Northumbria
University
NEWCASTLE

Unaccompanied Migrant Youth and Mental Health Technologies: A Social-Ecological Approach to Understanding and Designing

Franziska Tachtler
TU Wien
Vienna, Austria
franziska.tachtler@tuwien.ac.at

Reem Talhouk
Northumbria University
Newcastle, UK
reem.talhouk@northumbria.ac.uk

Toni Michel
TU Wien
Vienna, Austria
toni.michel@tuwien.ac.at

Petr Slovák
King's College London
London, UK
petr.slovak@kcl.ac.uk

Geraldine Fitzpatrick
TU Wien
Vienna, Austria
geraldine.fitzpatrick@tuwien.ac.at

ABSTRACT

Research increasingly shows that technology can improve access to mental health interventions. However, unaccompanied migrant youth (UMY) still struggle in accessing appropriate mental health resources in spite of their high need for mental health support. Through co-design workshops, and using the lens of the social-ecological model of resilience, we explored the social-ecological factors that support or hinder UMY's use of mental health apps as resources. We identified the strong influence of the macro-system (i.e. resettlement policies) on the bio-and micro-systems, which in turn limits participants' abilities to use the apps. Our findings highlight the factors specific to each social-ecological system—including personal experiences, technological infrastructure and social environment—that need to be accounted for when designing technological mental health resources for UMY. This contributes: a rich description of the interplay of mental health apps with social-ecological systems in which UMY are embedded; and the corresponding design considerations.

CCS CONCEPTS

• **Human-centered computing → HCI design and evaluation methods**; • **Applied computing → Health informatics**.

KEYWORDS

Refugees; Asylum-Seekers; Mental Health; Ecology; Social-Ecological; Youth; Marginalized

ACM Reference Format:
Franziska Tachtler, Reem Talhouk, Toni Michel, Petr Slovák, and Geraldine Fitzpatrick. 2021. Unaccompanied Migrant Youth and Mental Health Technologies: A Social-Ecological Approach to Understanding and Designing. In *CHI Conference on Human Factors in Computing Systems (CHI '21), May 8–13, 2021, Yokohama, Japan.* ACM, New York, NY, USA, 19 pages. https://doi.org/10.1145/3411764.3445470

CHI '21, May 8–13, 2021, Yokohama, Japan

ACM ISBN 978-1-4503-8096-6/21/05…$15.00
https://doi.org/10.1145/3411764.3445470

1 INTRODUCTION

Unaccompanied migrant youth (UMY)—young asylum seekers and refugees who arrive to the European Union (EU) without adult relatives—are at increased mental health risk [30, 40, 41]. Structural, financial, and social-cultural barriers hinder UMY from accessing mental health services and resources [40, 48, 55], which would help to strengthen their mental health. Mental health technologies have gained traction in Human-Computer-Interaction (HCI), psychology research, and industry as promising solutions that make mental health support more accessible with the help of online therapy [88] or mobile phone applications (apps) [3, 28, 34, 72]. However, there is still a lack of understanding of how to design technological mental health resources specifically for refugee and displaced communities, such as UMY [66, 75].

To prevent the onset of mental illness, practitioners and researchers working in this field recommend taking a social-ecological approach and integrating resilience building interventions into the everyday life of UMY [30, 40]. The social-ecological model of resilience by Ungar [81–83, 85] describes theoretically how to take a social-ecological approach: The model outlines the ideal interplay across systems that create a resilience-facilitating environment [83]. These systems are for instance the *bio-system* (individual factors), the *micro-systems* (direct social support systems), the *chrono-system* (temporal dimension) and the *macro-system* (political regulations and culture) [75, 85]. The environment is most facilitative of resilience if the individual can easily navigate, access, and apply resources to meet their needs. [81, 83]. In our previous work [75], we took a first step towards understanding how to design for this social-ecological approach. Focusing on the mentors of UMY, we developed a design framework based on the social-ecological model of resilience by Ungar that we used to identify intervention points to support the mentors. However, no work has yet engaged the UMY directly in what they need to promote their resilience from a social-ecological perspective. In addition, we lack insights on how to design technological mental health resources for UMY as an integrated part in their social-ecological environment and how the different social-ecological systems interplay with these technological resources [75].

In this paper, we investigate how to design technology driven interventions to integrate as a mental health resource in UMY's

social-ecological environment. In particular, we explore how social-ecological systems support and hinder UMY in using mental health apps as one form of resource that may be part of wider interventions in the future. The intention was not to design an app as a one stop solution but rather explore how UMY interact with mental health apps as they are one of the most accessible resources to UMY. Previous HCI research with refugees has highlighted the centrality of mobile phones in not only supporting refugees in overcoming challenges such as navigating their new country [6] and establishing a new life [24] but also in accessing health services [77]. Also for UMY, mobile phones are an important resource for managing some privacy when they do not have physical privacy in their accommodation [39]. Further, they often have to change their accommodation several times after arriving in the country of asylum [36]. Mobile phones could give a consistent point of communication access and overcome mobility issues hindering service delivery. Understanding how to design mental health apps for UMY, and how these interplay with the various aspects of the social-ecological system, enables us to design technological resources at other intervention points in the social-ecological environment, e.g., a resource to mediate the mentor-mentee relationship [75].

Towards this, we conducted two series of co-design workshops with 12 UMY in Austria, to explore the different social-ecological systems that interplay with mental health apps as resources to promote resilience. We focused on systems which build the social-ecological environment and directly interact with the UMY (see further details about these systems in Section 2.2.2). We investigated how these systems support or hinder the UMY's usage of mental health technologies. The workshop design activities, complemented by using the apps in-situ, supported participants in critically evaluating existing mental health apps and developing app concepts that are more suitable for their daily lives and social ecology.

Through these design activities, we identified how the different social-ecological factors interplay with the usage of the mental health apps. Across Section 4, we describe how the factors within the macro-system influence all systems negatively, and thus hinder the usage of the apps. We also identified factors that need to be considered within the micro-systems, mainly related to their everyday living situation, physically distant social contacts and person-of-trust. Furthermore, accounting for chrono-systemic development was identified as a key facilitator to applying the mental health apps as resources. We contribute to the body of HCI and mental health literature by adding considerations and understandings that need to be accounted for when designing for UMY from within a social-ecological model of resilience. We discuss these consideration in relation to HCI work in mental health, HCI4D, and activism context in Section 5. We conclude by reflecting on the limitation of this work and point to future work needed to further develop mental health resources for UMY and other marginalized people in Section 6.

2 RELATED WORK

To ground the findings in the context of participants and existing literature, we provide an overview of the interplay of UMY's mental health and their legal and living circumstances. We then discuss how technologies could enable access to mental health interventions, and explain the social-ecological approach to promote mental health.

2.1 UMY's mental health

Migrant youth have a high prevalence of mental health problems such as depression and behavioural problems [30, 33, 40]. Additionally, when compared to non-migrant youth and accompanied migrant youth, UMY show higher levels of post-traumatic stress disorder symptoms [12, 41] and signs of sleep disorders [46].

Political regulations and UMY's legal situation have a determining role in UMY's everyday life which also impacts their mental health. The UMY's status in the asylum-seeking process and age dictates the care services and accommodation benefits they may access [9]. The asylum application results in different possible types of residence status: a rejected application, subsidiary protection (i.e. a temporary residence permit) and granted asylum [4, 5]. The final decision of the asylum seeking process takes on average up to two years and often the UMY reach adulthood and thus lose the protection as a minor during the asylum seeking process [50]. The outcome of the asylum seeking process has an effect on UMY's mental health. A rejected asylum application, with the accompanying threat of deportation, is associated with high psycho-social distress [45], e.g., in Tachtler et al. [75] one interviewee reported that the UMY she cared for stated that he would rather kill himself than get deported. Besides the fear of deportation, UMY have different sources of anxiety and fear, such as worrying about the welfare of their family and friends left behind [55].

In addition, research shows that the living circumstances of UMY have an impact on their mental health. The psychosocial distress of UMY living at an accommodation for adults is much higher than for UMY living at a youth accommodation [45]. Austrian policies dictate the living circumstances: On arrival to Austria, UMY have to remain at a collection center—where they often share a room with 8 other persons of all ages [39]—until officials determine if Austria is responsible for processing their asylum applications [4, 5]. An age determination process, determining if the asylum-seeker is a minor or not, prolongs the waiting period and stay at the collection center [39]. If the age determination process decides that the UMY are under 18 years, they are usually assigned to a reception facility, which is responsible for caring and supervising them [50]. These facilities are solely for UMY [9], and often gender separated. The majority of UMY are male, e.g., 93 % asylum decisions in 2015-2017 concerned male UMY [9].

Some UMY have to live at emergency quarters or the home of a foster families [39]. In addition, UMY often have to often change their accommodation. The fluctuation in numbers of asylum applications often entails accommodations closing down and the relocation of UMY when applications are low. Changing accommodation can result in losing established support relationships from the previous place and result in the UMY feeling left alone and giving rise to hopelessness [36]. Traumatic events and the frequent loss of close relationships, such as when being relocated to a new accommodation, contribute to UMY adopting mistrust as a protective mechanism [55]. Upon turning 18, UMY not only have to leave their current accommodation, they also become fully responsible for their own welfare, education, asset management and legal representation [9].

Thus, UMY over 18 lack support, although the transition to adulthood is a crucial and difficult developmental period [31]. Overall, the psychological needs of UMY are not met as care infrastructure is based on a legal perspective rather than one of health and well-being [25].

Experts advise that having a daily structure and experiencing self-efficacy contributes to better mental health [90]. However, in the case of UMY, the legal policies inhibit this [90]: At the collection center, UMY lack structure in their everyday life as they are unable to access school or a vocational training [39]. Once they move on from the collection center, the legal policies of asylum seeking continue to have implications regarding the education and employment opportunities UMY can access. Education and employment policies lay down strict conditions for accessing education and jobs which is also dependent on their asylum status and their age. For instance, while the UMY are school-aged (6-15 years old), they receive special status which allows them to attend language classes for two years [9]. However, by the age of 16, they lose this status and access to education. In addition, until being granted asylum or subsidiary protection they are not allowed to legally access vocational training or employment [9]. Since 2018 asylum seekers in Austria are not allowed to apply for vocational training in so called shortage occupations until the age of 25, and the employment office has rejected all applications for employing asylum seekers as apprentices [36]. Thus, policies surrounding asylum seeking often lead to involuntary inactivity and hinder legal access to employment [36].

The mental health conditions of UMY are often exacerbated by barriers that hinder access to mental health services and resources [40], such as language-related and cultural barriers [40, 55], lack of knowledge of their rights, fear of deportation [40] and mistrust of services/authorities [40, 55]. Further, the currently available child mental health services and related service providers struggle to support the high number of UMY [30]. In addition, a study in Austria showed that male refugees and asylum seekers rarely seek psychological and psychiatric support [49], struggle to express their emotions and view mental health as a stigmatized topic [90]. Researchers and practitioners working in this field have called for solutions which meet the needs of this population and promote mental health by addressing the real and perceived access barriers [33], which may also have implications for accessing and using mental health apps.

2.2 Mental health technology

2.2.1 Enabling access to mental health interventions. In the field of HCI, researchers have developed and explored different technological systems that aim to make mental health interventions more accessible (e.g., via online therapy [88], peer-support systems [64, 65], and mental health mobile phone apps [7, 58, 72]). In parallel, mental health apps have become increasingly more commercially available (e.g., [17, 32]). Furthermore, in low-middle income countries (LMICs), mental health technologies have been identified as a possible solution to service access barriers, e.g., with the help of online, text messaging and telephone services [60]. However, research has highlighted barriers to using technology to deliver interventions including mismatch between the timing of reminders and user's individual context [63]; technological barriers such as data loss, battery, memory usage and internet issues [2]; and culturally appropriate language to talk about mental health [67]. In addition, within the HCI4D community, Pendse et al. [67] argue that the increasing research on the requirements for mental health technologies within high socio-economic contexts, will result in these technologies only meeting the needs and preferences of those communities. This would exacerbate the treatment gap between those of higher socio-economic status and those that are marginalized [67]. Thus, if the pool of mental health resources does not support the ability of UMY to navigate and apply the resources, this marginalized population might suffer from the exacerbation of the treatment gap.

2.2.2 Social-ecological approach to promote mental health. In the context of promoting mental health in UMY, researchers in psychology have emphasized that mental health support needs to happen in a multidimensional and social-ecological manner [30, 33, 40]. This means that interventions have to be targeted at different factors within their social ecology including the individual, school, families, community and societal levels [30, 33]. The social-ecological model of resilience is a further development of Bronfenbrenner's ecological theory of development [11] for promoting resilience [83]. It brings to the fore the ideal interplay across systems that create an environment which facilitates resilience. A few HCI researchers have adopted similar ecological approaches that rely on Bronfenbrenner's ecological theory of development for children [11] as a lens to understand the role of different social actors in promoting healthy eating habits [38], information brokerage [68], and providing emotional support [87]. In the context of supporting self-management, previous research in HCI used the lens of Bronfenbrenner's social systems [11] to understand the role of social contacts when managing their depression with technology [14, 59].

