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Identifying Causes of Burden in Ecological Momentary Assessment Studies

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Certificate of Completion

This final thesis has been carried out at the School of Engineering at Jönköping University within Informatics. The authors are responsible for the presented opinions, conclusions, and results.

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Attestation of Authorship

We hereby declare that this submission is our work, based upon research that we have conducted.

To the best of our knowledge and belief, it contains no material published or written by another person – except where explicitly defined in the Acknowledgements or listed in the References and properly cited.

Nor does it contain any material of mine/ours that, to a substantial extent, has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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1 Introduction

Hearing aid technology is constantly improving, due to technological advancements and the study of users' needs. Different methods are used to study Hearing Aid (HA) wearers. A method that is shown to provide beneficial results is Ecological Momentary Assessment (EMA). EMA is 'the repeated sampling of subjects' current behaviours and experiences in real-time, in the subjects' natural environments' (Shiffman et al., 2007). EMA studies assess subjects in occasional intervals, and it can be performed in many ways, such as using pen and paper, over the phone and as an application on a smartphone. This thesis focused solely on smart phone based EMA and the element of ‘burden’ that is experienced by the participants. Following this, design changes to the EMA application and procedure will be suggested based on the findings concerning burden, combined with UX knowledge obtained from the UX and IT Architecture master’s program.
This thesis project is conducted in association with WS Audiology (WSA). WSA is a global hearing aid company that manufactures and provides services for a series of hearing aid brands. The company has developed an EMA smartphone application and has an available group of EMA test participants. This thesis work is conducted over a five-month period, from January to June 2022.

This section begins with an introduction, the purpose of the paper, definition of the research questions and ends with the scope and delimitations of the thesis. The methodology section explains the reasoning behind the chosen methods. Following this, the collected data is represented in the results chapter. In the description, the data is described, and comparisons and judgements are made based on the literature review. Following this, the findings are summarised and the aims for future research are stated.

1.1 Problem Statement

EMA studies are used to analyse behaviour and in-moment thought processes and perceptions to receive genuine and accurate opinions, which are unaffected by memory recall. EMA is derived from clinical health psychology, and it is a development from Experience Sampling Methodology. It has been useful to receive real-time, unbiased feedback from hearing aid wearers and to discover any flaws in the hearing aid, in different environmental settings. Csikszentmihalyi et al. (1977) and Delespaul (1995) are early examples of the applications of EMA studies in the fields of mental health and research in adolescent behaviour.

EMA has become more frequently used in recent years, due to advancements in technology and newfound purposes for the method. The mediums in which EMA is used has evolved over time, from using forms and paging devices in one of the first EMA studies in Csikszentmihalyi et al. (1977), diary notes in (Bränstätter, 1983), to using smartphone applications in (Xuan, 2021), (Van Genugten, 2020) in Rintala et al. (2021), and smartwatches (Intille, et al.2018). Modern technology has benefited EMA studies, as it allows for more accessible ways to answer surveys, for example when

a participant is in various environments and situations. It also allows for the collection of objective data by documenting the hearing aid settings while the EMA is being answered.

In audiology, EMA studies are beneficial for discovering situational issues. For example, the wearer might not be able to understand (hear or follow) conversations when there are loud background noises. Also, the sound from the conversation could be amplified, and any noises in the background could be difficult to hear. A difficult listening situation like this could be documented by the EMA participant. This is valuable information, as it can show exact situations which are arduous for the hearing aid wearer. This information can be documented and used to improve the fitting of hearing aids, the development of hearing aid technology and assist researchers, in turn benefiting future developments of hearing aid technology (Xu, 2020; Jensen, 2019).

There is a problem with unanswered questions and noncompliance in EMA studies and this can lead to inaccurate results whereas these results shoul;d be factored into making hearing aids better. The lack of answers in the study results in distorted data, and it does not accurately represent the situations the participant has been in. This means there could be a selection bias, as the EMA is only answered at certain times. The researcher does not know if results are missing at random, or if they are skipped in particular situations. Therefore there is a presumed sense of burden that is inflicted by the EMA, which contributes to the reasoning why questions go unanswered.

The topic of burden will be focused on within this thesis, in particular the burden of partaking in EMA studies. The aim is to discover factors of burden in order to minimise burden and obtain optimal and unbiased results in future EMA studies. The quality of any EMA results are dependent on the subject's compliance. The reason for non-compliance is often due to the inconvenience of responding to the study, the long term commitment and a level of consistency necessary to provide unbiased and beneficial results.

It is important for the researcher to understand the factors that contribute to 'burden' and how high-quality data can be collected without bothering the participant. Some factors contributing to burden are known, such as the length of the study period, questionnaire and the number of triggers (Eisele et al., 2022; Intille et al.,2016). Although there are many more potential factors that are currently not well researched, including how the type of trigger contributes to burden.

New knowledge is expected to be found regarding burden in association with the length of EMA studies and the methods by which the studies are created and executed. EMA studies are used in many different research fields, therefore attempting to solve discrepancies in the methods and the issue of burden will benefit the EMA research community and also provide solutions that might be specific to EMA usage in audiology. Audiological EMAs are relevant to uncover hearing issues, as auditory perception is dependent on the acoustical environment and can change quite quickly. Uncovering issues of burden in studies, aims to create improved audiological EMA applications. This will improve the fitting of

hearing aids and consequently benefit wearers' listening experience. It aims to help understand hearing impaired individuals, which is a vital step in creating design solutions for them. It will assist the future development of hearing aids, hearing aid applications, and fitting software.

1.2 Purpose and Research Questions

The problem statement identifies the lack of knowledge regarding the causes of burden in EMA studies. The purpose of this thesis is to focus on identifying the burdens in EMA studies and the influence it has on users, with the intention to decrease the number of unanswered questions and increase participant compliance and decrease participant attrition. The aim is to identify factors that study leads and experts in EMA studies, believe contribute to burden. This knowledge obtained from experts will form the basis of questions that will be posed to past EMA participants which will then provide a round picture on the topic of burden that this paper aims to tackle. With these points considered, this thesis's first and second research questions are:

1. *What are the factors that contribute most to subjective burden and lower data quality in Ecological Momentary Assessment studies as observed by study leads?*

2. *What are the factors that contribute most to subjective burden in Ecological Momentary Assessment studies as perceived by participants?*

It is essential first to gather data from experts to uncover aspects of burden that are topical and meaningful to research. As the thesis aims to solve discrepancies in the EMA data through research on the topic of burden, it is vital to speak to study leads, and participants to gain insight into how burden is perceived. Study leads may see how participants with different characteristics struggle with different aspects of EMA. Then participants can provide a contextual description of their experience with burden. The methods used for collecting this data is discussed in detail in chapter two.

The information discovered from the first two research questions will be evaluated and formulate a response to the third question. The third question in this paper is:

3. *How can these burdens be reduced in future Ecological Momentary Assessment studies, using improved UX design or a better study design in general?*

The information retrieved from EMA participants and experts will be evaluated and will form a final artefact. This will consist of a structured index of UX and study design adaptations that would be suggestions that can be incorporated to future EMA studies to increase compliance and reduce burdens on participants and student leads. The EMA application used by WSA will be analysed using user

research techniques. The final artefact will act as guideline for the work that will be continued with WSA.

1.3 Scope and Delimitations

This study focuses on burden in EMA studies, by collecting qualitative data using focus groups to gather rich information and analyse insights from EMA participants and study leads. The study is limited to online work, as the authors and contributors to this thesis are based in different countries. The qualitative data is collected via Microsoft Teams, using a recording tool that documents video, audio, and transcripts simultaneously.

This topic is connected to psychology which is the root of many UX theories. The methods used in this thesis aim to uncover reasons of burden in EMA studies. WSA uses a smartphone application for their EMA studies, this could mean that our studies are most accurate for smartphone application-based EMA studies, and not other formats of EMA studies such as diary studies. Also there is a limitation that there is only access to participants that have used the WSA EMA application and not any other EMA application. Therefore it could provide elements of burden that are specific to this application.

WSA is a hearing aid company and has conducted EMA research in audiology involving older participants. There is a limitation with the topic of audiology and the subject group. The questions and results uncovered from the focus groups and interviews, could result in niche issues to this subject that are not applicable to all other EMA topics.

Heterogeneous focus groups provide richer results as different experiences are shared and compared. Although, the participant pool of WSA is limited therefore diversity amongst the participants is also restricted and might be biased. Memory recall is a delimitation to this study as EMA participants and experts will be asked about their past experiences. Individuals could remember events incorrectly and this could affect their responses to this thesis study. There is also a limited number of experts and participants available for the study and this could restrict the insights obtained in this thesis.

1.4 Outline

The following chapter, that is, Chapter two describes the methods used for the thesis, why they were chosen and how they are conducted. Chapter Three is the theoretical background of the study and contains the description of different terms used in the thesis. Chapter Four is the finding and analysis chapter which is the analysis of the data received from the research methods. The final chapter is the discussion and conclusion chapter which reviews the findings and puts the

results obtained in simpler terms in relation to the purpose of this research and areas for future work.

2. Method and Implementation

The methodology used in this research and providing the answers to the research questions above follows the principles of focus group. A focus group is a technique where a moderator facilitates a discussion among a small group of participants that have a shared experience, knowledge or interest.

To start with this qualitative methodology, brainstorming sessions were held first with two sets of experts, experienced with several EMA apps and studies. The sessions were held similarly to a focus group, as questions were asked and several aspects of the EMA study were discussed. Specific experiences relating to past studies were raised, and opinions were voiced regarding the perception of EMA participants' experiences over several studies.

The specifics into how this research was designed and carried out are described in detail in this chapter, beginning with a discussion of the choices to research approach, design, and method. This is followed by a description to the method and how it was used, followed by the development of the focus group, the recruitment of participants, the analysis method used for the gathered data, the measures we took to increase the validity and reliability of our results and then finally, with a discussion of the considerations we faced during the study.

2.1 Research Approach

There are three different major research approaches common in research methods: deductive, inductive, and abductive. This section describes each method and the chosen method for this thesis.

The deductive approach which can be characterised by its approach to generalisation holds that a theory is formed and then put through rigorous testing to see if the said theory can be proven false. This is a dominant approach in natural science (Saunders et al., 2016). The inductive approach on the other hand seeks to briefly understand the problem then create hypotheses and then form a theory. The strength of the inductive approach is the reliance on data first and the way humans interact in the social world especially in topics where there is little understanding (Saunders et al., 2016). The abductive approach which is then the combination of both the inductive and deductive approach.

