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An Exploration of Digital Hoarding Behavior:

"I don't know how to explain it, but i definitely do lots of it!"

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Abstract

Digital hoarding is a novel topic that has come to researchers' attention only in recent years. Research indicates that digital hoarding is not of particular interest to clinical psychology hoarding literature because it is not considered to lead to functional impairment. Nevertheless, in recent years, there have been reports of individuals struggling with digital hoarding. Digital hoarding continues to remain difficult to detect because it is not visible like physical hoarding. Existent research on the topic shows that the same factors that impact physical hoarding should be considered when trying to diagnose digital hoarding. Moreover, research shows that there are significant similarities between physical and digital hoarding. Therefore, the aim of the present study is to explore the factors that influence people's accumulation habits that, eventually, lead to digital clutter. For this, a study with 10 participants was conducted. The participants were extensively interviewed in relation to their *saving*, *managing*, and *retrieving processes*, according to the Personal Information Management (PIM) framework. The results indicate that the PIM framework can be used to determine which processes have the greatest influence on digital hoarding. The findings show that accumulation is directly influenced by excessive saving (acquiring) and failure to discard digital files. The factors that influence these processes are found to be similar to those promoted in physical hoarding, namely factors of sentimental value and of instrumental value. Our results indicate that instrumental value is invoked more often than sentimental value. Our findings should be interpreted in light of the most significant limitation of the study, namely the small number of participants.

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1. Introduction

Information can be considered the currency for knowledge, and the world is consuming increasingly more information. Information in all of its forms is invaluable but with the help of technological advancements, digitizing information has become possible. Digitalization has made possible the transition from physical form to digital form for most types of information. *Digital data* is considered a prevalent aspect in today's society, anything from texts to files, documents, and mobile applications (Vitale, Janzen, & McGrenere, 2018). Nevertheless, the amount of emerging digital information requires, like in the case of physical information, digital storage possibilities. To accommodate this need, unlimited means to storage have been developed, such as larger memory on the devices or the cloud (Vitale, et al., 2018). However, these unlimited storage capabilities afford increasingly large amounts of information to be stored by individuals. These are *personal information* used by individuals who form their own *personal collections* through acquiring the information (Jones, 2008).

Creating personal collections of information has led researchers to wonder how digital data is preserved (Vitale, et al., 2018). This is a matter of how much information is being collected, just like in the case of physical collections. Emerging research suggests that *digital clutter* is real, just like physical clutter (Van Bennekom, Blom, Vulink, & Denys, 2015; Vitale, et al., 2018; Sweeten, Sillence, & Neave, 2018; Neave, Briggs, McKellar, & Sillence, 2019). According to Neave et al. (2019), people tend to believe that digital clutter is harmless because it is not visible, nor does it cause sanitary problems. Nevertheless, the accumulation of digital possessions can become a problem, especially when information is hoarded. *Hoarding* is characterized as the excessive acquiring of objects, as well as the inability to get rid of possessions that are of seemingly limited or of no value at all (Frost & Gross, 1993). The excessive acquisition and the inability of discarding of possessions are the main aspects that lead to *accumulation*. *Digital hoarding* refers to the accumulation of digital information, even if considered useless, and it has been studied in connection to physical hoarding (Van Bennekom, et al., 2015).

As of now, the research conducted on digital hoarding is limited. It does not indicate clearly what influences people to become *digital hoarders* or what are the specific symptoms needed to identify a digital hoarder. Van Bennekom et al. (2015) have identified the first clinical case of digital hoarding and have brought this topic to researchers' attention. This study indicates that the symptoms of digital hoarding are similar to physical hoarding, and it could be identified following criteria specific to hoarding, such as difficulty and fear for discarding possessions, distress caused by the accumulation of the possessions, socializing difficulties, and emotional attachment (Van Bennekom, et al., 2015). More recent research supports these findings (Thorpe, Bolster, & Neave, 2019; Luxon, Hamilton, Bates, & Chasson, 2019). However, extensive research is required on digital hoarding and the factors that influence it. As such, considering the existing knowledge about digital hoarding, we aim to investigate the factors that influence people to hoard digital information.

1.1. Problem Statement

On the basis of the aforementioned aspects, the following problem statement has been formulated:

Which are the factors that influence the accumulation habits that could lead to digital hoarding?

1.1.1. Research Questions

The problem statement represents a concise description of the issue at hand. In order to comprehensively answer this problem statement, 6 research questions (RQs) have been formulated.

RQ1: To which extent are people familiar with the concept of digital hoarding?

Digital hoarding is considered a novel topic, and much of it is yet to be discovered. Thus, it is relevant to investigate whether the participants are familiar to the topic in order to explore if their understanding of the topic has any influence on their accumulation habits. Moreover, we are interested in our participants' perception of their own clutter. This research question is addressed in the beginning of the interview to establish the same level of knowledge about the concept for all the participants.

RQ2: What are the main practices that lead to accumulation of digital files?

Research indicates that accumulation of digital files is the main aspect involved in digital hoarding, thus it is important to investigate the main practices of participants that lead to it. Excessive acquisition and the inability of discarding of possession influence the accumulation process. Thus, the following sub-research questions are created:

RQ2a: Which are the factors that influence acquiring digital

Acquiring digital files is the starting point in the accumulation process. Thus, we seek to identify and understand the factors that can influence the acquisition of digital files. Excessive acquisition of digital files contributes to accumulation and, therefore, a practice that can lead to digital hoarding.

RQ2b: Which are the factors that influence discarding digital files?

Discarding digital files represents the process that can impede accumulation of digital files. However, the absence of a regular discarding habit of unnecessary digital files can contribute to excessive accumulation. Thus, we seek to identify the main factors that prompt participants to discard their digital files. Moreover, we also seek to identify the main factors that cause participants to not discard digital files that are of no use, as these factors contribute to their accumulation.

RQ3: What are the perceived consequences of digital hoarding?

Through this research question we aim to identify the consequences of hoarding digital files as perceived by the participants. Moreover, our own interpretation of these consequences, which emerge from the analysis, is considered. Understanding the potential consequences of digital hoarding is relevant in relation to establishing clear criteria for identifying individuals who may be digital hoarders.

RQ4: What is the relationship between physical and digital hoarding?

This last research question focuses on the relationship between physical hoarding and digital hoarding in terms of similarities and differences. This comparison will be based on both the literature research and the analysis of the SI-R scale and of the interviews. The purpose is to explore whether digital hoarding follows the same criteria as physical hoarding, or whether there are new remarks identified in the analysis that can contribute to the existing literature.

1.2. Research Scope

The underlying scope of this dissertation is to explore what factors influence individuals to hoard digital information. Moreover, we are interested in whether these factors are similar to those that have been determined to influence physical hoarding. As such, we will dive into the concept of hoarding to understand it thoroughly, and then continue to look at research available on digital hoarding for the same reason. Further on, we will review *personal information management* (PIM). PIM is considered the general concept used to describe how people collect, store, organize, and retrieve digital items (Neave, et al., 2019). Our interest is to understand what PIM entails and what are its implications on digital hoarding. Therefore, the present dissertation will focus on investigating the characteristics of digital hoarding.

The motivation for conducting this research is made out of two reasons. First, from an *academic perspective*, digital hoarding is a topic that has received limited attention. However, it is clear that the issue of acquiring and accumulating digital possessions is real and, considering the impact information has on people's daily lives, we consider that it should be studied more extensively. Moreover, although our research is from the perspective of Information Science, we focus on understanding physical hoarding as well because it seems to have direct implications to digital hoarding. Second, from a *personal perspective*, we believe that digital clutter is prevalent, and few people are able to recognize it or acknowledge it as a problem. We have witnessed digital hoarding tendencies in people in our lives and consider that it is fascinating that many do not recognize that there is a problem. This issue is authentic because most people are using information on a daily basis and they end up cluttering it for various reasons.

1.3. Contribution

The significance of the subject is underlined by the limited research conducted in this field, although digital information is prevalent in people's lives and digital clutter is a real issue. Considering that the purpose of this dissertation is to explore the aspects that influence digital hoarding, the motivation behind this investigation is to contribute with valuable and relevant knowledge to this field. As master's students in the field of Information Science, we will focus on exploring various aspects that are related to digital hoarding and PIM, which could be significant to consider in understanding digital hoarding and could potentially inspire further work in regard to digital hoarding.

As such, we hope to bring the following contribution to the field. One contribution is related to using the PIM framework to look at digital hoarding. Another contribution is related to investigating the perceived consequences of digital hoarding. Through this, we hope to contribute with new knowledge related to individuals' beliefs on how digital clutter can affect their lives.

1.4. Thesis Outline

Throughout the first chapter of our dissertations, i.e. *1. Introduction*, the concepts of *hoarding*, *digital hoarding,* and *PIM* have been shortly introduced. The upcoming sections are categorized in six chapters *(See Figure 1.1)*. The second chapter is a literature review conducted in relation to the previously stated concepts. Here, we are looking for related works, as well as theories that will provide a clear understanding of these concepts and the extent to which have been thoroughly researched. The third chapter describes the design of our research in terms of methods used for data collection and analysis. The following chapter focuses on the analysis of the results. The fifth chapter is a discussion of the findings in relation to the literature review, which end with the conclusion of the research where the problem statement is answered, as well as the research questions. In the last chapter, the directions that should be followed in connection to this investigation are emphasized.

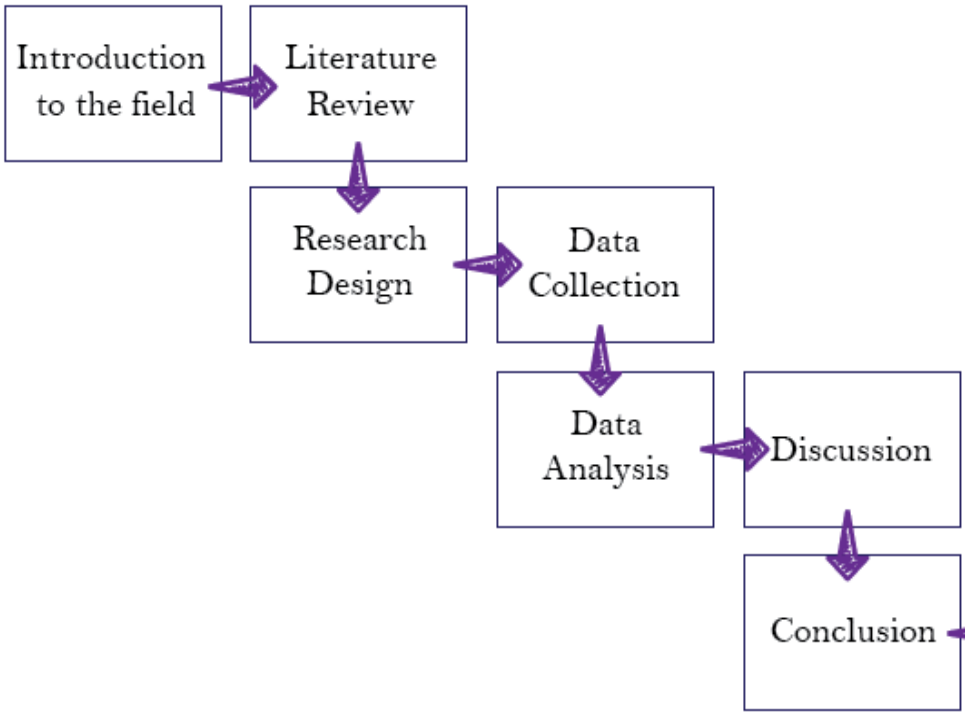

Figure 1.1 – Outline of the dissertation divided into chapters.

2. Literature Review

The novelty of *digital hoarding* has influenced the limited number of studies and investigations that uncover some of the aspects that should be considered in relation to this subject. In the following section, the existing literature will be reviewed in regard to digital hoarding and whether any specific diagnosis criteria are being identified along with the main factors that influence individuals to become digital hoarders. For deeper understanding of this domain, a review of the *physical hoarding* topic is also considered in order to uncover some of the factors that might trigger accumulation of things. Lastly, the process of *personal information management* (PIM) will be reviewed to get a better understanding on what implications it has on digital hoarding. In relation to the subject addressed in this dissertation, it is significant to comprehensively understand these concepts and their underlying characteristics.

On these bases, a traditional literature review is conducted with the scope of providing insights into the field of research by exploring it. This type of literature review is based on selecting papers that are to be used and further summarized and synthesized (Cronin, Ryan, & Coughlan, 2008). Conducting a traditional literature review is relevant because it allows for a meaningful volume of literature to be gathered in a specific subject. In this way, an adequate foundation for the knowledge in the field is created (Cronin, et al., 2008). Moreover, it allows the possibility of being selective in choosing which material should to be used (Cronin, et al., 2008). Prior to starting a traditional literature review, a preliminary literature search was conducted to get familiarized with the subject. The present literature review will focus on the current knowledge about hoarding, digital hoarding, and PIM.

2.1. Literature Search

The search process of the literature began with a brainstorm, based on the preliminary research conducted mainly in relation to hoarding and digital hoarding. The brainstorming session revealed that the emergent keywords could be categorized into four main blocks, namely *domains*, *categories*, *impact*, and *personality traits (See Appendix I – Keywords & Blocks)*. Each block contains words or phrases related to each other, and even synonyms. The first block, domains, contains terms in relation to information, data, hoarding and clutter, as these were established to be the main topics to be investigated in the literature review. The second block, categories, refers to terms in connection to the management and organization of the information or digital files, and different organization methods. The block called impact holds terms related to causes or triggers and their synonyms related to disorders. Lastly, the personality traits block contains terms in relation to psychological diagnosis, such as hoarding, obsessive-compulsive disorder, or addiction *(See Table 2.1*).

Block 1 - Domains	Block 2 - Categories	Block 3 - Impact	Block 4 – Personality Traits
Clutter Hoarding Digital hoarding Physical hoarding Compulsive hoarding Data hoarding Pathological hoarding Information clutter Digital clutter	Personal information management Piles Filers Minimalism Affordances	Cause Effect Enablers Triggers Symptoms Characteristics	Attachment Attentiveness Hoarding behavior Obsessive-compulsive disorder Hoarding obsessions Hoarding compulsions Hoarding addition

Table 2.1 – The final version of the block-sets and the words used for the literature search.

These blocks were used to perform multiple searches in different databases. The databases were selected through the university's library, AAU Library. Here, databases were sorted by subject of interest, namely *IT, electronics and programming*, *media, communication and information*, and *philosophy and psychology*. This results in 72 potentially relevant databases based on the area of interest. To narrow these down, it was decided to only focus on using databases with which we were familiar, namely ACM Digital Library, ProQuest, IEEE Xplore, Google Scholar, JSTOR, APA PsychNet, Scopus, SpringerLink, and Wiley Online Library. For each of these databases, keywords from the established blocks were used in different combinations. For example, different words from the first block were combined with different blocks from the second, third, or fourth block and so on. These combinations depended on yielded results because when noticed that certain keywords did not provide sufficient results or relevant results, they were changed *(See Appendix II – Integral Literature Search)*.

Additionally, several filters were used during the search. First, for each search there was a filter on the publication date. It was decided to search for material published between 2010 and 2020 because during the preliminary literature search it was discovered that most material focus on digital hoarding came after 2010. A second filter used was *NOFT* (Anywhere except full text), meaning that the searches were focused on the title, abstracts, and keywords of the material, but not within the full text. This was decided in order to avoid irrelevant material that might have used one or two of the keywords within their body of text but in a totally different context. The last filter was one applied to the language. For the search, only the material written in English was considered.

Once the search began, it was determined that some of these databases did not generate any results that were relevant by title and, as such, were disregarded. After saturation was reached in the search, the focus was on reading the titles through the final results. At first, the material was considered relevant or not based on the title. By reading through the titles of each search, it was determined that at around the 6th or 7th page of any search, the titles were not relevant to the problem at hand anymore. As such, the material was selected based on its relevancy and connection to hoarding, DH, and PIM. From each database, the following number of titles was considered relevant:

- ACM Digital Library – 9 relevant titles
- APA PsychNet – 27 relevant titles
- Google Scholar – 13 relevant titles
- IEEE Xplore – 2 relevant titles
- ProQuest – 23 relevant titles
- Scopus – 7 relevant titles

Afterwards, all the papers were merged, and any duplicates were eliminated. The total number of papers was 69 from the six databases. The next step was focused on further elimination of irrelevant material. Here, the abstracts of the 69 papers were read and, out of these, 51 were considered either partly or fully relevant. While for some of the papers the relevancy was clear by reading the abstracts, for others that was not the case. As such, these were papers considered to be potentially relevant, so were kept for a formal read-through as well. During the process of reading the abstracts, the subjects for the master thesis were identified, namely hoarding, DH, and PIM. A list was created that indicates which papers are relevant and which not, as well as the concept to which they are related *(See Appendix III – Relevant Literature)*.

These 51 papers were all thoroughly read. During this process, some of them were considered irrelevant and were further disregarded from use. Nevertheless, it is worth mentioning that the process of reading these papers, relevant or not, brought to the surface further papers, which were analyzed and used as well. Additionally, as part of the preliminary research, 27 articles were found relevant by title, out of which 22 were considered relevant after reading the abstracts. Out of the preliminary research, 5 papers were duplicates of what had been found during the literature research. The other 17 papers were not found as part of the literature research. It was decided to include these papers in the literature review as well because they are relevant in terms of content. The total number of papers used in the literature review is 58.

2.2. Hoarding

The need humans have for possessions is reinforced by their need to ensure survival through collecting and accumulating goods for when resources become limited (Grisham & Barlow, 2005). According to Neave, McKellar, Sillence, and Briggs (2020) most people tend to accumulate personal possessions during their lives. These possessions have greater sentimental value to their owners than their actual worth and, within these people, there is an increased level of reluctance in parting with some of these possessions (Neave, et al., 2020). In 1918, James (as cited in Grisham & Barlow, 2005) indicated that acquisition desire is a basic human instinct. Although acquisition behaviors are normal, these tendencies become pathological in some individuals (Neave, et al., 2020). Frost and Gross (1993) acknowledge *hoarding* to be a special case of *acquisition tendencies*. Hoarding is defined as the excessive acquisition and the inability to discard of possessions that are of seemingly limited or of no value, to the extent that it impedes appropriate use of living spaces which become overly cluttered and daily functioning is significantly impaired (Frost & Gross, 1993; Frost & Hartl, 1996).

2.2.1. History

In 1996, hoarding was a growing subject among humans as most research had previously focused on food hoarding in animals (Frost, Krause, & Steketee, 1996). According to Frost et al. (1996), literature existent at the time suggested that hoarding in humans is rarely associated with food items, and usually associated with items found in their daily lives. In this early literature, hoarding was mostly studied and mentioned in connection to obsessive-compulsive disorder (OCD). In a series of studies, Frost & Gross (1993) investigated the relation between hoarding and OCD ad found that hoarding can be associated with several traits of obsessive-compulsive personality disorder, such as indecisiveness and perfectionism, as well as with various obsessive-compulsive symptoms. The relation between hoarding and obsessive-compulsive (OC) symptoms has later been studied by Frost et al. (1996). They found a correlation between hoarding and OC symptoms using both self-report measures and an interview-based rating scale.

By 2005, hoarding was listed as one of the eight symptoms of obsessive-compulsive personality disorder (OCPD), with research viewing hoarding as a subtype of OCD (Grisham & Barlow, 2005). Throughout the years, hoarding has been studied extensively from various perspectives. By 2010, literature had emphasized that, although still commonly associated with OCD, hoarding was a symptom prevalent in multiple organic and mental disorders (Steketee & Frost, 2003; Pertusa, et al., 2010a). According to Pertusa, Frost and Mataix-Cols (2010b), at around the same time, the separation of hoarding from OCD was extensively

considered for several reasons. For example, one reason was that many individuals diagnosed with hoarding were not exhibiting any other OCD symptoms, while a second reason emphasized the fear of losing possessions and urges to save, which were exhibited differently in those with severe hoarding but no OCD symptoms (Pertusa, et al., 2010b). Other important reasons were the fact that evidence shows that hoarding worsen over time, unlike OCD, and the fact that hoarding patients were much less responsive to OCD treatments (Pertusa, et al., 2010b). Pertusa et al. (2010b) found in their research that OCD-based hoarding is rare and that more often than not, hoarding is not related to OCD.

In 2018, the World Health Organization (WHO) classified hoarding as a mental disorder in its revised International Classification of Diseases (Neave, et al., 2020). In the process of separating hoarding from OCD, research has been indicating that there is comorbidity in hoarding (Frost, Steketee, & Tolin, 2011; Hall, Tolin, Frost, & Steketee, 2013). Comorbidity refers to the presence of one or more mental health problems co-occurring in addition to a primary condition (Teesson, Degenhardt, Proudfoot, Hall, & Lynskey, 2005). According to Frost et al. (2011), comorbidity is present in up to 92% of those people who meet criteria for hoarding disorder (HD). However, Hall et al. (2013) conducted a study where the findings show that 42% of their sample is non-comorbid, meaning the participants did not show clinically significant levels of other conditions. Nevertheless, Hall et al. (2013) indicate that their findings could have been influenced by choosing to investigate different conditions than Frost et al. (2011). Novara, Bottesi, Dorz, and Sanavio (2016) also investigated comorbidity and found that hoarding symptoms are not exclusive to hoarders. Although these studies show that hoarding symptoms are present in individuals with other disorders as well, they also show that there is an absence of relevant comorbidity in 25 to 42% of hoarders (Frost, et al., 2011; Hall, et al., 2013; Novara, et al., 2016).

2.2.2. Hoarding Behaviors

In 1996, Frost and Hartl worked towards a systematic way of defining hoarding. They identified three essential characteristics of hoarding: "(1) the acquisition of, and failure to discard a large number of possessions that appear to be useless or of limited value; (2) living spaces sufficiently cluttered so as to preclude activities for which those spaces were designed; and (3) significant distress or impairment in functioning cause by the hoarding" (Frost & Hartl, 1996, p. 341). Acquisition is related to buying and acquiring of free things, which have been shown to play a major role in hoarding (Steketee & Frost, 2003). The inability to discard possessions that are worthless or no longer of use has been associated with beliefs of the instrumental and emotional value of these possessions (Steketee & Frost, 2003). However, Steketee and Frost (2003) indicate that these behaviors are generally considered pathological only when they are accompanied by extreme clutter, leading in this way to scenarios in which normal use of space around one's home is impaired.