Especially in the context of children and youth facing adversity and marginalization, such as the UMY, interventions are most effective when reflecting the complexity of this multi-systemic interplay [81–83, 85]. Thereby, the bio-, micro-, chrono-, and macro-system directly influence the youth's resilience. The *bio-system* describes characteristics of the individual such as bio-psychological triggers and personality [85]. These individual factors are shaped through the reciprocal interaction with other social-ecological systems. The *micro-systems* represent the physical and material features, roles, activities and interpersonal relationships of social support systems which directly interact with the UMY. For instance, micro-systemic processes such as a sufficient social support and respectful and trustful treatment by teachers support the occurrence of resilience [85]. The *chrono-system* describes the socio-historical dimension influencing the resilience of the individual such as the changing social and political context and the development of the individual (bio) over time [85]. *Macro-systemic* factors influencing the resilience of the individual and the social system are culture, values and political regulations such as those outlined in Section 2.1 [75, 85]. Overall, in the social-ecological approach the cultural and contextual factors are more important for the development of resilience than the individual factors [81].

Specifically for research on mental health and UMY, Tachtler et al. [75] present the relevance of the social-ecological model of

resilience as a framework to design technologies using an ecological approach rather than an individual approach [75]. The study identified the need for accessible and culturally meaningful digital resources that both the mentors and the UMY can navigate. However, the study was conducted with mentors and supporters rather than the UMY. Therefore, to begin designing technologies in this study we shifted our focus to UMY.

In this paper, we focus on the key characteristic of the social-ecological model of resilience, namely that the individuals in the model have the ability to navigate, access, negotiate and apply resources that promote mental health [81, 83]. This characteristic of the social-ecological model of resilience differentiates it from Bronfenbrenner's ecological theory of development for children [11]. In particular, we focus on mobile apps given their accessibility by this particular population and UMY's familiarity with mobile apps as sources of information and connectivity [23, 24]. The UN Refugee Agency [86] emphasized that non-governmental organizations (NGOs) and service providers need to better take advantage of the existing connectivity provided by the ubiquity of mobile apps and thereby maximize the impact of their services. Additionally, there are increasingly mental health apps available for delivering interventions such as mindfulness exercises and sleep hygiene techniques which mental health researchers recommend for UMY to support coping with sleeping problems and stress [33, 46]. In this study, we explore (i) how mental health apps integrate into UMY's social-ecological environment, (ii) how the social-ecological factors support/hinder the UMY's ability in navigating, negotiating and applying resources, and (iii) how we can more appropriately design mental health apps as resources for resilience.

3 METHODS

To explore mental health apps as resources within the social-ecological systems of UMY, we conducted two series of co-design workshops with two groups of UMY. The study received ethical oversight from TU Wien, Austria.

3.1 Recruitment

We recruited UMY aged 16-24 years, based on WHO's definition of youth [91] and the EU consent procedure [35], through local NGOs such as mentoring programs and initiatives for UMY. To accommodate different suitable workshop times, we offered two workshop series (see Table 1). In the first workshop series (WS1), five UMY participated. All were still in the asylum seeking process — either having received an initial negative decision and in the process of appealing against it or were still waiting for an outcome. In the second workshop series (WS2), seven UMY participated. One participant did not feel comfortable attending the workshop alone and, as per his preferences, he attended the workshop together with his mentor. Through different local mentoring initiatives mentors voluntarily care for UMY. All participants were male and had lived in Austria for about 3.5 years with the exception of one participant that had lived in Austria for 7 years. Additionally, only one participant had just recently finished his apprenticeship while the rest were either attending classes in the evening to receive a high school diploma or had yet to finish compulsory school. All participants regularly used mobile apps in their everyday life but none had used a mental health app. The main pre-workshop communication as part of the recruitment process happened via mobile messaging apps (e.g., Telegram, Signal, WhatsApp) as these were the preferred communication resources of the participants.

While we aimed to recruit participants of all genders, this study only included young men, as they were the only ones who signed up for the workshops. The fact that the majority of UMY in Austria are male [9] may have contributed to this. We also did not inquire regarding gender preferences among participants given the cultural sensitivity of the topic. To protect the participants' anonymity, we generated random names for each participant and do not link background information to them.

3.2 Workshop series

Each of the two workshop series consisted of three workshop days, each lasting half a day (3.5 hours). The activities and methods were the same across both workshop series. During the workshops participants were asked to work in teams. Since we had a different constellation of participants every day, the set up of the teams changed accordingly (see Table 1). Knowing that some participants might not attend each workshop day, we started each day with a recap activity where attendees of the workshop on the previous day presented to new attendees the work they had done. The third workshop of the second workshops series did not take place because only one participant was able to attend.

3.2.1 Workshop narratives. In the context of refugees and HCI, studies have shown that design workshops bring benefits for UMY, namely through creating a safe space [12, 15, 16]. For the participants, we chose an overarching narrative of the workshop series as being about designing mental health apps, for better sleep and less stress, and about learning design methods. We focused on sleep problems and stress since mental illness is stigmatized and stress and sleep problems are more common everyday problems experienced by UMY [33, 46]. In addition, we asked the participants to imagine they were *"creating their own company and designing an app"* as an overall narrative of the workshop, as previous literature [12] identified the need to support refugee youth in progressing from the problem identification phase of the design process to discussing solutions and added considerations. The research aim of the co-design workshops was not to develop new design ideas per se, but to understand why participants made certain design choices and what these might say about the interplay of the social-ecological systems with the mental health apps.

3.2.2 Selection of workshop materials. To evaluate existing available mental health apps, the participants worked with commercially available mental health apps. At the beginning of the first workshop, the participants engaged with four apps selected by the authors and then each participant chose one app, which they used throughout the rest of the workshop series and in-between the workshop days at home.

The lead author, who is well versed in the mental health interventions recommended for UMY, selected the apps by: (1) getting an overview of available mental health apps and the list of apps recommended by Michel et al. [56]; (2) generating a list of potential apps that focuses specifically on sleeping problems and stress

	First workshop series (WS1)			Second workshop series (WS2)		
	day1	**day2**	**day3**	**day1**	**day2**	**day3**
Facilitators	F1, F2, F3	F1, F2, F3	F1, F2, F4	F1, F2, F5	F1, F3	F1, F6
# Participants	4	3	5	7+1 mentor	4	1
Team 1	Cody, Sami	Cody, Sami, Marc	Cody, Sami, Marc	Qurin, Karim	Quirin, Arian	Dan
Team 2	Denis, Rian		Denis, Rian	Adam, Joshua, mentor	Dan, Luis	
Team 3				Dan, Arian, Luis		

Table 1: Overview of participants per workshop day

App	Mental health activities
Fabulous	Help to plan positive activities every morning, afternoon and evening to build healthy habits and sleep better, e.g., progressive muscle relaxation, gratitude exercise, darken/cool down the room in the evening
Mind Max	Activities to learn identifying and naming emotions, identify values and personal strengths, teach mindfulness
Pin It and Bin It	Activity to remember positive and forget negative things (e.g., worries), namely by first writing down positive activities or negative thoughts and then either pinning the positive or deleting the negative thoughts
Shleep	Short videos explaining which habits help and do not help to sleep better; Tasks to apply those advice in their life. E.g., reduce digital caffeine before going to bed, setting up the sleep environment

Table 2: Overview of the mental health apps

[33, 46] and promoting techniques that are recommended for UMY (e.g., managing worries, mindfulness exercises and sleep hygiene techniques) [46]; and (3) screening the apps according to interaction criteria recommended for maintaining youth engagement (primarily, offering multi-model input and output [56]) and their Google Play Store/Apple App Store rating. This resulted in four apps being selected to be used in the workshop as described in Table 2.

3.2.3 Workshop activities and data collection. Each of the workshop activities was designed to explore the interplay of different factors of the social-ecological systems with the usage of the mental health apps. Due to the abstract nature of the social-ecological model of resilience, we grounded the systems by talking about the factors within the systems that participants interact with and/or are familiar with, e.g., themselves and their peers –other UMY– for bio-system, asylum seeking process for the macro-system. Table 3 gives an overview of these workshop activities.

The beginning of the first day of the workshop focused on participants' current mental health activities. As part of the discussions, we asked the participants to reflect on activities that they engage with to improve their mental health and also strategies that may involve the use of technology (see Table 3, activity 1.1 and 1.2). The aim of these activities was to gain an initial understanding of the bio-system and factors of other social-ecological systems (e.g., the micro- and chrono-system), which influence their mental health. Then participants started to work in their teams to create a name and slogan of the company. This helped to steer the discussion towards mental health apps as a resource to better sleep and deal with stress, and to formulate forms of support they found helpful. We then introduced the mental health apps as a resource to promote resilience. As part of the activity 1.3 (see Table 3), participants explored the four different mental health apps and annotated screenshots of the apps with their evaluations. This activity enabled us to explore the interplay of the bio-systems with different types of apps and collect immediate factors of their social ecology that might interplay with using the mental health apps.

At the end of the day, each participant was asked to choose their favourite app to further explore throughout the rest of the workshops and at home. This guaranteed that the participants engaged with the app that they considered to be the most appropriate for themselves (i.e. the bio-system). In addition, the participants received notebooks to collect feedback about their use of the app in-between the workshop days. The participants could choose what language to use thus giving participants the option to express themselves in any language and at their own pace [12, 76].

On the second day, we deepened the understanding of the interplay of the different social-ecological systems (micro-systems and macro-system), the bio-system and the usage of the mental health apps by eliciting participants' new insights from using the app at their accommodation. This was done through several activities that promoted reflection by participants on their and their peers'– other UMY's – ability to apply the mental health apps when accounting for factors within the bio, micro and chrono-systems: The role play activity (activity 2.2 in Table 3) and storyboard activity (activity 2.4 and 2.5 in Table 3) helped to gain more insights into factors of the micro-system. Activity 2.3 in which participants were asked to identify a persona who would benefit from using the app provided more insights into the bio-systems.

On the third day, participants created their own concept for a mental health app and presented their final concepts by pitching them to a friend as part of a role playing activity. This helped to understand participants' vision of how the technological designs can be motivated by the different factors of the social-ecological systems, which they identified as a factor influencing the usage of the app at the previous workshop days.

#	Activity	Material	All/ Team/ Individually	Systems
Day 1: "Creating your own company and getting to know your competitors' products"				
1.1	Collect activities and things that help to sleep and feel better	Mind map	A	Interplay of factors of social-ecological systems with the bio-system's mental health
1.2	Create a company name and slogan	Mind map and sketching	T	
1.3	Explore four different apps and collect negative and positive aspect	Installed apps, screenshots, post-it notes	T	Interplay of the bio-system and factors of other systems with the usage of the apps
1.4	Choose the most interesting app		T	
1.5	Testing chosen app at home	Notebooks	I	
Day 2: "Identify the weaknesses of your competitor's product"				
2.1	Add more positive and negative aspects of the different apps based on testing at home	Mind map with screenshots and post-it notes	A	Interplay of the the bio-system, different social-ecological systems (macro- and micro-systems), and the usage of the app
2.2	Recommend a mental health app to a friend	Role play	T + A	Interplay of the bio-system, micro-systems (peers) and the features of apps
2.3	Create persona who would benefit from using the app	Mind map	A	Interplay of social-ecological factors and the bio-system's mental health
2.4	Collect places, locations, barriers and facilitators of using the app	Mind map	A	Interplay of everyday micro-system and the usage of the app
2.5	Create one story where the app works well and one where the app fails	Storyboard	I	Interplay of everyday micro-systems and the usage of the app
2.6	Ideation activities to generate ideas	Mind map, paper, post-it notes	A	
Day 3: "Create your company's better concept"				
3.1	Define the key features of the apps, and the ideal way how others find the app	Google Play Store description	T	Ideal design of apps reacting to the interplay of factors of social-ecological system with the usage of the apps
3.2	Create a prototype of your idea	Paper prototyping	T	
3.3	Pitch idea to a friend	Role play	T + A	

Table 3: Overview of workshop activities: Table shows the activity number (#), the activity for the participants, which material the participants used, if participants did the activity all together (a), in teams (t), or individually (i); and how the activity explored the interplay of the different social-ecological systems.

All activities were audio recorded, and artifacts made by participants during workshop activities (i.e. mind maps, storyboards, paper prototypes) and notebooks were collected for analysis. Before and in-between the team activities, the teams presented and discussed their work with each other. When we present quotes in the findings, we will refer to workshop day and the activity by stating the activity number from Table 3, e.g., *"WS2 2.1"* stands for second workshop series, second workshop day, first activity.