This paper investigates the topic of burden and seeks the understanding of participant's opinions regarding EMA, while navigating qualitatively to obtain data and insights. Therefore, it is most appropriate that an inductive approach is taken for this study.

2.2 Research Design

Research design can either be exploratory, descriptive, or explanatory. Exploratory design aims to understand and gain further insights on a topic, descriptive design has the goal of distinguishing a topic and portraying an accurate picture of it. Lastly, the explanatory design illustrates the relationship that exists between variables (Saunders et al., 2016).

In line with the aim of the study to identify the causes of burden, the research design will be of an exploratory manner. The exploratory research design seeks to understand why a situation happens especially if one is not sure of the reason (Saunders et al., 2016). According to Saunders et al. (2016), "there are a number of ways to conduct exploratory research. These include a search of the literature; interviewing 'experts' in the subject; conducting in-depth individual interviews or conducting focus group interviews".

The exploratory design and inductive approach are a good fit because we are studying opinions and feelings in an area that has little knowledge and to do this, we would have to gain more insights in an individualistic manner.

2.3 Research Methods

In research methods, there are two common methods: qualitative and quantitative studies, although a combination of the two is possible (mixed methods). For qualitative methods, the focus is on improving and exceeding the understanding of the topic discussed, and this usually results in theory creation and reasoning (Blandford, 2013). The data in this strategy is obtained from a narrower sample which is qualitative in nature and is not numerical (Saunders et al., 2016). Quantitative methods have a focus on using data to develop theory and retrieving generalizable results (Saunders et al., 2016). Quantitative data is usually obtained from a wide sample and is not as detailed as qualitative research (Blandford, 2013). Considering the aim of this thesis, qualitative methods have been chosen as best to use. Stebbins (2001) mentions it is most common to use qualitative methods for exploratory studies. Studying opinions and feelings around issues in Human Computer Interaction, this method seeks to discover insights in a deeper individualistic manner. This is most helpful in uncovering the causes of burden for EMA participants.

Semi-structured interviews are a method to conduct exploratory research. They are flexible and adaptable to change (Saunders et al., 2016). Blandford (2013) defines semi-structured qualitative studies as a "qualitative approach, typically involving interviews and observations, that have some explicit structure to them, in terms of theory or method, but are not completely structured". This style of interview is appropriate for the exploratory nature and purpose of this study, therefore this will be adopted as a method for this thesis.

2.4 Semi-Structured Interviews

Saunders et al. (2016) explained semi-structured interviews to be conducted as follows: “the researcher has a list of themes and possibly some key questions to be covered, although their use may vary from interview to interview”. With this in mind, the researcher can create a list of questions as a guide and depending on the direction the interview is going, the researcher can choose to ask or omit the prepared guide or question.

According to (Williamson, 2002) interviews are a good way to a deeper and better understanding of a target group in a design project. An advantage to organising a focus group is the environment that participants are in and how easy it can be for situations to be relatable (Krueger, 2000), thereby making it easier for better conversation and responses (Vaughn, Schumm, & Sinagub, 1996).

To find the points of the EMA studies that can be burdensome to the participants, it was required to gather insights in a qualitative manner. Semi structured interviews were first held with experts in the field of EMA to uncover aspects of perceived burden by EMA studies which was then followed by focus groups with past participants of various EMA studies.

2.5 Expert Interviews

Two expert interviews were conducted to gain a rich insight into the perceptions of burden according to EMA facilitators. The first session was with experts from WSA. Colleagues were invited based on their previous experience with EMA. The second brainstorming session was held two weeks after the first, this was held with external researchers based in Canada, Germany and Ireland.

Both sessions were structured in the following manner:

1. Opening the conversation
2. Introducing the research
3. Beginning the interview
4. During the interview
5. Closing the interview

Different researchers have varying structures on how to conduct a semi-structured interview. This plan is one that was proposed by Blandford et al. (2016). At the beginning the researchers introduced themselves, explained the aim of the study, and the research purpose. This was followed by obtaining the consent to record the session for further analysis, after this we kicked off the interview by asking questions and allowing the experts to talk and raise points and the researchers continued by stirring the conversation until the end of the session.

For exploratory studies, recording the audio is very important for later analysis to ensure no data is missing. Note-taking is also important both as a backup and also to jot down thoughts in the moment (Blandford et al., 2016). With these interviews, both researchers were present for all sessions, with one leading the interview and one focusing on the note-taking and technical support. This method ensured the facilitator was focused on the interviews and the other researcher ensured no data was lost and this information was added to the data analysis.

The interviews were fully conducted in English. The participants were based in different time zones, there had to be careful selection of a suitable time to hold the interviews. The video conference app, Microsoft Teams was used to hold the interviews, this also had a feature to record and transcribe the interviews directly within the app. Details of the interview participants are documented in appendix A.

2.5.1 Interviews Participant Selection

To have versatile and through input from experts, two rounds of expert interviews were conducted. The first one had five experts from WSA who have experience with the WSA EMA applications. The second round had five academia experts in audiology from different parts of the world who have experience with other EMA apps and study designs. Conducting the two interviews added to the validity of the information collected.

All experts interviewed have either led their own EMA study or been part of one in a major contributing role within the last two years. All experts were contacted via mail and the focus group sessions were done over Microsoft Teams within a span of three weeks. The resulting analysis of these interview sessions were taken into consideration when designing the focus group for the past EMA participants. A further description of the results and analysis are documented in chapter three and four.

A list of questions was created based on the experiences of experts that focused on the possible causes of burden and lack of response in EMA studies. The questions for the interviews were developed from findings from the literature review, and studying previous auditory and EMA studies. The questions were revised and checked with an expert in EMA, to ensure the questions were understandable and we covered areas that we wanted to find out. The questions created for this expert interview are documented in appendix B.

2.6 Focus Groups

“Focus groups generate qualitative data that can be used to both enrich and extend what is known about a concept and inform item development” (Vogt et al, 2004). A focus group was organised to gain a better understanding from the participants of past EMA studies. It was chosen as a method with the ambition that the focus group setting would trigger interesting discussions amongst the participants. The method

was also appropriate for the retrieval of the best qualitative data in the time frame provided for the thesis.

Saunders et al. (2016) states that content validity can be established by asking experts to comment on the representativeness and suitability of the questions enabling changes prior to a pilot testing with a group that is similar to the final population in your sample. With this insight by Saunders et al (2016), the authors created a list of questions to be asked during the focus groups, based on the findings from the expert interviews. A meeting was held with a researcher at WSA to clarify the questions, to ensure they were easy to understand, unbiased, open ended and encouraged discussion. The objective of the thesis and the research questions was considered with the careful revision of each focus group question. The aim is to encourage the participants to discuss in order to retrieve rich data.

Both researchers and supervisors were present during the focus groups. One researcher facilitated the focus group and the other focused on notetaking and background support. The roles were reversed to provide each researcher with the opportunity to facilitate. The facilitator read the prepared questions to the group. The order of the questions was asked interchangeably depending on the direction of the conversation.

The focus groups were held in English. The participants and researchers were based in different locations, therefore the focus groups were held online using the video conference applications ‘Microsoft Teams’, ‘Google Meet’ and ‘Zoom’. Different online hosting sites were used as technical difficulties arose. The focus group was recorded and transcribed using the automated feature in the software in Microsoft Teams, and using QuickTime and a free transcription tool; Grain.

The focus groups were organised by emailing the participants provided by WSA researchers with an invitation to a focus group, they were provided with a link to a ‘Doodle’ or given a selection of times. A consent form was also provided to the participants in the invitation.

2.6.1 Focus Group Dry-run

Saunders et al. (2016) explains that pilot testing a questionnaire is essential so as to get it refined thereby reducing the problems participants might have answering questions. In addition to that, pilot testing allows you to assess the validity and reliability of the possible data that can be obtained from the main session.

To begin the focus group sessions, a dry run was conducted to live-test the questions that were obtained from the literature review and expert interviews so far. A list of criterias were considered when recruiting participants for the dry run as it wasn’t possible to have a physical focus group, this created some restrictions.

Here are the criteria that were agreed upon for the dry run:

- Participated in an EMA study within the last 3 months.
- Willing to speak in English.
- Willing to participate in an online focus group.

- Availability of the most number of participants.
- Available at one of the times provided for the focus group

With this criteria, we had the following as the information of participants that participated in the study. According to WSA policy, a consent form was mailed to them and a signed copy returned.

Participant	Participant 1	Participant 2	Participant 3
Gender: **Age Group:** **Native Language:** **Last EMA Study:**	Male 50 and above Danish March/April, 2022	Female 50 and above Danish March/April, 2022	Male 50 and above Danish March/April, 2022

Table 1: Dry-run participants characteristics

The focus group was organized on Microsoft Team and the transcription was done automatically and insights presented in the result chapter. The questions asked during this section can be seen in appendix C

2.6.2 Focus Groups Implementation

After the dry-run focus group, we got some insights based on how to further make the focus group better. It was tricky to get all the participant to be available and meet the criteria stated above in the dry-run so the criteria was tweaked to make room for more participant availability.

The time period criteria which was 3 months was increased to 1 year on the condition that the participants had been in more than 3 studies within the period. With this change, we had 4 participants but couldn't find a mutually available time for all of them and so the focus group was done with 2 participants for each session and 2 weeks apart.

Participants	Participant 1	Participant 2	Participant 3	Participant 4
Gender: **Age Group:** **Native Language:** **Last EMA Study:**	Male 50 and above German July/Aug 2021	Male 50 and above German Dec/Jan 21/22	Male 30 - 40 German Jan/Feb 2022	Male 50 and above German Jan/Feb 2022

Table 2: Focus group participants characteristics

The structure of the sessions were similar to that of the basic plan by Blandford et al. (2016) used for the expert interviews.

The design of the focus group was strongly influenced by the dry-run. The dry-run uncovered some problem with how the questions were asked and phrased and this lead the researchers to believe participants might be biased in their answers. This

lead to the questions being edited again to make them more open and not as insinuating as the one used for the dry-run in order to receive better results. The final questions asked to participants are documented in appendix D.

2.7 Data Collection

There were several different data collection points as a part of this thesis, as different interviews and focus groups were held. Each focus group and interview were recorded to analyse the data. Consent forms were signed by the participants before beginning. These forms were provided by WSA, it was specific to the company, and it was confirmed by their legal team. A handwritten signature was required so the participants had to print the consent forms, sign the form and send it via scan or a photo for the consent form to comply with WSA policy.