In the initial investigation conducted by Frost & Gross (1993), indecisiveness, perfectionism, judgements about needs, and emotional attachment were found to be the core aspects behind hoarding. Frost and Hartl (1996) proposed a *cognitive behavioral model of compulsive hoarding* which attests for the three manifestations of hoarding, namely acquisition, saving, and clutter. This model was based on previous research that has been conducted by Frost and different colleagues. According to this model, the

manifestations of hoarding are a result of four types of deficits: information processing deficits, emotional attachment problems, behavioral avoidance, and erroneous beliefs about the nature of possessions (Frost & Hartl, 1996). In this first version of the model, Frost and Hartl (1996) mention that these facets of hoarding are overlapping in significant ways. As such, this cognitive behavioral model has been redefined to three deficits, namely information processing deficits, beliefs about and attachments to possessions, and emotional distress and avoidance behaviors (Steketee & Frost, 2003).

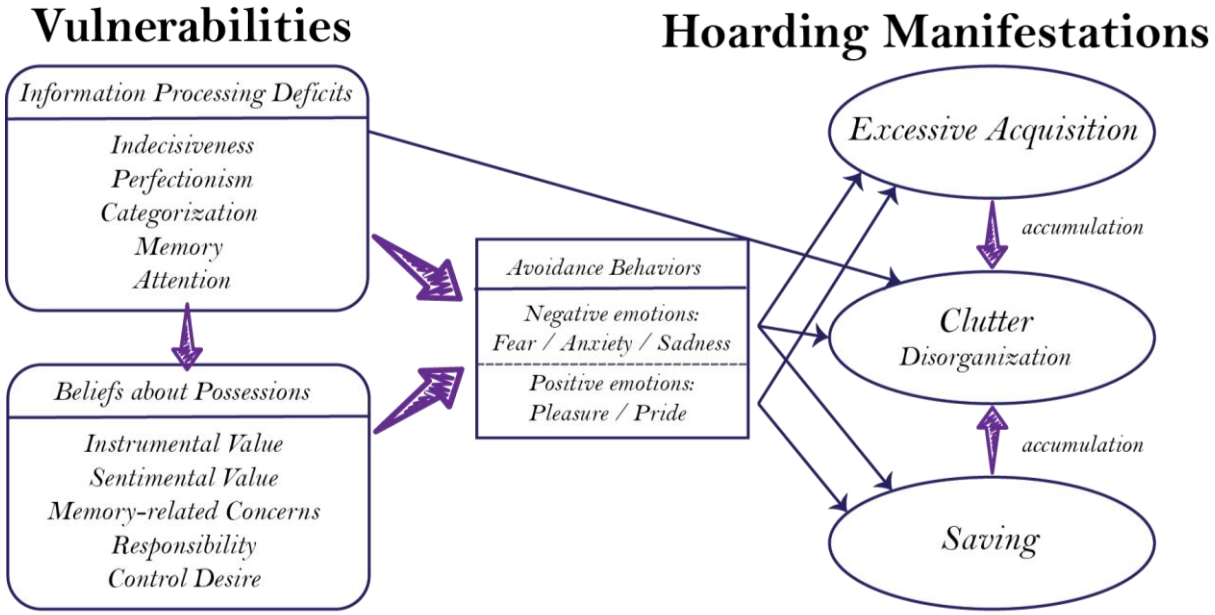

Figure 2.1 – Visual model of cognitive behavioral model of hoarding disorder, adapted from Grisham and Barlow (2005), Finneran (2010), and Steketee (2018). The model represents a contribution to the hoarding literature, as it emphasizes the relationships rather than influences.

2.2.2.1. Information processing deficits

Frost and Hartl (1996) claim that there are various information processing deficits that can be associated with hoarding. Decision-making problems, categorization problems, difficulties with memory functions, and attention have been consistently found to be core features of hoarding (Frost & Hartl, 1996; Steketee & Frost, 2003; Grisham & Barlow, 2005). According to Grisham and Barlow (2005), individuals who hoard tend to exhibit information processing deficits, which results in misjudgment about the value possessions have, leading to difficulty in organizing and discarding. Frost and Hartl (1996) indicate that decision-making is primarily related to indecisiveness. Research shows that indecisiveness is correlated with hoarding, as people who hoard are having difficulties in making decisions and are usually not able to decide whether an object is still of use or not (Frost & Gross, 1993; Thobaben, 2006).

In hoarders, the decision-making process is influenced by the belief that most of their possessions are very important and this contributes to the inability to discard or organize these possessions (Grisham & Barlow, 2005). In turn, this leads to saving all these possessions consistently. As such, the hoarder can avoid making a decision in relation to discarding a possession, as well as the uneasiness and fear that a mistake was made once a possession was discarded (Frost & Hartl, 1996). In general, research shows that there is a general tendency towards worrying about mistakes and being indecisive when it comes to hoarders (Frost & Hartl,

1996). Additionally, the decision to discard of a possession is influenced by the perceived value of that item, being it *instrumental value* or *sentimental value*, or both. According to Frost and Steketee (2008), instrumental value is reflected by the value given to possessions because of their potential use or need, whereas sentimental value refers to emotional attachment which is assigned to objects that have an emotional meaning, usually because there is an association with a particular person, place, or event. Frost and Steketee (2008) emphasize that these reasons do not differ between hoarders and non-hoarders but the extent to which possessions hold these values does differ.

Individuals with hoarding problems have been shown to suffer from underinclusive cognitive style when it comes to organization and categorization (Steketee & Frost, 2003). In a review conducted on the current status of research on hoarding, Steketee and Frost (2003) mention that, for hoarders, "each possession must be set apart to reflect its special importance" (p. 913). Consequently, this creates a mindset where each possession has to be in its own category because it is unique and could not be compared to any other possession. The result is that needless and meaningless items are placed together with more important things because the person will become overwhelmed by the situation and will discard the task, placing this item in a random place (Steketee & Frost, 2003). Kilroy-Marac (2018) indicates that this can either lead to over-categorization or under-categorization. Over-categorizers have the tendency to consider every object as being totally distinct from other objects, whereas under-categorizers tend to view objects as having similar features to other objects and to it makes no sense to separate these (Kilroy-Marac, 2018).

Memory deficits can also be present in people with hoarding issues. According to Frost and Hartl (1996), there are two aspects of memory that are applicable, namely the lack of confidence in one's own memory and the overestimation of the relevance of remembering and recording certain information. Steketee and Frost (2003) indicate in their review that the lack of confidence is, in reality, not accounted for by real and significant memory performance. Moreover, their review indicates that hoarders tend to be overconcerned about the consequences of forgetting information and end up with a stronger desire to keep their possessions in sight, as to not forget them (Steketee & Frost, 2003). This has been tied to the perfectionism that is associated with hoarding. Hoarding was highly correlated to perfectionism as well, leading Frost and Gross (1993) to infer that those who are overly concerned with their mistakes, end up hoarding items to avoid mistakenly throwing away anything that might be needed. The main reason behind hoarding was found to be the concern of having available resources through their possessions for possible future use (Frost & Gross, 1993).

Frost and Gross (1993) indicate that clutter seems to be caused by the inability to discard possessions that are of no use. The clutter that is created with the accumulation of possessions increases the risk of inattention. Grisham and Barlow (2005) claim that hoarders tend to shift their attention during a particular task, for example of discarding or organizing a possession. Although previous studies have linked hoarding with the attention deficit hyperactivity disorder (ADHD) and have focused on their comorbidity in terms of attention deficits, more recent studies focus on attaining that inattention is a symptom of hoarding independent of a ADHD comorbidity (Steketee & Frost, 2003; Baldwin, Whitford, & Grisham, 2018). Baldwin et al. (2018) conducted a study focused on the neurophysiological marker of inattention and found

that “the relationship between hoarding and inattention symptoms [is] independent of more general problems with anxiety and mood” (p. 919). This indicates that inattention can be present in an individual who has hoarding issues regardless of whether a diagnosis of ADHD is present.

2.2.2.2. Beliefs about and emotional attachment to possessions

Over time, research on people who hoard has shown that emotional attachment to possessions is a phenomenon associated with hoarding. Frost and Gross (1993) found that their participants reported feelings of loss when having to discard items. As such, it is hypothesized that certain beliefs can influence individuals to acquire and save items to avoid being upset emotionally and to prevent negative outcomes (Steketee & Frost, 2003). Steketee, Frost, and Kyrios (2003) describe these beliefs as emotional attachment, memory-related concerns, desire for control, and responsibility. Steketee and Frost (2003) point out that emotional attachment “encompasses beliefs about the emotional comfort provided by objects, fears of losing something important, and feelings of loss of self or identity” (p. 914). Memory-related concerns are related to individuals’ beliefs that possessions and objects can be used and needed as reminders, whereas the desire for control refers to individuals’ desire to keep others away from touching their possessions (Steketee & Frost, 2003). Responsibility refers to individuals’ belief that they are responsible for their possessions because these belong to them (Steketee & Frost, 2003).

Emotional Attachment Theory

Attachment relationships are recognized to represent a biological predisposition that has emerged to ensure survival, just like in the case of acquiring (Scharfe, 2017). John Bowlby, the founding father of attachment theory, laid his theoretical foundations on the construct that individuals are expected to develop attachment relationships with their caregivers, as well as to seek these caregivers in cases of stress, being ill, or afraid (Scharfe, 2017). According to Scharfe (2017), the differences seen in attachment from individual to individual are associated with the differences in care individuals experience. As such, infants’ perception of others as being good or bad is based on their early childhood experiences (Cornelius, 2017). In 1944, Bowlby found that poor parenting influences children’s behavior (Scharfe, 2017). Cornelius (2017) mentions, in her master’s thesis on emotional attachment and its influence on hoarding, that childhood abuse represents a main barrier to individuals’ development of secure attachment.

Experiencing abuse in childhood leads to higher rates of maladaptive patterns and insecure attachment (Sciakou as cited in Cornelius, 2017). Nedelisky and Steele (2009) investigated attachment to people versus attachment to inanimate objects with a small study. They found that hoarders presented higher levels of emotional attachment towards their inanimate possessions and lower levels of emotional attachment towards people than non-hoarders. This indicates that individuals who hoard are likely to direct their attachment towards inanimate possessions after withdrawing it from other people (Nedelisky & Steele, 2009). Scharfe (2017) indicates that the influence of these early experiences is apparent across an individual’s lifespan. Moreover, research shows that turning to objects is a pattern adopted by individuals who look to fulfill interpersonal needs (Kwok, Grisham, & Norberg, 2018). Therefore, emotional attachment to possessions is a cognitive outcome to which individuals unconsciously resort when lacking interpersonal affection.

Frost and Hartl (1996) found that pure sentimental attachment develops because possessions are seen as part of one's self and they are considered meaningful reminders of significant past events. This has been considered to happen because individuals who hoard tend to view many, if not most, of their possessions as extensions of themselves (Frost & Hartl, 1996). According to more recent research, emotional attachment to possessions and the sense of responsibility for the welfare of objects seem to be intensified the moment objects are given human-like traits and qualities, a phenomenon known as anthropomorphism (Burgess, Graves, & Frost, 2018). In their study on object attachment, Kwok et al. (2018) found that greater anthropomorphism is related with greater object attachment. Moreover, the study also indicates that greater levels of both sentimental and instrumental value can be predicted by greater anthropomorphism (Kwok, et al. 2018). These results show that hoarders become emotionally attached to their possessions as a coping mechanism to the emotional neglect that they experienced during their childhood.

2.2.2.3. Emotional distress and avoidance

Hoarding has been shown to be influenced by information processing problems, beliefs, and attachments to possessions. Research indicates that these behaviors are avoided by individuals who experience anxiety and unhappiness at the idea that they cannot acquire an object or that they have to discard of a possession (Steketee & Frost, 2003). In addition to the emotional upset that individuals might face in these situations, is the avoidance of decision-making. Acquiring and saving possessions instead of deciding to disregard or discard these, allows individuals to avoid or postpone making decisions in regard to objects (Frost & Hartl, 1996). Frost and Hartl (1996) indicate that organization is also avoided, given the unique importance of each possession that cannot be categorized like any other possession. Moreover, by saving everything, hoarders will avoid making a mistake that can be perceived to have harmful consequences if a needed possession is thrown out (Frost & Hartl, 1996; Wheaton, 2016). As such, avoidance is one feature that is directly related to indecisiveness, perfectionism, and emotional attachment (Frost & Gross, 1993; Thobaben, 2006).

Avoidance Behaviors

Avoidance coping is one of the major coping mechanisms that allows individuals to avoid dealing with stress and its sources in any events, either less significant or major (Carver, 2007; Balmores-Paulino, 2018). Balmores-Paulino (2018) emphasizes that, by employing the avoidance coping mechanism, individuals do not seek to address the problem that causes distress but rather to be able to live on peacefully in the middle of a difficult situation. More importantly, "sometimes avoidance coping is almost literally an effort to act as though the stressor does not exist, so that it does not have to be reacted to at all, behaviorally or emotionally" (Carver, 2007, p. 124). According to Carver (2007), avoidance coping is focused on emotions in general, because individuals often attempt to evade or escape feelings that cause them distress. However, attempting to avoid unwanted internal experiences can lead to other negative outcomes. In the context of saving and acquiring possessions, avoidance behaviors can have a double outcome; while distress and unpleasantry are reduced temporarily, the continuous avoidance of this behavior can eventually result in hoarding problems (Wheaton, 2016).

2.2.3. Onset Age & Gender Differences

The existing research on hoarding is dividedly focused on various aspects. Besides hoarding comorbidities, symptoms or tendencies, there is also a focus on HD progression throughout people's lives. In 1993, Frost and Gross found in their journey of investigating hoarding that, typically, the onset age for hoarding was around the participants' childhood or adolescence (Frost & Gross, 1993). Ayers, Saxena, Golshan, and Wetherell (2010) investigated age of onset in hoarding and found that onset of hoarding symptoms was generally happening in childhood or adolescence, supporting the initial findings of Frost and Gross. Research indicates that hoarding is more prevalent in older age groups than compared to younger age groups (Ayers, et al., 2010). According to Ayers et al. (2010), a review into this aspect illustrates that this might be the case because hoarding symptoms are often brought to clinical attention when participants are older.

These components imply that symptoms of hoarding are progressive, with individuals exhibiting severe hoarding levels by their mid-30s (Ayers, et al., 2010). Moreover, the research conducted by Ayers et al. (2010) indicates that hoarding severity increases throughout the participants' lives, worsening with each decade of their lives. These results are also supported by an earlier study conducted by Grisham, Frost, Steketee, Kim, and Hood (2006), who found both that common onset age was in early adolescence and that symptoms were accelerating with time. Grisham et al. (2006) indicate that hoarding can also be experienced for the first time late in life in participants who experience stress or significant loss. Przeworski, Cain, and Dunbeck (2014) investigated how traumatic events affect individuals with hoarding symptoms, among others. They found that onset is also affected by the number of traumatic events (Przeworski, et al., 2014). These findings indicate that hoarding symptoms start, usually, in childhood or early adolescence but there is the factor of traumatic events that can cause late onset.

In addition to age of onset, gender differences in hoarding are also explored with most studies (Frost and Gross, 1993; Steketee, et al., 2003; Frost, et al., 2011; Novara et al. 2016). Frost and Gross (1993) did not find any frequency differences between females and males in their study. Frost, Steketee, Tolin, Sinopoli, and Ruby (2015) investigated motives for acquiring and saving in HD and looked into gender differences too. They only found a significant difference for acquiring possessions to avoid waste which was more frequently rated by men than women (Frost, et al., 2015). Additionally, they found a pattern for men to rate saving more frequently than women did, but no significant difference. Overall, there were no gender differences that approached significance in their study (Frost, et al., 2015). In general, it is not clear whether there is a general gender distribution of hoarding. Moreover, in most studies, samples consist of primarily female participants, meaning that demographics of the hoarding population are not reflected accurately (Tolin, Frost, Steketee, Gray, & Fitch, 2008).

2.2.4. Diagnosis Criteria

The existent research on hoarding disorder indicates that a diagnosis can be established based on certain criteria. One of them is that a diagnosis can be made only after ruling out other comorbidities, such as any neurologic conditions or mental disorders (Mataix-Cols, 2014). Mataix-Cols (2014) mentions that it is especially important to rule out OCD, as hoarding was initially viewed as a symptom of this disorder, until it evolved to be considered a different disorder. This is the case because HD and OCD have several

symptoms in common, meaning that HD could pass as OCD even if that is not the case and vice-versa. Another important criteria is that pathological hoarding should be differentiated from normative collecting, which refers to common collections that individuals have but keep under control in terms of clutter and disorganization (Mataix-Cols, 2014). According to Kilroy-Marac (2018), the distinction between normative collecting and pathological hoarding is not in the amount of things a person has acquired, but in the way these are arranged and cared for. As such, hoarding disorder should be diagnosed on the basis of extensive testing, and not exclusively on self-reports.

2.3. Digital Hoarding

Nowadays, the world has reached a point where information is prevalent. However, information can easily overload the user, and turn into clutter due to wrong management. Beside the management factor, an individual's personality traits can also influence how much information is saved, and how much of it is retained because of the attachment that the user develops in regard to that particular piece of information (Bergman & Whittaker, 2016). Digital storage spaces have enabled new ways of storing big amounts of digital information and this has led to the possibility of *information clutter* (Bergman & Whittaker, 2016). Neave et al. (2019) indicate that people tend to believe that information clutter cannot have negative consequences in their lives just because it is not visible nor does it cause sanitary problems. However, accumulating digital possessions can become a problem when information is being hoarded. This has motivated researches to investigate *digital hoarding*, which is identified as a subtype of the hoarding disorder (Van Bennekom, et al., 2015). Van Bennekom et al. (2015) define digital hoarding as "the accumulation of digital files to the point of loss of perspective, which eventually results in stress and disorganization" (p. 1).

2.3.1. First Case of Digital Hoarding

The phenomenon of digital hoarding has been clinically studied first by Van Bennekom et al. (2015). In their study case, Van Bennekom et al. (2015) reported their findings in regard to a particular patient, who realized that through his daily activity, i.e. digital photography, he was taking around 1000 pictures a day and could not delete any of them, even though most of them were similar. The patient reported that he saved pictures and never deleted them because he was attached to all of them, and they brought back memories. The patient presented symptoms of physical hoarding, autism spectrum disorder, and depression, had no family and was unemployed (Van Bennekom, et al., 2015). By studying this patient, Van Bennekom et al. (2015), noticed many similarities between his physical hoarding disorder and his digital clutter problem, such as attachment to the possessions, distress, and unorganized digital storage space, similar behavior to that of a piler. Van Bennekom et al. (2015) indicate that some of the characteristics presented refer to the difficulty of discarding of digital possessions, the emotional attachment to these, and the fear of losing the data, which causes saving files until it leads to digital clutter. Digital clutter causes distress and disorganization, which interfere with individuals' daily activities (Van Bennekom, et al., 2015).

Van Bennekom et al. (2015) mention that their patient was emotionally attachment to his digital possessions. Digital possessions are digital items perceived by individuals as being theirs and can be distinguished from any other digital item that the individual owns (Cushing, 2013). Cushing (2011)

mentions that physical and digital possessions are perceived as sacred things and that individuals are removing these artefacts from their daily use because they are too important to be used. Digital possessions can be many objects, for example books, music, photos, or plane tickets that are losing their material form and that become digital (Odom, Zimmerman, & Forlizzi, 2011). According to Cushing (2013), while an individual might perceive a certain digital item as a digital possession, another individual might not consider the same item a digital possession. Thus, it is important to consider the relationship between an individual and digital possessions when investigating what can be considered a digital possession (Cushing, 2013).

Odom et al. (2011) found in their study about how teenagers perceive their virtual possessions and their practices, that their digital possessions were important and personal. For example, most of the participants expressed that they interact daily with these digital possessions in order to maintain their self-appearance for other people, both online and offline (Odom, et al., 2011). Another factor was that the participants enjoyed showing off their digital collections, such as photos with them in certain circumstances, or certain achievements (Odom, et al., 2011). In the individual-digital possessions relationship, it can be noticed a certain behavior, such as possession attachment (Cushing, 2013). Kleine and Baker (as cited in Cushing, 2013) mention that attachment with a certain possession must include emotional attachments, and a certain personal history with that possession. The study conducted by Cushing (2013) in order to find out what are the main characteristics of digital possessions, underlines the following characteristics: a digital possession provides evidence about an individual, represents an individual's identity, it has value for the individual and the individual has absolute control over that possession.

2.3.2. Emotional Attachment

A digital possession includes an emotional attachment of an individual for the possessed digital item. Digital hoarding is being investigated because there is evidence that people can become attached to non-physical possessions too, not only to physical ones (Thorpe, et al., 2019). According to the attachment theory, individuals who hoard are likely to direct their attachment towards inanimate possessions after withdrawing it from other people (Nedelisky & Steele, 2009) *(See Section 2.2.2.2. Beliefs about and emotional attachment to possessions)*. Kwok et al. (2018) indicate that a pattern adopted by individuals who look to fulfill their interpersonal need is to turn to objects. In the first studied case of digital hoarding, the patient was emotionally attached to his digital photographs and could not discard any of them because these were reminders of the past (Van Bennekom, et al., 2015). Furthermore, this patient was unemployed and not married. These aspects are underlying of emotional attachment and can be considered influential factors for the patient's inability to discard possessions.

Thorpe et al. (2019) conducted an online survey among 282 participants to explore the extent of the emotional attachment people might have for digital possessions. Their research shows that there are high scores of emotional attachment and hoarding behavior for digital possessions (Thorpe, et al., 2019). Another case study which investigates attachment to digital possessions is the one by Sweeten et al. (2018), where their participants presented struggles to delete personal files because of fear, laziness, anxiety or because the digital files represent emotions, such as photos with children. One of the participants mentioned that pictures represent parts of his past, while another mentioned that he hates deleting pictures with his children

(Sweeten, et al., 2018). Similar findings were reported by Vitale et al. (2018) who investigated tendencies in digital data preservation. A female participant mentioned that she cannot let go of the pictures with her children, as they capture experiences with her children, and are very important in her life (Vitale, et al., 2018).

These findings are not only supported by earlier findings, such as those of Cushing (2011; 2013), but are also in line with findings from studies that focus on physical hoarding (Frost & Gross, 1993; Frost & Hartl, 1996). Additionally, Frost and Hartl (1996) also found that possessions are seen by individuals who hoard as part of themselves and are considered meaningful reminders of past events of great importance. This can be integrated into the point made by the patient studied of Van Bennekom et al., where discarding of digital pictures was difficult as these represented memories associated with events. This suggests the implication of anthropomorphism, where objects are given human-like traits and qualities, as the presence of a person who could share the memory with the patient could have resulted in a different perspective on pictures for this patient. In addition, the findings of Thorpe et al. (2019), Sweeten et al. (2018) and Vitale et al. (2018) have similar implications in regard to what can lead to emotional attachment of digital possessions.