3.2.4 Facilitation and languages. All participants had received some German language learning classes and could communicate in German and English to varying extents. One participant spoke Arabic and the rest spoke Dari. The first author led the facilitation of all the workshops in German and English. Participants were able to use German and English interchangeably based on their comfort in using the languages. Additionally, participants who were more fluent in German and/or English often acted as translators when necessary. To assist the participants and help with potential comprehension problems, there was also at least one additional facilitator present at each workshop day (see facilitators in Table 3). One participant (WS2) also communicated with one of the workshop facilitators in Arabic, the mother tongue of both. The audio recordings were transcribed in German or English.

3.3 Analysis

We conducted thematic analysis on the transcripts, the design artifacts (e.g., storyboards) and the participants' notebooks and followed the six phases of thematic analysis by Braun and Clarke [10]. We inductively analysed the workshop data and then organized the resulting themes by deductively mapping them to systems in the social-ecological model of resilience in the following way:

(1) *Familiarization with the data.* The 1st author initially read the transcripts and discussed potential codes and themes within the research team.

Figure 1: Mind maps of potential personas, places, times, barriers and facilitators of using the app. Left: WS1, right: WS2

(2) *Initial coding of the data.* The 1st author coded the data, both the transcripts and the design outcomes, manually and inductively using MAXQDA, which led to potential topics such as living situation, time issues, conflict between app and real life, and impact of social network.
(3) *Identifying potential themes.* The 1st author grouped the codes in initial themes and discussed themes with the co-authors.
(4) *Reviewing potential themes.* The 1st and 2nd authors reviewed if the themes were accurate representations of the data by comparing the themes against the data.
(5) *Defining & naming themes.* In collaboration with the 2nd author, the 1st author named identified themes and described them by drawing from illustrative quotes for the theme.
(6) *Producing the report.* During the writing process, the themes were grouped deductively under different types of systems of the social-ecological model of resilience by Ungar [82–84]. (e.g., app assumes certain living ecology, app assumes given infrastructure were grouped to micro-systems).

4 FINDINGS

Our findings show the ways in which the interplay between the *bio-system* (individual factors), *micro-systems* (direct social support systems), *chrono-system* (temporal dimension) and *macro-system* (political regulations and culture) plays a central role in influencing the UMY's ability to apply the activities suggested by the mental health apps, and highlight that the lack of a facilitative environment for being able to use mental health apps as a resource within UMY's social-ecological environment. We first present a descriptive account of the artifacts produced by participants in Section 4.1. We provide this description to highlight how the findings were drawn from both the artifacts and the discussions surrounding the making process. We then present how the macro-systemic factors, which we described in Section 2.1, constrain the ability of the UMY to create healthy daily structures in which they can successfully apply the mental health apps. In addition, we found that these macro-systemic factors also influence their micro-systems: namely factors of the everyday living situation — the (1) living environment, (2) social factors, and (3) technological infrastructure — and (4) the exchange and contact to micro-systems — the physically distant social contacts, e.g., family and friends living in former home country. Participants also reflected on the potential role of mobile apps in relation to building micro-systems of persons-of-trust. Lastly, the findings highlight the chrono-systematic factors (i.e. mental health learning over time) to be an important consideration for the usefulness of the mental health app within UMY's social-ecological environment.

4.1 Mental health apps as a resource

The workshop outcomes include both the audio recorded and transcribed discussions held during the workshops and the design artifacts produced by participants (see material in Table 3). Participants created in total 13 storyboards (see Figure 2 and 3), and two final concepts (see Figure 4 and 5), which were communicated as a mind-map of features, a Play Store description and a paper prototype.

4.1.1 Mind maps. The mind map activities helped to guide the discussion and thinking process, and as well to inform the following design activities such as creating the storyboards and paper prototypes. For instance, the mind maps in Figure 1 emerged from the brainstorming activity where participants collected points in time, places, barriers, and facilitators of using the apps, and characteristics of a person who would benefit from using the apps for better sleep and against stress. Potential points in time were for instance: *"5am morning"*, *"on the way"*, *"in breaks"*, *"having time"*

Figure 2: Storyboards of WS1. Top: storyboard 1-4, bottom: storyboard 5-7

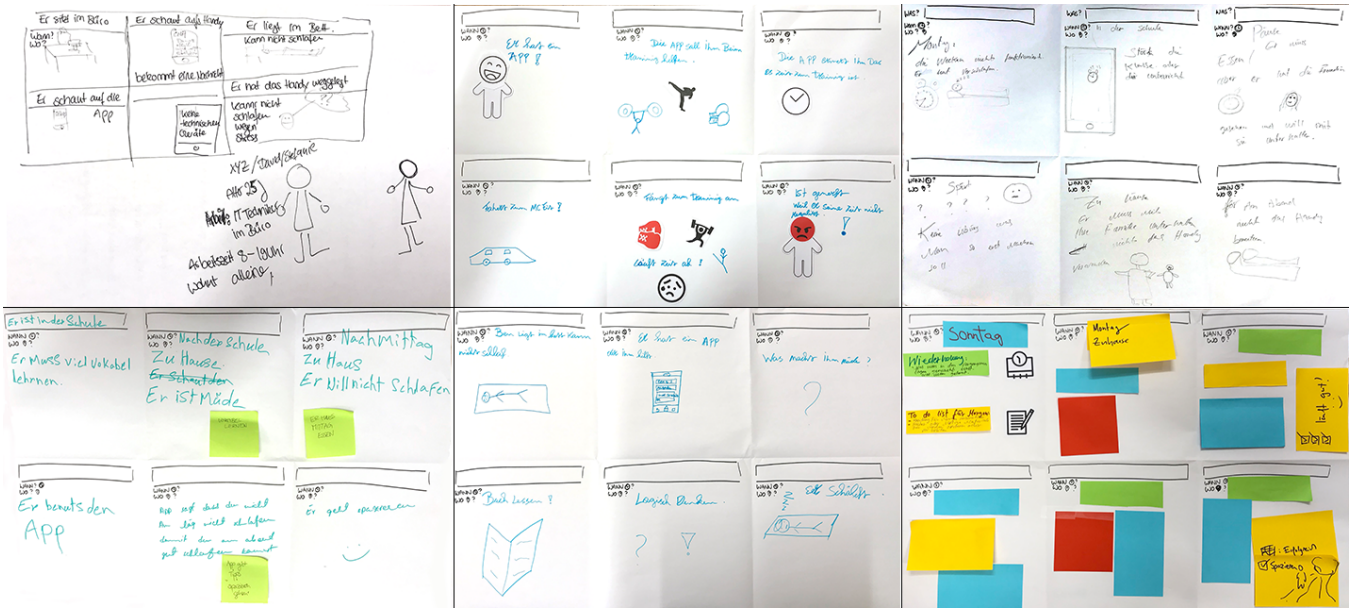

Figure 3: Storyboards of WS2. Top: storyboard 1-3, bottom: storyboard 4-6

and places: *"underground"*, *"bed"*, *"park"*, *"library"*. The variety of locations underlines the mobility aspect. In addition, the point of time points towards adapting the use of apps to tight schedules. As barriers, participants listed *"flatmates being awake until midnight"*, *"not possible to go to a different room"*, *"dictating tasks"*, *"timing"* and *"amount of advice"* and as facilitators of using the app: *"needing to want help"*, *"having job with routine"*, *"giving you a task"*. Characteristics of the persona were for instance *"working during the night"* and *"not sleeping during the night but then sleeping in the morning until evening "*. While these mind maps give an overview of the relevant aspects across all participants, the subsequent storyboard activity was done individually and thus the storyboard communicates what each participant considers most important.

4.1.2 Storyboards. The storyboards show how bio-system, micro-systems and macro-system play out in the everyday life of the UMY and how these hinder the successful usage of the apps. Each participant created at least one storyboard showing how the app does not work well and then a successive storyboard showing how the app would work well. Through the storyboards participants highlighted the relevant micro-systems being roommates and/or accommodation, contacts they message via social media, family, partners, employer or job, and friends.

Figure 4: Final prototype of WS1 by team 1. Mental health app delivering stories and music helping to sleep better.

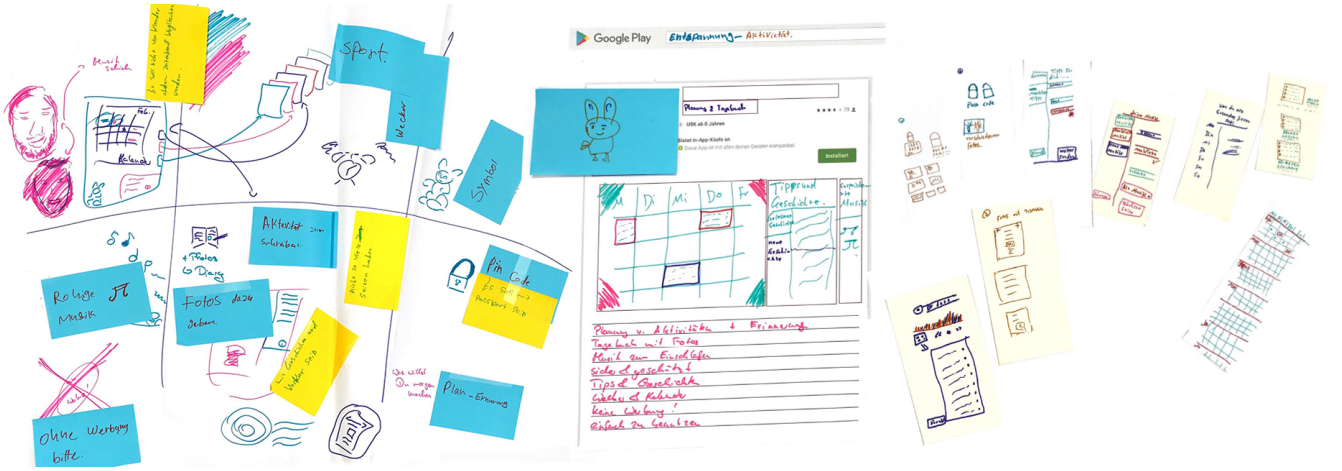

Figure 5: Final prototype of WS1 by team 2. Calendar to plan activities and collect pictures of positive activities.

The macro-system becomes visible when comparing the storyboards where the apps are successfully used vs where the persona is unable to use the app effectively. For example, Cody's first storyboard (see Figure 2, storyboard 1) shows how the persona is stressed and feels unwell and cannot use the app. In Cody's second storyboard which includes the changes to be able to use the app, the persona leaves his job and has time to use the app and time for positive activities (see Figure 2, storyboard 5). Other participants depicted various means to overcome macro-systemic problems, e.g., managing time constraints by creating a very detailed plan of how to organize a whole week (Arian, Figure 3, storyboard 6) and reacting to the most difficult moments, e.g., when coming home after school where many tend to take a nap instead of staying awake (Luis and Dan, Figure 3, storyboard 4). Besides the time issue, the storyboards also communicated stress caused by the technology due to the macro-systemic situation, namely being away from many close contacts, and how this conflicts with the usage of the mental health app. For instance, in the storyboard by Marc (Figure 2, storyboard 2) the persona gets frustrated by all the messages and notifications when turning on the internet to use the apps, deletes all notifications including the ones by the mental health app Shleep and instead plays with his phone.

4.1.3 Final concepts. The paper prototypes and how the participants communicated these concepts through the play store descriptions suggest how the participants imagine the ideal app and which features seem to be especially important for them (see Figure 4 and 5). One feature which caused detailed discussion during the workshops was the password protection of the app as participants fear that both other people, including those they are forced to share accommodation with, and technology companies can access their data. In addition, the concepts are characterized by multi-modal content and adaptability. Figure 4 shows a smartwatch which offers

"Good night stories" of varying lengths that are adaptable to the amount of time available to the user. The other mobile phone based prototype Figure 5 contains different screens showing features which support planing activities and setting reminders. Another key feature is that app stores the users' positive memories e.g., with friends represented by photos. These features of the final prototype indicate how the participants imagined their ideal app contrasted with the existing mental health apps they engaged with, e.g., participants added password protections, others pitched apps that could be personalized to their routines.

Overall, throughout the workshop, participants expressed their hopes and interest in an app that helps them engage in mental health strategies to deal with stress and sleep problems: *"I want to do all this (coping strategies), but I cannot. It would be able to do it, if there is an App that helps me. This would be very nice"* (Rian, WS1 1.2). This underlines the participants' positive attitude towards mobile apps as a resource to promote mental health in contrast to the stigmatized mental health topic and services.