As everything was held online, Microsoft Teams, Zoom and Google Meet were used as recording tools. For Microsoft Teams, the transcript was automatically recorded alongside the video recording. For Zoom and Google Meet, the video recording was placed into a website called 'Grain' which automatically transcribes videos and also anonymises the speakers. This is convenient for sharing the data among the team. The participants consented to the recording, as it was requested in the consent form and at the beginning of the live session. This data was then analysed using thematic analysis in Nvivo, to obtain a deeper understanding of the different aspects of burden. During analysis, the transcripts were checked for errors and manually altered where necessary to ensure it was comprehensible.

2.8 Data Analysis

To analyse the qualitative data collected from focus groups and interviews, thematic analysis was used to find recurring themes. A thematic approach to qualitative analysis is to seek out themes or patterns that can occur across a data set.

Qualitative codes capture the essential elements of the data, when they are gathered, on a basis of similarity and repetition. The gathering of the codes or 'lumping' creates themes, these themes can demonstrate the valuable outcome of the work (Saldaña, 2013). NVivo software was used to identify themes in the transcript. This program is created specifically for qualitative analysis and has an easy-to-use coding system that allows for quick analysis and identification of themes.

The style of questions asked during the interviews and focus groups were reflected upon when looking for a method to analyse the data. Two styles of questions were asked in the focus groups and interviews, meaning there are different types of data to be analysed in the transcript. Ontological and epistemological type questions were asked in the focus groups and interviews. For example, ontological questions focus on emotions and perceptions and epistemological questions focus on actions and processes. Both are relevant to the research questions and the aims of the paper. Therefore, the style of coding was not decided upon beforehand, and a

period of exploratory coding was first conducted. Different coding styles were experimented with to find the best method that is relevant for the transcript. This time was also used to become more familiar with the data.

Deductive and inductive coding methods were experimented with, to identify which method was best suited for the analysis of the data. Deductive coding is when the codes are identified first, then the data is analysed. The predefined codes are found and identified in the transcript. Inductive coding is the identification of codes as the researcher analyses the paper. Consequently, there are often many codes which need to be arranged into themes and prioritised. This can be more time consuming but lead to effective results (Saunders et al., 2016).

Deductive coding method was first used for the expert interviews, as the codes were first decided upon based on the research questions. Inductive coding was then used for the focus group, as codes were documented as they were found. This led to a more intensive analysis of each word that was said. It also led to thoughts about the quality of the codes over the quantity, as when something might be

Many different methods of analysing the codes had been spoken about by different people. For example, the process of the analysis followed the process as laid out by Saunders et al. (2016):

1. Becoming familiar with your data.
2. Coding your data.
3. Searching for themes and recognising relationships.
4. Refining themes.
5. Evaluation.

Additionally, in Saldaña (2013), two cycles of coding are discussed. Saldaña (2013), mentions first cycle coding and second cycle coding. First cycle is the initial analysis and findings of the first codes, where words and paragraphs are highlighted. Second cycle the analysis is revised, there are more defined notes given to the codes and the codes could be restructured. Different types of coding are used in each cycle.

Similarities were found when observing the methods suggested in Saunders et al. (2016) and Saldaña (2013). Section 1 and 2 in the process provided by Saunders, is similar to the first cycle in Saldaña (2013) , also Section 3 and 4 in Saunders et al. (2016) is similar to cycle 2 in Saldaña (2013). These resemblances were examined, and due to the more detailed descriptions it was decided to use Saldaña's (2013) method to analyse the transcript.

Following the research period of exploratory coding, which different coding styles were experimented with to find the best method that is relevant for the transcript. The two-cycle method of coding was adopted. It was decided to use an ontological 'In vivo' coding for the first cycle and epistemological focused style of coding for the second cycle. This allowed for the codes to be interpreted by the personal and social aspects of the data, and also the access and processes.

In the first cycle of coding using ‘in vivo’ coding, the names of the codes are taken from what is said in the transcript. Then the codes found in the first cycle are revised and categorised into themes. The codes have been renamed using focused coding based on the research questions and the objective of the paper, which is uncovering elements of burden in EMA.

Field notes were taken during the interviews by one of the facilitators and these were referred to when beginning the coding to get an overview of the important parts that stood out. In the data analysis it was required to rewatch the video recording of the focus group as the digital recording. The data analysis is documented in the results chapter.

2.9 Validity and Reliability

Reliability refers to if the research can be replicated and if the same results will be gotten, while validity refers to if the research is credible and the information presented is accurate (Saunders et al., 2016). To ensure the validity of the paper, interviews were conducted to understand how burden was viewed from both the researchers and participants side as they are both required for a successful study.

The expert interview was with internal experts within WSA and experts in the same field in other research capacity. All researchers had over 2 year’s experience on audiology and how EMA is important to research in the industry.

In running the focus groups with past EMA participants, the sessions were done in small groups and the questions were reviewed severally by EMA expert to check for understanding and after that a dry run session was done with 3 participants to see if prepared questions were easily understandable.

The learnings from this dry-run was then used to design the main focus group session with another set of past EMA participants and a better set of questions.

For both of the focus groups, the study participants that participated had recently completed an EMA study within the past 6 months or 1 year if they had done more than 3 studies so it is easier for them to be able to reflect on what happened during the study.

Going with the focus group also made it easier to get the discussions going as participants were more comfortable sharing their experiences as opposed to having a structured interview which would have been so formal and rigid.

3. Theoretical Framework

This chapter describes the relevant theories to the paper, based on the problem statement and the research questions.

3.1 Introduction

Hearing loss is a situation where someone cannot hear normally - which is hearing thresholds of 20dB or better in both ears. The loss can be in several forms ranging from mild to severe. This can happen to one or both ears and will eventually lead to difficulty in hearing speech or loud sounds. (*Deafness and Hearing Loss*, 2021)

In a study done in 2019 (Haile et al., 2021), it was found out that about 1.57 billion people globally had a form of hearing loss meaning 1 in every 5 persons, of these numbers, 62.1% were aged 50 above. These numbers are estimated to grow even as interventions such as childhood screening, hearing aids, effective management of otitis media and meningitis, and cochlear implants have the potential to reduce this burden. According to Sadaf Naz (2012), humans can process tonal frequencies from 20 Hz to 20kHz as our auditory system does this for a dynamic range of sounds.

Hearing loss can happen to both young and old individuals, however early detection and proper care is essential for an improved speech development. Hearing loss can affect a child’s intellectual growth and an adult’s societal integration (Sadaf Naz, 2012).

As an intervention to hearing loss, hearing aids were created, with the first electric hearing aid created in 1898. Since that time until now, hearing aids have continually been improved with different types for different purposes for different lifestyles. To properly study and to be able to improve the hearing experience, audiologists and researchers have carried out several in and out of laboratory experiments.

Galvez et al. (2012) and Henry et al. (2012) were the first to show the feasibility of EMA in carrying out these tests and analyses for hearing difficulties and tinnitus respectively and Hasan et al. (2013) to be the first to propose the use of mobile phones and web technology in the surveys.

3.2 Hearing Aids

A hearing aid (HA) is an electronic device that was created to assist in the solution of several types of hearing loss. It amplifies weak sounds, which differ depending on a patient's requirements. Generally, the patient visits an audiologist for the diagnosis and a HA type is chosen and settings are adjusted depending on the patient's requirements (Dillon, 2012). HA’s use complex signal processing algorithms that are highly dependent on the acoustic environment. It is important to test the hearing aids in a user’s natural environment and in different listening situations, in order for the HAs to have the correct settings selected. It is best to test the hearing aids in real life and not only in the laboratory.

There is an acclimatisation period required when a user starts wearing hearing aids. It can take a few weeks before the wearer is accustomed to their new listening devices. Different brands and price ranges of hearing aids have different features, therefore using a different hearing aid in a study can be a burden if it is very different to the hearing aid the participants are used to or if the study design does not allow for fine tuning.

Hearing aids have different forms such as Behind-The-Ear (BTE), Receiver-In-Canal (RIC), In-The-Ear (ITE and Completely-In-Canal (CIC). These different form factors are dependent on the type of hearing loss the patient has. The most common hearing aid is the BTE hearing aid, which rests neatly behind the ear and provides amplification of sounds via a microphone.

There are nuances to wearing a HA which could affect partaking in the EMA process, such as the type of HA usually worn by the participant compared to the HA provided for the test. For example, bone conducted transducer HA's are placed on the outside of the head and send vibrations through the skull, providing the sound to the inner ear. Wearing this type of hearing aid could be a hindrance during EMA studies, as interacting with the HA (if required by the EMA) can be indiscreet and can interrupt with daily activities. In comparison to a study comparing BTE HAs, where interaction with the HA can be easily done without as much interruptions. Another issue that might arise with HAs when taking part in EMA studies is using a different brand, or type of hearing aid for the study might contribute to the burden, as they might be used to certain settings or a type that can be distracting.

3.3 Ecological Momentary Assessment (EMA)

As mentioned in the introduction, EMA studies are used to analyse behaviour and in-moment thought processes, to receive genuine and accurate opinions, which are unaffected by memory recall. EMA has four valuable attributes according to Intille et al. (2016), which are:

1. Reduces the need for memory recall
2. Natural environment
3. Multiple assessments over time
4. Context sensitive behaviour can be learned about, due to real time documentation

EMA has become more frequently used in recent years, due to advancements in technology and newfound purposes for the method. The mediums in which EMA is used has evolved over time, from using forms and paging devices in one of the first EMA studies in Csikszentmihalyi et al. (1977), diary notes in Bränstätter (1983), to using smartphone applications in (Xuan, 2021) and (Van Genugten, 2020) to the use of smartwatches by Intille et al. (2018).

µEMA or micro-EMA is a style of EMA that can be answered quickly, using a single tap, and only answering one question at a time. (Intille et al., 2016). µEMA had a

higher compliance rate compared to EMA, as it was seen as less distracting. Standard EMA on a smartwatch can be difficult as the screen is so small and answering many questions for a period can be annoying for users.

3.4 Ecological Momentary Assessment in WSA

The main theories that are followed in this project are built on a basis of work originating from WSA employees such as Welling et.al. (2021), Lee (2021) and Schinkel-Bielefeld et al. (2020). This theoretical work serves as a basis for the analysis of the results found in the empirical investigations.