2.3.3. Digital Storage

Research indicates that it is not clear what causes digital hoarding. However, it has been argued that the unlimited possibilities of data storage spaces enable digital information clutter and, as such, digital hoarding is an increasing problem (Sweeten, et al., 2018). Nevertheless, according to Finneran (2010), if there is no clutter, hoarding is not considered pathological. The physical presence of clutter makes it easier to identify the problem, since the sight of an object was identified to increase its value in hoarders (Frost & Hartl, 1996). Even more so, Frost and Hartl (1996) indicate that some hoarders are motivated to have their objects displayed. Considering that digital clutter is not visible, and it is stored in digital devices, it is difficult to notice or to diagnose digital hoarders. Sweeten et al. (2018) found that endless digital storage spaces provide the reason people ignore data accumulation, and this gives them no reason to even consider deleting any piece of information.

Cloud storage is one of the storage spaces that enables digital hoarding, where organizations and individuals save information in multiple servers and locations, and where copies of the digital possessions of an individual are created (Thorpe, et al., 2019). The convergence offered by cloud computing, and the constant growth of networked devices creates new opportunities for people to store and move their digital items in the online (Odom, Sellen, Harper, & Thereska, 2012). Moreover, by moving away from local storage, users have the security that their digital items are safe and can be accessed from any device, at any time (Odom, et al., 2012). There are several reasons for people choosing to move their digital items to the cloud. One is the ease an individual has to share content with others, while another is to access files more easily from anywhere (Odom, et al., 2012) Additionally, clouds are considered secure and individuals believe that information stored online is safe from being lost in any accidents, so they use clouds as back-ups in case their devices will break down (Odom, et al., 2012).

Vitale et al. (2018) found that their participants were rarely deleting any digital data that they had. This happened because it was considered that it was easier to pay for more storage than to take time and delete

useless files (Vitale, et al., 2018). This indicates that the better alternative to running out of storage is to increase the storage, being it in the form of extra hard drives or extra cloud space. Research indicates that, in some cases, individuals do not consider themselves to be liable the storage they are using (Sweeten, et al., 2018). This happens especially in the case of cloud storage that is unlimited or in work settings. Sweeten et al. (2018) found that, in these cases, their participants considered that this storage did not belonged to them, so it was not their problem. This shows that individuals who hoard digital data take full advantage of what storage affords them, unlimited means of storing unlimited data.

2.3.4. Practical Value

Individuals can accumulate information for different reasons and under different circumstances, for work or private interests. Digital hoarding can be caused because of the practical factor in terms of job requirements. Gormley and Gormley (2012) investigated the impact data hoarding and information clutter has. They found that hoarding comes involuntary through the participants' daily jobs, and a huge part of the data clutter is because of organizations, which encourages this type of behavior (Gormley & Gormley, 2012). This could be because data is considered knowledge, and companies and organizations are afraid that they might not get back this knowledge if it is discarded and not stored over the years (Gormley & Gormley, 2012). Vitale et al. (2018) indicate that, besides emotional value, the practical value of digital information can also influence digital hoarding. Some of their participants reported keeping large amounts of information in their workspaces, such as tax documents for several years (Vitale, et al., 2018).

The practical value of digital possessions can be interpreted as the instrumental value physical hoarders attribute to their possessions. Vitale et al. (2018) found that, besides work data being of practical value, information regarding school projects are also considered of practical value because it could come in hand for future projects or when looking for jobs. Additionally, Vitale et al. (2018) found that their participants expressed fear of discarding digital files as these were considered to potentially be important in the future. As such, these were kept under the pretext of "just-in-case" (Sweeten, et al., 2018; Vitale, et al., 2018). These findings are supported by Gormley & Gormley (2012), who mention that one of the reasons for becoming a digital hoarder could be that individuals do not know how much information they need, so they are afraid to delete any of it, thus resulting in digital clutter.

2.3.5. Affordances

Digital storage spaces, such as the memory of the devices, the web, or the cloud can be perceived as new possibilities for digital items storage, offered to an individual by today's advanced technology. These possibilities or functions that a device offers in addition to the main function, can be perceived as *affordances* of the device. Maier and Fadel (2009a) explain that an affordance is "what one system (say, an artifact) provides to another system (say, user)" (p. 19). For example, the telephone was invented in order to enable communication at distance between individuals. However, the 21st century phones have evolved so much that they are not used only for their main function anymore, i.e. communication. The phones nowadays, namely smartphones, are designed to have more than just one function, such as taking pictures, emailing, recording, watching videos, storing information, sharing information and so on. Individuals can choose their own way to use the smartphone and its affordances.

2.3.5.1. Affordance Theory

Affordance theory was first introduced by Gibson (1979), where he expressed his own perception about affordances using an ecological approach, namely an animal and the environment as the main references to explain what affordances are. Gibson (1979) explains that "affordances of the environment are what it offers the animal, what it provides or furnishes, wither for good or ill" (p. 119). The word affordances was invented by Gibson himself, as a noun form of the verb afford, to express the complementarity of the animal and the environment (Gibson, 1979). The Gibsonian concept was further developed and introduced in the field of human-computer interaction by Don Norman in 1988 (Norman, 2002). He explained how things are designed and how their properties can determine how they can be used. He gives several examples of objects and what they afford to an individual, such as a chair affords support and therefore affords sitting (Norman, 2002). Through affordances, the individual gets a strong clue on how to operate the things (Norman, 2002). Based on Gibson and Norman, Maier and Fadel (2009a) defined the *Affordance-Based Design*, where concepts like user and systems are being introduced.

The relationship between the smartphone and an individual is that the individual uses the smartphone, but it is the affordance of the smartphone that determines how the individual uses that device (Maier & Fadel, 2009a). For example, in the case of a smartphone, there are two affordances presented, one between the device and the individual, i.e. *artifact-user affordances*, and one between the subsystems of the smartphone, i.e. *artifact-artifact affordances* (Maier & Fadel, 2009a). These affordances that a smartphone creates to the individual can influence not only how the device will behave, but also how the user will behave with the device (Maier & Fadel, 2009a). According to Norman (1999), it is important to recognize that the intended affordances of an object are only partial to what a user might perceive. This means that it is significant to recognize an object's intended use, *real affordances*, as well as the affordances that are perceived by the user, *perceived affordance* (Norman, 1999).

In order to better understand the concept of affordances and the affordance-based design process, Maier & Fadel (2009b) underline the important properties of affordances. The first property, *complementary*, refers to the relationship between the system and the user, or between two subsystems, and the interaction between them (Maier & Fadel, 2009b). Another property, *polarity*, refers to the fact that affordances have a positive and negative side, depending on whether the potential behavior has beneficial or harmful consequences (Maier & Fadel, 2009b). A third property is *multiplicity*. Multiplicity allows a system or a device to be designed to afford more than one affordance (Maier & Fadel, 2009b). For example, Gibson (1979) explains that water affords drinking, while it can also afford drowning or washing. Another property of affordance indicates the *quality* of it, which indicates how well that system was designed to afford a specific use or a behavior (Maier & Fadel, 2009b). For example, a chair affords both sitting and carrying, but the affordance of sitting is better offered than the affordance of carrying (Maier & Fadel, 2009a). Lastly, Maier and Fadel (2009b) mention the *form dependence* property, which implies that affordances depend on the physical structure of the system.

2.3.5.2. Affordances in Digital Media

Affordance theory has been receiving more attention in digital studies. Although affordances were explored in terms of ecologic systems (Gibson, 1979) and in everyday things (Norman, 2002), the digital field can

benefit from the theory of affordances as well. Although Maier and Fadel (2009a; 2009b) have investigated affordances of physical devices, the concept of affordances can also be explored in digital media. It is important to acknowledge that the development of technology has made it possible for many software and digital platforms to be created in order to ease people's daily lives, which are dependent on computers and smartphones. The features and properties of these software and platforms can be seen as affordances that are enabled by socio-technology (Hopkins, 2016).

Hopkins (2016) explored the concept of affordances in digital media and determined that the increasing use of affordances in digital studies could be because of the way in which software enables social technology. Additionally, the variously unanticipated uses of technology that are brought to the surface through interactions and social relations could also explain the increasing use of affordances in digital media (Hopkins, 2016). As mentioned, affordances are recognized as real affordances and perceived affordances, being what leads to unexpected uses of technology. Therefore, this can be applied to software and digital platforms as well. Michael (as cited in Hopkins, 2016) mentions that affordances can be seen as nested in each other, linked in chains that resonate. Thus, each digital platform contains *basic affordances* that represent its foundation, and *emergent affordances* that can be achieved depending on the user's interaction (Hopkins, 2016). From this point of view, it can be concluded that digital platforms and software offer affordances that are perceived differently by every individual, independent of the intended affordances of that particular software or digital platform.

2.3.6. Similarities between Physical Hoarding and Digital Hoarding

Although hoarding has been studied extensively, only limited research has been conducted in regard to digital hoarding. According to Finneran (2010), digital hoarding is not of particular interest to the clinical psychology hoarding literature because it is considered that it does not necessarily lead to functional impairment of domestic space or family distress. As such, digital hoarding is considered a subtype of the hoarding disorder since it does not interfere with people's living spaces and hygiene standards (Van Bennekom, et al., 2015). However, more of people's lives have been moved online and digitally and this can result in a growing problem as time goes by.

The main contributors to digital hoarding are the previously mentioned factors, i.e. digital storage, affordances, practical value, and emotional attachment. Cushing (2013) underlines the main characteristics of digital hoarding, namely that a digital possession provides evidence about an individual, it represents the individual's identity, it has value for the individual and the individual has absolute control over that possession. Although unlimited access to free storage, where clutter is not visible and does not cause sanitary problems, is leading people to believe that this hoarding behavior is harmless, the accumulation of both organizational data and personal digital possessions can become a problem (Neave, et al., 2019). Moreover, digital hoarding could have a negative impact not only in hoarders' personal lives, but also in the organizations, where information is used excessively every day (Neave, et al., 2019).

Digital hoarding is not visible like physical hoarding, so it is difficult to easily detect it. As Finneran (2010) states, without the presence of physical clutter, it is difficult to diagnose hoarding as being pathological. Even so, there is evidence that digital hoarding shares similarities to physical hoarding (Van Bennekom, et

al., 2015; Thorpe, et al., 2019; Luxon, et al., 2019). Thus, research indicates that the same factors that impact physical hoarding should be considered when trying to diagnose digital hoarding. These factors could be difficulty in discarding digital possessions, distress caused by the accumulation of digital possessions, socializing difficulties, fear of discarding, or emotional attachment (Van Bennekom, et al., 2015). Nevertheless, extensive research is required in relation to digital hoarding. Finneran (2010) has adapted the cognitive behavioral model of hoarding disorder to digital hoarding *(See Figure 2.2)*.

The literature that focuses on hoarding has identified acquisition and discarding to be the two aspects of keeping behavior, which lead to accumulation (Finneran, 2010). Finneran's (2010) adaptation of the model represents a framework for *personal information management*. According to the framework, when a digital file is accessed, the user has to decide on whether it should be acquired or to ignore it (Finneran, 2010). The acquiring process is equal to downloading or saving files in this case, being it free of charge or not. Once a file has been acquired, it is considered a *keep*. A second process happens when there is a decision to either discard or retain the digital item. In the case where the item is not being discarded, it is being retained, meaning that accumulation happens.

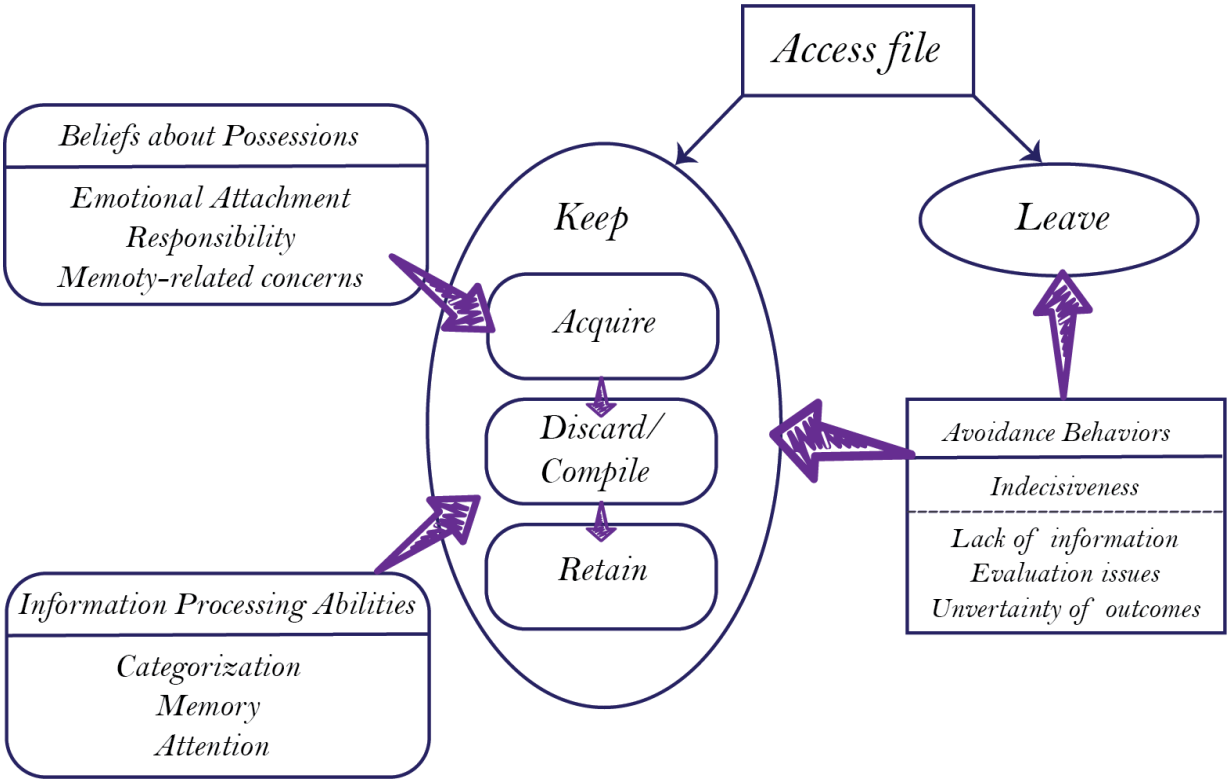

Figure 2.2 – Framework of digital hoarding, adapted from Finneran (2010).

Finneran (2010) indicates that action and inaction have different implications in relation to physical hoarding versus digital hoarding. When it comes to physical hoarding buying or acquiring an item means taking a decision. When it comes to digital hoarding downloading or saving a file indicates the highlights the initiative to do so. However, Finneran (2010) points out that in relation to digital hoarding, acquisition can happen without an individual's personal action, such as in the case of emails. In this case, the

individual's inaction will lead to accumulation, if the file is not deleted. Furthermore, Finneran (2010) emphasizes that "a person's emotional attachment to the possession, feeling of responsibility for the possession, and avoidance of negative feelings such as imperfection, all contribute to their acquisition and/or retention of the item" (p. 46). As such, the framework represents an approach to digital hoarding by considering its similarities to physical hoarding.

2.4. Personal Information Management

The *information* available at the moment is growing at a fast pace and can be found in various forms and shapes, such as physical form or digital form, from paper, books, letters, and photographs, to emails, digital files, passwords, and applications. Information can be defined in many ways and has different shapes and forms. Information is what people access to understand the world, to accomplish things, to understand what is good and what is bad (Jones, 2008). Information is knowledge, resources, data, and communication (Madden, 2000). Throughout the years, information in the physical form has been transitioned to the digital form, and this has enabled easier and unlimited ways of storing it, making it more accessible or searchable. People are using their smartphones, computers, and tablets to store the digital information they acquire in their daily lives. However, according to Jensen, Jægerfelt, Francis, Larsen, and Bogers (2018), it is difficult to get a clear overview of how information is being managed or organized on someone's device.

2.4.1. Basic Concepts

Personal information (PI) can be defined as a wide range of information retrieved from different resources that a person keeps for personal use, as well as the users' personal and unique strategy to organize that information in order to be later on accessed by themselves (Bergman & Whittaker, 2016; Jones, 2008). Individuals accumulate PI daily, forming their own *personal collections of information* (PCI) based on their own needs and behaviors (Bruce, 2005). PCI is defined as "the space we turn to first when we need information to do a task or pursue an interest" (Bruce, 2005, p. 2). In the formation of a PCI an individual adds all the needed information, and a *personal space of information* (PSI) is created. The PSI of a person is the space where the information is stored, and it "includes all the information items that are, at least nominally, under that person's control" (Jones, 2008, p. 44).

All the PI that individuals are accumulating in their own PSI to create different PCI, has to be controlled and managed in one way or another. This activity is defined as *personal information management* (PIM). Bergman and Whittaker (2016) define PIM as "the process by which individuals curate their personal data in order to reach the data later" (p. 1). According to Bergman and Whittaker (2016), PIM has not received special attention until recently because people used to have smaller collections of digital possessions. PIM can be considered an important aspect for individuals when performing a computer-based activity (Bergman, Boardman, Gwizdka, & Jones, 2004). An improved PIM can have a significant impact on how individuals use their time, money, or resources, and impacts the efficiency with which the information is accessed at the right time and in the right place, as well as its quality (Bergman, et al., 2004).

2.4.2. The Curation Process

Personal information management is characterized by three main stages, namely saving, managing, and retrieving the information, also known as the *curation process* (Bergman & Whittaker, 2016). According

to Bergman and Whittaker (2016), depending on the type of the needed information, people act differently in terms of how they save it, how they prioritize the organization, and when and how it is retrieved. Alon, Hardof-Jaffe, and Nachmias (2019) mention that the management of personal information spaces can be distinguished from public information spaces through the purpose for which the user manages that information, either because of work, or because of personal reasons. Thus, the curation process has the goal to organize the information with the purpose to be successfully retrieved at a point in time. PI is undergoing a curation process by the user, where the information will be saved to form their own PCI, organized and later on, retrieved from the created PSI.

2.4.2.1. Saving, Managing, and Retrieving

In *the saving phase*, the user needs to choose between what information is relevant, and whether it will be useful again in the future (Bergman & Whittaker, 2016). This is a difficult decision that the user has to make because there is no answer to what is right to keep and what is not. Users try to find the information that meets their needs, needs that can be large and vague or small and simple (Jones, 2008). Often, people save information that they consider to be useful at that point in time but the information might turn out to be useless (Bruce, 2005). There are different factors that influence this decision, such as the type of information, the expectancy of when it will be used or the context in which the information might be needed (Bergman & Whittaker, 2016). All these factors depend on the users' own perception of how they are going to use the information.

The second step of the process, *managing* the information, refers to the way it is stored and organized in the storage location (Bergman & Whittaker, 2016). Managing information depends on different factors and varies from user to user. One factor is the type of information being managed, such as work related or private. Alon et al. (2019) investigated the PIM experiences of knowledge workers. They concluded that workers have a difficult time and a responsibility to manage information as they are working on a daily basis with large amounts of information (Alon, et al., 2019). For example, in the work environment, most of the participants had their email structured in folders to represent different clients, and even though the folders were not structured perfectly, they had some system in place. On the other hand, in the case study of Jensen et al. (2018), where they investigated the PIM practices of owners of private handheld devices, they found that five out of six participants had no folder structure in their personal email.

Another factor is the information space, being it public or personal. In the public information space, the information management is made from the perspective of two main parts, the information professional and the information consumer (Bergman & Whittaker, 2016). It is important that the information is organized in a one-size-fits-all approach because each information consumer is different from the other (Bergman & Whittaker, 2016). Personal information spaces are managed by the same user who retrieves the information. Therefore, the curation process can be seen as an interaction process between the user and their self in two different stages, namely the saving stage and the retrieving stage (Bergman & Whittaker, 2016). The personality of the user can also influence the way PI is managed. Usually, there are individuals who have a more systematic approach, such as *filing* or a more relaxed one, such as *piling*. Bergman & Whittaker (2016) mention that people who chose folder and file names can trigger retrieval successfully, while those who

chose a more relaxed way to save their information, in a piling system, could harden the retrieval process. These two ways of organizing the information places people in two categories, *filers* and *pilers*.

Malone (1983) mentioned the concepts of filers and pilers in a study where he observed how office workers were organizing the physical information from their desks and offices. He defines files and piles as "two ways of collecting groups of elements into larger units" (Malone, 1983, p. 5). Files are the units where physical folders or papers are titled or arranged in a systematic order, whereas piles contain untitled folders or papers, not organized in a logical order (Malone, 1983). Malone (1983) categorizes people into filers and pilers because of this observation. Even though his study is based on physical information, this categorization can be translated in the digital space as well. For example, organizing digital files in folders based on years and file types versus placing all files in one big folder. Nevertheless, the managing stage can be an iterative process, as the user can always go and modify the way the information is organized (Bergman & Whittaker, 2016).

The last stage of the curation process is *retrieving* or *exploring* the information once saved into the users' storage location. This stage defines the successfulness of the PIM process (Bergman & Whittaker, 2016). The goal of the PIM is not achieved if the user cannot successfully retrieve the saved information, and that information becomes useless (Bergman & Whittaker, 2016). There are two different ways to retrieve information, namely *manual retrieving* through which the user will be *browsing* through files and folders, and *searching* by using the predefined *search function* that most devices hold (Bergman & Whittaker, 2016). PIM process plays a fundamental role in an individual's decisions when retrieving information, regardless if it is in physical or digital form. According to Bruce (2005), due to the complex world we live in, it can easily overload an individual with information, and can easily turn into information cluttering. This has pushed research on designing new PIM systems and developing new tools to help individuals in the curation process.

2.4.3. Implications of Digital Hoarding

Van Bennekom et al. (2015) show in their study case that digital clutter is possible and it can cause distress and living difficulties for individuals. Similarly, Sweeten et al. (2018) found that within their sample of participants, some of them considered that their accumulation habits of digital data was having a negative impact on their mental well-being by contributing to increased levels of stress and anxiety. On the other hand, Gormley and Gormley (2012) show in their study the reasons why people hoard data and the impact hoarding plays in relation to big organizations. They found that emotions represent the main factor in hoarding for individuals, namely emotional attachment in relation to digital possessions, so the hoarding is caused by the individuals (Gormley & Gormley, 2012). However, for companies and organizations, the culture within the company could represent the main reason (Van Bennekom, et al., 2015; Gormley & Gormley, 2012). According to Gormley and Gormley (2012), the culture of a company can consist of "competitive environments, the management system, or the insecurities of the employees" (p. 93). These factors can contribute to the hoarding environment.

Companies are keen to keep data and accumulate it because data is considered valuable, and this leads to data hoarding. However, to store this data, a bigger physical space is required, which leads to cost problems,

as spaces are becoming more expensive (Gormley & Gormley, 2012). Another problem caused by data hoarding is the impact of the effectiveness of the teams within a company, which leads to poor communication practices and false knowledge (Gormley & Gormley, 2012). There are many layers in what makes an individual or a company hoard, such as fear of losing collected information, emotional attachment, or the inability to decide whether the information is valuable or not. However, becoming a digital hoarder depends on whether the hoarder tries to change this behavior, but also on how the data is stored, organized, retained, shared, and used (Gormley & Gormley, 2012).