4.2 Occupation and daily structure (the macro-system)

We go on now to discuss the findings through the lens of the different system levels. The macro-system, namely the political regulations dictating the living situation, occupation and daily structure of participants (see details in Section 2.1), predominantly influences the integration of the mental health app in UMY's everyday life. The workshop showed that the UMY struggle to pursue their key mental health strategy, namely having positive daily structures. The participants highlighted that their asylum status and connected macro-systemic regulations dictate their daily structure: their daily structures depend on the education services and/or occupations they can access, which in turn depend on their asylum status and regulations for asylum-seekers. This results in two extreme cases of daily structures that were shared by participants: one in which the UMY cannot access any educational services or be employed; and the other, where the youth is working long hours and struggling to keep up with school work. Participants reported that they or their peers–other UMY–either do not have any planned routines, or they do not have any free time at all, as they e.g., have to work long hours during the night and attend courses to learn German and catch up with the education of their Austrian peers. Due to the long waiting periods of the asylum seeking process, this situation remains the same over years (see as well Section 2.1):

"My roommate (...) is here for three years (...), has no fixed status and is always awake during the night and sleeps in the morning." (Marc, WS1 2.3)

"He is already in Austria for 7 years. Sometimes he works during the night, sometimes during the day. He has to work more than 40 hours. He is not yet ready with school (and) is already at school for three years. He sometimes sleeps four or five hours. He always has stress." (Cody, WS1 2.3)

As shown in both quotes, participants identified that the daily structures—set by the macro-system—have a negative impact on their sleep quality.

Participants' lack of control over their daily structure, as it is so intimately tied to their asylum status, posed a challenge for them when exploring their ability to apply the mental health apps as a mental health resource. For instance, the app Fabulous suggests performing certain morning, afternoon and evening activities, but the participants deemed the timing and the delivered prompts and activities as not appropriate to their daily structures. Participants stated that a key barrier to put the activities recommended by the app Fabulous into practice is that *"(UMY) always have something to do. Therefore they cannot (use this app)."* (Cody, WS1 2.4). Participants further re-iterated the difficulty of fitting the apps and suggested activities into their daily structures through the storyboards that they created. In one storyboard (see Figure 2, storyboard 4), the persona has to get things done during the day and when he comes home, the persona is too tired to do an activity suggested by the app and thus sleeps badly.

The participants further highlighted that the inability to tailor the timing and lengths of suggested activities based on their schedules triggered stress and frustration and thus resulted in them abandoning the mental health apps: *"You get stress with this app, sometimes it does not fit well (with your daily schedule)."* (Arian, WS2 2.1, tested Fabulous). When providing feedback on the Fabulous app, Quirin stated that *"I (cannot use the app in short breaks) during working time"* (Quirin, WS2 2.1, tested Fabulous app) and in addition, in his notebook, he shared his frustration with not being able to regulate the lengths of the gym activity suggested by the apps. Participants even suggested that for the persona to be able to apply the suggested activities, the persona *"should leave his job, so then he has more time to use this app."* (Cody, WS1 2.5, see Figure 2, storyboard 5), or change to a better occupation (compare Sami's storyboard, see Figure 2, storyboard 7).

In response, participants suggested solutions to help deal with the limitations set by the macro-system on their daily structures. One participant developed a concept where the app helps the persona to plan both mandatory and positive activities throughout the whole coming week (see Figure 3, storyboard 6). In addition, as described in Section 4.1, when pitching their final concept for an app (see prototype, Figure 5), one team advertised the feature that the user can adapt the length of the activity to their available time: *"This app (...) takes little time (just so) that it helps. For instance before going to sleep, (depending on if) you have 10 minutes or (...) up to half an hour time, it reads a short story."* (Rian, WS1 3.3)

4.3 Everyday living situation (micro-system)

Throughout the workshops participants indicated how the micro-systems that they and other UMY interact with at their home influences their experience in applying the mental health apps, especially since it is within this micro-system that interactions with the mental health apps take place. Participants identified the relevant physical and social factors within the micro-system that hindered their ability to engage with the mental health apps. Similar to the daily structures, the physical and social factors within their everyday life are also dictated by the macro-system, namely the (local) regulations, which dictate their living accommodation including the location and flatmates, and the political situation, which influences their interactions with their mobile phones.

4.3.1 Physical factors: Living environment. The physical qualities of the UMY's living environment were found to hinder the performance of the strategies recommended by the mental health apps. Participants discussed how some of the activities the apps suggested were not feasible because of the constraints in their accommodation. Due to the political regulations and limited resources—which is a consequence of the political regulations—UMY cannot choose where, with whom and with how many people they live. Thus, many live in a *"shared flat"* (Marc, WS1 2.5) or *"institutional care"* (Rian, WS1 1.1), where they share their rooms with other UMY. One participant narrated that the apps suggested assigning roles to different rooms such *"working place and (...) sleeping room"* (Rian, WS1 1.2), but he was unable to do this because of the restricted space within his accommodation and his roommates using the bedroom.

Participants also highlighted that some UMY at their accommodation had no occupation due to the legal situation and long waiting periods of the asylum-seeking processes, and they tended to not sleep during the night and did not get up early in the morning. This made it difficult to stick to the routine suggested by the app as the sound of the apps and the participant undertaking the routines disturbed their roommates. One of Marc's storyboards (Figure 2, storyboard 6) visualizes very well the physical set up of the living environment, namely showing the bunk bed and also how he spends his day next to the bunk bed while his other roommate still sleeps. Marc decided to focus on improving the sleep patterns of his roommate as that negatively impacts his own living environment. During the creation process, Marc who gets up early every morning explained: *"(My roommate) sleeps during the day and I always disturb him (...). He is sleeping when my alarm goes off, (so) he kicks against the (bunk) bed with his foot (as) he doesn't want to wake up."* (Marc, WS1 2.5). Similarly, Quirin who tested the Fabulous app described the conflict between the behaviour of the mental health app and his roommates being physically close: "I did not want to hear the music (of the app) because it is was still dark in the morning and my two roommates were still sleeping. I clicked on it (the app) and then it made (imitates sounds)." (Quirin, WS2 2.1). As shown in both quotes, the physical factors of the living environment available to UMY hindered their ability to apply the recommendations provided by the mental health apps within their micro-system.

4.3.2 Social factors. Social factors of the micro-system also influenced the usage of the mental health apps, beyond the issues of shared physical space. Participants highlighted the importance of having peers, namely other UMY: *"It is boring when you are alone at a care institution and you do not have any friends (...) Then it is better to have friends."* (Rian WS1 1.1). However, the different routines and opinions of these important social contacts can also create social pressure that hinders them in following mental health recommendations, e.g., to go to bed early to improve their sleep quality and mental health. One participant stated: *"my flatmates (other male UMY) are awake until around 3am in the night. (...) (and) they get angry at me if I do not speak or play with them. (...) thus I also cannot sleep and do not make it in time for my appointment on the next day."* (Rian, WS1 1.3). Another participant explained: *"I tried (yoga) (...) (and) closed my eyes and tried to think of something else and my (male) friends (...) laughed at me"* (Karim, WS2 1.4).

These findings highlight the participants' concerns that engaging in mental health interventions or changing routines could be perceived negatively by their peers. The social perception and pressure additionally ties into their living environment, which is decided by the macro-system, where UMY live with other UMY who have similar unhealthy daily structures, and where every resident lacks the private space to engage with the app and proposed activities in isolation and without disturbing their roommates and without fear of ridicule or critique.

Despite the challenges caused by the social factors, participants also pointed out the importance of reaching out to their peers if the participants have problems to talk: *"if nobody is at home, I call my friend (...)(and) at school, we talk at our breaks and take a walk."* (Luis, living at his mentor's home, WS2, 1.1). However, here the openness to talk about mental health problems and overcome the stigma varied amongst the participants. While, in one instance, one participant, Rian, was discussing how he used one of the apps with his flatmates, this surprised another participant, Marc, who said that it is only appropriate to talk about mental health issues with very close friends.

The lack of privacy from their roommates and the perceived sensitivity of the topic of mental health had, according to the participants, implications on the need for the mental health app to be password protected. They expressed concerns that their everyday social contacts (e.g., friends) might gain access to their mobile phones and see what was in the mental health apps. Thus, depending on the content of the app, e.g., if the app functions as *"like a dairy"* (Rian, WS1 3.2) or *"there is a lot of personal things inside"* (Dan, WS2 1.3), and therefore having a *"password is important"* (Rian, WS1 3.2,). While explaining the need of a password, one participant pointed at his friend and explained: *"I do not want that he (my friend) can see it (the dairy entries)."* (Rian, WS1 3.2). It is not surprising then that all the prototypes developed by the participants contained a security pin that further reflected their need to maintain their privacy within their micro-system.

4.3.3 Physical factors: Technological infrastructure. The technological infrastructure available to participants was another factor from their everyday micro-systems that influenced their ability to apply the mental health apps as a resource. Participants highlighted that the apps required certain technological infrastructures including more modern smartphones than the ones that some of them have; up to date operating systems on their phones; and access to WIFI and/or mobile phone data. The lack of availability of the aforementioned infrastructures hindered some participants' ability to use the mental health apps outside the workshops. Participants explained that they and their peers often did not have money to purchase mobile phone data. At the same time, they explained that their home WIFI network did not work and/or the accommodation, they were assigned to live in, had a strict schedule for when the WIFI was available to be used by them. In addition, participants had other apps that they deemed to be more essential than the mental health apps and their mostly old phones had limited storage space. Therefore, they highlighted that they could not install the app because the *"phone has no storage, unfortunately"* (Cody, WS1 1.4). Lastly, when one participant was trying to install one of the apps being evaluated we found that he was unable to because he

only had access to the Google Play Store of another country where the app was unavailable (WS1).

4.4 Physically distant social contacts (micro-system)

Participants indicated that physically distant social contacts also influenced their mental health and how they may interact with the mental health apps. Discussions regarding the use of the mental health apps naturally led to discussions regarding stressors introduced into participants' lives through other apps on their mobile phones through which they interacted with their physically distant social contacts (e.g., relatives and friends who are not physically close). Participants highlighted that social media, messaging and phone apps were essential to stay in touch with these contacts, and not being able to contact their physically distant social contacts is an added stressor:

"'I do not know what is with my parents. This is my stress. I only see having a phone call as a solution (that helps to deal with the situation) because now I cannot reach them." (Rian, WS1 1.2).

However, they also highlighted that it is those same apps that they use to stay in contact and up-to-date with their physically distant social contacts that also introduce stressors: *"In the morning you should not check the news or Facebook (...) That destroys your whole day."* (Cody, WS1 1.1).

"Not seeing any bad news about refugees (helps my mental health). That you know if they did manage to cross the borders and not that they got stuck." (Rian, WS1 1.1).

The need to stay in contact with physically distant social contacts and up to date on the news of their home countries intervenes with their experience of the mental health apps. Marc's storyboard (Figure 2, storyboard 2) where the persona gets annoyed by all the notifications of both the social media apps and mental health app and thus do not use the mental health app, visualizes this conflicting influence.

4.5 Person-of-trust (micro-system)

While discussing mental health apps as a resource to promote mental health, participants brought up the crucial role of a person-of-trust for their mental health and compared this role with the role of mental health apps. Participants emphasized the importance of having access to a person-of-trust who can *"accompany you in some aspects (...) in the area of work or at a hearing"* (Arian, WS2 1.1) and with whom the participants can *"talk about problems"* (Arian, WS2 1.1 and Quirin, WS2 1.1). The importance of a person-of-trust was also evident in the organizing and facilitation process of the workshop. Five mentors were in exchange with the workshop facilitator to enable/ease the participation of the UMY in the workshops. For example, one mentor contacted the workshop facilitator to get help to install the app. Another mentor asked the workshop facilitator to contact her if there were any misunderstandings or challenges and one participant did not attend the workshops without his mentor.

However, in connection to this micro-system, participants pointed out the challenge to start trusting a mentor. Participants explained that *"(his peers) are restrained because they do not want to talk about their problems because they are scared they cannot trust."* (Arian, WS2, 1.1). Another participant confirmed that by explaining *"it took a while that I can trust them (my foster parents)"* (Quirin, WS2 1.1). But at the same time, this brings many benefit such as to *"know that you have someone, this person, then (to) get more courage."* (Arian, WS2 1.1). However, even after establishing a certain level of trust, it is difficult to talk about problems, namely because of language barriers and the fear of *"expressing things wrongly (could cause) a problem or conflict."* (Arian, WS2 1.3) and especially, to *"express some emotions and explanations (causes a challenge, as) in German (a translation) doesn't exist."* (Luis, WS2 1.3).

At the workshops, participants highlighted that mental health apps could create or extend existing social factors within micro-systems. New connections to persons-of-trust could be created in the online space and either lead to micro-systems which exist both online or offline or micro-systems which stay in the online space and are (potentially) anonymous. When presenting their design ideas, participants suggested that mental health apps could help to reach others *"whom you could ask questions about what you should do in your situation"* (Sami, WS1 3.3) or *"who can help you to forget your stress (by) driving with you somewhere or playing football."* (Quirin, WS2 1.1).