EMA study designs are structured in many ways, for example in Jensen et al. (2019), when the EMA app notified the user, they had two options to start the assessment or reject it. The participants had the option to turn off the notification, when they were in a situation that interruptions were intolerable. Subjective data from the EMA was collected, the objective data from the hearing aids was simultaneously gathered, which gave an insight into the user's opinions when certain settings were applied to the hearing aid.

Compliance has been proven to be higher amongst older adults in EMA studies (Cain et al., 2009). Older people do not have a demanding lifestyle compared to younger people, this factor could contribute to their compliance capabilities (Wu, 2012). According to Eisele et al., (2022), the frequency of the notification did not cause incompliance, although burden was still felt by the participant. Reasons for incompliance are often asked in questionnaires, by asking the user 'why did you not respond to a notification?' or in retrospective interviews.

In Welling et al., (2021), careless responses can happen in EMA when participants select random answers or always choose the same answer, without paying particular attention to the questions asked. This can happen due to the frequency of the questions and the length of the questionnaires can jeopardise the study. To ensure user input is of value, it is vital to quality assure the questions provided in the study. It can also be beneficial to agree on times that best suit the participant to answer the EMA, to get optimal results.

3.5 Burden

Burden is the central subject of this thesis, with a particular focus on the burden of partaking in EMA studies when it is inconvenient for the user. Montgomery & Stull (1985) refers to burden as 'the load borne, the responsibilities carried, or the time and effort required'. Burden is generally seen as negative and should be controlled or obviated. The idea of burden is explored in research with elderly and mentally ill (Thompson & Doll, 1982; Montgomery & Stull, 1985; Hoening & Hamilton, 1967; Schene, 1990).

Burden is categorised by Hoening and Hamilton (1967) into two different types, objective, and subjective burden. Objective burden solely focused on the facts, without consideration of feelings. The subjective is based on personal taste, opinions, and feelings. Categorising and identifying the type of burden can make it easier to analyse and resolve. The causes of objective and subjective burden differ depending on the topic. In Flyckt et al. (2015), objective burden is seen as the time and money provided to the caregiver and subjective burden is how the caregiver perceives the burden.

In EMA research, objective burden could be in relation to the length of the study, the number of notifications and the compensation given to the participants. The subjective burden is the perceived feelings the EMA left with the participant.

It is also related to personality, mood and environment. The amount of burden felt by the participant due to the EMA, can influence their motivation and compliance in the study (Courvoisier et al., 2012). The level of disturbance is associated with the participant's emotional state, meaning the notification of the EMA study can be more disturbing to some than others Van Genugten et al. (2020). In Rintala et al. (2021), incompliance increased in the mornings and weekends due to activities outside of the study. Higher levels of stress, activity and tiredness, and being in company also correlated to the level of burden. To finalise, due to aspects outside of the study, not all aspects of burden are controllable by developers and facilitators.

3.6 Burden in EMA

Burden is identified as one of the biggest issues of EMA as mentioned by Intille et al. (2016), although, there are many different aspects of burden in EMA that are not completely understood. Some researchers have touched on the subject, for example, Holube et al. (2020) states that burden can be caused by usability issues in EMA studies. Burden is especially cumbersome when the study goes on for a long time and requires a lot of questions to be answered during a short space of time. Survey length and frequency has been known as causes of burden in EMA studies (Eisele et al., 2022; Intille et al.,2016).

It is difficult to determine the true cause of burden in a lot of studies, as the length of study, the number of questions and the assessment method vary depending on the study requirements. This makes it difficult to compare and to uncover the true cause of burden. Studies can also be insufficiently documented which adds to the difficulty of comparing and distinguishing burden.

Schinkel-Bielefeld et al. (2020), found that participants avoided questionnaires or left the test phone at home if they were going to a social event, they considered inappropriate to be taking part in an EMA study at that time. This further illustrates the predicted burden that the EMA is associated with. The interruptions from the questionnaire can be disturbing when the device is not easily accessible. Research

results show that phones are often in the same room as people but they are usually out of reach).

Participant experiences in EMA have been evaluated by (Xu et al., 2020), their findings show that 60% of participants mentioned that the surveys interrupted their activities, and this resulted in them skipping a survey. Burden is assessed often in retrospective interviews (Jensen et al., 2019; Eisele et al., 2022), but also in the questionnaire users are asked questions like ‘How disturbing was this questionnaire’ or how much effort the questionnaire took using a Likert scale.

Designing an EMA consists of many trade-offs; on one hand there is a requirement to collect the necessary data, on the other there is a risk of participants skipping questions due to the length of the questionnaire. Although data regarding the consequences of design decisions on data quality and quantity is sparse, Eisele et al. (2022) advises not to use long questionnaires. Schinkel-Bielefeld et al. (2020) emphasises the need to create a balance in study design where enough questions are asked so the study is accurate and retrieves the results necessary but does not disturb the participant to the point, they get careless with their responses.

3.7 User Experience and User Interface

User experience (UX) relates to the ability to meet the user’s need by adopting a combination of excellent engineering, marketing, and design. It is a subjective notion that covers the overall aspect of a person's interaction with a design (Norman & Nielsen, 2020; Hassenzahl, 2013). Hassenzahl (2013) has described it as ‘transcending the material and creating experience through the device’. For a person to experience ‘good user experience’, they must find value and benefit from a product. Good user experience flows seamlessly with your everyday life, and it is linked to usability.

User Interface (UI) is based on the looks of style and interface. It defines the appearance, the digital or physical components that allow the product to work. The shapes, colours, fonts are all relevant in relation to customer use and retention but also to brand marking and purpose (The Interaction Design Foundation, 2022). UI is the surface of the design in comparison to UX which depicts the entirety of the experience. It is important for the UI to work together with the UX, so that the user can achieve their goals without confusion or problems arising. Consistency in the design is essential; in the UX and layout and in the UI regarding colours, shapes, and font types. Consistency in design reduces learning time and increases usability (Krug, 2006).

3.8 User Experience and Usability

'User experience' and 'usability' are buzzwords often used in modern design and technology, words which are often misinterpreted. As stated in the previous section, user experience relates to how the users' needs are met and the overall experience provided by the product (Hassenzahl, 2011 & Norman & Nielsen, 2020).

The definition of usability according to the ISO guidelines is 'extent to which a system, product or service can be used by specified users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use' (ISO Online Browsing Platform, 2022). Krug (2006) defines usability as having attributes such as 'useful, learnable, memorable, effective, efficient, desirable and delightful'. In comparison to user experience, usability relates to the 'ease of use' of the product, the users' ability to navigate, understand and achieve a desired goal with the digital product efficiently (Norman & Nielsen, 2020).

Generally, a UX process will start with research which defines the issue, ideating solutions, testing and revising the design. Most of the user research derives from the testing, and the solution is adapted based on the results of the testing. A longer process, begins with identifying the issue, conducting desk research such as, market research and competitor analysis. Some existing data could be analysed in order to get an overview of the user, then some first-hand information could be gathered in the form of interviews and surveys. All this information gathered, is then used to create personas, scenarios and user stories. These show a visualisation of the user and how they would use the product. Following this, wireframes and mock-ups would be created, tested on participants and this feedback would be used to adapt the product to ensure it has good usability.

These steps are not used for every UX project, some steps are not always necessary or required depending on the project. There are many processes used such as Design Thinking, Lean UX process and Agile (Raz, 2018). Each project is different, the requirements and time constraints vary, therefore different processes are utilised. Figure 1 shows the steps in the processes for Design Thinking, Lean UX and Agile. Design thinking focuses on defining a need, in relation to the user and the business, then there is a period of brainstorming ideas, developing a hypothesis and testing it. Lean UX focuses on generating new ideas, testing them and learning from that process in an iterative style.

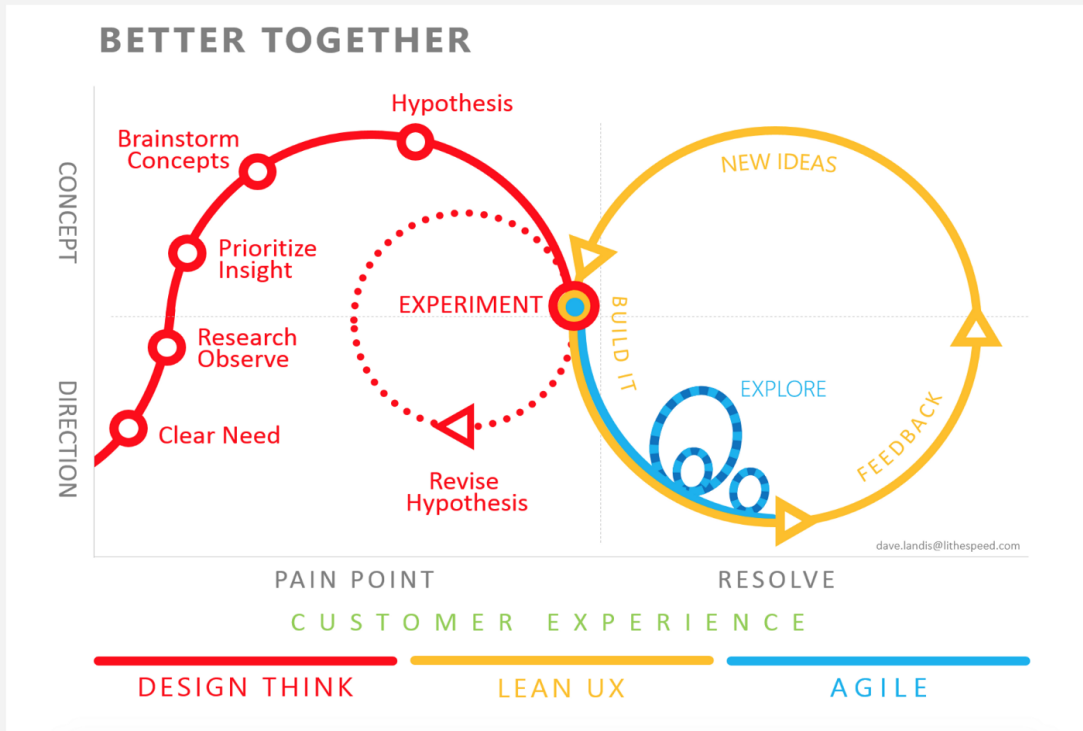

Figure 1: Design processes

It is valuable for UX designers and researchers to know about different forms of the design processes when beginning a project. Design processes provide organisation for teams and promote effective research and design work which is suitable for a project's objectives. It is important for future designers of EMA applications to use the design process when adopting the list of recommendations provided as a result of this thesis work

3.9 Importance Of Good User Experience

The user experience and usability of a design is an integral part in achieving success in a product. There are other contributing factors which should be considered for an EMA application to be successful.