2.5. Summary

Throughout this literature review, we found several important aspects to be further considered in our study. First, it can be suggested that physical hoarding shares similar features to digital hoarding and this reasoning can be induced in determining the main factors that can lead to digital hoarding. As such, this dissertation aims to investigate what causes digital hoarding, how it is perceived, how detectable it is, and what could be the factors needed to identify digital hoarding tendencies. Second, the current literature on digital hoarding and that on PIM indicates that there are aspects that can be translated from PIM to digital hoarding. For example, the Curation Process as proposed earlier *(See Section 2.4.2. The Curation Process)*, is similar to the framework proposed in relation to digital hoarding *(See Section 2.3.6. Similarities between Physical Hoarding and Digital Hoarding)*. These both emphasize the acquiring (saving) of files to be the initial process, with the managing process to follow. This process is equivalent to the processes that can lead to accumulation of digital files, namely failure to discard and retention of files.

A third aspect indicates that, based on the affordance theory and its properties, it can be argued that the development of technology and high-tech devices provides positive and negative affordances for the user. For example, a mobile phone affords access on the go to information due to the mobility provided by the size of the device, while its subsystem, the storage disk, affords saving the information for later review. These two affordances can be considered positive. However, the affordance of ease-of-use and mobility can influence the user to use the phone at all times, and may interfere with social life, or the affordance of storage can influence the user to save at all-time information considered important at a point in time. In this way, the user can forget to discard it, and this leads to information clutter. These can be seen as negative aspects. Therefore, we are interested in how affordances of hardware and software used by people to accumulate and manage their personal information can influence their decision to keep, discard, and organize that information. For example, as related works indicate, storage is a system which affords users the possibility to keep unlimited number of digital files. Additionally, various online storing software afford participants the possibility to share their files easily with others, while having themselves remote control to their files.

3. Methodology

Social research is a type of research conducted when trying to understand particular aspects of a subject that are, to some extent, unresolved or not completely defined (Bryman, 2012). For this, researchers draw on social sciences for conceptual and theoretical inspiration. There are several identified elements of social research, namely the problem formulation, a literature review, concepts and theories, research methods, and writing up the findings (Bryman, 2012). Previous to this chapter, the problem investigated in this study has been introduced *(See Chapter 1. Introduction)* and a literature review has been conducted in connection to existent work and studies that draw upon digital hoarding *(See Chapter 2. Related Works)*. As such, this chapter covers the methods and techniques involved in this project with the purpose of answering the problem statement.

This chapter includes six sections that address the various stages of conducting the study. The first section emphasizes the difference between deductive and inductive theory. The purpose of this section is to establish a foundation for the present study. The second section includes the data collection methods used in this study, as well as their relevance and importance to the problem. The following section focuses on the sampling methods and the procedure through which the study is carried out. Following up is section fourth which is meant to describe the methods employed for data analysis and their significance. In the end of the chapter, reliability and validity of the study are discussed in section five, while section six addresses ethical issues.

3.1. Research Design

In general, research is conducted in relation to a problem that has been raised. On one hand, research is done with the purpose of answering questions that emerge from theoretical considerations but, on the other hand, the alternative is think about the theory as something that emerges from the collected and analyzed data (Bryman, 2012). Philosophers consider that there are two vast methods of reasoning, namely the *deductive* and the *inductive* approaches (Soiferman, 2010). These approaches, referred to as *deductive* or *inductive theory*, are followed when conducting the research. The deductive approach focuses on testing theories, meaning that the researcher will deduce hypotheses based on the existing theory and, through data collection, the hypothesis are either confirmed or rejected (Bryman, 2012).

In an inductive approach, a new theory is generated based on the conducted research (Bryman, 2012). The deductive approach is associated with quantitative data, whereas the inductive approach is associated with qualitative data. Bryman (2012) indicates that researchers can take an inductive approach to link theory and data, using their findings to strengthen existing theory. Although quantitative and qualitative approaches are seen as complementary to each other, there are some fundamental differences between these two approaches that exceed data (Soiferman, 2010). According to Soiferman (2010), these differences are generated by epistemological assumptions about where knowledge lies within the problem.

3.1.1. Philosophy of Science

Over the years, epistemology has been used by philosophers to explain the nature, origin, and scope of knowledge (Moser, 2010). According to Bryman (2012), epistemology is the theory of knowledge that

focuses on addressing what is considered acceptable as knowledge in the social world. There are different philosophical positions and each of them takes a different approach on how knowledge is defined (Saunders, Lewis, & Thornhill, 2019). In social research, positivism and interpretivism are the commonly met philosophies of science. Positivism is considered the natural science of epistemology, and it has the purpose to test theories through hypotheses in order to prove whether facts are true or false (Ryan, 2018). In positivism, scientific methods are used, meaning that quantitative data plays an important role, as the facts have to be observable and measurable (Saunders, et al., 2019). On the other hand, interpretivism is focused on the target group of the research and on understanding the differences between individuals and the meaning of their social actions (Bryman, 2012). In interpretivism, qualitative methods are dominant as the focus is on narratives that can be interpreted (Saunders, et al.,2019).

This indicates that an interpretivist approach can lead to the emergence of unexpected findings, since qualitative methods result in induced findings (Bryman, 2012; Saunders, et al., 2019). Interpretivism can employ research methods that have a personal nature, such as interviews. Therefore, with interpretivism, researchers should adopt the attitude of an outsider and should not get involved in the problem that is being studied (Bryman, 2012). Saunders et al. (2019) emphasize that it is important for the researcher to present an empathic attitude in order to understand the society from the participant's perspective. However, researchers can never be completely detached of their own perceptions when conducting research and will inevitably influence the way data is collected and analyzed (Ryan, 2018). Interpretivism is highly subjective due to its nature. Researchers admit that their own beliefs and values are being involved in their interpretation of the data (Saunders, et al., 2019).

In the present dissertation, an interpretivist approach is primarily considered. The aim of the study in this dissertation is to explore which factors could play a role in the accumulation habits of individuals that may be revealed to lead to digital hoarding. As such, interpretivism is relevant in this dissertation because of its explorative nature through which answers are sought. Moreover, an interpretivist approach can lead to unexpected findings for the subject at hand, namely digital hoarding. This is relevant especially considering the novelty of the subject, because new and unexpected information about digital hoarding can arise. However, the existing literature and theories are also considered, with the purpose of strengthening it through the findings. This indicates that, this dissertation, although limited, takes a deductive approach as well.

3.2. Data Collection Methods

Research indicates that qualitative and quantitative methods are not always just inductive or just deductive. Over the last few decades, qualitative research methods have been used increasingly in evaluation studies, even though quantitative methods were the preferred choice when it came to evaluating information technology (Kaplan & Maxwell, 2005). This change is embraced by researchers due to the nature of qualitative and quantitative methods and what these can provide in terms of findings. Quantitative methods involve data that is in the form of numbers, whereas qualitative methods do not (Preece, Rogers, & Sharp, 2015). Therefore, while quantitative methods can be used to evaluate error rates or time-completion based tasks, qualitative methods are beneficial for studying and understanding the interaction between information

systems and individuals (Kaplan & Maxwell, 2005). According to Kaplan and Maxwell (2005), in a study, qualitative methods can be combined with quantitative methods and can include various techniques to gather data.

Gathering data represents an essential part of evaluation in a study (Preece, et al. 2015). As mentioned, in this dissertation, an inductive approach is primarily employed, as the aim is to investigate the factors that influence the accumulation habits of those who show tendencies towards hoarding. The data will primarily be gathered through semi-structured interviews. In this way, qualitative data will be gathered. Nevertheless, this data can be quantified as well, for example by looking at frequencies of patterns and themes. Additionally, quantitative data is also gathered through the use of a standardized scale designed to measure different aspects related to physical hoarding. As such, the following subsections address these two data collection methods in terms of characteristics and reasons for being relevant in this study.

3.2.1. Saving-Inventory Revised Scale

Quantitative research methods result in collections of numerical data that can be quantified (Bryman, 2012). As a strategy, the use of quantitative data in a study can prompt the relationship between theory and research as the findings can be used to support the theory (Bryman, 2012). Additionally, quantitative data can also be used to identify frequencies or averages in patterns of data. One of the most common techniques to gather quantitative data are questionnaires. Questionnaires are considered a well-established technique for collecting data about participants and their behavior (Preece, et al., 2015). Questionnaires can include closed or open-ended questions. In general, open-ended questions provide data that is considered qualitative, whereas closed-ended questions provide data that is considered quantitative. One strength of questionnaires is that it can be distributed to a large number of participants at once, which leads to more data being gathered (Preece, et al., 2015). Often, questionnaires are referred to as self-completion questionnaires, as the respondents will complete the these themselves (Bryman, 2012).

There are different types of questions that can be used, and this influences the format of the questionnaire. Additionally, the question and response format are relevant for the findings. According to Preece et al. (2015), “selecting the most appropriate question and response format makes it easier for respondents to answer clearly”. The inappropriate choice of questions and responses can deter the findings of a study, through biases and ethical issues. One common format of questionnaires is *rating scales*. The purpose of using rating scales is to acquire a range of responses to a question from the participants that can be compared across them (Preece, et al., 2015). In this case, Likert scales are often use. The Likert scale is a set of *multiple-indicator measures* that address opinions, attitudes, and beliefs towards certain subjects (Bryman, 2012). In a Likert scale, the questions are formulated as statements, called *items*, to which the participants have to indicate their level of agreement. In this way, their general attitude towards each item is measured and later analyzed.

In this dissertation, a standardized scale is employed that focuses on hoarding. Frost and Gross (1993) developed the Hoarding Scale, which is a 21-item questionnaire. It is designed to measure different aspects related to hoarding behavior, having been generated based on literature that existed at the time on nonfood human hoarding (Frost & Gross, 1993). As the definition of hoarding has changed with time by becoming

more specific, Frost et al. have been focusing on adapting the scale to better include all the specified aspects of hoarding (Frost, Steketee, & Grisham, 2004). Thus, with the intention to develop a scale that focuses on all the factors that define hoarding, Frost et al. (2004) generated "items from earlier versions of the scale and from pilot testing […] to measure each of the components of compulsive hoarding" (p. 1165). As such, the original Saving Inventory-Revised (SI-R) was developed, which contained 26 items in the format of self-reports using a Likert-like type of scale, ranging from 0 to 4. Through further examination and studies, Frost et al. (2004) found that using 23 of the 26 original items was a better solution because items 24, 25, and 26 did not have a significant weight.

Thus, the final version of the scale includes 23-items that represent a 3-factor solution. The three factors are *Clutter*, *Difficulty Discarding*, and *Excessive Acquisition*, which represent three different subscales (Frost, et al., 2004). Furthermore, these factors correspond to those emphasized in the cognitive-behavioral model of hoarding. Items 1, 3, 5, 8, 10, 12, 15, 20, and 22 are related to the Clutter factor. The Difficulty Discarding scale includes items 4, 6, 7, 13, 17, 19, and 23. The rest of the items, 2, 9, 11, 14, 16, 18, and 21 are related to the Excessive Acquisition factor (Frost et al., 2004). The scale is divided into three sections, where the ranges have different meaning based on the questions. The first section ranges from *none* (0) to *almost all/complete* (4), with *a little* (1), *a moderate amount* (2), and *most/much* (3) as the middle response points. This section includes items 1 to 5. The second and third range from *not at all* (1) to *extreme* (4), with *mild* (1), *moderate* (2), and *considerable/severe* (3) as the middle response points. These sections include items 6 to 16. In the last section, questions 17 to 23 have response points from *never* (0), *rarely* (1), *sometimes/occasionally* (2), *frequently/often* (3), and *very often* (4).

Frost et al. (2004) found that the SI-R to be a reliable and valid measure of compulsive hoarding. Moreover, it is considered that the subscales reflect significant phenomena that is related to hoarding (Frost et al., 2004). The scale has demonstrated good internal consistency and has been used successfully to differentiate between individuals with and without hoarding disorder (Frost, et al., 2004). Over time, the SI-R scale has been used in multiple studies to measure physical hoarding and to differentiate between individuals with or without hoarding, such as Ayers et al. (2010), Frost et al. (2015), Wheaton (2016), Burgess et al. (2018), Luxon et al. (2019), as well as others.

In this study, the scale is used in its original format, without additional changes being brought to it. However, because it has to be distributed online and results have to be gathered on spot, it was decided to convert it into a Google Forms questionnaire *(See Appendix IV – SI-R Scale)*. Although the scale is not altered at all, the questionnaire contains an additional section that participants go through before having to fill out the SI-R scale. In this section, the participants are introduced to the concept of *clutter*. This happens through a written definition. Nevertheless, we wanted to give the participants a common ground to start from. As such, this section contains nine images that present different levels of clutter. The images are divided into three sets, one set representing the kitchen, one representing the bedroom, and one representing the living room. In each set, the same image is present three time with different levels of clutter, from no clutter to moderate clutter and to extreme clutter.

The decision to use these images is based on the idea of creating a common ground for participants in regard to clutter. We want them to perceive different levels of clutter in a similar matter. Without these images, it would have been difficult to establish how much clutter is too much for the participants. These images are from the *Clutter Image Rating*. This is a rating scale where participants have the opportunity to rate the clutter level in their home based on a standardized scale (Frost, Steketee, Tolin, & Renaud, 2008). In this scale, Frost et al. (2008) include nine images for each room and are rated from 1 to 9. Considering that the purpose is to create a common ground with these images, we preferred using only three. These images were added based on the initial pilot test, where it came to our attention the fact that the concept of clutter could be perceived differently across participants.

In this study, the SI-R scale is used with the purpose of determining whether the participants show any tendencies towards physical hoarding. This is relevant because it provides the means to compare between the participants' tendencies of physical hoarding and those of digital hoarding. In this way, the total score of the scale is a relevant aspect. Furthermore, we are interested in exploring whether there are any patterns that can be discussed on the basis of the similarities or differences noticed between participants and their tendencies.

3.2.2. Semi-Structured Interviews

Qualitative research results in data concerned with words and, as a strategy, using qualitative data in a study will emphasize an inductive view of the relationship that is between the theory and the research (Bryman, 2012). Kaplan and Maxwell (2005) indicate that qualitative research is used with the purpose of "understanding issues or particular situations by investigating the perspectives and behavior of the people in these situations and the context within which they act" (Kaplan & Maxwell, 2005, p. 30). There are various qualitative data collection techniques, but interviews are most commonly used. According to Preece et al. (2015), interviews can be seen as a conversation between two individuals that has a scope. Various research indicates different accounts for the main types of interviews available (Lowdermilk, 2013; Preece, et al., 2015). Nevertheless, the main choice is often between *unstructured* interviews, *semi-structured* interviews, and *structured* interviews. These three types of interviews are developed based on how much control the interviewer has over the conversation (Preece, et al., 2015). Unstructured interviews allow the interviewer to openly explore of the issue that is being studied, whereas structured interviews are based on consistency and rigorous scripts (Lowdermilk, 2013). In the case of semi-structured interviews, the interviewer follows a set of questions that have been prepared in advance and that are focused on the context (Lowdermilk, 2013).

In choosing which approach is the most appropriate for a study, the researcher has to focus on the purpose of the interviews, as well as the questions that are addressed. In this dissertation, semi-structured interviews are conducted because the aim of the study focuses on an exploration of the factors that affect the accumulation habits of individuals who show digital hoarding tendencies. In a semi-structured interview, a basic script is formulated that contains a set of questions that are to be addressed to all the participants (Preece, et al., 2015). Nevertheless, additional questions can be addressed based on the participants' answers. This can lead to the emergence of unexpected answers which can lead to unexpected findings. As

such, a semi-structured interview is relevant in this thesis because digital hoarding can be explored from various perspectives, those of the participants and those based on existing literature.

The structure of the interview was brainstormed based on the literature review. As the main scope of our thesis is to understand the factors that influence the accumulation habits that could lead to digital hoarding, it was important to structure the interviews in a manner that will lead to the right answers. As such, we used the literature topics and findings to structure the first draft of the interviews. Thus, the initial draft contained 16 questions *(See Appendix V – Interview Initial Draft)*. The questions were formulated to uncover different factors for different topics. The first seven questions addressed topics related to acquiring practices, types of digital files that are being acquired, devices used to acquire files, and frequency and easiness of retrieval. The last nine questions focused on finding what influences the participants' habits in regard to the organization of the acquired digital files in terms of preferred methods, as well as if they prioritized the organization of certain digital files over others. Beside organization practices, the questions also had the purpose to identify the discarding practices of their digital files in terms of how frequent they discard the files, what influences them to discard certain digital files and which digital files are discarded most often or never if the case.

The initial interview structure had to be tested prior to conducting the actual interviews in a pilot testing interview. After the first pilot test, we noticed that the structure of the questions is in a more formal language. Therefore, we decided to formulate the questions more informally to create a more relaxed interview atmosphere for our participants and for a clear understanding of the questions' meaning. We also noticed that we need to included questions regarding the concept of digital hoarding, such as whether the participants heard about this concept previously and if so, in which context. Further on, we introduced questions to identify which are the most common files are acquired on a daily basis, with which purpose, and if the accumulated number is considered excessive. Most of the organization, retrieving, and discarding questions were kept, but reformulated in a more formal language, as well as removing some repetitive questions.

Additional follow-up questions to the main questions were introduced in order to be prepared if the participants needed additional questions to elaborate their answers. Lastly, a scenario was introduced, about what digital files could be considered the important for the participants if they were in a situation where their devices would break or would be lost, and about how losing these digital files would affect them. The second version of the interview consisted of 12 questions with additional supportive sub-questions. The restructured interview was further tested in a second pilot test. It is important to mention that, in the second pilot test, we noticed that additional questions beside the interview's pre-defined questions were required. This is because we considered that some answers required follow-up questions to be finalized. As such, the final version of the interview questions was ready *(See Appendix VI – Interview Questions)*.

The Internet has made it possible for research to be conducted online. Researchers use the Internet because it offers a wide range of advantages. Bryman (2012) indicates that online research is more economical from the perspective of money and times, and that, in addition, a larger number of participants can be gained more easily as distance is not considered a reasonable reasons for refusal. In this case, the interviews were

not initially planned to be conducted online. However, the established plans for conducting this dissertation has to be altered. This dissertation has been written during a world-wide pandemic, namely the Corona virus pandemic (Covid-19). As such, the data for this study is gathered online. One weakness of conducting the interviews online could arise from the rapport that is established with the respondents (Bryman, 2012). A personal connection cannot be established as well as when the interviewer is face-to-face with the interviewee because it feels more impersonal (Bryman, 2012). Nevertheless, the implication of video-calls is significant because it can eliminate, to some degree, the impersonal factor.

In addition, conducting online interviews can be affected by the occurrence of technological issues, such as bad internet connection or missing software that is required for the interview to be carried out. As such, the interviewer needs to ensure a stable software that is to be used during the interview and that does not require the participant to be subjected to further actions, such as additional cost or installing a new software. On the other hand, one significant strength of conducting interviews online is that, once suitable participants are found for the study, it is easier to get their approval of being involved because they can do it from the comfort of their home, without having to travel to a remote location. Even more, in the case of potential participants that may have a reservation towards face-to-face conversations, online interviews might prove beneficial. This could create a more relaxed and comfortable environment for the participants.

3.3. Procedure

This masters' dissertation focuses on digital hoarding and exploring factors that play a role when this phenomenon takes place. As such, the aim of the present study is to investigate emerging factors could potentially influence individuals' accumulation habits which could play a role in the emergence of digital hoarding. In order to establish these factors, as well as the accumulation habits of individuals, data has to be gathered and analyzed. For this, interviews have been developed *(See section 3.4. Data Collection Methods)*. The interviews were conducted online, by using a video-conference software, Google Hangouts Meet. The participants were recruited beforehand based on a set of limited criteria. During these interviews, qualitative data is primarily gathered. Additionally, quantitative data resulting from the SI-R scale is also gathered. The following subsections focus on the population and its characteristics, the sampling methods employed in this study and the final sample, the materials used in this study. The final subsection addresses the protocol that is followed throughout each interview.

3.3.1. Population and Setting

In general, researchers are interested in answering questions that can be generalized to individuals outside their participants (Field & Hole, 2003). Depending on the field that a study belongs to, researchers are interested in collecting data from different populations. For example, a psychologist will be interested in a population that includes anyone, whereas a market researcher will only be interested in a population of consumers (Field & Hole, 2003). Choosing the correct population is significant in a study because each population has its own characteristics. According to Field and Hole (2003) populations can be very general, more specific, or extremely specific. In this dissertation, considering that it has its foundations on social research, we are interested in collecting data from those who use digital technologies on a daily basis. This can be considered a more specific characteristic for our population.

Another characteristic of the population to be considered is age. The population should be older than 20 years, but an upper limit does not have to be established. This is because of the existent literature which shows that the general onset age for physical hoarding is around late childhood and early adolescence. There are no studies indicating an onset age for digital hoarding. Therefore, by assuming a similar onset age as that shown by literature in the case of hoarding, the population should be older than 20 years to have to show a potential effect. Additionally, our population should include both males and females. Although studies do not show a difference in frequency of hoarding between males and females, once again, this aspect has not been investigated in digital hoarding. Nevertheless, the population should include both males and females to make the results more generalizable.

As mentioned, the study is conducted online, meaning that the setting is online. However, more clear characteristics of the setting cannot be established. Ideally, the population should be studied in its natural environment as this would give us a better understanding of all the factors that play a role in the accumulation behavior. These characteristics of the population are not strictly defining it but still provide an overview of individuals who should be included in the population for the study to yield relevant results.

3.3.2. Sampling

In an ideal world, data would be collected from the entire population to ensure all the possibilities for findings have been exhausted (Field & Hole, 2003). However, this is not possible due to constrains of time and the ability to reach everyone in the population. As such, researchers are interested in gathering data from a small subset of the population, subset known as *sample* (Field & Hole, 2003). The sample should be as large as possible as to be representative of the population. The sample has to be representative for the results and findings to be generalized to the entire population (Bryman, 2012). There are two types of sampling methods, namely *probability sampling* and *non-probability sampling.* In probability sampling, a sample is selected randomly in such a way that any member of the population will have the chance of being selected (Bryman, 2012). In general, it is more likely to reach a representative sample when a probability method is used. On the other hand, in non-probability sampling the sample is not selected randomly, meaning that some individuals have a higher chance of belonging to the sample than others (Bryman, 2012).