However, participants emphasized that talking to an app about their problems was different from talking to a person-of-trust, but that technology could provide a different form of a person-of-trust-micro-system, namely by connecting them to a person who they can entrust with their worries but stay anonymous:

"(The other participant) said an app cannot be like a person-of-trust. I think he is right, but through using the app you can find someone you can trust. E.g., there has to be an app to talk about your emotions with someone. This has to be anonymous, e.g., the person, with whom I talk, doesn't know me. I do not know that person so it is easier to tell your emotions. That could also be helpful" (Dan, WS2 1.1).

These findings highlight the complexity of identifying a person-of-trust online; indicating that online interactions can not be a substitute to offline engagements with a person-of-trust. The findings also show participants' interest in creating online interactions that complement the existing offline social contacts by facilitating anonymous conversations or positive activities.

4.6 Development over time (chrono-system)

Lastly, participants discussed how their personal development and experiences over time (chrono-system) shapes their evaluations of the mental health apps as mental health resources. The chrono-system development contributes to the development of the mental health knowledge of UMY which influences if the content of the mental health app is perceived to be appropriate.

Participants emphasized that over time they gained knowledge about which activities are beneficial for their mental health. For instance, one participant learned that *"to sleep for half an hour after work"* caused him to *"not be able to sleep anymore in the evening"* so now he *"immediately goes to the gym (...) and can sleep very easily."* (Adam, WS2 1.1). Another participant recognized how a certain activity made him calm: *"Always when I have stress, I take paper and a pen and stick my head in it and draw – no matter what. And after a while, I am very calm. Thus, I forget."* (Dan, WS2 1.1).

Not feeling a change over time, namely that the activity helps, stopped participants' from using the mental health app completely.

E.g., one participant, Luis, explained in his notebook that he tested the app for three days and did the activities, however, he stated in his notebook: *"Nothing happened. Then I stopped. I did not get much energy."*.

In addition, we found that if the app does not take into account participants' pre-existing knowledge and experience, they evaluated the app as not useful: When evaluating Shleep, one participant highlighted that he does not see a need to continue using an app as he *"watched two, three videos and know(s) everything"* (Dan, WS2 2.1, tested Shleep). One team questioned the Mind Max app, as the suggested activity was integrated in a game, and based on their knowledge they perceived that a game *"distracts from sleeping"* (WS2 1.3, team 1).

Based on these reflections, participants highlighted that they viewed one of the roles of the apps as facilitating their learning process by enabling them to *"read through and simply try which (activity) is helpful for (them)"* (Luis, WS2 1.3), as this helps to identify what a person (i.e. the bio-system) needs as the things that help them are *"different for everyone"* (Dan, WS2 1.1, Luis, WS2 1.3). To support this learning, participants suggested integrating chrono-systemic learning development in their designs of mental health apps by creating functions such as calendars that document their learning progress. Documenting their activities and how this effects their mental state would help them to identify the long-term effects of certain activities (e.g., by identifying if they feel more energy or fit):

"You should learn from your mistakes (so) that you do not repeat them. (...) — What are the things I should stop? (...) What needs more energy?" (Arian, WS2 2.5, presenting storyboard 6, Figure 3).

"The most important thing (of our App) is the calendar(...) when the time passed, (...) (the app) shows I used this and now I feel really fit and I continue using this" (Rian, WS1 3.3, prototype, Figure 5)

Overall, the chrono-systemic development of the UMY contributed to a certain mental health knowledge and personal preference for mental health activities. This knowledge and preferences impacted the participants' evaluation of the usefulness of the mental health apps as a mental health resource. In addition, participants highlighted that mental health apps needed to support this continuous learning process to function as a mental health resource.

5 DISCUSSION

In this paper, we investigated how mental health apps integrate as mental health resources into UMY's social-ecological environment and how the factors of the different social-ecological systems influence the UMY's ability to use these mental health apps. We gained a deep understanding of how the macro-, micro-, and chrono-systems interplay with the UMY's experience of mental health apps (see interplay in Figure 6). Based on our findings, we discuss the pivotal need for accounting for the macro-system's influence when designing mental health technologies for this population, as this influence impacts fundamentally all other systems, e.g., the physical and social factors of the micro-system where UMY live (micro-system B in Figure 6). We then elaborate on how to account for and manage the interplay of different social factors by designing for the different micro-systems—namely the social in the everyday living situation, the person-of-trust, and the physical social contacts. Furthermore,

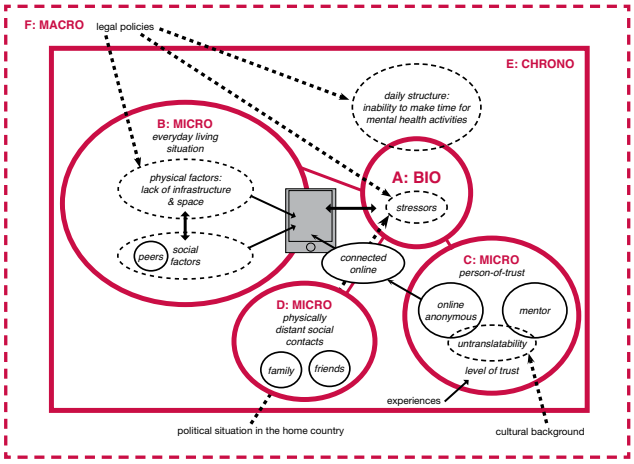

Figure 6: Interplay between bio- (A), micro- (B-D), chrono- (E) and macro-system (F), and the mental health app. The theoretical elements are written in bold and red and the empirical data in italic. The dashed circles and arrows symbolize the influence of the macro-system (F) on other systems (e.g., legal policies cause lack of time which in turn hinders the bio-system to engage with the app).

we outline the need to design for the chrono-systemic development of the bio-system and for the long-term change of the macro-system to create resources that promote resilience in the long-term.

5.1 The macro-system's influence

The findings show that the macro-system predominantly influences the ability of UMY to apply mental health technologies, and the activities that they recommend, as a resource to promote their resilience. Research within the field of HCI has identified culture, language, and access divides as factors within refugees' and asylum seekers' social ecology that technologies can be designed to account for and indeed designed for [42, 70, 89]. Within the HCI4D community, Pendse et al. [67] highlight how the cultural, linguistic and socio-economical factors within the macro-system need to be accounted for when designing mental health technologies in the *"global south"* to prevent the exacerbation of the treatment gap. Our findings extend this knowledge by bringing to the fore the political and legal factors associated with asylum seeking and their influence on the fit of mental health technologies, as mental health resources, within the UMY's social ecology.

We further add to this knowledge by highlighting how the macro-system shapes the UMY's daily structure and the micro-systems in which the interaction with the resource mainly takes place. Policies and legal structures shape the social and physical factors of the micro-systems, i.e. resulting in the lack of infrastructure and space in micro-system B, Figure 6. This influence contributes to micro-systems that are non-facilitative environments for applying the mental health apps as resources. These factors, and the interplay that they result in, go beyond understanding the influence of culture and financial resources on the ability of refugees and asylum seekers

to access mental health apps. This highlights how the system of political and social injustice propagates the marginalization of UMY and further widens the treatment gap.

The exacerbation of the treatment gap for this particular population may have consequences regarding their ability to meet the formal and informal requirements within the asylum seeking process, one of which is social and economic integration in their countries of asylum. There is increasing work in HCI to support refugees and asylum seekers in socially integrating and accessing the job market [1, 12, 61]. However, research has shown that pursuing these goals is not manageable with mental health challenges [71]. In our findings, participants created a persona and suggested through a storyboard that the persona should leave their job in order to be able to use a mental health app. This shows a tension between the pressure to economically integrate and their ability to effectively apply mental health apps to become mentally resilient enough to engage in work/study.

Therefore, we argue for purposefully designing mental health technologies that account for the social and ecological factors within UMY's lived experiences. In the following sections, we present the factors identified in the findings section as design considerations together with design implications for mental health apps that are appropriate within UMY's existing social ecology.

5.2 Designing for the micro-systems

Our findings show that the constraints set by the macro-system hinder UMY's ability to access and apply mental health apps as a resource: The macro-system—political regulations connected to the asylum status—dictates UMY's occupations and daily structure and the physical and social factors of the micro-systems, namely of their everyday living situation (micro-system B in Figure 6). Mitigating and managing these constraints would increase the fit of mental health apps within their existing social-ecology and thereby become resources that UMY *"can easily navigate, access and apply"* [84].

Mental health apps need to tailor the timing, the content and the means of delivery to fit with the social and physical factors of the current micro-system, and should be designed for trade-offs: Due to the constraining situation, the UMY need to be able to use the mental health app even if the social and physical factors of the micro-system are restrictive. For instance, participants highlighted that the lack of technological infrastructures and resources, and that they have no control over the availability of WI-FI in some accommodations—to which they are assigned by the asylum system to live in—influences the modality through which they can access and use mental health apps. In addition, participants' lack of private space within their shared accommodation limited their ability to engage with the mental health apps. In other work in HCI, college students suggested discreet text-based resources to overcome the barrier to engaging with mental health resources due to the lack of privacy and alone time [52]. However, research has also shown the benefit of multi-modal content, not just text, in promoting the engagement of youth in mental health interventions [56]. Therefore, a hybrid model that detects the technological infrastructure that is accessible at a point in time and responds accordingly with the appropriate medium of intervention delivery would enhance UMY's ability to apply mental health apps as a resource.

Machine learning (ML) and different forms of data tracking solutions could support this tailoring of mental health apps. For instance, technological solutions delivering interventions for behaviour change are able to identify the best timing to deliver support to the individual when they are most vulnerable, and minimize disruptions [18, 54]. Passively sensed data could provide insights into the physical and social factors of the micro-system (i.e. ML using Bluetooth data helps to understand the location-based social networks in dynamic group situation such as meetings other in the hall [20]). The passively sensed data could be complemented and improved with actively collected data via self-reporting solutions such as ecological momentary assessments [27]. However, as Thieme et al. [79] have indicated in their review of ML in mental health, much work is needed in understanding what data individuals are willing to share passively and actively to design appropriately responsive ML driven mental health technologies. Our findings show that UMY have high privacy concerns. Other studies in the context of refugees and asylum seekers have also shown that this population have increased privacy and security concerns related to their data [24] and yet have low agency in detailing what data they are willing to share and how it is used by service providers [23, 73]. These privacy concerns need to be taken in to account when designing future ML driven mental health apps.

Our findings also highlighted the importance of the different factors within micro-systems when interacting with mental health apps, primarily: the social factors within their everyday living situation, physically distant social contacts and persons-of-trust.

5.2.1 Designing for the social in the everyday living situation. Similar to Burgess et al.'s [14], and Lattie et al.'s work [52], our findings show that the design of mental health resources need to take into account the different social contacts and their role within UMY's social ecological environment. To integrate into the social-ecological environment, mental health apps need to support the UMY in managing the different influences and roles of the different micro-systems. Our findings show that the social factors of the (predominantly male) everyday living situation (Figure 6: micro-system B) not only impact the engagement with mental health resources, but also the ability to apply the advice and activities (i.e. yoga) because of peer pressure and mental health stigma. While mobile phone apps may facilitate the private engagement with a mental health intervention, further research is needed about how such individual interventions may interact with and connect to wider interventions within their everyday micro-systems.

Pendse et al. [67] suggest designing mental health technologies for families by providing two apps, one for the cared-for person and one for the family. In the context of behaviour change, technologies such as FitBit provide the option to create challenges among friends [47]. Similar mobile phone based interventions could leverage existing supportive relationships, such as the two UMY talking about their problems at school breaks. For example, building on the prototype suggested by participants (Figure 5) which stored positive memories, individuals may be able to select positive memories collaboratively with close friends.

Furthermore, to support overcoming mental health stigma and the risk of being negatively perceived by their peers, and counter

the pressure to adapt to the mainstream daily rhythm at the accommodation, some mental health activities could be designed to include the majority of the people in their living situation, e.g., by creating popular shared activities that promote a more healthy daily structure in the accommodation. For instance, participatory design research on targeting specifically men's mental health suggested a more self-improvement approach and masculine tone through a football-themed app [21, 22]. However, it is important to take into account whether participants experienced games as having a negative impact on their sleep qualities (as this hindered participants of this study using the football-themed app), and that the level of openness towards mental health topics differs among individuals, accommodations and peer groups. Such an approach would require social workers, who take a professional care role in these accommodations [75], to introduce and moderate mental health activities within the accommodation.

5.2.2 Designing for the person-of-trust. Participants wished to be able to talk anonymously to others, in spite of having access to a person-of-trust, and they shared concerns regarding sharing mental health information among their different social micro-system (i.e. peers). Thus, our findings highlight the need to consider the different levels of trust within online and offline social micro-systems (micro-system C in Figure 6) and their relation to privacy and social identity. Our findings are in line with Tachtler et al. [75] in that mentors are an important social factor within the micro-system for UMY. Several participants trusted their mentors to support them in engaging with research workshops. Furthermore, participants emphasized that a mental health app can not substitute for a person-of-trust. However, participants also highlighted the challenge of expressing emotions due to untranslatability of the terms and expressed hesitance in sharing mental health problems due to distrust and stigma. The mobile apps can build on experienced mentors' practices to create a code language with their mentee to overcome challenges of untranslatability and distrust [75]. For instance, the apps could support sharing current mental health status by offering features such as data sharing tools [93] and creative means of expressing emotions [78].