UX writing is an important factor to consider for user interfaces to ensure that the appropriate message is conveyed to the user and that the functionalities of the product are understandable (Podmajersky, 2019). UX writing relates to usability as it affects the perceptive meanings of the product. Bad UX writing can make a design difficult to understand in turn affecting the ability of an application. UX writing and usability work in harmony, as Krug (2006) documents a usability principle that text should be kept short, as it will be more likely to be read. Clear titles and concise text are essential in creating digital products that are easy to use and understandable.

Like every digital product, when designing an EMA application, UX, UI, usability and UX writing are important factors. There are some unique aspects to consider for audiological EMA studies, in comparison to other EMA applications. Firstly, the participants are hearing aid wearers. The average age of hearing aid wearers is 55+.

At this age, sight and dexterity issues are also prevalent, therefore it is important to keep this in mind when designing an EMA application for audiology studies. Accessibility standards and UI design factors such as colours, font size, placement of buttons should be considered to ensure older people are able to use the app easily. Involving older users early in the design process is vital in creating technology for them as they often do not accept technology as it provides a sense of lack of control, confidentially, change in their home environment and usability issues (Gitlow, 2014).

4. Results

In this chapter, the results of the semi-structured interviews with EMA experts and focus groups with EMA participants are documented. As stated in chapter 2, there was a period of exploration at the beginning of the analysis phase and different styles of coding were experimented with. This was due to the different types of data collected, as ontological and epistemological type questions were asked in the focus groups and interviews

Beginning with the first transcript, a two-stage process was adopted from Sandaña (2012). The codes were categorised first using In Vivo coding, then re-coded and organised based on the research questions. The codes were highlighted, and a decision was made regarding the quality of the codes. Some points were regarded as more important than other codes. The prioritisation of topics was decided by using the notes taken from during the interview or focus group, then the transcript was analysed for a further insight. This was an informative process but unfortunately very time consuming. In response to this and to be more time efficient, the significant codes found during the analysis of the first transcript were applied to the analysis of the rest of the transcripts. Therefore, the coding style changed to deductive following the analysis of the first transcript where the transcript was coded to already decided themes.

The following are the significant findings for the semi-structured interviews with the EMA experts. These findings are organised by priority to guide researchers what to focus on in their future studies.

4.1 First Semi Structured Interview

This semi-structured interview was held with EMA experts that worked at WSA. It was held online, using Microsoft Teams and it was 90 minutes long. It was automatically transcribed and then analysed using Nvivo.

The following themes were the themes created from the research questions and it was used for the analysis of the transcript.

1. Contributing Factors to Burden
2. Reduce Burden
3. EMA Study Design

4.2 Second Semi Structured Interview

This interview was held with EMA experts based in Germany, Ireland and Canada. It was held online, using Microsoft Teams and it was 90 minutes long. It was automatically transcribed and it was analysed using NVivo. The following are topics that were found as the most important factors to consider, based on the analysis of the first semi structured interview. The themes found were based on the research

questions therefore it was most appropriate and effective to re-use these themes highlighted above with the analysis.

4.3 Expert Interview Results

To ensure the results are easy to understand, the results of both interviews are shown together under the headings of the themes that were based on the research questions.

4.3.1 Contributing Factors to Burden

There are several factors that contribute to the burden that study leads (EMA experts) could see from their previous experience leading several studies. This section highlights subthemes that were mentioned from participants and therefore deemed important.

4.3.1.1 Technology

The subtheme of 'technology' refers to the factors that arise from the use of the equipment used in the study.

Technology was an issue for some of the older participants. During the interviews, one expert described as follows:

> *[...] The complexity of the equipment and the technology and just the logistical issues of recharging things and connecting things.'* can be an issue for some participants.

In both interviews, the experts mentioned the topic of a separate phone for the study and its relation to burden.

> *'I think the big problem is always that the subjects have to carry two telephone mobile phones with them.'*

> *'[...] for our participants, a big issue for them that was causing burden was carrying around the two phones and again as people said already, just kind of using two different forms, two different systems.'*

In some remote studies, one researcher noted that participants felt intimidated setting up the equipment.

> *'People were more intimidated at first because we included different sizes of receivers and usually the acoustician would just fit the hearing aids and make sure you have the right receiver size. I mean, many mentioned that they were a little bit intimidated and one person said he would drop out of the study.'*

The timing and the frequency of the notification was documented as a perceived disturbance.

> *'A couple of working people say that it was annoying for them that a meeting starts at the hour and that's exactly when they get the prompt.'*
>
> *'Prompting every couple of hours contributes a lot to the burden'*

Some users were accustomed to streaming using their hearing aids, this was not possible with the hearing aids provided for the study. One researcher recounted study where participant complained about this but continued for the sake of the study. The researcher mentioned this being said by them:

> *'It's annoying. I'm used to streaming but I will do it for the sake of the study.'*

The type of hearing aid used for the study was an issue for some participants:

> *'We had an external study where one participant dropped out when he heard that it's behind the ear instruments and he would only wear inside-the-ear instruments.'*

4.3.1.2 Mood and Personality

The mood and personality of the participants was a contributing factor to the study. For example if they were 'stressed and insecure' in their daily lives outside of the study, it would affect how they answered the questions in the EMA. The personality, self awareness and ability to express yourself makes a difference to the type of data collected.

These can be seen in the following statements mentioned by researchers:

> *'[...] there is the insecurity of the subject to answer right and to contribute the right way to this kind of study, which is really bad for some people. Very strange to interact with the system and perhaps very complex topics they have to do. This also might increase well some kind of insecurity and burden therefore.'*

Personality and preference is a factor that affects how people react to situations and how their minds work. This can have an effect on how burden is experienced for different people. These are two statements from two different researchers:

> *'I think it might be a personality thing there as well, but for some people they may even might like the attention that they get when they people ask about 'What are you wearing around your neck[1]' and others think it is annoying that they are exposed in that way.'*

[1] The Widex EMA-app uses a prolink, an induction loop that is worn around the neck, and this is necessary for the hearing aid's communication with the phone.

Understanding EMA participants' motivation during the study can be a way to help understand the topic of burden and how researchers can design better studies.

One researcher stated:

> *‘ I do think there is overlap between motivation and burden.’*

Another researcher mentioned that it might be the fact that EMA participants wants progress pertaining to the hearing-aid development and that contributes to their motivation and participation and for that reason might not consider it so burdensome. One researcher puts it like this:

> *‘[...] maybe we need to be seeking out people who are having a tough time with their hearing aids or tinnitus or really struggling in noise like those. Maybe the people who are more motivated to participate and give good data are the ones having challenges, and I do think that being motivated reduces the feeling of burden, even if not the actual burden’*

Researchers in the first interview stated that the age and lifestyle of participants can be a factor that influences the burden.

> *‘I would say that the younger people find it much more burdensome because their lives are active, whereas the older people they sometimes, I would say take them more seriously. Go to the gym and keep the equipment on, whereas the the younger people just remove it’*

Lastly, on the topic of personality, the nature of participants can reflect how they rate and phrase their input into the app.

> *‘It seems that some people don't like reporting anything negative.’*

4.3.2 EMA Study Design

The topic of ‘EMA study design’ includes different aspects, including the communications between facilitators and participants, and also about the design of the EMA application.

The communications between facilitators and participants varies depending on the requirements of the study. This includes the initial communication and introductory sessions between facilitators and participants, setting up the equipment, providing extra support and checking in with the participant during the study.

The design of the EMA application is also included in this section, which consists of; the elements of the user interface, the types of triggers, the amount and frequency of questions. These elements of EMA study design were identified as essential to document, as a result of the research questions.

In the semi structured interviews with EMA experts, topics arose about the style of questioning and the wording of questionnaires. The style of questioning, the types of answers required and the time required to participate were aspects of presumed burden. Researchers stated:

The number of questions we ask each time and the complexity of answering definitely contributes to burden.

[...] responding to the same questions over and over again might cause annoyance.

I've noticed we had a couple of subjects who said they didn't want to participate after being invited because of the sheer amount of questionnaires and about and the number of questions that they would have to answer daily.

All researchers interviewed highlighted issues arounds the wording of questionnaires. The complexity and layout of the questions was discussed as an influence burden.

I find it difficult to write clear information. You think it's clear when you read it, but then when you read it out loud to somebody else, you realise it's not so [easy to understand]. Revising those is important.

The number of questions we ask each time and the complexity of answering definitely contributes to burden.

I'd just add another thing that was a burden in our study, the way some of the questions were formatted…

One researcher mentioned that they provided the ability to skip questions in their EMA and that this helped 'decrease burden'.

Made use of adaptive questionnaires where we try to skip questions if they're not relevant in a situation. So that'll keep the number of questions as low as possible with the technique that we have. I think that's also a strategy of decreasing burden.

Most EMA participants are older people, therefore they can have issues with their eyesight. This affects how they use a mobile phone and the design requirements for them:

[...] the font on the smartphone has to be large enough and they're handling problems associated with that when it comes, for example, glasses reading glasses which you have to put on to read on your smartphone, the small practical issues which are inconvenient in some situation or the other situation.

The intervals between the notifications can be adapted to reduce burden;

I think we went for a one and a half hour interval and there were some complaints. But then the next study we went for two hours or just in half an hour, but it made quite a big difference in terms of burden.

4.3.3 Reduce Burden

To reduce the burden, It was important to see how researchers have tried to adjust their studies to serve the needs of their participants. This is closely related to the previous theme of how researchers designed EMA studies.

Closely related to the last researcher's statement in the previous section. It continues thus:

> *…So in particular, slider scales, some participants found those difficult to use. So when we ran the second study, we removed slider scales altogether and we found that generally participants were happier with the format of questions when they were multiple choice or selected an option questions as opposed to using the slide for scale…*

One researcher mentioned going this route when it comes to reducing burdens:

> *[...] we have a very clear description of the study and that we introduce people in a very honest and clear way of what it is about and what is expected from them. And that's how this study is going to look like so that they don't have the wrong expectations.*

Closely with the questionnaires, one researcher mentioned the importance of making it a collaborative study in a bid to reduce burden.