In qualitative research the focus is on using non-probability sampling methods. Probability sampling is rarely used because it is implausible to get a random sample as it is generally difficult to map the entire population (Bryman, 2012). However, Bryman (2012) indicates that the main reason why qualitative researchers prefer non-probability sampling is that they prefer gaining access to a wide range of individuals who are actually relevant to their studies. In qualitative research, sampling tends to revolve around the notion of *purposive sampling*, as most sampling tends to be purposive in some way (Bryman, 2012). Other commonly used types of sampling include *convenience sampling* and *snowball sample*. A sample of convenience refers to a sample that is readily available to the researcher by means of accessibility, whereas a snowball sample focuses on getting participants through the involvement of existing participants (Bryman, 2012).

In this dissertation, the sample is selected based on convenience and purpose. Initially, the sampling was supposed to take place at Aalborg University in Copenhagen, where random individuals would have been

asked to consider participation. However, given the current situation, the sample is selected based on pure convenience. For this study, 10 participants are selected, out of which 3 are males and 7 are females. The participants' ages range from 21 to 49 years. Out of the participants, 7 are in their mid-twenties, one participant is 24 years, one is 26 years, and five are 25 years. The other three participants are 21, 34, and 49 years old, respectively. The sample consists of individuals with whom we are familiar. However, we avoided selecting individuals who are family, close friends, or relatives. Nevertheless, these individuals possess the main characteristics of the population, namely all of them are older than 20 years and are familiar with technology, using it on a daily basis, making this a purposive sample as well.

Although gathering participants is considered a strength of online research, this proved to not be the case for this study. This happened because gathering participants for interviews that take place over video-calls is more difficult in comparison to asking individuals to fill out a questionnaire or to answer a series of questions. As such, we had to resort to using personal acquaintances. This can represent a bias in any research because the participants might act differently on the basis of being familiar to the interviewer. Participants can potentially hide the truth if perceived intrusive with the purpose of avoiding sharing personal information with the interviewer. On the other hand, there is also the risk that participants could act as to please the interviewer especially considered that there is a deeper level of familiarity in this case. In this case, we are aware of these possible biases and we take these into considerations in regard to our findings. Another consideration is related to the gender distribution, which is not equal. These aspects impact the possibility of generalizing the findings using this sample to the entire population.

3.3.3. Materials

Materials that are used to conduct a study can influence its outcome. The process can be facilitated or, on the contrary, slowed based on the materials that are used and the different ways in which these are used. In this study only a limited number of materials is used. These are the following:

- Saving-Inventory Revised (SI-R) Scale
- Interview questions
- Consent form
- Digital devices
- Google Hangouts Meet software
- Smartphone voice recording application
- Transcription software

The SI-R scale represents the standardized scale that measures the participants' levels of physical hoarding *(See Section 3.2.1. Saving-Inventory Revised Scale)*. As mentioned, this has been adapted to a questionnaire, using Google Forms. Although this was time-consuming in terms of re-writing the scale in this online application, it was beneficial for collecting and comprising the data. Moreover, the participants did not indicate any troubles with this application. Additionally, there was a list of questions prepared in advance for the interviews and used consistently in each interview. A set of questions was developed because the conducted interviews were semi-structured, and this facilitated the flow of the interviews because they provided a guideline to be followed *(See Section 3.2.2. Semi-Structured Interviews)*.

The consent forms represent another material used to inform the participants about the study and their rights. These were written in an online document that could be edited by the participants who had access a new consent form each. Signatures were gathered in the forms of names where the participants felt comfortable with that and by making with an X for those who did not. This approach was chosen because we did not want the participants to have to install any other software that would give them the possibility to hand-write their signatures. However, this can raise issues because the signatures can be considered unauthentic.

In terms of digital devices, the participants had to use either a computer, a phone, or a tablet to be present for the interview. The choice of device was not important but can represent an advantage because the participants were not directed to use something specific and had the opportunity to choose themselves. Additionally, the Google Hangouts Meet software is used for the video-calls. This software was chosen because it does not require the user to download or install anything on their computer and it is for free. However, using it from a tablet or a phone requires the user to download and install the application. Nevertheless, this was not an issue mentioned by the participants.

The interviews were recorded. For this, a smartphone voice recording application was used. Initially, during the first pilot test, an application embedded on the computer was used to audio-record the interviews. However, once the pilot test was conducted, we realized that the audio was not clear. In fact, the audio was so weak that the transcription software that was used could not recognize almost none of the text. As such, for the second pilot test the recording application from the smartphone was introduced. It was determined that the audio was clearer when using the smartphone to record and it ended up being the tool used in the rest of the interviews. The interviews are transcribed using a software called Descript. This software offers free transcription of text from audio. This software is used because it facilitates the transcription process even though it is not 100% accurate. Nevertheless, the verification of the transcripts is not as time-consuming as manual transcription. This is an advantage that gave us more time to focus on more conducting interviews rather than fewer.

3.3.4. Protocol

The interviews were conducted in different days during a period of two weeks, namely week 19 and 20. These interviews were held using online video software, Google Hangouts Meet and were audio recorded *(See Section 3.3.3. Materials)*. We aimed to conduct two interviews per day as following: Participant 1 and 2 were interviewed Monday in week 19, Participants 3 and 4 were interviewed Tuesday in week 19, and Participant 5 and 6 were interviewed Wednesday in week 19. In the week 20, the rest of the participants were interviewed as following: Participant 7 and 8 on Tuesday, Participant 9 on Wednesday, and Participant 10 on Thursday. A total of ten interviews were conducted in the course of the two weeks. These interviews were semi-structured in which the participants were mentioning their habits in regard to accumulation of digital hoarding based on pre-defined questions and emerging questions based on the participants' answers. The questions were structured in order to identify the main practices in regard to acquiring, accumulation, discarding and retrieving of digital files. All ten interviews were conducted by one of us, while the other

was in the position of the observer who should ask additional questions if needed and calculate the score of the Saving-Inventory Revised scale.

Each interview started with the briefing procedure, which has the purpose of introducing the participant to the focus of this study *(See Appendix VII – Briefing Notes)*. During the briefing, the participants were informed that they should read a consent form and sign it if they agreed to participate in our study *(See Appendix VIII – Informed Consent Form)*. The consent form was sent as a link to the drive document, though the chat box of the video platform used at the time of the interview. Each consent form was previously filled in with the date of the interview and the participant's respective number. Each participant took the time needed to read the consent form and sign it. Further on, the interviewer informed the participants to fill in the questionnaire mentioned in the consent form and ask questions if needed *(See Appendix IV – SI-R Scale)*. The link to the questionnaire was also sent through the chat function of the video platform. We would like to mention that the participants were informed that they need to fill in a questionnaire and not a scale. The choice of using the term *questionnaire* instead of *scale* was to avoid confusion for the participants. This was found to be problematic during the first pilot test and, as a consequence, it was modified.

After the questionnaire was filled out, the actual interview began. Each interview lasted between 30 and 50 minutes, depending of each participant and whether their answers requested more or less additional questions. All the interviews were completed without any particular issues that would require pausing or a repetition of the entire interview. After the last questions was reached, the interviewer asked the observer if any additional questions should be addressed and proceeded accordingly. After all the questions were answered, the participants were asked if they had any additional questions. Depending on each participant, the questions regarding the score of the questionnaire were addressed, and after the reveal of the score, an explanation of what the score indicates, was given. Together with the explanation of the score, the participants were informed that neither of the researchers are specialist, and no diagnostic can be established based on these results. In the end, the participants were debriefed and informed that all the information and their identity will remain anonymous and only the research team has access to any private information filled in prior to the interview *(See Appendix IX – Debriefing Notes)*. Lastly, the participants were informed that they have the right to retrieve their data any point from the study and they were thanked for their participation.

3.4. Data Analysis

The analysis method preferred for a set of data is influenced by the goal of the conducted research, as well as the data that has actually been gathered (Preece, et al., 2015). According to Preece et al. (2015), most analyses begin with what is known as initial reactions or observations from the data. In general, this indicates that a researcher will start by identifying patterns in data or by calculating simple values, such as averages or percentages (Preece, et al., 2015). Following, more detailed work is conducted with the purpose of interpreting the findings. Considering that both quantitative data and qualitative data are collected in this study, the following two subsections focus on describing the approaches use to analyze the data, namely *descriptive statistics*, and *thematic analysis*.

3.4.1. Descriptive Statistics

In general, quantitative data is analyzed using descriptive statistics, and then, in the case of more detailed research purposes, inferential statistics. In this dissertation, descriptive statistics are applied on the SI-R scale. This is relevant because we are interested in the participants' total scores. Furthermore, by calculating averages and frequencies we can determine whether there are differences between them. However, far too few participants are involved in this study to determine whether the findings are significant in any way. As such, descriptive statistics are used to describe the sample from the perspective of the SI-R scale, meaning their tendencies towards physical hoarding.

Once the data has been gathered, a database of the answers is created. This represents the *raw data*. In general, when it comes to questionnaires, the data can be filtered in various ways (Preece, et al., 2015). One way is by dividing the data according to gender, or age, while another way is to divide the data according to a particular question (Preece, et al., 2015). In the case of the SI-R scale, the most relevant way to look at the data is to compare the participants' total scores between themselves. Another way is to calculate the scores for the different factors involved in the scale, namely *clutter*, *excessive acquisition*, and *difficulty discarding*. These scores can then be compared across the sample. Furthermore, these scores are interpreted in relation to the qualitative findings to explore whether there is a direct link that indicates that those who hoard physical items, hoard digital files as well. The analysis process of the SI-R scale is further described in a later chapter, and the findings are presented *(See Chapter 4. Results)*.

3.4.2. Thematic Analysis

Qualitative research is considered attractive because of the data's rich potential. Nevertheless, it is considered to result in large and chaotic databases, that can be challenging to manage (Bryman, 2012). Bryman (2012) indicates that the key in working with qualitative data is to find an analytic path through it. There are various approaches to qualitative data analysis. One common approach is *thematic analysis*. Thematic analysis is described as the process through which patterns and themes are identified in a set of qualitative data (Maguire & Delahunt, 2017). This is considered a flexible method, as there are various ways to approach thematic analysis (Braun & Clarke, 2006; Maguire & Delahunt, 2017). For example, some see a *theme* as being more or less the same thing as a *code*, while others consider that themes are build out of groups of codes (Bryman, 2012).

In any case, are two ways to identify themes or patterns in thematic analysis, an *inductive* coding, or a *deductive* coding (Braun & Clarke, 2006). An inductive approach indicates that the identified themes result from the data (Braun & Clarke, 2006). This is also known as *open coding*, where the codes inductively emerge from the data. A deductive approach tends to be influenced by theoretical literature (Braun & Clarke, 2006). This approach is also called *priori coding*, and pre-existing literature is used to establish the codes. These are all aspects that should be considered before the analysis begins. Maguire and Delahunt (2017) suggest that, during the thematic analysis, the following steps should be taken:

- Step 1: Become familiar with the data
- Step 2: Generate initial codes
- Step 3: Search for themes

- Step 4: Review themes
- Step 5: Define themes
- Step 6: Write-up

The pre-analysis consideration that is relevant for our dissertation is that here, codes are considered as being different then themes and that multiple codes make up a theme. Moreover, considering the aim of the study, we are using both open coding and priori coding. The integral thematic analysis follows in a later chapter *(See Chapter 4. Results)*.

3.5. Replicability, Reliability, and Validity

The design of a study influences the usefulness of its findings. According to Field and Hole (2003), if a study is poorly designed, it is worthless. With most research, the aim is to design a study that produces results which are valid, reliable, and generalizable (Field & Hole, 2003). As such, the commonly used criteria for evaluation in social research are *replicability*, *reliability*, and *validity* (Bryman, 2012).

3.5.1. Replicability

Replicability is one criterion that evaluates the extent to which findings can be replicated by others (Bryman, 2012). This happens in cases where researchers are in doubt about particular findings and decide to replicate studies to determine whether the same findings emerge. For a researcher to be able to replicate another researcher's findings, the study has to be capable of replication. As such, replication is affected by the method of reporting the study. In the case that the procedures are not explained in detail, with study cannot be replicated (Bryman, 2012). This criterion is not often used in social research, especially considering its qualitative nature. Nevertheless, in the present study, the integral procedures involved in data collection and data analysis are explained *(See Section 3.2. Data Collection and Chapter 4. Results)*. Transparency plays a key role in allowing others to replicate the findings as this allows them to follow the same steps as we did. However, it should be considered that this is qualitative data that is being interpreted and, as such, the findings can be influenced by the researchers' perspectives.

3.5.2. Reliability

Reliability is the criterion that evaluated whether the results of the study are consistent and repeatable (Bryman, 2012). Reliability is evaluated from two different perspectives, namely *external reliability*, and *internal reliability*. Similar to replicability, external reliability deals with a study's capability of being replicated (Bryman, 2012). In qualitative research, replicating a study is difficult, even when all the details about procedures are communicated. The biggest issue is the social setting, in which the study is conducted, is unlikely to be reproduced. Therefore, it is suggested that, in case of replication of another study, the social context is as similar as possible to the initial one (Bryman, 2012). In connection to this study, the social context in which the study was conducted could prove an impediment for replication. This is related to the fact that this study was conducted during the world-wide pandemic, COVID-19. During this time, many people were working from home and this is something that might have influenced their habits in relation to digital clutter. Thus, if the study would be replicated, this issue could affect its reliability.

Internal reliability is concerned with agreement between the members of a research team in relation to what is seen and heard (Bryman, 2012). This criterion is addressed in our study especially in the data analysis phase. As an analysis step, part of the interviews is analyzed individually by each member of the research team. In this way, each member generates their own codes and themes, and these are compared afterwards. In our case, the first three interviews were coded individually and then the individual codes were compared. In general, the codes and themes were consistent and, even though at times there were different codes and themes, these represented similar ideas *(See Chapter 4. Results)*. Furthermore, a codebook was developed based on the initial analysis which was used for the analysis of the remaining interviews. In this way, our study demonstrates internal reliability because no new themes emerged from the remaining interviews and the codebook was accurate. Nevertheless, after all the interviews were analyzed, the codebook was changed to a more specific version. Further details on these processes and the reasoning behind these, are discussed in a later chapter *(See Chapter 4. Results)*.

3.5.3. Validity

Validity is the criterion that refers to whether the researcher is observing, identifying, or measuring what has been intended (Mason as cited in Bryman, 2012). A study's results can lack *external validity* or *internal validity*. In internal validity, the concern is whether there is a causal relationship between concepts and observations (Bryman, 2012). The focus is on whether it can be determined that the findings cannot have an alternative explanation. In this case, the pandemic situation could have an influence on the findings because, being more at home and possibly working from home, could lead people to accumulate more digital files than usual. At the same time, it could also have the opposite effect as, now that people have more time, they could take more care of their possessions.

External validity is concerned with the sample which is not representative of the population (Bryman, 2012; Field & Hole, 2003). This is especially relevant in qualitative research due to its nature. This indicates that, for the present study, external validity is not high because of the small number of participants, namely 10 participants. This is relevant because the small number of participants indicates that our results are difficult to be generalized to the entire population. For this, further studies conducted in relation to this project should focus on the determining whether the same findings can emerge from a larger sample.

3.6. Ethical & Legal Issues

The focus of social research is to learn about people in particular contexts. Working with people entails important ethical issues that have to be considered before, during, and after a study has been conducted. According to Bryman (2012), ethical considerations are significant because they speak directly to the integrity of a piece of research. Most questions in regard to ethics revolve around the ways which participants should be treated in a study (Bryman, 2012). The focus of ethics is to maintain minimization of harm and maximization of benefits, respect, and justice for those involved in the research (Tiidenberg, 2018). There are different ethics that should be considered during a study.

Ethical guidelines indicate that, the most important consideration in regard to ethics, is whether there is harm to participants (Bryman, 2012; Tiidenberg, 2018). Bryman (2012) indicates that participants should not be harmed by their participation in a study, even if it refers to stress that can arise during the study. In

relation to this, the participants involved in our study were informed from the beginning that they might consider the study and questions intrusive and personal and were told that they could abandon the study whenever they did not feel comfortable anymore, through the consent form.

This represents another significant ethical consideration. The idea of informing participants and getting their consent to become participants is connected to the principle of individual autonomy and free will (Tiidenberg, 2018). In this study, the participants were all given a consent form to read and sign if they agreed with the stated conditions. Here, they were informed about the study and what they had to do. Moreover, they were also informed about their rights to withdraw from the study *(See Appendix X)*. One problem related to the informed consent in this study is that participants were not able to manually sign. They were asked to either write their names, if comfortable with that, or just to mark an X next to the signature field. This happened because the interviews were conducted online, and it can be interpreted as lacking authenticity. However, we wanted to avoid asking participants to install or pay for software that would have allowed them to insert a manual signature.

A third ethical consideration accounted related to anonymity and confidentiality. These aspects are important especially from the participants' perspectives because, often, they do not want their data to become public or to be linked back to them (Tiidenberg, 2018). This is especially relevant in sensitive cases. In our study, we focused on anonymity because, as research indicates, this is easier to ensure more than confidentiality (Bryman, 2012; Tiidenberg, 2018). Confidentiality of data is questionable when data passes through multiple hand and this can be especially applied to data collected and analyzed online. Moreover, the interviews were transcribed using Descript software. In this, the projects that are created within the desktop application, are also stored online. This means that, even if deleted from their cloud, there is no guarantee that the data is completely deleted. As such, we focused on not using our participants names and referred to them only by their participant numbers. This was also the case for the interviews' analysis as, the moment they agreed to participate, they became participant number X, instead of being named. The only problem in this case is that we are familiar with our participants and that could indicate that full anonymity cannot be established.

4. Results

The analysis of data is one of the most important parts in a study because it allows researchers to understand the data. In this chapter, the integral data analysis processes are described. In the sections that follow, the data from the SI-R scale and then from the interviews is interpreted. The last section focuses on the presentation of the findings. Here, meaningful patterns that emerged during the interviews are presented.

4.1. SI-R Analysis

The Saving-Inventory Revised (SI-R) scale was used to measure participants' tendencies towards physical hoarding. In general, a database of raw data is available in order to analyze it *(See Appendix X – Scale Raw Data)*. In this case, the results from the SI-R scale are written in a table that allows calculation *(See Appendix XI – Scale Calculation Data)*. This is a standardized scale and, as such, it includes directions on how the ratings should be calculated to have any meaning. As mentioned, the scale is divided into three factors, Clutter, Difficulty Discarding, and Excessive Acquisition. As such, there are four different totals that can be calculated, namely those of the factors individually and the grand total, which includes all three factors[1].

Each factor includes its own items from the scale *(See Section 3.2.1. Saving-Inventory Revised Scale)*. As a general rule, the individual scores are summed to obtain the final score. For example, for the Clutter scale, items 1, 3, 5, 8, 10, 12, 15, 20, and 22 are summed. However, in the case of items 2 and 4, the scores have to be reversed before being summed because of their formulation and their relevance in relation to the Likert scale. The SI-R total, as well as the scores for the Clutter, Difficulty Discarding, and Excessive Acquisition subscales are calculated for each participant individually *(See Table 4.1)*.

	P1	*P2*	*P3*	*P4*	*P5*	*P6*	*P7*	*P8*	*P9*	*P10*
TOTAL	16	33	6	56	18	25	31	28	40	23
Clutter	9	14	4	19	3	7	7	7	10	9
Difficulty Discarding	4	11	0	20	11	11	11	10	15	6
Excessive Acquisition	3	8	2	17	4	7	13	11	15	8

Table 4.1 – Scores for the SI-R Scale, as well as its subscales, Clutter, Difficulty Discarding, and Excessive Acquisition. The total scores for each participant are indicated.

[1] Information retrieved from: https://www.oxfordclinicalpsych.com/view/10.1093/med:psych/9780199340965.001.0001/med-9780199340965-appendix-4

4.2. Interview Analysis

The purpose of conducting the interviews was to investigate the possible factors and patterns related to participants' accumulation habits of digital possessions. In order to analyze interviews through thematic analysis, the first step is to become familiar with the data. Here, the raw data is represented by the audio recordings from the interviews. Before being able to start with the analysis, these interviews are transcribed to then be used for detailed analysis *(See Appendix XII – Interviews Transcripts)*. Preece et al. (2015) suggest that, in some cases, it might not be relevant to spend the time to transcribe the interviews integrally. However, for the transcription process, we used Descript. This software is automated, and it transcribes audio to text *(See Section 3.3.3. Materials)*. The most important aspect is the quality of the audio because, just like in the case of manual transcripts, bad quality can interfere with the transcription process. Once the interviews are transcribed, the analysis process can start. In this analysis, themes and sub-themes are used to create a codebook that serves as guideline for an in-depth analysis of the data. The coding process was divided into three steps. These steps are described in detail in the following subsections.

4.2.1. Step 1 – Initial Coding

In order to start with the coding process, the transcripts of the first three interviews were read and coded individually by each of us. For this initial coding process, keywords that emerged from the interviews, as well as keywords that were known from the literature review, were used. Afterwards, each keyword that emerged from our individual analysis was written on post-it notes and displayed visually in the work area. Although both of us had codes that described the same thing, in some cases they had different names. As such, the codes were discussed and grouped together according to their relevance. This resulted in 12 initial groups of codes that were related to similar subjects. For example, the codes *files importance*, *time spent*, *relevance*, *value*, and *responsibility* were grouped together because they all referred to different factors that determined the importance of the participants' files *(See Appendix XIII - Integral Post-its Categorization)*.

After the first coding scheme, we decided that some of the codes were irrelevant as a theme, but relevant for the analysis. As such, the codes were regrouped. This resulted in codes that were equivalent with a theme or a subtheme, depending on the relationship between codes and how they could be grouped. Thus, the second categorization resulted in three main themes, *Factors*, *PIM*, and *Domains*. The first theme, Factors, included three sub-themes, namely *Emotions*, *Affordances*, and *Files Importance*. The second theme, *PIM* also consisted of three sub-themes, namely *Acquiring*, *Managing*, and *Retrieving*. The last theme, Domains, included three sub-themes, namely *Work vs. Personal*, *Delimitation*, and *School*. Additionally, each sub-theme was further divided into sub-sub-themes and included several codes *(See Appendix XIV - Integral Post-it 2nd Categorization)*.

4.2.2. Step 2 – Initial Codebook

The next step was to create a codebook based on the second coding scheme. However, after further discussion, some of the names of the sub-themes were reconsidered based on the literature research. Moreover, the levels of the second coding scheme were reconsidered as well, as we realized that many of the codes and sub-sub-themes were too repetitive. Therefore, we decided to only have themes and sub-themes, and for each sub-theme to include the most relevant codes for further analysis. For example, the sub-theme *Files Importance* was renamed to *Practical Value*, while *Emotions* was renamed to *Emotional Value*. Additionally, the sub-theme *Delimitations* was removed, which resulted in only two sub-themes. The rest of the sub-themes remained unchanged in terms of names and content *(See Table 4.2)*.