5.2.3 Designing for physically distant social contacts. Our findings show that the micro-systems who are physically distant (micro-system D in Figure 6), and the stressors associated with these micro-systems, influenced engagement with mental health apps. Participants identified that while social media and news from home caused stress (i.e. showing re-traumatizing news about refugees), the apps are also needed to minimize other stressors (i.e. not knowing the well-being of their social contacts back home). Participants presented scenarios in which social media notifications dissuaded them from engaging with their mobile phones and consequently the mental health apps. This highlights that mental health apps are part of the technological ecology of the phone and do not function in a silo. Researchers [13] have pointed out that there is a lack of understanding of the interplay between different mobile apps, as research in HCI mainly focuses on the user's interaction with one app and ignores the fact that the user is engaging with multiple installed apps. Therefore, mental health apps need to provide solutions to support UMY to manage these competing tensions. The apps could identify the other mobile apps that introduce stressors and then accordingly provide the option to mute those apps. In addition, they could help to counter the stressors introduced by identifying when the UMY are using social media apps and then prompting them to engage in a mental health activity afterwards to help cope with the triggered worries.

5.3 Designing for the chrono-system

The chrono-system (Figure 6, E) influences the situation and constellation of all social-ecological systems and their relationship to the UMY [82, 85]. Due to the macro-systemic regulations, UMY often have to change accommodation (e.g., having to leave their accommodation when turning 18 [9]) and thereby lose contact with the care infrastructure. This is especially traumatic for UMY as building trust takes time due to previous traumatic experiences where their trust was abused [55]. Besides the social-ecological factors, the bio-systemic factors such as mental health knowledge changes over time. Thus, technological interventions need to adapt to the ongoing changes and be adaptable to be able to move with the UMY. For instance, mobile apps facilitating engagements between mentors and UMY [75] need to account to the changes in levels of trust as their relationship develops.

In the workshops, participants also identified the need for mental health apps to consider chrono-systematic development to create mental health resources that engage with their learning process over time. Participants' ideations of mental health apps suggested the need for the apps to document the strategies and multi-model content (e.g., recorded goodnight stories and meditation music) that they have applied and were experienced as beneficial. In addition, they suggested integrating the learning process in the design of mental health apps by creating functions such as calendars that document their learning progress (see Figure 5). Such functionalities of planning, documenting and reflecting on activities have been previously explored within HCI, e.g., for Behavioral Activation psychotherapy [69] and improving well-being [44]. Furthermore, in some instances the participants based their evaluations of the apps on their knowledge of what mental health activities work for them. Consequently, the mental health app needs to initially identify the pre-existing knowledge and preferred strategies before the user engages with the content of the app. Literature on mental health and UMY emphasizes the importance of care and support for UMY by primarily helping them in further developing their strengths, patterns of agency and resilience [26]. Mental health apps could learn the existing strengths and strategies, and increase UMY's awareness of them and strengthen them.

5.4 Designing for the long-term change of the macro-system

Recent work within the HCI4D and ICT4D community has called for the adoption of aspiration based design when designing mental health technologies in the *"global south"* [67]. Within this approach, Toyama [80] calls for asking participants what they would want to change using means that are in their control and using those aspirations as the basis for design. However, our findings highlight that, due to the influence of the macro-system, UMY have limited control on factors within their social-ecological environment that hinders their ability to use mental health technologies as resources.

Therefore, we argue for a two-pronged approach to designing for the mental health of this population. Besides purposefully designing mental health technologies that account for factors within their social-ecology, we also need to design towards societal transformation that would enable a more socially just macro-system that in turn contributes to a facilitative environment in which UMY can apply mental health apps as a resource.

Kumar et al. [51] discuss how, in the context of young girls in India, the aspirations of the girls must either be aligned with that of their parents to make them operational and/or social technology designers should design for the alignment of aspirations. In addition, Kumar et al. [51] highlight the need for aspirational design to engage with transforming social norms that inhibit and may even erode the aspirations of marginalized groups. Our findings extend this rhetoric to considering how the political and in turn the legal policies that constitute the macro-system of UMY need to be transformed. Therefore, we cannot design technologies for the mental health of UMY without supporting ways of acknowledging and countering unjust macro-system factors. Just as the bio-system and micro-systems do not function in a silo isolated from the macro-system, neither should design efforts. We call on HCI researchers engaging in the design of mental health technologies for marginalized communities, such as UMY, to consider how their technological designs may contribute, complement and/or extend existing activist movements and technologies employed within that space.

Work such as [57, 74] highlight how technologies may be used to share experiences for the purpose of laying the foundations for activism and political debates and for catalyzing activist initiatives. In this context, technological solutions could build on participants' wishes to anonymously discuss their experiences and mental health stressors with others. We may consider how these technological solutions could make activist groups more proximal within UMY's micro-system; indeed none of the participants indicated activists or advocacy groups as part of their micro-systems. Activist networks connected through Social Networking Sites (SNS) have been found to be a successful modality in building solidarity [43]. However, participants identified the negative impact of social media on their mental health. Therefore, further exploration is needed into how UMY would want to safely connect to such networks to contribute their mental health experiences and advocate for change. For example, PhotoVoice, where participants become heard through sharing pictures [8, 37], may be integrated into mobile apps, such as the diary app suggested and prototyped by participants (see Figure 5). In doing so, the mental health state and environment of UMY, that are influenced by the macro-system, can be collated in the mental health app and shared through the app to SNS networks without the need of the UMY to actively engage with social media apps.

Zegura et al. [94] have demonstrated how communities can use data to advocate for better living conditions. Similarly, we can envision that data contributing to the personalization of mental health apps (as detailed in Section 5.2) can also be used to identify and quantify factors attributed to the macro-system that negatively impact the mental health of UMY and pose a barrier for mental health interventions. For example, UMY can opt to share and annotate data reflecting the lack of usage of an app in the morning due to the cramped living situation or instances where they feel stressed about not hearing back about their asylum application. With their consent, such data can be pooled anonymously by advocacy groups and organizations to generate evidence calling for changes in policies; thus contributing to the shifting care infrastructures away from a legal perspective, as detailed in Section 2.1 to one that is based on promoting health and well-being.

5.5 Broader implications

While this paper focused on one specific context and on mental health apps as one form of mental health resource, we argue that the gained insights help to design mental health technologies to become accessible resources for other (non-mobile phone based) technology driven resources and other contexts of marginalization. Even if mental health apps currently do not integrate well into the existing physical factors of the micro-systems, our findings underline that mobile technologies are the technological tools which are most suited for UMY's everyday life (e.g., adapting to the forced mobility and the need of privacy). Nevertheless, we point to opportunities to extend the ecosystem of mental health resources and learn from these findings to better design technological solutions for other intervention points in UMY's social-ecological environment, as pointed out in our previous work [75]. For instance, when designing resources for the mentor-mentee relationship, the design of the technology needs to account for the limited agency of UMY to shape the structure of their everyday and physical environment.

In addition, our findings show the dominant influence of the macro-system on the other systems and in turn UMY's ability to use mental health apps as a resource. The need to account for macro-systemic influences is transferable to other marginalized populations. Other populations including formerly incarcerated individuals [62] and homeless young people [92] and mothers [53] face similar challenges related to accommodation and stress introduced by social media and social dynamics that may limit their ability to engage with mental health apps. In addition, usage of technological systems are bounded by larger contexts such as the local homeless care guidance [53] and re-socialization systems [29].

6 LIMITATIONS AND FUTURE WORK

Even if it is important to investigate the unique needs of male UMY, due to the increased challenges they face in accessing mental health services [19], further studies are needed that engage women and LGBTQ+ members of this population to explore the variance in the social-ecological environment in which they interact with mental health resources. In this study we engaged with a limited number of participants due to the expected language barriers. Furthermore, the workshops may have attracted participants who are more open towards the topic of mental health and digital technologies. Therefore, further research with a wider participant pool is needed. It is also important to note that UMY's everyday life is continuously changing, based on changes in policies in their country of asylum and situations in their home countries, and the workshop only provides insights into a snapshot of UMY's lives during the time of the study. In future research, we plan to further develop and test concepts that account for the constraints imposed by the macro-system in situ in order to account for changes over time. In addition, future research could further explore different

types of mental health technologies at different intervention points, beyond the individual (e.g., an accommodation level intervention) and how they integrate as resources within the social-ecological environment and thereby complement mental health apps.

7 CONCLUSION

This paper investigates the interplay of the social-ecological systems and the UMY's ability to apply mental health apps as a resource by conducting co-design workshops with UMY. Our findings highlight how the macro-system influences the micro- and bio-systems. This influence hinders UMY's ability to use the mental health apps, as these apps do not account for constraining factors within their social ecology and are designed for users who for instance have the agency to choose where, how and with whom they live. This barrier to the use of mental health apps as a resource to promote resilience could increase the treatment gap. Therefore, we argue that mental health technologies need to account for the social and ecological factors in UMY's everyday life. Thereby, the mental health technologies need to promote UMY's ability to counter and mitigate the limitations set by the macro-system and adapt to UMY's individual chrono-systemic development.

ACKNOWLEDGMENTS

This project has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No. 722561. Talhouk's contribution was funded by EPSRC award EP/L016176/1 (Centre for Doctoral Training in Digital Civics).

REFERENCES

[1] Asam Almohamed and Dhaval Vyas. 2019. Rebuilding Social Capital in Refugees and Asylum Seekers. *ACM Trans. Comput.-Hum. Interact.* 26, 6, Article 41 (Nov. 2019), 30 pages. https://doi.org/10.1145/3364996

[2] Felwah Alqahtani and Rita Orji. 2019. Usability Issues in Mental Health Applications. In *Adjunct Publication of the 27th Conference on User Modeling, Adaptation and Personalization* (Larnaca, Cyprus) *(UMAP'19 Adjunct)*. Association for Computing Machinery, New York, NY, USA, 343–348. https://doi.org/10.1145/3314183.3323676

[3] Fernando Estrada Martinez de Alva, Greg Wadley, and Reeva Lederman. 2015. It Feels Different from Real Life: Users' Opinions of Mobile Applications for Mental Health. In *Proceedings of the Annual Meeting of the Australian Special Interest Group for Computer Human Interaction* (Parkville, VIC, Australia) *(OzCHI '15)*. ACM, New York, NY, USA, 598–602. https://doi.org/10.1145/2838739.2838806

[4] Asylkoordination. 2016. Nr. 3 Übersicht zum Asylverfahren. Retrieved December 7, 2020 from http://www.asyl.at/files/173/01-asylkoordinaten_2019_asylverfahren_web.pdf.

[5] Asylkoordination. 2019. Nr. 3a Asylverfahren Stand Juni 2019. Retrieved December 7, 2020 from http://www.asyl.at/files/173/02-asylverfahren2016.pdf.

[6] Jennifer Baranoff, R. Israel Gonzales, Jay Liu, Heidi Yang, and Jimin Zheng. 2015. Lantern: Empowering Refugees Through Community-Generated Guidance Using Near Field Communication. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI EA '15)*. Association for Computing Machinery, New York, NY, USA, 7–12. https://doi.org/10.1145/2702613.2726950

[7] Jakob E. Bardram, Mads Frost, Károly Szántó, Maria Faurholt-Jepsen, Maj Vinberg, and Lars Vedel Kessing. 2013. Designing Mobile Health Technology for Bipolar Disorder: A Field Trial of the Monarca System. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris, France) *(CHI '13)*. Association for Computing Machinery, New York, NY, USA, 2627–2636. https://doi.org/10.1145/2470654.2481364

[8] Lisa Bashore, Gina K Alexander, D Lynn Jackson, and Paige Mauch. 2017. Improving health in at-risk youth through Photovoice. *Journal of Child Health Care* 21, 4 (2017), 463–475. https://doi.org/10.1177/1367493517734391

[9] Maria-Alexandra Bassermann and Alexander Spiegelfeld. 2018. Unaccompanied minors following status determination in Austria. https://publications.iom.int/system/files/pdf/unaccompanied_minors_following_status_determination_en.pdf

[10] Virginia Braun and Victoria Clarke. 2012. Thematic analysis. *APA Handbook of Research Methods in Psychology* 12 (2012), 57–71. https://doi.org/10.1037/13620-004

[11] Urie Bronfenbrenner. 1979. *The ecology of human development*. Harvard university press, Cambridge, MA.