> *'Really, bringing participants in as equals in designing the study. So if it fits within the research question.'*

Another researcher supported this by saying:

> *'At the training session, [we] talked with participants about what the purpose is, what we're trying to do, what we're trying to get here. So they're on board as well. And allow them to have some control over which hours of the day they get triggers, how often they get triggers...You know, thinking about the integrity of the data versus participant burden and how that can balance out that as much as possible, bring them in. Bring them like we're doing this together. Let's set something up that works for both of us.'*

A suggested way of reducing burden mentioned was to allow the users to change the volume depending on their setting;

> *'At a dinner party, they could turn it down a little bit [volume of the phone], uh, so they wouldn't have to worry so much. And if they were in the subway where it's a lot noisier, perhaps they could increase the volume.'*

To decrease burden, a recommendation was to explain the purpose of the study and involve participants in the organisation so they can connect to it;

> *'If people can see what they're contributing to and can see the purpose of it and can relate to it, I think they would be willing even if they're not super tech savvy.'*

4.3.4 Expert Interview Conclusion

The insights obtained from the EMA experts were used to create questions that guided the discussions with the focus group participants. The themes found in the codes influenced how the questions were designed. The questions can be seen in appendix C.

4.4 Focus Groups

Three different rounds of online focus groups were held. The first focus group was a dry run and was held with three Danish participants. The focus groups were held in English.

4.4.1 Dry-run Group Results

The first focus group was held with three Danish participants. They were recent EMA participants from a study conducted in WSA a few weeks prior to the focus group. A date was arranged by sending out a Doodle, which is a scheduling website which allows people to provide available dates for meetings, in order for a swift organisation process. One participant responded using the Doodle, others emailed back their available time.

Being able to answer EMA questions in a different environment is what makes the results more beneficial to researchers. One participant said;

> *'Every time I was in a new situation when I was in a club or in a restaurant, I just started the session and actually answering the questions because I thought it was important to you that I tried them in different situations. So I think it's kind of easy to use.'*

With regards to motivation, all the participants mentioned how trying new hearing aids were one of the benefits they looked out for during these studies.

> *'I am a very curious person, so I think it's very interesting to figure out what's going on the hearing aid market. So when I try these new hearing aids, I'm always interested in figuring out how they work in loud environments like restaurants. And so, and every time I try some new ones, it's interesting to see how they work.'*

> *'It's very interesting for me to follow your work about doing things better. Um, I'm also fond sounds around me, the rooms I am living in…'*

Regarding the format of the questionnaires, participants mentioned it might be a little difficult when asked questions related to grading or rating scales. One participants put it like this:

[...] when I should answer, it's like levels, you know, maximum, minimum or where should I put my level? And I thought about, what about other people? Where do they put their level?

Like, was this good, or this was excellent or whatever, but other people may look a little differently and put grading differently.

Another participant frames it in this manner:

[...] when you asked how many percent of the speech can you hear that could sometimes be a little tricky, I think, could I hear 50%, 60, 70, 40, that does get a little difficult

The situation of having a test phone specifically for the test came up also with participants having mixed feeling about it. One participant said:

*And the only thing I could wish was the telephone was kind of smaller. It's very difficult to have two telephones in a small woman's ba*g.

Another participant puts it like this:

[...] a problem that we could not use our own telephone because I had to walk around the two telephones, which I'm not used to. So when I walked home from work, I forgot the telephone sometimes because I only took my own…I'm always streaming everything, I'm streaming a telephone conversation, sometimes streaming TV. When I go to the fitness center, I am hearing music and all these things I could not do with those with the test hearing aids. So I had to take it off and put my own in.

4.4.2 Focus Group #1

After the dry run, the questions were revised again with the assistance of a researcher at WSA to ensure the questions encouraged conversation and were understandable. The final version of the questions which was used for the following two focus groups is in appendix D.

This focus group was held with two German participants and held using Google Meet and recorded using Quick Time. Then the recording was transcribed using Grain. A technological check was held with each participant individually before the focus group.The transcription was coded using codes previously found on the topic of causes of burden, how to reduce burden and EMA study design.

The design of the questions is something that has been mentioned several times. Participants stated:

I remember some time I had to use the free space to write more precise answers to the questionnaire. You have to wait until the end of the questionnaire and then try to remember what it is you want to write to complete your questionnaire.

It would be a little bit strange to sit in a restaurant having a discussion and try to answer the questions [...] It would be very nice to have the ability to answer the questions later about past situations.

I'm in a hurry, I would later, or something like that as a first question. And then if you don't say I'm doing it now then as a it's cancel completely, or you have the possibility to take it later on something like that.

The pandemic was documented as a factor that contributed to the testing experiences, as their environments did not change when they were in quarantine and as such answers were the same for multiple questionnaires.

A participant puts it like this:

Because of COVID, it was not possible to have many different situations for me. So I had often the same questions, but problematic,

One participant had an issue with the technology provided in the study, as the participant had to use BTE (Behind The Ear) hearing aids. Wearing PPE masks during the pandemic was an issue.

[For the study] I had BTE hearing aids, and I always had problems knowing the direction [of the sound]. It doesn't distinguish if it's behind you, or in front.

'It's the main problems that with the mask, it's very easy to lose the hearing aid, when you put off the mask'

4.4.3 Focus Group #2

The final focus group was conducted with two male German participants. The questionnaire used in this session was the same one used in the last that was revised after the dry run. The session lasted for forty five minutes.

The format and styling of the questions have been mentioned a couple of times in the previous studies. One participated mentioned:

I think in some cases, when you have only one choice on one page, on the next page, you have multichoice. And this may be a little bit confusing, because then when you only have one choice, and you click the second choice, and the first disappears, then you have to be careful not to switch between one and the other possibility.

The other participant mentioned that using a finely granulated rating scale was confusing as judging yourself truthfully might be a difficult task. The participant stated:

For example, when the question is, was it 'a little bit annoying', or was it 'very annoying' or 'very, very annoying'. Then I think it's very individual to judge

them. Maybe for some people 'annoying' is not good enough and for other people, 'very annoying', is not too good.

The information given to participants at the beginning of the study serves as an important and defining point as this can greatly affect the rest of the study. One participant said:

I think it will be quite helpful if there are some special options that need some special answers or if they sound similar, maybe but they have a different meaning, then mentioning this in the information procedure at the beginning would be very helpful just to get okay if you do this, then this and so on.

On speaking about mediums of communication with study leads, one of the participants said this:

What I would really like, would be a little, I have a question and then I can send a message into the team. So that's a nice idea to just type it and send it into the team. And then I get my answer a few hours or a day later, that is still sufficient for me. And I don't want to call in the moment because maybe I'm in a bar with friends, and I don't want to bother you with this question.

At the beginning of the studies, a manual is usually sent across as a backup text guide on the equipment (phone and hearing aid) and one participant said this about it:

I read the manual for my first car, the whole manual of my first car…I was like, yeah. Wow, that's nice. And I think if somebody has problems with the app or with something, it's very nice because you can always find it in the manual, it has everything in there. So I didn't really need it, but I looked at it and I really appreciated your effort putting it together

The participants were asked about their motivation during the study, both participants answered similarly to other participants responding:

I'm very interested in the progress and what happens in the field that's why I attend these studies.

I have hearing aid since 30 years now, roughly, and I really like the progress. And I really like to stay in touch with the new stuffs. And I mean, these studies are testing the devices to the fullest, and it keeps me in touch with it. And I really like the people, especially in your team because we are working together mostly. So the people are very nice. And I like to stay in touch with all that with all the technical innovations.

Regarding the EMA triggers and app notification, one participant said:

> *[…] the reminder for me was great because then when I went to bed, I had a look at the phone and there was this reminder. And I was like oh, yeah, right. You should do that. It worked good for me, without a reminder it would be very hard. I think I would forget it in half of the day. Yeah. And that's optimistic.*

Regarding a dedicated test phone being used for the study. One participant mentioned:

> *[...] installing it on your own phone and then use this, that would be a lot better. That's right, because carrying around the second phone, I mean, they are not small. It's really annoying…*

When asked about answering the questionnaire while in the public the participants responded:

> *I mean, my friends are familiar with hearing aids and I tell them, 'Hey, I have a study again'. That's why I'm very impolite and put my mobile phone on the table. When I don't think there is a nice situation, I just tell them what I'm doing, and then everyone is fine with it. So maybe for some people it's difficult in a bar or something, what I think is maybe difficult especially if you're in a church. I think that it would be a difficult situation to do an EMA survey at that moment.*

> *I think in general it is not an issue, I think others maybe it can be complex. But when you are outside now for example, when you are doing some activities like cycling or sports, I think this is not so easy to take your cell phone and also when you're outside the phone display is not so easy to use and therefore, one idea could be for for simpler questions that could be combined with a smartwatch. I do not know why but I think the contrast on the smartwatch outside it's easier to read than a cell phone and maybe is the 'yes or no' can also easily be done on a smartwatch for example.*

With the intention of EMA to fitting into one's live and record data, that might be hard if normal activities can't be done. To that effect one participant mentioned:

> *For me, what is really difficult is when I'm having a phone call and I can't stream it with a complex or directly into the phone…it's really disturbing because having a phone call without the hearing aid is much more difficult.*

5. Discussion and Conclusion

In this chapter, the methods chosen will be examined in relation to the research questions. Following this, the findings documented in the results chapter will be critically discussed based on the knowledge obtained during the thesis work.

5.1 Methods Discussion

The methods used in this thesis were semi-structured interviews and focus groups. This was chosen to encourage discussion amongst participants and to gather rich qualitative information in the provided timeframe. The information retrieved from the literature review provided a good foundation for the preparation of the practical work.

The semi-structured interviews were first conducted with the experts that worked in EMA in audiology in their respective industries and research. The first expert interview was conducted with experts within WSA. Following this a second interview was held with researchers in different universities. Both of the interviews had participants that had organised one or more EMA studies and most had written papers on the topic. Insights were retrieved from the researchers in interviews. As a result of this, a list of questions were formulated that served as a guide to the focus groups with past EMA participants. Then, a dry-run for the focus group was held, this resulted in a revision of the questions in order to remove bias and to ensure questions were easy to comprehend and answer.

When choosing the participants for the dry run, one inclusion criteria was to have participated in an EMA study within the last three months. With that criteria, three participants were chosen for the session. That criteria was later changed as participants recruitment for the main focus group was proving difficult.