Theme	**FACTORS**							
Sub-themes	Emotional value			Practical value			Affordances	
Codes	Attachment	Feelings	Fear	Time consuming	Valuable	Responsibility	Systems	Storage
Theme	**PERSONAL INFORMATION MANAGEMENT (PIM)**							
Sub-themes	Acquiring		Managing			Retrieving		
Codes	Personal Collection	Devices	Accumulating	Organizing	Discarding	Search Modalities	Search Difficulty Level	
Theme	**DOMAINS**							
Sub-themes	Work vs. personal				School			
Codes	Delimited		Intertwined		School			

Table 4.2 – Themes, sub-themes, and categories emerged after the initial data analysis.

Each code was further explained through a short description, and quotes were used as examples from the three interviews initially analyzed. The purpose of analyzing only three interviews initially was to identify common themes and sub-themes to create the codebook *(See Appendix XV – Integral Initial Codebook)*. Based on this initial version of the codebook, the rest of the interviews were then analyzed individually once again. This was done to ensure that similar patterns were distributed throughout all the interviews. Additionally, by coding the interviews individually first, we wanted to verify whether there was a sense of agreement between our interpretations.

4.2.3. Step 3 – Final Codebook

Once all the interviews were coded, the codebook was modified. Only one new code emerged from the remaining interviews, which focuses on participants' perspective on digital hoarding. However, it was discovered that, by having multiple sub-themes and codes, the analysis process became too complicated due to the fact that multiple codes were overlapping with themes and sub-themes. Consequently, it would have been difficult to identify distinct patterns and conclusions. Thus, a second codebook was created that includes only themes and sub-themes. Additionally, the remaining themes and sub-themes were slightly modified in terms of naming. Nevertheless, the content remained the same throughout the themes *(See Table 4.3)*.

Theme	**DIGITAL HOARDING**			
Sub-themes	Apprehension	Awareness		
Theme	**ACQUIRING DIGITAL FILES**			
Sub-themes	Hardware and Software	Digital possessions		
Theme	**MANAGING DIGITAL FILES**			
Sub-themes	Accumulation habits	Organizing modalities	Discarding	
Theme	**RETRIEVING DIGITAL FILES**			
Sub-themes	Search Modalities	Retrieving Difficulty		
Theme	**INFLUENTIAL FACTORS ON DIGITAL HOARDING**			
Sub-themes	Sentimental value	Instrumental value	Affordances	Domains

Table 4.3 – Final codebook version, including the themes after being defined.

Several sub-themes from the initial codebook, namely *Acquiring*, *Managing*, and *Retrieving*, became main themes in this second version. Moreover, a new theme was introduced, *Digital Hoarding*, which focuses on participants' perspective on digital hoarding. As it can be noticed, the codes were completely removed from the codebook structure *(See Figure 4.3)*. Therefore, the final codebook includes five main themes, namely *Digital Hoarding*, *Acquiring Digital Files*, *Managing Digital Files*, *Retrieving Digital Files*, and *Influential Factors on Digital Hoarding (See Appendix XVI - Integral Final Codebook)*.

4.3. Data Interpretation

The last step in thematic analysis is data interpretation. In the following subsections, the data will be further interpreted. The first subsection focuses on the interpretation of the SI-R scale in relation to the data from the interviews. In the second subsection the themes and sub-themes from the codebook are further described and discussed using direct quotation from the participants. We decided to indicate the most important parts within the direct quotations by emphasizing them with bold text. Here, certain topics are discussed in relation to more than one sub-theme, based on their relevancy.

4.3.1. SI-R Interpretation

These scores have to be interpreted in relation to the established cut-offs. These cut-offs represent the minimum scores required to consider that people are showing tendencies towards physical hoarding. The cut-off for the SI-R total is at 41, for the Clutter scale is at 17, for the Difficulty Discarding is at 14, while for the Excessive Acquisition scale, it is at 9.

The final scores for each participant indicate that most of the participants, namely 8 out of 10, were well below the cut-off score for the SI-R total. One participant was at the limit with a score of 40, while one participant (P4) was well above the cut-off limit, with a total score of 56. This indicates that, out of 10 participants, only one shows clear tendencies towards physical hoarding. By looking at participants' scores for the subscales, it can be noticed that P4 was the only one to exceed the cut-off for the Clutter factor. The cut-off for the Difficulty Discarding factor was exceeded by two participants, P4, and P9. Out of the three subscales, the Excessive Acquisition factor was the one where more participants exceeded the cut-off, namely four, P4, P7, P8, and P9, while two were right under the limit, P2 and P10 *(See Figure 4.1)*. This suggests that, out of all the difficulties associated with physical hoarding, our participants indicate a tendency towards excessive acquisition. This shows that although they acquire a larger number of physical items, they are efficient at discarding items, considering that the other total scores are, in general, below the cut-off.

Several aspects can be interpreted in comparison with the data from the interviews. First, the SI-R total scores indicate that only one participant shows tendencies towards physical hoarding. On the other hand, there were multiple participants to say they considered that they are hoarding digital items, and several to show tendencies towards it:

> P6 → "(…) I don't know how to explain it (digital hoarding), but I definitely do lots of it."
> P2 → "(…) my photos are not organized (…) it's a huge, huge, huge folder of like, 20.000 photos, 30.000 photos."

In terms of physical clutter, only one participant was above the cut-off limit. However, in relation to digital clutter, many participants mentioned that they are accumulating large numbers of files. Similarly, in relation to difficulty discarding physical items, most participants did not find this problematic. However, when it came to digital items, most participants mentioned that there were categories of files that they never cleaned. These two aspects are especially relevant in connection to pictures on the participants' phones and emails.

The last factor on the SI-R scale, excessive acquisition, is the factor where participants show similar tendencies in relation to both physical and digital items:

> P2 → "Um, emails…yes. I have lots of emails."
> P3 → "I think I've got about 12 - 13,000 photos."
> P9 → "Q: How often do you clean your devices, both phone and computer? / A: The computer almost never (…) pictures, I don't really clean (…)"

There was a general tendency towards less accumulation of physical possessions and more of digital possessions. However, there were exceptions to this, namely participants 3, 4, 5, and 8. Participants 3 and 5 scored a total of 6, and 18 respectively on the SI-R scale. These scores are well-below the cut-off and indicate that these participants do not show any tendencies towards physical clutter. These participants indicated similar tendencies in relation to digital clutter:

> P3 → "(…) the zero-inbox policy (…) you basically at the end of the day, should have nothing in your inbox that is uncategorized or unread."
> P5 → "I don't think about it, I just delete (…) also for the physical stuff (…) I'm such a clean freak!"

Similarly, P4 had the highest score on the SI-R scale and indicated tendencies towards excessive accumulation of digital files as well. On the other hand, P8 had a score below the cut-off but indicated to be accumulating digital files excessively:

> P4 → "I never delete anything in my phone. And sometimes it can be stressful when you have so many things, I feel like."
> P7 → "I'm never going to use the email, but I will keep it just in case. So, to be honest, in my house is very clean, I hate clutter. But I think with my phone I've always been too scared to delete anything."

All these interpretations indicate that most participants tend to accumulate a larger number of digital items than compared to that of the physical items. We suggest that the main reason for doing it is storage, which promotes retention of digital files. These aspects are further discussed in the following subsection.

4.3.2. Digital Hoarding

The first theme in the codebook, *Digital Hoarding*, refers to participants' understanding and acknowledgment of the concept in terms of its definition and meaning. Moreover, some participants underlined that they identify with digital hoarding as a concept based on their tendencies towards hoarding. Thus, the sub-themes *Apprehension* and *Awareness* describe the understanding participants have about the digital hoarding concept and their awareness towards their hoarding tendencies, respectively.

Apprehension

This sub-theme illustrates the participants' own understanding on what digital hoarding refers to. Only a few participants were familiar with the topic. This can be because this is a novel topic and, only recently, digital hoarding has come to researchers' attention, having been investigated only briefly.

P10 → "Um, **I have heard about it**. Uh, it was briefly touched upon in some of my lectures, but nothing too in depth."
P2 → "**Yeah, I had!** (…) because I'm writing, um, also on how people acquire or organize their music."

However, most participants were not familiar with the concept of digital hoarding as a subject. Nevertheless, all of the participants knew what physical hoarding was. As such, they were able to identify what digital hoarding is based on their knowledge on physical hoarding and the word *digital*. When asked to describe the concept using their own words, after having been told a formal definition, the participants showed a clear understanding of the concept. Although each participant described digital hoarding differently in their own words, a general finding across most of them was that they perceived digital hoarding as being focused on accumulation of "files of no real use":

P8 → "Acquisition of unnecessary materials that we kind of like at the moment, but then **don't have any use of**, but we've never deleted it."
P9 → "Um, yeah, hoarding like collecting digital data with **no real use for it**, I think."
P4 → "For example, in my phone, when I accumulate so many photos, or files or apps or things like that, and **they are of no use**."
P5 → "I was just thinking; I feel like (digital) hoarding for me is very much about how much stuff you have but also like **how much of it is actually useful for you**."
P7 → "Uh, I would have imagined a lot of pictures and a lot of notes that you might keep. Emails that you kept for one day, even though you never use it."

Awareness

This sub-theme refers to the participants' awareness in relation to their accumulation problems and digital hoarding tendencies. Throughout the interview, some of the participants mentioned that they are aware of their accumulation problems, and identified themselves as being actual digital hoarders:

P6 → "Q: Uh, have you ever heard about this concept, the digital hoarding part? / A: Well, I don't know if I heard about it, like I don't know how to explain, **but I definitely do lots of it**."
P7 → "The thing is that **I know I'm a digital hoarder**, but not in my house!"
P2 → "Yeah, but in general I can say **I am a photo hoarder** [laughs]."

The purpose of introducing the concept of physical and digital hoarding from the beginning of the interviews was to establish a common ground for all the participants. Their comprehension and awareness of digital hoarding was relevant for the interviews because it made it easier for them to understand the questions and formulate their answers.

4.3.3. Acquiring Digital Files

The second theme in the codebook, *Acquiring Digital Files*, focuses on digital possessions that are usually acquired on a daily basis, as well as on the devices that are most commonly used for this activity. Thus, two sub-themes are used to explain the main theme, namely *Hardware and Software* and *Digital Possessions*.

Hardware and Software

This sub-theme refers to the different digital means used by participants to acquire digital items. It was noticed that phones and laptops are the primary devices among the participants that are used to acquire digital files. However, as a pattern, it can be seen that the phone is the preferred device for acquiring digital files, while the computer is the second most preferred device. One remark from one participant in regard to why the phone is more used than a computer, indicates that it is because the phone is more readily available and more comfortable to use than the computer:

> P7 → "I need to be comfortable. I don't want to have a pain and now I have to go to the cupboard, take out my laptop. So, **it's easier for me** to just use my phone."

Additionally, there are other types of hardware preferred for acquiring digital files, both physical hardware and online software. Other physical hardware are tablets, hard drives, and PlayStation for games. Beside physical hardware, there were mentions of online software that allow them to acquire items. In terms of online software to store and share digital files, two online software are mentioned, namely Google Drive and iCloud. Most of participants mentioned that they acquire plenty of emails on a daily basis, using in particular the emailing system, Gmail. Other online software are music platforms, such as Spotify, or digital game distribution software, such as Steam. Streaming services for acquiring movies and series are also mentioned, such as Netflix. Lastly, social media platforms are used as digital means to acquire items, such as Facebook, which is used for receiving messages and news, Pinterest which is used to acquire pictures into pin boards, WhatsApp which is used to acquire various digital files, like videos, pictures, documents or messages, and YouTube, used for videos:

> P10 → "Um, **my laptop** and **my phone**. (…) Um, **Spotify** (…) or **hard drives** and so on."
> P3 → "I have quite a lot of **hard drives** actually. (…) my music on **Spotify** (…) I use **YouTube** quite a lot (…) It's only like for messaging that I use it (Facebook)."
> P7 → "(…) save it on **iCloud** so I can access it from my phone too (…) **Netflix** (…) movies and the series and then I add them to my list (…) **WhatsApp** is also one of those that I use it 100 times a day."
> P1 → "I mean; I do have **a tablet** […] but I use **the computer** a lot more than **I use my tablet**. [...] I have a **Gmail** (…) Actually, I also accumulate, um, games on my **PlayStation**."
> P2 → "I started using **Pinterest** more (…) even **Facebook** messenger"
> P5 → "We… right now everything is on **Google Drive** [company wise]."

Digital possessions

This sub-theme emerged from the participants' mentions on what are the types of digital files they usually acquire, as well as how much it is acquired, or if they are aware of the number of digital files that they own. The most predominant file types mentioned are photos, videos, and emails. However, each participant mentioned different digital files acquired for different reasons and usage. For example, photos and videos are acquired mostly for personal use, but there were mentions of acquiring these files with the purpose of using them in work projects. Emails are acquired for personal use and for work purposes as well. Other digital files mentioned are notes, games, music, movies and tv series, and messages, either on WhatsApp or on Facebook, being acquired for personal use. A few participants mentioned digital files acquired because they are valuable and need to be saved in a safe place, such as contracts, documents, receipts, and

guarantee certificates. Other participants mentioned school related digital files, such as project reports, presentations, PDFs, assignments, and articles. This shows that a wide range of digital files are acquired and accumulated among different participants:

> P3 → "Mostly **images** and **video files**!"
> P1 → "(...) I also accumulate, um, **games** on my PlayStation (...) so it would also be some personal things like, uh, **resumes**, um, **applications** (...) study related **documents** about certain theories and stuff like that."
> P9 → "On the phone I would say it's mostly **pictures**. And, uh, on the computer it's, it's **work and school related stuff**. So, um, **written documents and PDFs**."
> P4 → "I have like I have a lot of **emails** because I have like 5 accounts [laughs] (...) Um, I have **a lot of documents** (…) kind of papers that I have to sign, **contracts**."
> P10 → "Um, **Spotify playlists** on my phone."
> P6 → "The rest of it would be on the computer. It could be mostly either **movies or series** or, uh, **games** (…) on the phone, (it's) **pictures and notes**. (…) some PDFs"
> P2 → "It's like one folder for university and inside (…) It has like **slides** and also, um, **assignments** and also **articles** (…) (also) Facebook Messenger **messages**"

In terms of how much it is acquired on a daily basis, most participants do not think about this aspect, while others acquire as little as two or three files per day. On the other hand, all the participants indicate that they have accumulated a large number of files, often being files that are of the same type. This is mostly because their work and study lives intersect and influence their personal life:

> P1 → "**I haven't thought** about how much I accumulate on a day (…) I mean, these days would probably **be like three or four**, I think, something like that (daily)."
> P10 → "**I haven't thought** about the (…) number. However, my hard drive display is the number, **so I'm quite aware**."
> P2 → "Oh, yes, of course I am (thinking), because **it's quite a lot** (the number of files) (…) I would say it's medium (the amount). It's not like extreme, but it's not like very little. (…) And it's just a huge (…) folder of like, **20.000 photos… maybe 30.000 photos**."
> P6 → "On average, I would say maybe **five** (digital files acquired daily), including random pictures from the internet." (P6)
> P9 → "I would think somewhere around **50 per day**. (…) I feel like that's **is quite a large number**."
> P7 → "I got **hundreds of notes**. (…) I think I've got about **12 - 13,000 photos**. (...) I take around **20 to 25 photos** a day and it stays on my phone. (…) I have **20.000 emails** in my inbox."

Based on these reports, we argue that the participants show an understanding of the number of digital files that they are acquiring. Moreover, some of them indicate awareness towards the aspects that their acquiring habits can be considered excessive. Nevertheless, the data suggests that even when the participants show awareness of their acquiring habits, they can justify these habits and consider that it could not be different.

4.3.4. Managing Digital Files

The third theme in the codebook covers three important sub-themes that underline the participants' practices on how they manage the acquired digital files, what are the modalities to organize their data, and what are

their discarding habits and motives. Therefore, the following sub-themes that are used to describe these practices, namely *Accumulation Habits*, *Organizing Modalities*, and *Discarding Practices*.

Accumulation habits

This sub-theme describes the factors or the circumstances that determine participants to accumulate digital files. Most participants are accumulating a big number of digital files because their work or study life is overlapping with their personal life. This is either because they are using the same device for work, study, and personal use, or because the rules of the organization they are working for, promote accumulation. Another factor is because their personal interests are similar with what could be considered work interests. For example, one participant mentioned that it is a habit for her to always take a picture before, in the middle, and after she built or changed something around the house or at work, to have it as a comparison. One participant also mentioned that the fact that, sometimes, she ends up downloading duplicates because she cannot remember if a specific file has been downloaded, and this affects the amount of data that she accumulates:

> P2 → "Uh, well, because **I have this kind of habit to save a lot of things**, like photos, um, for, like design inspiration (for work). Or just some kind of information, you know!"
> P8 → "Q: (…) the fact that you are studying right now affect (…) how many files you're saving on a daily basis? A: Um, **it does affect** because there's **a lot of studying, um, materials** that I have to download (…) And then **I often download something twice or multiple times** because **I don't remember** that I already have it then it definitely **affects the amount of data that I store**."
> P3 → "So, I definitely, um, I would not say I hoard, but maybe **I accumulate a lot of files when I'm working**, especially **when I also study**."
> P10 → "(…) I only have **one computer** that is also **for work and for myself**."
> P5 → "I accumulate stuff on a daily basis because, as you know, **I have my own company and I have to download** and sign and all that."
> P7 → "I do a lot of physical work and the, for instance, I'll do some silica in the bathroom, **I always take before photos, in between photos and after photos, with the results**."

Another accumulation factor is in regard to different circumstances created by the systems used to accumulate files, such as emailing systems, where unlimited storage is available. This gives the participants' choice and the flexibility to accumulate increasingly more emails without being bothered about the space. Therefore, they end up not cleaning these systems:

> P10 → "I read it. I reply to it or I do whatever task is related to that email, and then (…) **I don't file it or anything**."
> P4 → "**I don't care** so much about the emails because you know, they just go through and they stay in the app."
> P7 → "Q: You end up storing so many (emails) of them because storage doesn't actually become a problem with it? / A: **Yeah**. I think if we were **forced to have a smaller mailbox** or make sure to delete more emails."

For some participants, the fear of needing digital files that are considered important, such as contracts or receipts, at a later point in time influences their accumulation habits, because they are inclined to keep everything just in case it might be useful again. Another habit for accumulating digital files was the need

to take screenshots as a reminder for the participant not to forget important things that need to be done, such as answering an email or paying a bill. This is because they consider it is faster to take a screenshot instead of writing a note about it:

> P9 → "It's because, um, it can always happen, it, especially with products and if **there's a two year guarantee** on it, uh, I want **to be able to go back** and find that particular order information or invoice and so on, in order to be able to do, uh, reclamations."
> P4 → "I never know when **I will use them**, or I just want to make sure (…) I have all the information on my phone, or I just want **to make sure I don't lose anything**."
> P7 → "I'll never going to use the email, but **I will keep it just in case**."
> P2 → "**I also have this habit**, if I want to (…) **keep something as reminders**, uh, I take screen shots of things, so it all comes up as a photo. (…) So, **I have lots of screenshots**. (…) You know, **not to forget** some things! I even take screenshots of, let's say, **an email** or something, **or a bill I have to pay**. (…) sometimes I write notes, but most usually **it's faster to take a screenshot**."

Organizing modalities

This sub-theme emerged from the participants' mentions on their organization habits and practices in regard to their accumulated digital possessions. It can be seen that different file types impose different organizing strategies, even among the same participants. Pictures are, in general, stored mostly on phone, and these tend to be unorganized by the participants unless the phone automatically categorizes the photos. This factor is valid even in the case of participants who are very engaged in their organization routines. The same applies for emails, especially because, in some cases, the email system used by participants offers a default categorization of some emails, such as spam folders, or newsletters:

> P7 → "**I do not organize them**. **I have all in one folder** instead of folders for family, folders for kids, folder for work…. because I've got work stuff on my phone, I've got private stuff. So yes! Everything is just lying in my phone."
> P8 → "Uh, in my phone **automatically sorts** them according to date. So, it's, uh, yeah, chronologically."
> P10 → "But, um, you know, my **photos app** does a good job of, of **keeping those organized** by moments and albums and all that."

In terms of categorization practices, participants tend to be both filers and piles. This depends on different types of files, how important these are, and the frequency of use of those files. For example, work and study files are usually more organized than personal files, using folders to categorize everything, while photos in their phones tend to be kept in the default folder of the phone, like a pile. The same pattern can be seen with emails, where work and school emails receive more dedication in terms of being filed accordingly, while private emails are just being read and left in the main inbox folder:

> P1 → "I definitely prefer **keeping it in folders**, given the strict model, in terms of like, having the like for this semester projects. I would have called them P1, P2, P3."
> P2 → "I have like these **different folders**. One is like studies, one is work. And one is like design stuff (…) if it's really, really **important** (email), I have **like separate folders in my email**. Let's see…**work is separated** from others."

> P9 → "I do **organize by purpose** as well, whether it's **pictures they get into one folder**, whether it's **invoices they get to in one folder** and so on."

From the perspective of over-categorization and under-categorization, participants tend to place themselves more towards under-categorization or in the middle. Some participants perceive over-categorization as too much clicking, making it difficult to navigate:

> P6 → "Generally, I have things quite organized. But in **wider categories**. For example, I will have pictures all together, have programs all together, so on."
> P2 → "**I had a huge folder and it has folders in it**. So, first, it's like one folder for university and inside (…) I have different folders, for different lecture basically."
> P9 → "It's a **pretty much in the middle** (over and under categorization). I don't think I struggled with finding stuff and I know where it is and I don't feel like it's, **it's too much clicking**, so it's the **appropriate amount**."

However, it can be noticed that participants tend to prioritize the organization of files that are perceived as more important, such as work files or school files. The same thing applies for files that are more frequently used. In these cases, the participants tend to have a very structured way of placing the correct file in the correct folder, from the moment they acquire that specific file. Some of the participants also adopt different organization strategies, such as naming conventions, extensive foldering structures, or spending time at the end of the day to sort everything in the right places:

> P9 → "**I do have several other folders**. So, it's either **school**, uh, **work**, uh, **housing invoices**, shopping, whatever. Uh, **I do categorize those** and yeah, if necessarily, I do subfolders in those as well. **That's only important ones**."
> P8 → "Uh, yes! I think, eh, the school files **I do (organize) the most**, it's **because it's the ones that I do work with the most**."
> P10 → "(…) the naming of those files is crucial. It is crucial, um, **to help everyone find something** without having to ask someone else. So, **naming helps all the time**. **Naming is key**."

