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ESCALATOR PASSENGER COMFORT

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ABSTRACT

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Standards and design documents exist, which are used to define the technical parameters that might impact a passenger's sensory perception of escalator ride comfort. In order to have a broader understanding of passenger comfort as a consciously experienced phenomenon underlying several cognitive processes, a heterophenomenological research approach can be used. In this thesis, the experience of escalator ride comfort was researched via a survey and researcher observations. Results were analysed by statistical and spatial-contextual analysis. The results indicated that half of the experience of comfort can be predicted by the experience of vibrations and smooth movement of the escalator steps and handrail. The other half may be explained for example by the individual differences in a person's mental and physical properties, or other reasons. These factors may be important for the experience of comfort in escalators because they are relevant for maintaining balance and posture during the escalator ride. Their relevance can be explained through the evolutionary and biological reasoning, by the activation of specific sensorimotor programs, as well as by explaining the human functioning as a goal-oriented, interactive process between the environment and the internal mental processing. This subsequently underlies the individual's subjective needs, emotions, experiences, estimations and expectations. Using a heterophenomenological research approach in the future, together with the existing measurement methods, can support the design of comfortable escalator rides by both confirming the relevance and importance of the existing parameters, seen as factors predicting comfort, as well as providing further suggestions for new emerging factors.

Keywords: User experience, user psychology, escalators, comfort

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Tiettyjä standardeja ja suunnitteludokumentteja käytetään määrittelemään sellaisia teknisiä parametrejä, jotka voivat vaikuttaa matkustajan aistihavaintoon liukuportaiden ajomukavuudesta. Laajemman ymmärryksen saamiseksi matkustajamukavuudesta tietoisesti koettuna ilmiönä, jota edeltävät useat kognitiiviset prosessit, voidaan tutkimuksessa käyttää heterofenomenologista lähestymistapaa. Tässä tutkielmassa liukuportaan ajomukavuuden kokemusta tutkittiin haastattelututkimuksella sekä tutkijahavainnoilla. Aineisto analysoitiin käyttäen tilastollista sekä spatiaaliskontekstuaalista analyysia. Tulokset osoittivat, että 50 % mukavuuden kokemuksesta voidaan ennustaa portaiden sekä käsikaiteen tärinän ja tasaisen liikkeen kokemuksen tekijöillä. Loput mukavuuden kokemuksen tekijöistä voidaan selittää esimerkiksi ihmisten yksilöllisillä eroilla heidän mentaalisissa ja fyysisissä ominaisuuksissaan, tai muilla syillä. Löydetyt tekijät voivat olla tärkeitä mukavuuden kokemukselle liukuportaissa, koska niillä on merkitystä erityisesti tasapainon ja ryhdin ylläpitämiselle liukuporrasmatkan aikana. Niiden merkityksellisyyttä voidaan selittää evolutiivisilla ja biologisilla syillä, tiettyjen sensorimotoristen ohjelmien aktivaatiolla, sekä näkemällä ihmisen toiminta tavoiteorientoituneena, ympäristön ja sisäisten mielen prosessien välisenä vuorovaikutteisena prosessina, jonka taustalla ovat yksilön omakohtaiset tarpeet, tunteet, kokemukset, arvioinnit ja odotukset. Heterofenomenologisen lähestymistavan käyttö tulevaisuudessa, yhdessä olemassa olevien mittausmenetelmien kanssa, voi tukea mukavan liukuporrasmatkan suunnittelua sekä vahvistamalla olemassa olevien parametrien merkitystä ja tärkeyttä mukavuutta ennustavina tekijöinä, että tarjoamalla ehdotuksia uusista esiin nousevista tekijöistä.