The criteria was relaxed to accommodate more participants, with a longer time since they have taken part in an EMA. Memory recall is a factor to consider for the bias in some of the opinions of the focus group participants. Four participants were recruited and the focus group, this was conducted in groups of two due to time availability of the participants. Overall the focus groups and semi-structured interviews proved to be a successful method to answer the research questions regarding the cause of burden in EMA. The participants had open conversations where they shared ideas and opinions on their past experiences in EMA.

5.1.1 Reliability and Validity

Reliability refers to whether the research can be replicated and if the same results will be obtained, while validity refers to if the research is credible and the information presented is accurate (Saunders et al., 2016).

Semi-structured interviews are an effective way to obtain qualitative answers. This method allows the facilitator to move through the planned questions and ask follow up questions spontaneously.

To ensure reliability and to reduce bias, two sets of semi-structured interviews were conducted. One interview was held with WSA researchers and a second with external researchers. Both interviews provided a range of information which was beneficial to the project. The participants in both studies had a varied range in backgrounds and experience in audiology and EMA. In the interviews, they expressed their opinions on aspects of perceived burden and in EMA studies. The second interview provided another aspect of information which differed from the WSA researchers. This was due to the external researchers using different EMA applications and had a wider variation of study requirements. Some of the WSA researchers worked on projects together so they had similar opinions and experiences. Holding two semi-structured interviews one with WSA researchers and external researchers increased the reliability of the data retrieved. This data provided a good foundation to build versatile questions for the focus groups.

To ensure reliability, the focus group questions were reviewed twice in order to ensure the best results were obtained. A dry run of the focus group was first conducted to test the questions and the recording environment. The learning outcomes from the dry run were incorporated into the following two focus groups. The transcripts from the dry run confirmed that the questions were interpreted as intended.

The review and verification of the focus group questions ensured the reliability of the data produced from the focus groups. The dry run was beneficial for the success of the following two focus groups, therefore that helped the reliability of the overall results.

5.1.2 Ethical Consideration

For this thesis work, it was vital that all participants were provided the correct information and that they granted consent before part-taking. This was due to the necessity to record the interviews and focus group and to abide by GDPR regulations. Consent forms were sent to the participants prior to each interview and focus group. At the beginning of every interview and focus group, a reminder was provided that the session was recorded and the transcript would be used for analysis. Furthermore, all transcripts have been anonymized before analysis started. The transcripts and the recordings were stored according to the policies within WSA and in compliance with GDPR.

5.1.3 Bias in Study

Bias was evident in different areas of the study and affected the results retrieved from the focus groups. The specific requirements necessary for participants to take part in the study facilitated bias. For example, participants had to speak English, be

willing to take part in an online group session, have recent experience with EMA studies and wear hearing aids. These requirements resulted in a niche group of people who were highly motivated and tech savvy.

One motivated participant expressed that when they were in a new setting they would open the EMA application and fill out a survey to provide information. Another participant went to look through notes that were documented in a file during an online focus group, showing he had made personal notes during the study. These participants were a unique group that provided rich and beneficial information, but they all had overall a pleasant EMA experience and were willing to take part again and this might be a bias also in the study, as participants who might have only participated in one study might have done this and stopped because it was burdensome.

A wider variety of participants would show a more accurate overview of burden in EMA. It would be beneficial to recruit participants who are less tech literate. To facilitate this, conducting physical focus groups would be beneficial. It is possible that the people who are less tech savvy find handling the phone and answering repeated questionnaires, more burdensome, therefore their opinion would be beneficial to the study of burden in EMA.

Another aspect to consider is the many different study designs of EMA studies available and that are used with audiological research. To obtain knowledge saturation on the topic of burden, interviewing participants that have taken part in different studies, would provide a better overview of burden in EMA.

5.2 Discussion of Findings

The purpose of this research is to identify factors that contribute to burden in EMA studies. Three research questions were created to provide answers to the topic of burden in EMA audiology studies. Many things were discovered from the two expert interviews and the three focus groups which will be discussed in this chapter, this is followed by a list of areas to improve when designing future audiology studies in order to get better results.

Data saturation was not achieved in this study, regarding the amount of information possible to be retrieved from past EMA participants, due to the time constraints of the project.

5.2.1 Participant Motivation

Throughout the interview sessions, the topic of ‘motivation’ as a reason for participants to take part in EMA studies arose on many occasions.

The requirement of EMA studies to answer frequent questionnaires can be burdensome by nature. Participants must answer questions multiple times in a day and often the same questions repeatedly. Burden can appear differently to a person who is highly motivated compared to a person who is unmotivated. Motivation is not always controllable by the facilitator and there are many contributing factors to

motivation such as the personality and mood of the participants. EMA is a study conducted in a participant's own environment and they are not being monitored. Therefore the motivation of a participant plays a big part in the success of an EMA.

The results found from the interviews show that participants are more likely to participate in the research, when they feel they are contributing to the improvement of audiology technology. Some participants wanted to test out a different type of hearing aid and were interested in the technology. They were motivated by the ability to try new technology and to contribute to improving hearing aid software.

To promote further motivation and enthusiasm for EMA studies, it is beneficial to show participants the progress of the study. Emphasising and selling EMA to possible participants, in a way that shows that their help is benefiting future audiological technology and hearing aids. Indicating the ability to try a new hearing could also motivate more participants. It is important to highlight the value of their impact and contribution to research on a broader scale. This could motivate participants to overlook the perceived burden before beginning or during a study.

Another way to increase motivation in studies would be to give a good reward for partaking and also to regularly check in with the participants.

5.2.2 Technology

The technology used in EMA studies have a big impact on participants' experiences. Discussions on technology are documented under the following headings to understand the effects of burden:

Test phone

Most EMA studies in audiology provide participants with a test phone, however issues can arise with the use of another phone. For example, the operating system can be different to their own and the usability of the phone and technical errors involving both the app and the phone. Participants said in the focus groups they forgot the test phone when leaving the house and they had issues with the app/phone not responding or crashing. These issues can lead to burden and have an effect on the responses received.

The possibility of participants having the ability of using their own mobile phones for the studies, would be of great benefit as technical issues would decrease. The test phone is less likely to be forgotten and there could be a higher response rate. On the other hand with a test phone, study apps can be more controlled and phone settings can be kept constant which reduces the room for inconsistent running of the app across different devices.

Streaming

Connection with the hearing aids to music or TV was a popular choice amongst the focus group participants. For the EMA studies that they participated in, they could not stream while partaking in the study and this was a burden for them. They were

accustomed to frequent streaming and the inability to do so during partaking in EMA was an issue for them. The participants in the focus groups were very tech literate, so this could be a unique issue. It is worth noting that the burden would be reduced if the option of streaming was provided or hearing aids could be connected to multiple devices at the same time in such a way that the participant's experience is not affected.

Hearing aid type

Another aspect of technology that can cause a burden, is the type of hearing aid used for the study. This topic arose in the interview with WSA researchers and the second focus group.

Some focus group participants wanted to try out a new hearing aid and their motivation was linked to trying out a different or modern hearing aids. They were curious about experimenting with new audiology technology and did not experience burden when issues arose with the test hearing aid.

In another case, a participant was accustomed to using In-Ear hearing aids every day. As a requirement for the specific study, Behind the Ear (BTE) hearing aids were necessary to be used. The participant had significantly reduced hearing with the BTE hearing aid. This meant they were providing negative feedback in the EMA and documenting poor listening situations. This would not have occurred if they had their own hearing aids. Depending on the nature of the study, presumably a hearing aid should always be fitted correctly to ensure the wearer can hear as well as possible

An ill-fitting hearing aid could jeopardise the results of the EMA. Participants might switch between their personal hearing aid and the test hearing aid. This invalidates the data retrieved and contributes significantly to the burden experienced by participants. The fitting of the hearing aid and the type of hearing aid should be reviewed before beginning a study, as they are considerable factors of burden.

Communication with facilitator

A participant in the second focus group mentioned the use of a messaging feature within the EMA app to contact facilitators when a question arose. This is a good idea as instant messaging is one that is very popular with apps like iMessage, WhatsApp and Facebook and most people are accustomed to sending text messages. Incorporating similar features that participants use in other applications could be of benefit to the EMA studies.

Currently, in many studies the way to contact a facilitator is by phone call. The participant could be doing the EMA at night, or it might be an inappropriate time to call. They might be more likely to ask relevant questions if there is a quick and accessible feature. A messaging capability in the app would allow for a spontaneous and unobtrusive way to ask questions that is quick for users at the

moment. It could lead to more issues during the study being solved, in turn reducing the burden.

5.2.3 EMA Study Design

The topic of ‘EMA study design’ includes different aspects, including the communications between facilitators and participants, the questionnaire format and answering style, the trigger types and the design of the EMA application.

The communications between facilitators and participants varies depending on the requirements of the study. This includes the initial communication and introductory sessions between facilitators and participants, setting up the equipment, providing extra support and checking in with the participant during the study.

In the focus group, the topic of question format arose. The participants spoke about the number of times they were alerted and for most participants, this was manageable. In the first interview an expert stated that a participant could find it difficult to write clear information. In the focus group, a participant had an issue with some of the options provided using the radio buttons. She felt like she was missing something and would have liked a text field to write a comment. It could be beneficial for some studies to provide a more flexible way for participants to answer, to ensure that their honest and complete opinions are collected.

The experts stated in the second interview that, ‘responding to the same questions repeatedly might also cause annoyance.’ They were correct, as many of the participants mentioned the questions were repetitive and their situation did not change. Due to the pandemic and quarantines, a change in listening situations was not as frequent for many participants. Therefore, they often documented the same answers to many questions, and they found it burdensome. Participants wanted to be able to skip questions if their situation did not change from before. This could decrease burden for participants, but also lead to careless answers and unbeneficial results.

A pandemic is not an optimal condition to do an audiological EMA study, as researchers are often looking for a variation in the listening situations. In these unique circumstances, as a solution a listening situation could be simulated in order to retrieve the required results.

5.2.4 Areas of Improvements

From the insights retrieved from all the interviews, it is beneficial to highlight a list of issues that EMA study leads could pay more attention to when designing a study. The aim of this list is to reduce perceived burden felt by participants as a result an EMA study.