[12] Alice V. Brown and Jaz Hee-jeong Choi. 2018. Refugee and the Post-trauma Journeys in the Fuzzy Front End of Co-creative Practices. In *Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1* (Hasselt and Genk, Belgium) *(PDC '18)*. ACM, New York, NY, USA, Article 15, 11 pages. https://doi.org/10.1145/3210586.3210598

[13] Barry Brown, Susanne Bødker, and Kristina Höök. 2017. Does HCI Scale? Scale Hacking and the Relevance of HCI. *Interactions* 24, 5 (Aug. 2017), 28–33. https://doi.org/10.1145/3125387

[14] Eleanor R. Burgess, Kathryn E. Ringland, Jennifer Nicholas, Ashley A. Knapp, Jordan Eschler, David C. Mohr, and Madhu C. Reddy. 2019. "I Think People Are Powerful": The Sociality of Individuals Managing Depression. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW, Article 41 (Nov. 2019), 29 pages. https://doi.org/10.1145/3359143

[15] Ana Maria Bustamante Duarte, Mehrnaz Ataei, Auriol Degbelo, Nina Brendel, and Christian Kray. 2019. Safe spaces in participatory design with young forced migrants. *CoDesign* (2019), 1–23. https://doi.org/10.1080/15710882.2019.1654523

[16] Ana Maria Bustamante Duarte, Nina Brendel, Auriol Degbelo, and Christian Kray. 2018. Participatory Design and Participatory Research: An HCI Case Study with Young Forced Migrants. *ACM Trans. Comput.-Hum. Interact.* 25, 1, Article 3 (Feb. 2018), 39 pages. https://doi.org/10.1145/3145472

[17] Shleep B.V. 2020. We help the world to better sleep. Retrieved December 23, 2020 from https://www.shleep.com/.

[18] Stephanie M Carpenter, Marianne Menictas, Inbal Nahum-Shani, David W Wetter, and Susan A Murphy. 2020. Developments in Mobile Health Just-in-Time Adaptive Interventions for Addiction Science. *Current Addiction Reports* 7 (2020), 280–290. https://doi.org/10.1007/s40429-020-00322-y

[19] Anita Chandra and Cynthia S Minkovitz. 2006. Stigma starts early: Gender differences in teen willingness to use mental health services. *Journal of adolescent health* 38, 6 (2006), 754–e1. https://doi.org/10.1016/j.jadohealth.2005.08.011.

[20] Zhenyu Chen, Yiqiang Chen, Lisha Hu, Shuangquan Wang, Xinlong Jiang, Xiaojuan Ma, Nicholas D. Lane, and Andrew T. Campbell. 2014. ContextSense: Unobtrusive Discovery of Incremental Social Context Using Dynamic Bluetooth Data. In *Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct Publication* (Seattle, Washington) *(UbiComp '14 Adjunct)*. Association for Computing Machinery, New York, NY, USA, 23–26. https://doi.org/10.1145/2638728.2638801

[21] Vanessa Wan Sze Cheng, Tracey Davenport, Daniel Johnson, Kellie Vella, Jo Mitchell, and Ian B Hickie. 2020. Naturalistic evaluation of a sport-themed mental health and wellbeing app aimed at men (MindMax), that incorporates applied video games and gamification. *Internet Interventions* 20 (2020), 11. https://doi.org/10.1016/j.invent.2020.100306

[22] Vanessa Wan Sze Cheng, Tracey A Davenport, Daniel Johnson, Kellie Vella, Jo Mitchell, and Ian B Hickie. 2018. An app that incorporates gamification, minigames, and social connection to improve men's mental health and well-being (MindMax): participatory design process. *JMIR mental health* 5, 4 (2018), e11068.

[23] Lizzie Coles-Kemp and Rikke Bjerg Jensen. 2019. Accessing a New Land: Designing for a Social Conceptualisation of Access. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3290605.3300411

[24] Lizzie Coles-Kemp, Rikke Bjerg Jensen, and Reem Talhouk. 2018. In a New Land: Mobile Phones, Amplified Pressures and Reduced Capabilities. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, Article 584, 13 pages. https://doi.org/10.1145/3173574.3174158

[25] Ilse Derluyn and Eric Broekaert. 2008. Unaccompanied refugee children and adolescents: The glaring contrast between a legal and a psychological perspective. *International journal of law and psychiatry* 31, 4 (2008), 319–330. https://doi.org/10.1016/j.ijlp.2008.06.006

[26] Ilse Derluyn and Marianne Vervliet. 2012. The wellbeing of unaccompanied refugee minors. In *Health inequalities and risk factors among migrants and ethnic minorities*, Vol. 1. Garant, Antwerp, Belgium, 95–109.

[27] Kevin Doherty, Andreas Balaskas, and Gavin Doherty. 2020. The Design of Ecological Momentary Assessment Technologies. *Interacting with Computers* 32, 3 (2020), 257–278. https://doi.org/10.1093/iwcomp/iwaa019

[28] Tara Donker, Katherine Petrie, Judy Proudfoot, Janine Clarke, Mary-Rose Birch, and Helen Christensen. 2013. Smartphones for smarter delivery of mental health programs: a systematic review. *Journal of medical Internet research* 15, 11 (2013), e247. https://doi.org/10.2196/jmir.2791.

[29] Tanja Ertl, Sebastian Taugerbeck, Margarita Esau, Konstantin Aal, Peter Tolmie, and Volker Wulf. 2019. The Social Mile-How (Psychosocial) ICT can Help to

Promote Resocialization and to Overcome Prison. *Proceedings of the ACM on Human-Computer Interaction* 3, GROUP (2019), 1–31. https://doi.org/10.1145/3370270

[30] Seyda Eruyar, Julia Huemer, and Panos Vostanis. 2018. How should child mental health services respond to the refugee crisis? *Child and Adolescent Mental Health* 23, 4 (2018), 303–312. https://doi.org/10.1111/camh.12252

[31] Rosalind Evans, Claudia Lo Forte, and Erika McAslan Fraser. 2013. UNHCR's Engagement with Displaced Youth. Retrieved May 22, 2020 from https://www.unhcr.org/513f37bb9.pdf.

[32] Fabulous. 2020. Build Better Habits & Achieve your Goals. Retrieved December 23, 2020 from https://www.thefabulous.co/landing/get-started/.

[33] Mina Fazel and Theresa S Betancourt. 2018. Preventive mental health interventions for refugee children and adolescents in high-income settings. *The Lancet Child & Adolescent Health* 2, 2 (2018), 121–132. https://doi.org/10.1016/S2352-4642(17)30147-5

[34] Joseph Firth, John Torous, Jennifer Nicholas, Rebekah Carney, Abhishek Pratap, Simon Rosenbaum, and Jerome Sarris. 2017. The efficacy of smartphone-based mental health interventions for depressive symptoms: a meta-analysis of randomized controlled trials. *World Psychiatry* 16, 3 (2017), 287–298.

[35] European Union Agency for Fundamental Rights. 2020. Consent to use data on children. Retrieved September 8, 2020 from https://fra.europa.eu/en/publication/2017/mapping-minimum-age-requirements/use-consent.

[36] Andrea Fritsche, Katharina Glawischnig, and Lisa Wolfsegger. 2019. Dreimal in der Woche weinen, viermal in der Woche glücklich sein. Zur kinderrechtlichen Situation begleiteter Kinderflüchtlinge und ihrer Familien. http://www.asyl.at/files/337/01-unicef-studie-kinderfluechtlinge-in-oesterreich.pdf

[37] Bianca Camille Girang, Denzel Patrick Chu, Maria Isabella Endrinal, and Nico Canoy. 2020. Spatializing psychological well-being: A photovoice approach on the experience of stress alleviation among university students. *Qualitative Research in Psychology* (2020), 1–26. https://doi.org/10.1080/14780887.2020.1716424

[38] Tad Hirsch, Catherine Lim, and Jennifer J. Otten. 2016. What's for Lunch? A Socio-Ecological Approach to Childcare Nutrition. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems* (Brisbane, QLD, Australia) *(DIS '16)*. Association for Computing Machinery, New York, NY, USA, 1160–1171. https://doi.org/10.1145/2901790.2901793

[39] Christoph Hochwarter and Eva Zeglovits. 2016. Unbegleitete minderjährige Flüchtlinge in Österreich. Forschungsbericht im Auftrag der Österreichischen Bundesjugendvertretung [Unaccompanied minor refugees in Austria. Research report on behalf of the Austrian Youth Association]. https://www.jugendportal.at/sites/default/files/bjv-studie_fluechtlinge.pdf

[40] Matthew Hodes and Panos Vostanis. 2019. Practitioner Review: Mental health problems of refugee children and adolescents and their management. *Journal of child psychology and psychiatry* 60, 7 (2019), 716–731.

[41] Julia Huemer, Niranjan S Karnik, Sabine Voelkl-Kernstock, Elisabeth Granditsch, Kanita Dervic, Max H Friedrich, and Hans Steiner. 2009. Mental health issues in unaccompanied refugee minors. *Child and adolescent psychiatry and mental health* 3, 1 (2009), 13. https://doi.org/10.1186/1753-2000-3-13

[42] Azalea Irani, Kriti Nelavelli, Kristin Hare, Paula Bondal, and Neha Kumar. 2018. Refuge Tech: An Assets-Based Approach to Refugee Resettlement. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, 1–6. https://doi.org/10.1145/3170427.3188680

[43] Farnaz Irannejad Bisafar, Brooke Foucault Welles, and Andrea G Parker. 2020. A Dramaturgical Approach to Online Activism within Youth Empowerment Organizations. *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW2 (2020), 1–22.

[44] Ellen Isaacs, Artie Konrad, Alan Walendowski, Thomas Lennig, Victoria Hollis, and Steve Whittaker. 2013. Echoes from the Past: How Technology Mediated Reflection Improves Well-Being. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Paris, France) *(CHI '13)*. Association for Computing Machinery, New York, NY, USA, 1071–1080. https://doi.org/10.1145/2470654.2466137

[45] Marianne Jakobsen, Melinda Ashley Meyer DeMott, Tore Wentzel-Larsen, and Trond Heir. 2017. The impact of the asylum process on mental health: a longitudinal study of unaccompanied refugee minors in Norway. *BMJ open* 7, 6 (2017), e015157.

[46] Dorothy King and Glorianne Said. 2019. Working with unaccompanied asylum-seeking young people: cultural considerations and acceptability of a cognitive behavioural group approach. *the Cognitive Behaviour Therapist* 12 (2019), 23. https://doi.org/10.1017/S1754470X18000260

[47] Predrag Klasnja and Wanda Pratt. 2014. Managing Health with Mobile Technology. *Interactions* 21, 1 (Jan. 2014), 66–69. https://doi.org/10.1145/2540992

[48] Judith Kohlenberger, Isabella Buber-Ennser, Bernhard Rengs, Sebastian Leitner, and Michael Landesmann. 2019. Barriers to health care access and service utilization of refugees in Austria: Evidence from a cross-sectional survey. *Health Policy* 123, 9 (2019), 833–839. https://doi.org/10.1016/j.healthpol.2019.01.014

[49] Judith Kohlenberger, Isabella Buber-Ennser, Bernhard Rengs, Sebastian Leitner, and Michael Landesmann. 2019. Gesundheitszugang von syrischen, irakischen und afghanischen Geflüchteten in Österreich: Ergebnisse aus dem Refugee Health and Integration Survey. *Migration und Integration 7: Dialog zwischen Politik, Wissenschaft und Praxis. Reihe Dialogforum Integration* 7 (2019), 239–259.

[50] Saskia Koppenberg. 2014. Unaccompanied minors in Austria – Legislation, practices and statistics. , 120 pages. https://publications.iom.int/system/files/pdf/unaccompanied_minors_in_austria_en.pdf

[51] Neha Kumar, Marisol Wong-Villacres, Naveena Karusala, Aditya Vishwanath, Arkadeep Kumar, and Azra Ismail. 2019. Aspirations-Based Design. In *Proceedings of the Tenth International Conference on Information and Communication Technologies and Development* (Ahmedabad, India) *(ICTD '19)*. Association for Computing Machinery, New York, NY, USA, Article 2, 11 pages. https://doi.org/10.1145/3287098.3287117

[52] Emily G. Lattie, Rachel Kornfield, Kathryn E. Ringland, Renwen Zhang, Nathan Winquist, and Madhu Reddy. 2020. Designing Mental Health Technologies That Support the Social Ecosystem of College Students. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3313831.3376362

[53] Christopher A. Le Dantec, Robert G. Farrell, Jim E. Christensen, Mark Bailey, Jason B. Ellis, Wendy A. Kellogg, and W. Keith Edwards. 2011. Publics in Practice: Ubiquitous Computing at a Shelter for Homeless Mothers. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Vancouver, BC, Canada) *(CHI '11)*. Association for Computing Machinery, New York, NY, USA, 1687–1696. https://doi.org/10.1145/1978942.1979189

[54] Peng Liao, Walter Dempsey, Hillol Sarker, Syed Monowar Hossain, Mustafa al'Absi, Predrag Klasnja, and Susan Murphy. 2018. Just-in-Time but Not Too Much: Determining Treatment Timing in Mobile Health. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 2, 4, Article 179 (Dec. 2018), 21 pages. https://doi.org/10.1145/3287057

[55] Pallab Majumder, Michelle O'Reilly, Khalid Karim, and Panos Vostanis. 2015. "This doctor, I not trust him, I'm not safe": The perceptions of mental health and services by unaccompanied refugee adolescents. *International journal of social psychiatry* 61, 2 (2015), 129–136.