In terms of emails, some participants mentioned that they prefer to read emails as they come and use the *Star* option, provided by the email system, to categorize them as important files when relevant. One participant discussed his "zero-inbox policy", which indicates that, at the end of the day, there should be no unread emails in his inbox:

> P2 → "Emails… if **it's an important email I always mark it with the star** (…)"
> P9 → "**I don't like having notifications like I have unread emails** (…) Like **I don't create folders for them** (emails), but I do like to mark them, like **star mark them** that really, **really important ones**."
> P4 → "I mean, **I star them** (emails). And then, I just keep them there if **it's something really important**."

Lastly, it can be noticed that participants are more inclined to organize their digital items as they come in, and not after a longer period of time. Similarly, if files are not organized right away, there is a tendency towards never being organized. It can also be noticed that the smaller their digital possession collection is, the easier it is for them to organize. Some participants mentioned their reservation in regard to spending time to organize their digital possessions because they have too many files and this would take too much

work, causing them an inconvenience. However, some participants are aware that having their digital files organized will ease their life, but they still prefer not to waste time on doing it:

> P3 → "I have like **3000 images** or something, (…) **I don't sort that out**. Yeah. I don't think I've ever sort out that."
> P4 → "Um, it's **really hard** (organizing) because when you have around **5,000 pictures** in your phone (…)"
> P7 → "(…) if I just spent **the time** (…) Make that folder and put that folder in [laughs]. Just different folders just to make your life easier. But if I sit, **it's going to take me days**, so **I just put it off**. It's like I'll do it maybe next month or next year. Is just, I do not want to sit down and sort through my things."

Discarding practices

The third sub-theme from the *Managing Digital Files* theme covers the factors that influence the participants' discarding practices in terms of habits and motives. This sub-theme also indicates the frequency of discarding digital files. Participants have different habits in terms of how often they go through their digital items and clean unnecessary files. Some of the participants prefer discarding files as often as possible, such as every day, or after downloading a specific file that is immediately considered irrelevant. Others prefer to do it every week or once a month. Some participants see the cleaning of their devices as a positive activity that makes them feel good about decluttering. Nevertheless, the participants that clean their devices and discard digital files often, are inclined to clean regularly because they need to have tidy folders to ease their work or school lives:

> P5 → "Q: So, in general, how often would you say that you clean your device? / A: **Each afternoon**. (…) I don't think about it, **I just delete**. (…) **I love cleaning**!"
> P2 → "Q: How often would you say you clean your emails? / A: I would say **once a month**."
> P6 → "Because I keep the, the number low, only for the things that I am **using at work**. Uh, and every time I create some PDFs or anything like that, that I don't need to send emails or receive emails, **I would delete them afterwards**."
> P8 → "I don't clearly have a schedule, but I would say I do (delete) it maybe **once a month for my phone**. **For my laptop not even once a month**. (…) when I download it (the file) if I see it's not relevant type, **I delete that at that point**."
> P9 → "I opened my mails and if it's, like I said, newsletters and so on, **they get deleted right away**."
> P6 → "(…) the files that I get on the computer daily, as I said, **I delete them every day**. At the end of the day, the ones that are just temporary and that I don't need to use."

However, there are few participants to discard their digital files very rarely, such as once a year, or never. Those who rarely or never discard digital files mention that time and storage play an important role in keeping all the files and never deleting any of them. The unlimited storage is provided either by online drives, such as Google Drive or iCloud, or by the unlimited storage their devices hold. In regard to time, participants mention that they find it time consuming to stay and delete unnecessary digital files. Therefore, they discard items if it comes in hand, such as when they sit in a train or a bus and there is nothing else to be done. Time is also one of the reasons why participants do not engage in cleaning their email inboxes more often:

P1 → "I mean, um, I have a **Gmail** (…) I don't think I've cleaned out no cause because I know **I have enough space**."
P7 → "But **the emails** in my phone, **I never ever delete it**. (…) I think if we were **forced to have a smaller** mailbox or make sure **to delete** more emails. (…) I will try **once a year** to go through the rubbish photos **to delete** it, but not in a monthly basis, not on a weekly basis. **I don't have to time for it**."
P4 → "**I never delete** anything in my phone. (…) **It's mostly about the time. I don't want to take my time to stay and delete** stuff from my phone. (…) If **my storage** gets full, then I realized **I have to delete** some stuff."
P3 → "Q: **How often do you delete** or like clean your pictures from your phone? / A: **Never**! [laughs]"
P6 → "So, with my computer, **I have a lot of space**. Uh, I would say maybe it **happened three**, **four times in the last five years** that, uh, I went on **to delete some things and then I would just delete the big stuff**."

Beside storage and time, there are other factors that stop participants from discarding their digital items more often, such as the importance of some digital files as perceived by each participant. Work or school projects and important documents are kept by most participants because they see these files as being useful sometime in the future and, therefore, should not be discarded:

P7 → "I've always been too scared **to delete anything**, because **what if I will need it again**?"
P3 → "I always archive them (emails) in some way. **I don't want to delete** them because **I might actually need them** at some other point."
P9 → "No, I don't. **I don't delete** them right away. It's because, um, it can always happen, it, especially with products and if there's a two year guarantee on it, uh, **I want to be able to go back** and find that particular order information or invoice and so on, in order to be able to do, uh, reclamations, uh, and so on."
P4 → "Even though there's **no use of them**, I want to leave them there **just to make sure I have it in case someone would ask me about it**, just to make sure I have contracts."

Another important factor worth mentioning is the presence of emotional attachment to certain digital files, pictures in particular. Participants indicate that are not able to part ways with their photos or are having a hard time to delete them. This could be because, these pictures capture memories with families and friends and are precious for the participants. P4 mentions that she considers all the pictures as a part of her life and she could never part ways with them:

P7 → "Q: Why would you be afraid to delete pictures? (…) / A: I just don't think you can ever have enough **pictures of your family**. / Q: So, would you say that in terms of personal photos, there **is emotional attachment** related? / A: **Definitely yes**!"
P4 → "Q: So, would you say that when it comes to deleting a picture for you, it's about the emotional attachment and the memory? A: Exactly! **Emotional attachment** (…) I find it **hard to delete** the pictures even though they're not maybe really important, but **they're a part of my life**."
P8 → "Q: And why would it be difficult for you to **delete pictures**? / A: Well, if I, um, yeah, only if there have like a **sentimental meaning** behind them"
P3 → "Q: And, um, when you do clean your devices, which are the files that you have the hardest time discarding off? / A: I **accidentally I delete my old website**, like my very first project that I ever saw and I saw that was kind of a scene because that's funny **to have like a memory** but that you usually don't going to need. (…) **I guess is just the emotional attachment**, I would say it's, yeah!"

4.3.5. Retrieving Digital Files

The fourth theme in the codebook, *Retrieving Digital Files*, uncovers means through which participants are finding the digital files that are needed at a certain point in time through their devices. Moreover, they also mention how difficult they find the process of retrieving the files in terms of how fast and easy they find what they are looking for, in their devices. Thus, the sub-themes, *Search Modalities* and *Retrieving Difficulty* emerged.

Search modalities

This sub-theme uncovers the main modalities used by the participants when they need to recover specific digital files in their personal collections. The preferred way of retrieving files is by using the Search function that devices provide. The participants that use the Search function indicate that they need to have a good organization system in terms of properly naming files, or a good memory of how these files are named.

> P6 → "I prefer the **search function**. Yeah. The function at the bottom left of the Windows."
> P9 → "**Search function**! (…) because **I do use naming** and I know what I named the stuff, so that's why I can the search function."
> P8 → "Mostly, um, **search function**."
> P2 → "Usually I try to remember **how I named** it or how it's named. So, **I use the search**, you know, on my computer?"

However, some participants, besides using the Search function, also prefer to retrieve files by browsing through their devices. This is mostly because they have a good overview of the things they have and where they are placed. This happens mostly when they are looking for photos in their devices, because they know that pictures are saved in a folder created by their devices and are organized chronologically. Another reason is that they are using these files more frequently than other files. Both searching practices are used for different reasons. For example, participants use browsing more for their phones because the devices show on the screen most of the apps that the participant might need, while the search function is used only when they are looking for something that is not on the screen already. In addition, the phones are very structured in terms of creating the right folders. For example, participants know where the pictures are because the device is creating the folder for it. On the other hand, the search function is mostly used for computers and systems, such as Pinterest and Gmail, but also within apps, such as looking for specific things within a conversation on WhatsApp:

> P2 → "Q: Okay. So, would you say that you use mostly a search function or a foldering search? / A: **Both**…"
> P10 → "Um, on computer is always search function for everything. Um, which is also why I have learned to name my files correctly. Um, and on the phone, browsing is easier, and often it's browsing by date or like going back in time, uh, to some moments that I remember might have what I need."
> P7 → "(…) we've got this Ikea card, you know, the, the family card. Now I **don't** have the physical one, so every time I go to Ikea, **I just search on What's App** - Ikea card. And it pops up!"
> P6 → "I also use the **search function in my phone**, uh, but only **for things that aren't on the phone screen**. I would place some of them on the screen or in different folders, but, uh, most of the ones that I use are on the screen."

P1 → "Most often it (the search) will be **by folder**. I will go in to get it **unless I can't find it**, and **I will go to a search function**, see if I can get an idea of where it would be. (…) I mean, um, I have a **Gmail** (…) Um, personal mails, but I don't really sort it. Just one note, that that's **where I will use my search** function always if I ever need something to find."

Retrieving difficulty

This sub-theme emerged from the participants' mentions of how challenging it is for them to retrieve a specific digital file. The number of files a participant accumulates, and their organization process affects the retrieval process. If a participant does not organize their collection throughout the accumulation process, this will make the retrieval process much more difficult. Moreover, if the collection is large and unorganized, it affects even more the retrieval process:

P8 → "(…) **it's not easy to find everything** that I need at the moment. I don't know on which device it is and on which platform and things like, okay."
P7 → "Q: How easy is that process for you? Do you know where to find it? Does it take a lot of time to find it? / A: **Sometimes**, because **I've got a lot of the things**, I have to think about where I save it."
P4 → "(…) sometimes, uh, when you have **too many (files)**, it's **hard to look** through them and **find exactly what you need** (…) I find that difficult to look after exactly what I need."
P2 → "But **photos are more difficult to retrieve**, to find (…) **because my photos are not organized**. (…) And it's just **a huge, huge, huge folder** of like, 20.000 photos… maybe 30.000 photos."

Those participants who indicate a very easy and successful retrieval of their digital files, do it because they have good strategies to help them search for what they need. Some participants use particular keywords that they remember in connection with specific files, while others have well-defined naming conventions from the moment that they acquired the files. Naming occurs in the organization process of these files, which is very useful for a successful retrieval at a later point in time. Another reason is because these files are used frequently, or on a daily basis, meaning the participant has already a good knowledge of where these particular files are:

P6 → "If it's something **that I use on the daily**, I would say I would find **it pretty easily** (…) Everything should **be organized** so that it's a lot **easier for me to find them** later on."
P3 → "Q: Okay. And **how easy is it for you to access** the files that you have stored on your devices? / A: I think **it's pretty easy**, I would say… Yeah! (…) I think most files and things **I can remember**."
P8 → "(…) **I remember a keyword** from a conversation where I had saved this or send this file. So that's the way I find it."
P5 → "**I have a system** (organization), I have like a folder system that we programmed on my computer, so everything I do is arranged in specific folder. So, **I can easily**, **like, manage where everything is**."

4.3.6. Influential Factors on Digital Hoarding

The last theme that emerged from this analysis described the influential factors that cause participants to have a big collection of digital possessions. These factors are mentioned in regard to the other themes as well. Nevertheless, it is important to describe and underline them separately. As such, we consider that participants' accumulation, organization, and discarding habits are influenced by factors of *Sentimental Value* and *Instrumental Value*. Moreover, due to the technology' development, some of the devices and the

systems used by the participants enable different *Affordances* that contribute to accumulation, organization, and discarding habits of digital files. Lastly, we mention the different *Domains* that influence participants' habits, namely work, school, and personal.

Sentimental Value

The first sub-theme uncovers different emotions in regard to discarding or losing digital files. Most participants have specified that they have a hard time to delete any digital files to which they feel emotionally attached. In general, this attachment is related to pictures with families and friends, or pictures that are reminders of special moments from the participants' lives. Moreover, P8 mentions that her writings create an emotional value because she feels connected with the characters that she has written about:

> P9 → "Q: Something happens, and you have to do it, which would be the files that you would have the hardest time discarding off and for what reasons? / A: I think it would be pictures, uh, of certain events and mostly because of **sentimental reasons**."
> P6 → "Q: So, in the case of this pictures that create memories, there's some attachment to those or, and otherwise, why do you keep them? / A: Yeah! **A lot of emotional attachment**!"
> P3 → "Q: Would you have a harder time losing some of those than others or? / A: Like, I think the most important files are the ones that **I'm emotionally attached to** (...)"
> P8 → "Um, yeah, I think **it has emotional value** to me because of how much effort I put in and how much, um, I am connected to the characters that I write about."

However, beside emotional attachment, negative emotions as fear and stress are also mentioned in regard to deleting or losing particular digital files. Participants do not give enough arguments to why fear and stress is present, but they indicate that this causes them to accumulate and hold on to digital files even though these files do not have a meaningful or specific use:

> P7 → "But I think with my phone **I've always been too scared to delete anything** (…) my whole life is on my phone."
> P4 → "I always keep videos, and photos, of course. I just don't want to delete them because **it can cause me stress**."

Instrumental value

This sub-theme refers to the participants' feelings in regard to loosing or deleting some of their digital files because they are considered important. These important digital files are, in general, kept just in case they might be useful again in the future. This factor contributes to the accumulation process and impedes the participants to delete some digital files that might be of no more use. Moreover, the accumulation of excessive files causes negative feelings, such as stress:

> P3 → "Q: So, do you think that you are running into the situation where you save certain files with the mindset of, **I might use this later**? / A: Yeah! (...) I would say, **like 50 % of the time**."
> P4 → "Of course **it causes me distress** (to delete). I can't think of else that is **causes me distress then photos, videos, and a contract**. Even though **there's no use of them**, I want to leave them there just **to make sure I have it in case** someone would ask me about it, just to make sure I have contracts."

Another instrumental factor is the time that participants invest in creating some of their digital files, such as school or work projects. Even though these projects are successfully finished, participants have a hard time discarding them. Thus, they decide to keep these files in their devices even though these are of no use at later times. In addition, P9 mentions that she likes keeping some of her projects just because they can be used as future references in future job searches, as these could be more valuable when used for job applications:

> P1 → "Um, I think **I will be most sad** about all the accumulative knowledge I have on it, um, or **my studies**, uh, **semester project**, **stuff like that** (...)."
> P9 → "I would prefer keeping stuff such as calculations so that I can use them as examples if I later want to use it in my work life. (...) **I do keep longer projects**, but also **I can use it as a reference later on**."
> P6 → "Yeah, **I'd say the invested time I put into it**. Then it could always **stay there and maybe be used** either in a portfolio or maybe actually for whatever use it was intended for in the beginning."
> P2 → "Yeah. I usually keep because I think, **what if I need it again**?"

Responsibility is another instrumental factor that emerged from the interviews. Some participants feel responsible for some of their work items, such as work emails, pictures taken for work purposes, contracts, or financial records. These files are important, and even though they have no immediate use, participants keep them:

> P7 → "Q: Why **would you be scared to delete something**? (…) / A **Especially with my work**. Um, **I have to cover the company**. So, say for instance, we have a problem with the pool, and like I said, I liked to take pictures before someone does something, then in between and then the end result. / Q: And do you **feel responsible** for these work-related files that you have? (…) / A: **I think so, yes**!"
> P5 → "But **if I lost your pictures**, for example, **it would be devastating** because you have had that event and you had it once, and I've lost your only documentation, so that would just… **I would cry for days**. / Q: And, from what **perspective would you say that that would affect you**? / A: **Because I've let another person down** (…) Q: Then, would it be fair to say that **you feel responsible** for some of those files? / A: **Yes, definitely**!"

It is important to mention that the instrumental value of certain digital files influences also the participants' organization practices, because these files need to be placed in the right folders in order to be used later, if and when needed.

Affordances

This sub-theme emerged from the participants mentions on how their devices and the systems that they use, create particular affordances that influence both their organization practices and their discarding habits. For example, in case of P7, the phone is seen as an affordance because it is comfortable to use it on the go, instead of using the computer. Its physical form affords the participant to easily carry it and use it at any time and in any place, while on the go:

> P7 → "The thing is **about with my phone**, that you always **do it on the go**, and I rather do a document on the phone, while I am in train, or it depends. **I rather use my phone** to do a document or things like that, **instead of taking the computer out, it's more about comfortable**."

The most important affordance that most participants mention, either as a factor in accumulation or for discarding, is storage; both internal storage on their devices and virtual storage drives, namely Google Drive and iCloud. For some participants, the storage is a factor that forces them to clean their devices, because these provide limited storage. This forces some participants to move their digital files on physical hard drives. These hard drives are used, not only because participants run out of space on their devices, but also because they are considered practical to back-up any digital files that should not be lost. Participants indicate that hard drives are perceived appropriate in terms of security. In addition, virtual storage drives such as Google Drive and iCloud are preferred by most participants for different reasons. Google Drive is used for work and school because files can be easily shared between different individuals, but also because it affords unlimited storage. On the other hand, iCloud is used for safely storing digital files and also because the digital files stored here can be easily accessed at any time, from any place, and from multiple devices:

> P10 → "If I **still have storage** list, I usually **don't think to clean** it. / Q: Okay. So that's the most influential factor in deciding to do the task? / A: Absolutely! **If I had unlimited space, I don't know if I would delete things**."
>
> P5 → "And **with the pictures** on my phone… I accumulate so many because I take so many, (…) for example, **now I can see that my storage is almost up**, so **I'll go through them one of these days and delete**."
>
> P5 → "We (the company) … right now **everything is on Google Drive** and we have **unlimited amount of storage** because we bought it. But because we are dealing **with confidential** and very (important)… **information** that we need to be careful with, there's most people's personal information, you know, we have CPR numbers and account numbers and stuff like that, we are not buying a server online so everything is **on that secure server**."
>
> P1 → "I guess, **I do that quite a lot (cleaning)**, because **my computer doesn't have that much space**. Um, so if I **want to download a game, I have to delete another**. So, it was quite a one for one at the moment."
>
> P7 → "So on my phone, I think I've got about 12 - 13,000 photos. Even though **I will upload it to iCloud**, I'll still want to see it. **I want to have access to my notes, my emails, my photos from my phone**."
>
> P9 → "Because, um, at least for the computer, **the storage room is quite big** that I have. And most of the files that I use, they **are stored online**."
>
> P6 → "I have **unlimited storage** on my phone because I have to have a **Google drive** on my phone. I have **a phone from Google**, which gives me unlimited storage. I've **never deleted** anything on."
>
> P3 → "Yeah. I have upgraded my storage in there, so I **can pretty much put all my work-related stuff in the cloud**. So, if I, by any chance ever **needed on my phone, it's also accessible there**."

In terms of organization, participants mention different systems help with certain organizational practices. For example, P2 finds Pinterest helpful in her organizing pictures into different boards that hold pictures from the same category. Moreover, this stops her from accumulating digital files on her own devices because the system stores them in the online:

> P2 → "Um, yeah, **I started using Pinterest more**, so it **helps** a bit with that, you know, **to save it in one place** because it is like a mess with all the different files on my desktop."

Gmail was mentioned by most participants. This particular emailing system can help in partially organizing some of the emails, by creating different folders depending on the nature of the emails, such as *Inbox*,

Unread, *Important*, *Spam*, or *Starred*. The starring option included in this system, helps participants to highlight the emails that they consider the most important. It is worth mentioning that the star function helps placing these emails in a special folder called *Starred*. Thus, this affords better structures of emails. On the other hand, the unlimited storage provided by this system, encourages accumulation of emails, and due to this affordance, participants are not inclined to discard their emails more often:

> P2 → "Yeah. Emails… if it's **an important email** I always **mark it with the star** or if it's really, really important, I have like separate folders in my email. (...) Because it's like **you can have so many emails**, so **there's no like storage issues**, so I choose to keep it."
> P4 → "Q: What about in terms of more personal and more information, important emails? /A: Mm. **I try to (..) star them**. And then **I just keep them there if it's something really important**."
> P9 → "I like **star mark** them (emails) the really, **really important ones**."
> P1 → "I mean, um, **I have a Gmail**, which does **a quite nice job of putting the things in different tabs**. So, all kinds of **commercial stuff will be on a one section**, **new news mail would be under one section** and it will have **a social network as well with notifications from LinkedIn** and stuff like that. **Then I have my primary email** where I will do my own mails."

In terms of gaming, PlayStation and Steam libraries help in organizing the participants' games. These libraries keep the accumulated games, and it also helps in categorizing these by genre. In addition, these shows if the game is installed or just downloaded. In terms of music, the software Spotify, helps participants to create different playlists depending on their needs and moods, as well as to keep the music organized and accessible. This system also affords storing the music without worrying about space. Lastly, movies and tv series streaming services, such as Netflix, afford the organization of the movies and the series for the participants, and help them in saving movies or series for future use in the *My List* function:

> P1 → "So, I will often get those two games, and then I would **add them into my library** without actually a download on me. Then, there **would be on my profile, but I wouldn't be on my PlayStation** just so I know I have it if I wanted to play. I think that's also **the same with my computer and my games on the Steam**. So, if there's a game that's free, I'll download it. I mean, it will add it to my library, but I wouldn't necessarily download it. **I'll just do it for the sake of having it in case** of if I wanted to do it, use it because is free... It would just download it."
> P3 → "I am really picky with **my music on Spotify**. I have like **a playlist for every year**."
> P2 → "Um, well**, I have few playlists on my Spotify**. **One** is kind of like, just **a list of favorite songs** all sorted out (…) And you know, when you follow a playlist on Spotify, it's saved in the same place in your music library, you know? Um, so it's like few playlists that I made myself and then like few playlists from Spotify that are not mine, I just follow. **So, it used to be in one pile**, but **then I found out that it has folders**. So, **I created two folders**. One is like my playlists and another one is Spotify."
> P7 → "Q: Um, you were also talking **about Netflix**, what about that? Do **you use save to my list function**? / A: Okay. I'll go **through all the movies and the series** and then **I add them to my list** to watch them, like in a later stage."