Asiasanat: Käyttäjäkokemus, käyttäjäpsykologia, liukuportaat, mukavuus

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1 INTRODUCTION

Escalators are a transportation method used in many different contexts in the built environment. Escalators usually have a general technical structure and working mechanisms. Typically they are fitted according to the building plan and the global and local ISO- and ENA-standards, as well as the escalator manufacturing company's own design documents. Standards also define some of the criteria effecting the user experience of an escalator ride. These can be described as ”ride comfort parameters”. Adjusting these technical parameters is seen as a way to improve the user experience and user’s feeling of comfort by creating e.g. a smoother and quieter escalator ride.

However, one can question whether these existing parameters do actually fit with the passenger’s experienced escalator ride comfort. Ride comfort parameters are based on the escalator’s technical settings and suggested technical levels in the ISO- and ENA-standards. The settings are measured with tools for physical properties, using scales common to natural sciences. The concept of comfort and passenger’s felt experiences are related to events and phenomena that happen in the human world. There is an ontological difference with the ways the experience of comfort can be investigated and what kind of knowledge is acquired. As Kim (2001) states:

> The central difference between natural and human sciences is that, in the human sciences, we [humans] are both the object and the subject of investigation. The type of knowledge that can be obtained in the natural sciences is qualitatively different from the knowledge that we can obtain in the human world. (Kim, 2001, p. 55.).

Acknowledging this difference raises the question: do the emerging conscious phenomena of moving in this particular way relate to the ride comfort parameters? On which levels and to what degree do they relate to the parameters? There might even be some other aspects and factors affecting the overall experience and the passenger's feeling of comfort, which have not been investigated or included as meaningful factors in the standards. The research of the technical parameters escalators and how they apply to human experiences are similar to studies of computer systems. The first article about using the appropriate approach and methods to study users of computer systems was written by Moran (1981). In his article he highlighted the importance of understanding the emerging feelings and behaviour of a user by using psychological methods. Moran (1981) writes: "the only way to attain a coherent understanding of the user is to look beyond the superficial features of the computer system and consider the user on his own (psychological) terms" (Moran, 1981, p. 6). This means that humans need to be seen as thinking, learning and interacting beings. The user's experience needs to be seen as a conscious phenomenon underlying several subconscious processes, influenced by for example physiological, psychological, cognitive and sociocultural factors.

Models have been proposed for perception-action loop (Ernst & Bülthoff, 2004), for attention and conscious events (Baars & Gage, 2010), for the emerging feeling of comfort (Vink & Hallbeck, 2012), as well as for comfort and discomfort and their underlying factors (De Looze, Kuijt-Evers & Van Dieën, 2003). All describe sets of mental events, which play their part in the explanation of perceiving and having a conscious experience. Several additional key terms and concepts that are seen as basic elements of human conscious experience are presented in the theoretical background chapter. Figure 1 illustrates the complex system of user experience as a cognitive process in interaction with the environment. This process results in observable outputs, such as physical behaviour and introspective reports of a certain felt experience, such as the feeling of comfort.

