtlé 2007; Maletzke 1996; Stapelkamp 2013). Based on the results of our study, the visualization concept can be further divided into text and icons. Related to text, a maximum of 40 characters should be shown per line in a sans-serif font in order to avoid the impression of a “wall of text”. Additionally, the LTR and RTL compatibility needs to be ensured. Icons can provoke diverse associations across different cultural backgrounds. Consequently, icons must not appear alone, instead, they have to be used in combination with a textual description and have to be validated across the involved cultures. Reflecting the refugees’ different levels of literacy (Hannides et al. 2016), not too many elements should be displayed at once (Butz and Krüger 2013; Krug 2005).

Consequently, an intuitive **structure** of the information is indispensable. The results demonstrate that the overall amount of information has to be clustered in a strictly hierarchical way to ease navigation. In combination with the hierarchical clustering, the 3-Click-Rule should be fulfilled, i.e. users should be able to find the desired information within three clicks starting from launching the application. Despite the fact that each task could be conducted successfully (see Figure 6, top) as well as two-thirds of the tasks could be accomplished faster with the new *INTEGREAT* application, this does not necessarily mean that refugees *always* find the information faster within the app by applying the proposed design principles. Task 3 in Figure 6 (bottom) illustrates that information can be definitely found within the mobile application at an expense of possibly longer search times. However, users do not want to think about functionalities of the application, otherwise frustration will rise (Krug 2005). For that reason, **usability** is another main principle designing mobile applications as our study shows. Based on previous findings that refugees often have technical problems or even no internet access after arriving in a new country (Maitland and Xu 2015; Wall et al. 2015), the mobile applications need to be usable offline. Regarding the interaction with the application, common possibilities like swiping or scrolling should be used. Another problem that comes along with a lack of connectivity is that refugees often suffer from not getting trustful information (Hannides et al. 2016). Instead they are used to be confronted with irrelevant, dangerous information or misinformation (Wall et al. 2015). Contributing to these findings, our study reveals as well that **credibility** of information is a main design principle. For example, a clearly visible disclaimer referring to a trustful organization in the application is crucial.

By developing design principles, we contribute to literature related to HCI in an intercultural context. The main challenge to implement intuitive user interfaces that provide a positive UX across various cultures is that the design concept needs to adapt to the experiences and background of the users (Reinecke and Bernstein 2013). For example, our findings confirm that especially visual elements like icons or pictures can provoke diverse associations and reactions across users with different cultural backgrounds (Stapelkamp 2013). As we developed *INTEGREAT* in an user-centered and intercultural design approach, it also contributes to improving user experience by applying an offline capability and intercultural intelligibility (Maitland and Xu 2015).

Our results furthermore contribute to the ongoing discussion on information deficit that pushes refugees to the margins of the host country's society and how IS could tackle this issue (Andrade and Doolin 2016; Hannides et al. 2016; Rutkin 2016). Enhancing Hannides' (2016) work, we analyze what information refugees need when arriving in the host country. We further show how these information needs can be satisfied with mobile applications, focusing on the aspect of intercultural design of such applications. We thereby seize suggestions that Sawhney (2009) derived in his work with marginalized youth in refugee camps and contribute to ongoing work on the design of software artefacts that support refugees (Baranoff et al. 2015; Ngan et al. 2016).

By following our design principles, intercultural design concepts for mobile applications that transmit information across different cultures can be created within the *INTEGREAT* project and beyond. As our findings enrich research on intercultural design concepts by focusing on users with Arabic, African or Western backgrounds, interface designers can use them in intercultural projects, not necessarily focusing on refugees.

Future research could examine how further design elements and principles can be used to present information intuitively. For example, videos or even non visual elements like audio recordings can be envisioned. In addition, large scale quantitative evaluation of design elements across cultures could support our analysis with statistical results. Also live data concerning the navigation behaviour through the hierarchy can be tracked in order to optimize the performance of the application.

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