[56] Toni Michel, Franziska Tachtler, Petr Slovak, and Geraldine Fitzpatrick. 2019. A review of youth mental health promotion apps towards their fit with youth media preferences. *EAI Endorsed Transactions on Pervasive Health and Technology* 13 (2019), 8. https://doi.org/10.4108/eai.13-7-2018.161419

[57] Lydia Michie, Madeline Balaam, John McCarthy, Timur Osadchiy, and Kellie Morrissey. 2018. From Her Story, to Our Story: Digital Storytelling as Public Engagement around Abortion Rights Advocacy in Ireland. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3173574.3173931

[58] David C Mohr, Kathryn Noth Tomasino, Emily G Lattie, Hannah L Palac, Mary J Kwasny, Kenneth Weingardt, Chris J Karr, Susan M Kaiser, Rebecca C Rossom, Leland R Bardsley, et al. 2017. IntelliCare: an eclectic, skills-based app suite for the treatment of depression and anxiety. *Journal of medical Internet research* 19, 1 (2017), e10.

[59] Elizabeth L. Murnane, Tara G. Walker, Beck Tench, Stephen Voida, and Jaime Snyder. 2018. Personal Informatics in Interpersonal Contexts: Towards the Design of Technology That Supports the Social Ecologies of Long-Term Mental Health Management. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 127 (Nov. 2018), 27 pages. https://doi.org/10.1145/3274396

[60] John A Naslund, Kelly A Aschbrenner, Ricardo Araya, Lisa A Marsch, Jürgen Unützer, Vikram Patel, and Stephen J Bartels. 2017. Digital technology for treating and preventing mental disorders in low-income and middle-income countries: a narrative review of the literature. *The Lancet Psychiatry* 4, 6 (2017), 486–500.

[61] Marcel Neuenhaus and Maha Aly. 2017. Empathy Up. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI EA '17)*. Association for Computing Machinery, New York, NY, USA, 86–92. https://doi.org/10.1145/3027063.3049276

[62] Ihudiya Finda Ogbonnaya-Ogburu, Kentaro Toyama, and Tawanna R. Dillahunt. 2019. Towards an Effective Digital Literacy Intervention to Assist Returning Citizens with Job Search. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–12. https://doi.org/10.1145/3290605.3300315

[63] Fabian Okeke, Michael Sobolev, and Deborah Estrin. 2018. Towards A Framework for Mobile Behavior Change Research. In *Proceedings of the Technology, Mind, and Society*. Association for Computing Machinery, New York, NY, USA. https://doi.org/10.1145/3183654.3183706

[64] Kathleen O'Leary, Arpita Bhattacharya, Sean A. Munson, Jacob O. Wobbrock, and Wanda Pratt. 2017. Design Opportunities for Mental Health Peer Support Technologies. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (Portland, Oregon, USA) *(CSCW '17)*. Association for Computing Machinery, New York, NY, USA, 1470–1484. https://doi.org/10.1145/2998181.2998349

[65] Kathleen O'Leary, Stephen M. Schueller, Jacob O. Wobbrock, and Wanda Pratt. 2018. "Suddenly, We Got to Become Therapists for Each Other": Designing Peer Support Chats for Mental Health. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. ACM, New York, NY, USA, Article 331, 14 pages. https://doi.org/10.1145/3173574.3173905

[66] Ashwed Patil. 2019. The Role of ICTs in Refugee Lives. In *Proceedings of the Tenth International Conference on Information and Communication Technologies and Development* (Ahmedabad, India) *(ICTD '19)*. Association for Computing Machinery, New York, NY, USA, Article 48, 6 pages. https://doi.org/10.1145/3287098.3287144

[67] Sachin R. Pendse, Naveena Karusala, Divya Siddarth, Pattie Gonsalves, Seema Mehrotra, John A. Naslund, Mamta Sood, Neha Kumar, and Amit Sharma. 2019. Mental Health in the Global South: Challenges and Opportunities in HCI for Development. In *Proceedings of the 2nd ACM SIGCAS Conference on Computing and Sustainable Societies* (Accra, Ghana) *(COMPASS '19)*. Association for Computing Machinery, New York, NY, USA, 22–36. https://doi.org/10.1145/3314344.3332483

[68] Laura R. Pina, Carmen Gonzalez, Carolina Nieto, Wendy Roldan, Edgar Onofre, and Jason C. Yip. 2018. How Latino Children in the U.S. Engage in Collaborative Online Information Problem Solving with Their Families. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 140 (Nov. 2018), 26 pages. https://doi.org/10.1145/3274409

[69] Darius A. Rohani, Andrea Quemada Lopategui, Nanna Tuxen, Maria Faurholt-Jepsen, Lars V. Kessing, and Jakob E. Bardram. 2020. MUBS: A Personalized Recommender System for Behavioral Activation in Mental Health. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376879

[70] Dina Sabie and Syed Ishtiaque Ahmed. 2019. Moving into a Technology Land: Exploring the Challenges for the Refugees in Canada in Accessing Its Computerized Infrastructures. In *Proceedings of the 2nd ACM SIGCAS Conference on Computing and Sustainable Societies* (Accra, Ghana) *(COMPASS '19)*. Association for Computing Machinery, New York, NY, USA, 218–233. https://doi.org/10.1145/3314344.3332481

[71] Matthis Schick, Andre Zumwald, Bina Knöpfli, Angela Nickerson, Richard A Bryant, Ulrich Schnyder, Julia Müller, and Naser Morina. 2016. Challenging future, challenging past: The relationship of social integration and psychological impairment in traumatized refugees. *European journal of psychotraumatology* 7, 1 (2016), 28057.

[72] Jessica Schroeder, Chelsey Wilkes, Kael Rowan, Arturo Toledo, Ann Paradiso, Mary Czerwinski, Gloria Mark, and Marsha M. Linehan. 2018. Pocket Skills: A Conversational Mobile Web App To Support Dialectical Behavioral Therapy. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3173574.3173972

[73] Emrys Shoemaker, Gudrun Svava Kristinsdottir, Tanuj Ahuja, Dina Baslan, Bryan Pon, Paul Currion, Pius Gumisizira, and Nicola Dell. 2019. Identity at the Margins: Examining Refugee Experiences with Digital Identity Systems in Lebanon, Jordan, and Uganda. In *Proceedings of the 2nd ACM SIGCAS Conference on Computing and Sustainable Societies* (Accra, Ghana) *(COMPASS '19)*. Association for Computing Machinery, New York, NY, USA, 206–217. https://doi.org/10.1145/3314344.3332486

[74] Angelika Strohmayer, Janis Lena Meissner, Alexander Wilson, Sarah Charlton, and Laura McIntyre. 2020. "We Come Together as One...and Hope for Solidarity to Live on": On Designing Technologies for Activism and the Commemoration of Lost Lives. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference* (Eindhoven, Netherlands) *(DIS '20)*. Association for Computing Machinery, New York, NY, USA, 87–100. https://doi.org/10.1145/3357236.3395452

[75] Franziska Tachtler, Toni Michel, Petr Slovák, and Geraldine Fitzpatrick. 2020. Supporting the Supporters of Unaccompanied Migrant Youth: Designing for Social-Ecological Resilience. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3313831.3376458

[76] Reem Talhouk, Madeline Balaam, Austin L. Toombs, Andrew Garbett, Chaza Akik, Hala Ghattas, Vera Araujo-Soares, Balsam Ahmad, and Kyle Montague. 2019. Involving Syrian Refugees in Design Research: Lessons Learnt from the Field. In *Proceedings of the 2019 on Designing Interactive Systems Conference* (San Diego, CA, USA) *(DIS '19)*. Association for Computing Machinery, New York, NY, USA, 1583–1594. https://doi.org/10.1145/3322276.3322335

[77] Reem Talhouk, Sandra Mesmar, Anja Thieme, Madeline Balaam, Patrick Olivier, Chaza Akik, and Hala Ghattas. 2016. Syrian Refugees and Digital Health in Lebanon: Opportunities for Improving Antenatal Health. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 331–342. https://doi.org/10.1145/2858036.2858331

[78] Anja Thieme, Madeline Balaam, Jayne Wallace, David Coyle, and Siân Lindley. 2012. Designing Wellbeing. In *Proceedings of the Designing Interactive Systems Conference* (Newcastle Upon Tyne, United Kingdom) *(DIS '12)*. Association for Computing Machinery, New York, NY, USA, 789–790. https://doi.org/10.1145/2317956.2318075

[79] Anja Thieme, Danielle Belgrave, and Gavin Doherty. 2020. Machine Learning in Mental Health: A Systematic Review of the HCI Literature to Support the Development of Effective and Implementable ML Systems. *ACM Trans. Comput.-Hum. Interact.* 27, 5, Article 34 (Aug. 2020), 53 pages. https://doi.org/10.1145/3398069

[80] Kentaro Toyama. 2017. Design, needs, and aspirations in international development. In *International Conference on Social Implications of Computers in Developing Countries*, Vol. 504. Springer, Cham, 24–32. https://doi.org/10.1007/978-3-319-59111-7_3

[81] Michael Ungar. 2010. Families as navigators and negotiators: Facilitating culturally and contextually specific expressions of resilience. *Family process* 49, 3 (2010), 421–435.

[82] Michael Ungar. 2011. The social ecology of resilience: Addressing contextual and cultural ambiguity of a nascent construct. *American Journal of Orthopsychiatry* 81, 1 (2011), 1.

[83] Michael Ungar. 2012. Researching and theorizing resilience across cultures and contexts. *Preventive Medicine* 55, 5 (2012), 387–389.

[84] Michael Ungar. 2012. *The social ecology of resilience: A handbook of theory and practice*. Springer Science & Business Media, New York, NY, USA. https://doi.org/10.1007/978-1-4614-0586-3_2

[85] Michael Ungar, Mehdi Ghazinour, and Jörg Richter. 2013. Annual research review: What is resilience within the social ecology of human development? *Journal of child psychology and psychiatry* 54, 4 (2013), 348–366.

[86] UNHCR. 2016. Connecting refugees: how internet and mobile connectivity can improve refugee well-being and transform humanitarian action. https://www.unhcr.org/5770d43c4.pdf

[87] Ralph Vacca. 2017. Bicultural: Examining Teenage Latinas' Perspectives on Technologies for Emotional Support. In *Proceedings of the 2017 Conference on Interaction Design and Children* (Stanford, California, USA) *(IDC '17)*. Association for Computing Machinery, New York, NY, USA, 117–126. https://doi.org/10.1145/3078072.3079742

[88] Greg Wadley, Reeva Lederman, John Gleeson, and Mario Alvarez-Jimenez. 2013. Participatory Design of an Online Therapy for Youth Mental Health. In *Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration* (Adelaide, Australia) *(OzCHI '13)*. ACM, New York, NY, USA, 517–526. https://doi.org/10.1145/2541016.2541030

[89] Anne Weibert, Max Krüger, Konstantin Aal, Setareh Sadat Salehee, Renad Khatib, Dave Randall, and Volker Wulf. 2019. Finding Language Classes: Designing a Digital Language Wizard with Refugees and Migrants. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW, Article 116 (Nov. 2019), 23 pages. https://doi.org/10.1145/3359218

[90] Marion Weigl and Sylvia Gaiswinkler. 2019. Blickwechsel–Migration und psychische Gesundheit. https://jasmin.goeg.at/1016/

[91] World Health Organization (WHO). 2020. Adolescent health. Retrieved September 8, 2020 from https://www.who.int/southeastasia/health-topics/adolescent-health.

[92] Jill Palzkill Woelfer and David G. Hendry. 2012. Homeless Young People on Social Network Sites. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Austin, Texas, USA) *(CHI '12)*. Association for Computing Machinery, New York, NY, USA, 2825–2834. https://doi.org/10.1145/2207676.2208686

[93] Naomi Yamashita, Hideaki Kuzuoka, Keiji Hirata, Takashi Kudo, Eiji Aramaki, and Kazuki Hattori. 2017. Changing Moods: How Manual Tracking by Family Caregivers Improves Caring and Family Communication. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 158–169. https://doi.org/10.1145/3025453.3025843

[94] Ellen Zegura, Carl DiSalvo, and Amanda Meng. 2018. Care and the Practice of Data Science for Social Good. In *Proceedings of the 1st ACM SIGCAS Conference on Computing and Sustainable Societies* (Menlo Park and San Jose, CA, USA) *(COMPASS '18)*. Association for Computing Machinery, New York, NY, USA, Article 34, 9 pages. https://doi.org/10.1145/3209811.3209877