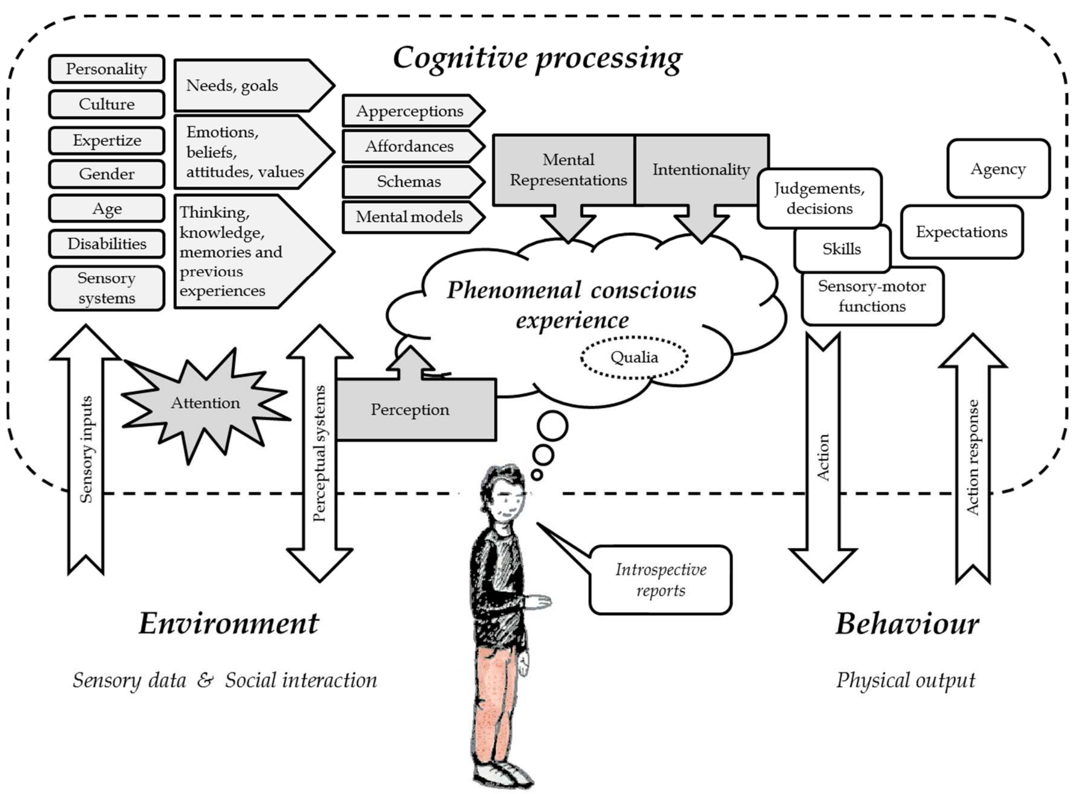

FIGURE 1 A framework for user experience as a cognitive process.

In this research the escalator passenger is seen as an active user of a product. The user is seen from a holistic view, as a mental being, taking into consideration different factors that are involved when humans interact with technology and the world. It is essential to understand that human behaviour is action-oriented, where different sets of activities are driven by different sets of needs and goal directed intentions (Saariluoma, 2004). At the core of using a product is the interaction between the user and the product. According to Saariluoma and Oulasvirta (2010), humans should be seen as intentional actors. They are using the product for something, whether the product was for example a service, software, a computer, an escalator or any other technological device or machine. At the centre of this thinking is that human action is intentional, where the action and experience is "being directed towards something" (Saariluoma & Oulasvirta, 2010, p. 320). Interaction with the world is also the basis for one's experiences, as Saariluoma and Oulasvirta (2010) state:

> Being a user boils down to one's experiences and meanings of "being in the world" achieved by using one's body to interact through technological artifacts. This characterization highlights the constructive relationship between the user's felt experience and intentions on the one hand and the material-social-cultural-historical conditions on the other. (Saariluoma & Oulasvirta, 2010, p. 320.).

Our thinking and behaviour underlies several processes and mental events which can be investigated from the sensory level to the overall consciously experienced phenomena. Motor control concerns functionalities such as the basic mechanisms of controlling movement of limbs, eyes and head, timing and coordination of movements, motor learning, and differences between individuals. Cognitive features of a human mind include themes like perception, the qualities and limits of attention, memory and learning. User needs and emotions have biological and social backgrounds, and needs and emotions can have different content, meaning and motives. They also have an impact on the person's cognitive processes. Mental representations, intentionality, apperception and affordance are some of the key concepts when describing how a person perceivers, constructs and interprets his or her view of the world, especially in cognitive science. Psychological research shows that different personalities, individual goals, attitudes, values and ways of thinking effect how person experiences things. Experiences are affected also by social groups, cultures, and communication. (Saariluoma, 2004.). The functionality and sensitivity of a person's sensory and perceptual systems are impacted and altered by aging and disabilities (Shumway-Cook & Woollacott, 2000; Mather, 2009). Differences in the content of experience can also be caused by the level of expertise; a more experienced person might have a psychological bias towards how he or she perceives and assesses the objects in their environment (Mather, 2009; Evans & Gärling, 1991; Kaplan 1991).