The list is made from the learnings from the research methods highlighted in previous sections of this paper:

- ***Design and format of the questions***

The format the questionnaire and the method in which questions are asked should be as simple as possible. Text boxes should be provided as an extra option, for when the participants cannot express their opinion with the selections provided. Clear indications on the rating scale and the meanings of each grade on the scale in the design

- ***Chat or messaging functionality***

The addition of a chat or messaging functionality between participants and facilitators, would encourage participants to ask questions when they are having issues. This is particularly beneficial for times when they cannot ring the facilitator, or if they prefer to text message compared to phone call in general.

- ***Timing of notifications***

The timing and the regularity of the notifications of the EMA study should be planned with the participants before beginning the EMA. When the participants are expecting the notification, they are more likely to remember to complete the questionnaire.

- ***Eliminate the test phone***

The elimination of a test phone is guaranteed to decrease the burden for participants, as found in the research from the focus groups. For light weight studies, install the EMA application on the participants phone and don't give a test phone. EMA application on participant's phone if possible.

- ***Ability to revisit questions***

An option to revisit a question that they cannot currently answer, if a participant is busy would be beneficial to participants. Although, this is difficult as the aim of EMA is to answer questions in the moment. An alternative solution is to provide a notification stating that a survey was missed, with a request of if the user would like to retry in their current listening environment.

- ***Ability to stream audio during a study***

Participants who took part in EMA were quiet tech literate and were accustomed to streaming audio using their hearing aids. It would be benetifcal to allow users to do this with the EMA test hearing aids. This way they would not change hearing aid to stream audio, and it could significantly reduce the burden encountered.

- ***Hearing aid***

A possibility for the participant to wear their own hearing aids could be beneficial and reduce perceived burden. Specifically in cases where the participant has a unique hearing impairment, and they can hear better with a specific type of hearing aid. If a test hearing aid is a requirement for the study, extra measurements should be taken to ensure that the participant can hear correctly in different environments, before they begin the EMA.

- ***Gamification and EMA design***

There was an issue raised amongst facilitators that they did not have enough information of users in a certain acoustical environment. A suggestion for a way to retrieve more beneficial results is to encourage users to go into more listening situations by adding an element of gamification. Showing users the different listening situations that they have answered questionnaires in and indicating situations that they need to answer questionnaires, could motivate them.

5.3 Conclusion

The purpose of this study was to learn about what causes burden in EMA studies to improve future studies and increase user retention. Following the literature review, the two interviews and three focus groups, many beneficial results were collected.

The technology was a big cause of burden, because of the requirement to carry two phones or hearing aids that were used. Sometimes it is unavoidable that test phones or a certain hearing aid are used for a study. These technologies should be reassessed and inquire about a possibly to install a version on the user's personal phone or use their own hearing aid is possible.

The length of a study and the timing of the notifications was a burden for many participants. The participants would have liked more control, the ability to plan the timings of notifications and the ability t to come back to a survey or to answer the same answer as before with one button click as they were still in the same listening situation.

There was a large bias in the work, as all the participants were tech literate and enthusiastic about EMA studies. This was due to the nature of the focus group, as it was held online and in English. These were unique participants that did not

resemble all EMA participants. In future, conducting physical focus groups with people in their own language would provide a wider range of results.

To conclude, there was some informative and beneficial information gathered from the research conducted for this paper. There was a large participant bias in the study, as each participant was highly motivated and technically literate.

Despite the evident bias, there was advantageous findings such as the clarification that two phones are an issue in studies. The overall findings were aligned with conversations with EMA experts and some of their predictions in the interviews were correct. This research will be used by future EMA study facilitators and organisers to improve their EMA studies by reducing burden for participants.

5.4 Future Research

This paper was conducted in conjunction with WS Audiology. The topic of this paper is beneficial to the work done in WSA and can be valuable for other researchers that organise and facilitate EMA studies, in audiology and perhaps in other fields. Therefore there is an aim to publish this paper together with future research conducted with new focus group participants.

As there was a big subject bias in the research conducted, it is advantageous for this research paper to be extended, to include focus groups with a larger diversity of participants from different studies. Different opinions and more information on the experiences in EMA will expectantly increase credibility of the paper. Although mixing further nationalities and people with different test experiences might be bring completely different results and further bias, this is something that should be explored to get a fuller sense on burden as a subject in EMA.

Following the submission of this thesis, there are intentions to do further focus groups with EMA participants in the USA. These participants are available through a contact in the WSA network. This will require a different type of consent form and requests from a legal perspective.

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7. Search Terms

8. Appendices

Appendix A - Information about the researchers in the Expert Interviews

Half of the participants in the expert interviews worked in WSA. The rest of the participants worked in audiology companies in Canada, Ireland and Germany. The group had a mixture of experience with EMA studies. For example, one participant was known as the EMA expert at the company and another participant was a student and has conducted one EMA study. All participants have organised facilitated and analysed their own EMA studies. Some participants have worked together. All participants have wrote papers about EMA studies, although not every participant has had papers published.

Appendix B - Brainstorm Plan with Experts

A. Introduction:

Hi everyone, we are masters students studying UX and IT Architecture in Jönköping. We are doing our thesis with Nadja, and as you might know already it is on the topic of burden, we aim to uncover the main causes of burden by holding focus group with past EMA participants. So we have asked you to be here, so we can brainstorm questions to ask for the focus group. We want to make sure we are covering as many areas of burden as possible.

B. Engagement/Main Questions:

1) What do you believe contributes to burden? Are there any further aspects that contribute to burden besides triggers?
2) What do you do to reduce burden?
3) Are there aspects that are particularly burdensome for certain subject groups?
    a. What kind of participants did you have in your previous studies and were they any issues you remembered?
4) Did you see an influence of burden on the data quality?
    a. What did you think the data quality was reduced at the end?
5) Are there special aspects of burden that are relevant in audiology that are not relevant in other areas?
6) How did you think the burden related to the motivation of participants?

7) Have you done anything to access burden?

8) Could the equipment used to be a burden? For example, the hearing aids, the mobile phone.

9) How does the burden depend on the kind of trigger?

10) The participant must answer the same questions every day, over and over as part of the study, in your experience, did you have any complaints about this, and does it have any correlation to burden?

11) What role did you think the instructions played on the level of burden?

C. Further Important Questions

1. What questions do you think we can ask in a focus group?
2. What should be added to a burden questionnaire?

D. Extra Questions

1. During the pandemic, was the level of burden affected and did it differ, between remote studies compared to physical studies?
2. Some of you might have worked with changing programs of the hearing aids, how does this effect the burden the participant experienced?
3. Any specific and unique cases that stand out to you, in relation to lack of response or burden?
4. Are there any final things you would like to mention?

Appendix C - Dry-run Question

1. How was your last EMA experience, what did you like and not like? How did you feel when you were participating in the EMA study?
2. Do you think you were well informed at the beginning of the study? Did you feel you got all the information you needed at the beginning?
3. Why did you choose to take part in this study?
4. Do you think the information you received made it easier or more difficult during the study?
5. What do you think about the effort required to answer the questionnaires?

6. Was it easy to understand what is required from you?
7. How did you find using the phone and hearing aids together, what were the positives or negatives? How did you find this experience of using the technology?
8. What occasions that were most suited to partaking in EMA? What occasions that were least suited to answering the EMA?
9. How did the people around you react to you partaking in EMA? How did that make you feel?
10. Would you have wanted more control over the process the study?
11. Is there anything in the app that could be changed to make easier for you to participate make it easier in the study, for example single choice questions, or change of font size, colours?
12. How did you find the process of answering of the questions? Would you say you enjoyed it or found it more annoying?
13. Are there any other aspects of burden in EMA which we have forgotten to talk about?
14. Would you take part in another EMA study, why so?

Appendix D - Focus Group Plan Document

Introduction

Thank you very much for taking the time to meet us today. We are going to ask you some questions and feel free to discuss the topics with each other. This is Grace and Simeon, we are students in Sweden, studying web development. Nadja is our supervisor in WSA. As mentioned in the consent form and email, we would like to record this session to use the information for the thesis work. If that is okay with everyone, I can start the recording now.

Our thesis topic is about improving EMA studies. EMA which stands for Ecological Momentary Assessment and this is the official name for questionnaire type study that you took part in.

For this focus group, please feel free to express your honest opinions about your time in the study. The information you provide to us here will not be shared with anyone, except in anonymized form. This is a safe and confidential space to share your true and honest experiences and opinions.

So, without further ado, let's get started:

1. How was your last EMA experience?
   Later Prompt:
   - What did you like about it?
   - What did you not like about it?

2. Can you tell me about the information you were given about the EMA study?
   Later Prompt:
   - Was it helpful?
   - Were you able to understand the study?
   - Did the information make the study easier or more difficult to do?
   - How was the recruitment process, before the study began?
   - How was the first meeting?
   - Can you describe the information you received during "receiving the manual"?
   - Do you wish there was a possibility of getting more information?
   - Was there anything you wish you knew before starting?

3. Can you tell me why you participated in the study?
   Later Prompt:
   - Can you tell me about your motivation during the study?
   - How did it affect you?

4. Can you describe the effort it took for you to participate in the study?
   Later Prompts:
   - What did you think about the questions?
   - Can you tell me about the effort it took to answer the questionnaires?
   - Was it easy or difficult to understand the questions?
   - Can you tell me your thoughts on the number of questions?
   - Can you tell me your thoughts on the frequency of the questions?
   - Was it understandable what was required of you? - Why?/ How so?

5. What are your thoughts on the design of the app?
   Later Prompt:

- What did you think about the notifications from the phone or hearing aid?
- What do you think about how information/questions were displayed on the app?
- Is there anything in the app that could be changed to make easier for you to participate make it easier in the study? For example single choice questions, or change of the text size or colours?

6. Tell us about a time it was particularly difficult to use the app.
   Later Prompt:
   - How did you feel about using the app when you were with other people?
   - How did the people around you react to you using the app?
   - What times was the most convenient to use the app?

7. Can you tell me your experience using the test phone?
   Later Prompt:
   - Could you tell me about any challenges you had using the test phone?
   - Can you tell me about any limitations you felt you had when using the test phone?

8. Can you tell me your experience using the hearing aid?
   Later Prompt:
   - Can you tell me about any challenges you had using the hearing aids?
   - Can you tell me about any limitations you felt you had when using the hearing aids?

9. Can you discuss anything that you would change in the study?

Final questions

Our study is about burden in relation to EMA

10. Can you tell me of any aspects of burden you faced during the study that we haven't spoken about?

11. Could you tell me any reason for which you may or may not take part in a future EMA study?

12. You were our first focus group participants; would you recommend us to do anything to improve the questions or the format of the focus group?