Domains

This last sub-theme describes the purposes for which the participants have so many digital files, for work, school or for personal reasons. Even though we briefly mentioned in the previous themes how work and

school influence some of the participants' choices for accumulating, organizing, and deleting some of their digital files, it is worth explaining in depth how these domains influence their habits. In general, most participants had jobs, and their work positions were mostly in the digital media field, where they accumulate digital files such as videos, pictures, or emails. These jobs influence their accumulation habits because the work and personal lives are overlapping, as participants have jobs within the same interests as their personal lives. In these cases, they end up using their personal devices both for work and personal reasons. It can be noticed that there is a fine line between work and personal life in terms of accumulating digital files. Besides the accumulation habits, work organization also influence the way participants organize their personal files:

> P7 → "Especially **with my work**. Um, **I have to cover the company**. So, say for instance, we have a problem with the pool, and like I said, I liked **to take pictures before someone does something, then in between and then the end result**."
> P2 → "A: Well, it's kind of, you know, it's **kind of difficult to differentiate** because you know, all these like design, inspiration things, are also **related to work**. / Q: Okay. Yes. This sort of relates to what I was asking earlier, **if there is a very fine line between your work and your personal**? / A: **Yeah, I would say so**."
> P3 → "So, I definitely, um, I would not say I hoard, but maybe **I accumulate a lot of files when I work**, **especially when I also study** (…) Like when **I'm not working, I don't really have any files** at all."
> P5 → "Q: Um, would you say that **your work has an influence on your accumulation**… on the number of files that you accumulate? / A: **Oh yes, definitely**! If it was me personally doing, I don't know, a 9 to 5 job, I don't think I would have as many files."
> P10 → "Q: So, I guess in that sense **we could say that your professional life influences your organization habits** because you are forced to have things related to your work in your computer? / A: Yes. **It's, it's definitely helped in a way**."

When work and personal lives are not overlapping, participants indicate that their personal accumulation are not influenced by their work life. For example, P6 mentions that he does not organize or delete digital files in this private life but, on the work computer, he likes to have files organized and to clean the unnecessary files after each shift. He also mentions that it is a must to have the work files organized because there are other people with access to these files who might need to use some of them:

> P6 → "So I'm a lot more **careful and (more) tidy with the work computer** than I am **with my own computer**. (…) I would say, uh, **under categorizing everything when it comes to my own files** and **over categorizing everything when it comes to work**. (…) I think I do it more when it comes to when I'm at work, because **it involves other people having to go through my files** (…) So that's why **I want everything to be organized**."

The school domain is seen as separate from both work and personal lives and does not overlap with either of these domains. However, the study life also can influence the accumulation habits of the participants. In addition, participants who are students mention that they like to have their study related files organized in folders, because these are used frequently and need to be organized to be easily accessed. Moreover, the school projects are usually the ones that participants prefer not to delete because they are important. Additionally, participants invested a lot of time in these projects and these end up having a certain value to them, as they consider that these projects could be used in their portfolios or as references:

P9 → “Q: Do you ever find yourself **prioritizing the organization of certain files** more than others? / A: Uh, yes! I think, eh, **the school files I do the most**, it's because it's the ones that I do work with the most.”
P1 → “Q: Can I ask what the main reason is **behind keeping these files**, even when you're done with like a milestone, I would call it a milestone. Like you said, **the bachelor’s** (referring to studies). / A: I mean; I keep these just to, **like, make references for myself**.”
P8 → “Q: And do you think that **the fact that you are studying right now affect**s **how many files you're** saving on a daily basis? / Um, **it does affect because there's a lot of studying materials** that I have to download.”

4.4. Findings

The interviews analysis has brought forward specific patterns that were mentioned by the participants in relation to their accumulation habits, practices, and motives. As such, it is important to emphasize the findings and describe each pattern that emerged. These patterns are based on different indications in relation to the same habit, practice, or motive.

Acknowledgement

This pattern is the outcome of the first theme, Digital Hoarding. Most of the participants were not aware of the digital hoarding concept. However, they were able to describe it based on previous knowledge about physical hoarding. As such, they described digital hoarding as the accumulation of items that have no real use. In addition, the descriptions provided by the participants with no previous knowledge about digital hoarding, are similar to the ones provided by participants familiar with the subject.

Accumulation awareness

This pattern was visible in the second theme, Acquiring Digital Files. All the participants have accumulated large collections of digital files and, even though they do not know the actual number, they are aware that it is a big one. This is a pattern that can be observed in both participants who are accumulating digital files daily, and in participants who do not accumulate as much. The large collections of digital files do not seem to be a consequence of not being organized or unable to discard, as even the participants who are very organized and discard items regularly admit that their collections are quite large.

I need it for work and school!

Most of the participants were either students or having jobs. According to them, the study life and their jobs influence the accumulation of digital files. As such, some participants were acquiring study documents because they are currently students, and they were accumulated because these might be used in the future as references, while other participants where acquiring digital files because of their jobs, most of it in the digital field, where a lot of pictures and videos are needed.

Filers and pilers

In terms of organization, there are two types of organization modalities chosen by the participants, namely filing, and piling digital files. In general, both of these can be seen in the same participant, being a pattern consistent among all participants. This is due to the prioritization of organizing some files more than others, based on their importance and frequency of use.

Piling photos

This pattern emerges from the participants habits of never organizing the photos in their phones. They also mention that they clean the picture folder in their phone very rarely or almost never. Even participants who have good routines to organize and delete most of their digital files, fail to give the same attention to their folder with pictures.

I don't have time!

This pattern captures one of the most common reason for participants to not organize their email inboxes, pictures folder on their phones, or less important files. This is also a reason that stops them from cleaning their digital collections more often.

Only if it's important!

This pattern is important because all the participant consider some digital files in their collections to be more important than others. These files receive more attention from the participants in terms of keeping them organized and clean. Moreover, most of the digital items considered important are backed-up using additional hard drives or secured online drives and are kept in their digital collections for longer period of times and, in some cases, never discarded.

Searching and browsing

A pattern in the modalities preferred for retrieving items, is using the search function for computers, and browsing for phones. Participants rely on naming practices or keywords when using the search function. In terms of browsing, this is a more common practice in relation to their phones because it is used on a daily basis and most of participants are aware of where they can find specific files in their phones.

It's hard to find it!

This pattern is present for most participants, that even though they use either searching or browsing, they still find it difficult to find some specific files. The reason for this is unorganized content, unknown file location, or large digital collections.

Often or never

This pattern highlights the participants' discarding habits in terms of how frequent they clean their devices. As such, participants have a preference for each category of digital files in terms of which get cleaned often, daily, weekly, or monthly, and which are not cleaned. This pattern is present for all participants. There are participants who discard as little or as much as needed, and there are participants who are regularly cleaning their most frequently used files.

Plenty of storage

This pattern captures an important factor that stops participants from discarding their files and contributes to the accumulation process. Storage was mentioned by all the participants either in regard to the storage capability of their own devices, or the online software that are used, or the inbox of the emails. It indicates that participants are more likely to access new storage dimensions than clean their devices.

Unlimited inbox

Emails' inboxes represent the digital files that do not receive attention as much other digital files. Participants organize very little or not at all their inboxes because there is no limitation in how many emails can be stored. As such, this pattern results from all participants as they mention that their inboxes are unlimited, and they do not spend time to delete or organize emails.

Emotional attachment

This is a pattern present in most participants who feel emotionally attached to some of their digital files and have a hard time discarding these. The emotional attachment manifests in relation to pictures but also to personal projects where the participants invest time and effort.

What if I need it again?

Participants are expressing feelings of fear and uncertainty in regard to losing or discarding digital files, because these might be needed again in the future. This fear is related to the importance of these files because they might be useful again. In addition, some of the files acquired by the participants create a sense of responsibility for their owners.

My system does it for me!

This pattern is seen in regard to the systems the participants use. Some of these create different affordances, such as unlimited storage, safe location to store the files, organization possibilities, or discarding reminders. This pattern is not observed from the perspective that all the participants use the same system affordance, but from the perspective that they all use systems that afford them something.

The frequency of each pattern is indicated to emphasize their importance since these are considered the main findings in relation to this study.

Pattern	X participants out of 10	Exception
Acknowledgement	10/10	None
Accumulation awareness	10/10	None
I need it for work and school!	8/10	Participant 4 and 6
Filers and pilers	8/10	Participant 4 and 7
Piling photos	9/10	Participant 1
I don't have time!	10/10	None
Only if it's important!	10/10	None
Searching and browsing	10/10	None
It's hard to find it!	7/10	Participant 1, 3, 5
Often or never	10/10	None
Plenty of storage	10/10	None
Unlimited inbox	10/10	None
Emotional attachment	9/10	Participant 1
What if I need it again?	10/10	None
My system does it for me!	10/10	None

Table 4.4 – Frequency of patterns within the participants and exceptions.

5. Discussion

Digital hoarding has become a topic of interest and the findings in the current research demand further research and work in this domain. As such, through this master thesis we aimed to uncover the main factors that influence the accumulation practices that could lead to digital hoarding. Thus, interviews were conducted to be analyzed in order to identify these factors from the perspective of each participant and find possible patterns across the participants. From the beginning of each interview could be identified that all the participants understand what digital hoarding is and that their digital collections are very large. These two facts describe the acknowledgement of the phenomenon as well as the awareness of an accumulation problem, and in specific cases, the auto-definition of being a digital hoarder. These digital collections consisted in all sorts of files such as photos, videos, movies, documents, 3D files, emails, games and music. These two facts were consistent across all participants which identifies the first two patterns in our research. Moreover, these patterns led the research further in understating each participant reasoning for accumulating a large number of digital files as well as what are these digital files. Each participant had different reasons for what and why is accumulated, depending on his own interests and the circumstances around it. Through the analysis two main processes are responsible in forming the accumulation process, namely acquiring digital files and the ability of discarding these digital files.

In the acquiring process, participants acquire different digital files for various reasons. These files are involuntarily acquired from other sources, such as emails, messages, different graphics sent through different social applications. While others are acquired in bigger volume voluntarily because their work or study life is overlapping with their personal life. Thus, this factor is a pattern across majority of the participants. Even though only the acquiring and discarding processes are leading to accumulation from a literature review perspective, it is important to mention the organization of these digital files after the acquiring process. This process has been identified in the analysis as being of two kinds, filing or piling. These organization practices are influenced by different factors. Participants prefer to prioritize the organization of certain files over others because these are more frequent used or are perceived as being important. In addition, time is considered another factor that influences the participants organization systems and prioritization. At the same time, participants that have organization system in place, such as foldering or naming conventions, are less inclined to organize digital files of personal use, such as photos in their personal phone or emails in the inbox. These organization habits are seen as patterns across most of participants. Just two participants have no organization system in place, because the overwhelming accumulated digital files makes it difficult for them to start organizing it. Further on, an organized digital collection helps participants in their retrieving process at a latter point in time. For this process, the preferred retrieval methods are browsing through the folders or suing the search function of the devices used. In the case of the search function, participants rely on naming conventions and specific keywords to find what they are looking for. On the other hand, browsing requires a very structured foldering system and a good memory about the location of the file. Even though some participants are expressing their easiness of retrieving the files when needed, most of the participants have a hard time of finding a specific item fast and easy. This is due to the fact that their organization practices are not efficient enough, or they do not remember where that particular item was placed or how it was named. As such, the organization of digital

files is an iterative process that participants are adjusting based on the new acquired items and discarded files and if done correctly assures a successful retrieval of files when needed.

In terms of discarding digital files, this a process that can impede the accumulation of digital files or amplify it. Just as in the case of organization, there are participants that clean their devices as often as daily, weekly, or monthly, and there are participants that never clean their devices. Moreover, participants that clean often some part of their digital collections, at the same time they never organize the photos pile in their phones, or the library of PlayStation games. This pattern of often and never discarding is seen in all the participants in different situation with different digital files in their collections. In the case of never discarding, it is important to mention the factors behind it. Just as in the case of the organization, time is also seen as a factor. Participant do not want to spend time to go through some of their digital collections to delete certain files, or in their email inboxes. This is because they are not creating any inconvenience for them, or because the collection they own is overwhelmingly large to start cleaning it. Beside time, storage plays another important factor, such as limited or unlimited storage. Participants own devices with big storage memory or unlimited, they own online drives with unlimited storage, or their email inboxes. Some participants mentioned that only when their devices are alerting them about the full storage, they are forced to clean some of their stuff, but not before. As for the ones that own unlimited storage, they never take the time to clean and discard items. Beside time and storage, participants have other motives for not discarding some of their digital files. Emotional attachment to personal photographs with family and friends or some particular projects that represent memories or life events is one of the main reasons for participants for not discarding them. Beside this factor, the fear of needing a certain file in a future point in time impede the participants in discarding several digital files that have no real use anymore. This fear is usually related to important and official documents, such as contracts, guarantee receipts, financial documents. Additionally, some participants feel a certain sense of responsibility for some of their owned files, because these are sensible files for work purposes.

These processes are influenced by the above-mentioned factors. As such, these factors are enables by some of the devices and systems that the participants use and own. These enablers are perceived as different affordances such as limited storage, safe location to store the files, organization possibilities or discarding reminders. The devices and the systems used afford to the participants certain possibilities to ease their organization and discarding practices, which can be considered positive consequences. At the same time, the affordance of unlimited mail inbox the affordance of unlimited storage enables accumulation of a bigger number of digital files, which can be seen as a negative consequence.

5.1. Limitations

These findings should be considered in light of the following limitations. First, this study includes data from only 10 participants and the findings cannot be considered representative of the population. Moreover, these cannot be generalized to any extent. Nevertheless, these findings can serve as a starting point for the research that looks into digital hoarding. It is important to note that our findings are in line with previous studies (Van Bennekom, et al., 2015; Sweeten, et al., 2018; Neave, et al., 2019; Vitale, et al., 2018). Second, further studies on digital hoarding should also focus on a sample that includes both males and females in

an equal number. Additionally, the age of the sample should be more diverse than in our case. This could also prove beneficial in regard to exploring possible onset age for digital hoarding. Moreover, it could also be explored whether differences in age have different impact on digital clutter tendencies.

A fourth limitation is that the relationship between physical hoarding and digital hoarding is not investigated to a full extent. Therefore, future studies should include interviews that examine these two concepts in parallel. In this way, a clear relationship could potentially be established between physical hoarding and digital hoarding. Another important limitation was created by the world-wide pandemic, COVID-19. Although it did not have a direct impact on the study, the findings should be interpreted by considering this aspect. This situation forced people to stay home, and work from home in some cases, and this could have influenced their accumulation habits. This aspect was not addressed during the interviews but one of the participants mentioned that, because of the situation, more work is done online, meaning that more files are acquired and stored digitally. As such, a larger sample should be gathered and a study focusing on these aspects should be conducted.

6. Conclusions

Throughout this dissertation, we have conducted a study investigating digital hoarding. Additionally, we analyzed the findings which provided answers to our research questions. Based on these, we are going to formulate the final answer to our problem statement. In this chapter, the research questions are answered based on the literature review and the findings from the interviews, and this will lead to the final answer, that of the problem statement.

RQ1: To which extent are people familiar with the concept of digital hoarding?

In the beginning of each interview, participants were asked to describe what is their understanding of the concept digital hoarding and if they heard of it prior to this study. Most of our participants were not familiar with the concept of digital hoarding, and very few participants have heard about it through their current studies. However, based on their physical hoarding knowledge participants gave definitions on what digital hoarding means for them. As such, participants define digital hoarding as the accumulation of the digital items with no actual use. This definition was consistent across all the participants.

RQ2: What are the main practices that lead to accumulation of digital files?

Accumulation of digital files is an activity that was performed by all the participants. Moreover, all the participants were aware that their current digital collections are quite large. This is due to a number of factors in relation to why and how they acquire digital files as well as their discarding practices.

RQ2a: Which are the factors that influence acquiring digital?

Each participant' acquiring practices were influenced by different factors:

Work and school: a starting point in the acquiring process was the reason or the circumstance for which they were acquiring. Most of the participants had an overlapping work life with their personal life, which were influencing the volume of digital files that were acquired daily. This overlapping was due the fact that their personal devices were used for work purposes as well. As such, these acquiring practices in work purposes influenced their personal life acquisitions. The same situation is in the case of the participants that were students. These were accumulating on a daily basis documents related to their studies in large amounts.

For later use: most of participants had a habit of acquiring different digital files with the purpose of using them later. For example, games were saved in libraries with the purpose of being played, video projects were accumulated with the purpose to be reused for another project, pictures were accumulated to make before and after comparisons in relation to a work and personal activity, Spotify playlists were downloaded in their devices with the purpose to be accessed in offline modes, graphic inspirations were accumulated daily from different sources with the purpose to be used at some undefined point in time and important documents and school projects were kept for longer periods of time because they might be needed in the future.

Involuntarily: often participants were acquiring items involuntarily, such as messages that were received over social media platforms, different pictures or videos that were received from other individuals or newsletter and spam emails that were received unrequested.

RQ2b: Which are the factors that influence discarding digital files?

Discarding practices can be beneficial to minimize an individual's digital collection or can maximize it. As such, these factors are:

Storage: this factor is an affordance that participants are using as a reason to discard or not their digital collections. The property of multiplicity of this affordance is that it affords unlimited space for the participants to store their digital collections, but it also affords excessive accumulation of digital files. For example, emails are very rarely or never deleted, and this is because the email inboxes have unlimited storage. The same things apply for participants that use online drives to store their digital collections or as a back-up method. In addition, the internal storage of their personal devices is quite large, and therefore they do not feel the need to discard of their items. However, to some participants, smaller devices like their smartphones have a more limited memory comparing to their computers. When the memory gets slowly full, some of the participants have mentioned it as a reason for starting to delete some of their digital items.

Emotional attachment: some of the participants' personal digital files are very difficult to discard because there is emotional attachment involved. Participants feel attached to some of their digital files. For example, pictures with family, friends or pictures that are reminiscent of a particular life moment are very difficult to discard because they have emotional value. Besides pictures, the emotional attachment has been mentioned in relation to some projects as well.

Fear and responsibility: these two factors have the same meaning to some extent and there is a fine delimitation between these two. Participants fear losing or discarding certain digital files because these are important and could be useful in the future. Thus, they are afraid they might be unprepared in the future because they have discarded these important files. Moreover, some participants feel a sense of responsibility for some of these digital files such as financial statements or guarantee receipts.

For just in case: participants were mentioning the need to keep certain digital files of no immediate use or use at all for just in case they might become important or useful at some point. Thus, this impedes the participants to discard these digital files that do not have any value anymore. For example, school projects are kept even if these projects were finalized in previous years, just in case it might be useful as a reference at some point in their life. The same things apply for several email conversation, work projects from a previous workplace or contracts from old apartments.

Time: this factor was mentioned by all the participants in different situations. For example, some participants do not wish to spend time to clean their devices because it does not bother them, or because their storage is not full or unlimited. This is the case of the email inbox that rarely or never gets cleaned.

Moreover, for collections that are quite large and were not organized from the acquiring moment, is it time consuming to go through it and clean what is needed anymore.

Large collections: this factor pushes participants to avoid clean their devices and discarding digital files. This is because the large number causes distress and impatience and makes the participants to postpone this activity for another time. As such, their collections never get cleaned and more items gets accumulated daily.

RQ5: What are the perceived consequences of digital hoarding?

Even though the participants of this master thesis cannot be diagnosed as digital hoarders, due to the fact that acquisition of items is a human thing, they presented awareness that they are continuously accumulating digital files. As such, different consequences of digital hoarding were perceived:

Negative feelings: participants are exhibiting different negative feelings in regard to their accumulation habits, such as distress, fear and annoyance and insecurities. Participants feel stressed when they think about the big number of their digital collections or the thought of having to discard any of it. Moreover, participants feel fear of losing or accidentally deleting some of these digital files, and in some case, they consider themselves responsible for these files. Annoyance is present when participants have a hard time finding a specific file in their collection, or when they are forced to delete something because their memory becomes full. In addition, participants feel the urge to secure their digital files, therefore they back them up in online drives or multiple hard drives. This multiplies their collection and creates hoarding.

Additional purchases: most participants are spending money on upgrading their devices in order to increase their memories. Moreover, they spend money on monthly subscriptions for online drives to store more and more of their digital files, or to keep it there safe as a backup.

Dependence: the different possibilities provided by the devices of current times are enabling different ways to accumulate and store different digital files. These affordances make the individual to become slowly dependent of these devices and keep information about their entire life in the online. Some participants mentioned that their entire life is on their devices and these represent a part of themselves.

Ignorance: the fact that digital clutter is not visible as the physical clutter makes individuals to ignore any potential issues that excessive accumulation that leads to digital hoarding can cause, as mentioned above. This ignorance could make digital clutter become a bigger problem in the near future.

RQ6: What are the similarities and differences between physical and digital hoarding?

After carefully analyzing the interviews, there were noticed certain similarities and differences between physical and digital hoarding.

<u>Similarities</u>

- Both forms of hoarding are caused by the accumulation in excess of possessions. The accumulation process is caused by both acquiring and discarding of possessions;

- Emotional attachment can be inflicted for digital possession which is a common hoarding criterion for physical hoarding;
- Instrumental value, such as fear, responsibility and the perceived value of some possessions impedes discarding and encourages clutter in both physical and digital hoarding;
- Individuals tend to avoid cleaning their collections of possessions because they feel stressed about the large number of it which is one of the causes for physical and digital hoarding;

Differences

- Physical hoarding causes socializing problems in the individuals lives. However, this was not present in digital hoarding analysis of this master thesis;
- Physical clutter is visible, unsanitary and makes individuals to feel depressed, sad, unmotivated to a point where it takes over their living spaces. Digital clutter is not visible, does not causes hygiene problems and does not interfere with their living spaces;
- Physical hoarding becomes a compulsive habit where participants cannot let go of acquiring items at all times. In the case of digital hoarding, the accumulation happens most of the times due to the digitization of their workplaces and study lives or involuntarily, and none of the participants exhibited a compulsive accumulation habit.

Based on the above answers, it is possible to formulate a conclusion of the problem statement.

Which are the factors that influence the accumulation habits that could lead to digital hoarding?

The factors that influence the accumulation habits are in relation to both acquiring process and discarding practices. In the case of the acquiring process, individuals acquire digital files because of their work and school, for later use of these digital files or involuntarily. Participants' discarding practices are dependent on factors such as *storage*, *emotional attachment*, *fear of losing*, and *responsibility* towards digital files, files not being discarded being kept *just in case*, *insufficient* time to clean their collections and the large number of these digital collections. Together, these factors can lead to digital hoarding, a phenomenon that, even though is not yet considered problematic, can have perceived consequences as mentioned earlier. This is also suggested by existent literature, which shows that physical hoarding and digital hoarding are similar in terms of factors that can lead to their apparition. Moreover, our study supports these findings too. In addition, we can argue that digital hoarding is not as severe and problematic as physical hoarding, but research must direct the attention of information consumers towards this phenomenon, in order to bring more awareness and possible solutions on how to impede it to become a medical disorder.

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8. Appendices

The appendices of this dissertation are available in a separate document.