Typically the ride comfort in escalators has been reviewed by inspecting the physical properties of an escalator and comparing the results to the knowledge about how these physical properties are reflected in human sensations. This kind of knowledge of sensations and sensory perception is usually gained in psychophysical research. In addition, usually the experiments and evaluations to measure the assumed equivalent physical parameters of an escalator for the corresponding psychological features of those physical stimuli are done by escalator designer experts. They are using complex technical devices and mathematical algorithms in rather artificial testing situations. However, we want to examine a phenomenal conscious experience, such as the experienced feeling of comfort, from the point of view of the passenger as a user of the escalator. We must extend the research approach to ensure we additionally include the complex mental processes and other external factors that precede and influence the user experience. We also need to test people from different backgrounds, with various sets of skills and experiences. We need to test people who are not escalator experts but rather represent the typical passenger without much knowledge of the technology and the physical parameters that an expert might feel biased to attend to. So, despite the complexity of the technical measurements and calculations, it is rather easy to use fixed physical measurements to test a machine. In order to describe psychological qualities of a sensation or a perception of a mental experience, the task becomes much more difficult.

User experience emerges out of a mental event, prompted by internal or external stimuli. An experience has a certain property of feeling, such as the feeling of comfort (Revonsuo, 2010; Chalmers, 1996; Dennett, 2002, 2015; Carruthers 2000; Brown 2012). Thus, investigating the experience of comfort requires adopting a method and research approach that is used for studying experiences. Phenomenology provides a way to study humans' experiences from the personal, subjective point of view (Hartson & Pyla, 2012; Moustakas, 1994a; Chalmers, 1996; Mather, 2009). When the research combines the first-person internal reports and the benefits of using a third-person observer, it can be called heterophenomenology, a methodological concept proposed by Daniel Dennett (2003).

The heterophenomenological approach in this research includes using a survey to collect quantitative data in a questionnaire. The questionnaire is constructed of 40 questions, arranged in a semantic differential scale. Those questions represent the variables for possible underlying factors that are listed in the ISO-standards for escalator ride comfort. Additional variables are included to reflect the other possible aspects that might impact the experience of comfort during an escalator ride. These aspects are concluded from the previous models for investigating the feeling of comfort. They include for example, dimensions for social an environmental qualities. Other aspects relate to variables concerning human perception, agency and gait, which may impact comfort, especially while travelling on an escalator. The questionnaire also includes open-ended questions for passengers' general comments on the how the ride was felt. Those open-ended questions are then reflected with observations that were done by the researcher at each of the tested locations. Things such as the appearance and properties of the escalator and their environments are listed in the observations. The notes from the researcher observations and the passengers' comments in the open-ended questions are then compared and reviewed against each other. They are also reflected with the theoretical background to form the qualitative analysis part of the research. These findings in turn can support the results from the statistical analysis. They can also explain the underlying factors that might be related to the experience of passenger comfort.

Results from this research suggest, that the most important statistically significant factors predicting the feeling of comfort are related to vibrations and smooth movement of the steps and the handrail. These predicted approximately 50 % of the experience of comfort. Half of the experience of comfort needs to be explained by other factors. Those factors can vary among people according to individuals' physical and psychological properties. This makes sense when we think about the escalator ride from the view that standing on a moving, slightly vibrating surface does not require much conscious mental effort. However it does require management of posture and other sensorimotor activities. Also, people seem to perceive those sensory signals which are most important for their survival and goal-driven actions in that specific situation. Thus, during an escalator ride it seems logical that the most important things that every person, at least in this research population, has in common are those factors that relate to sensations from the vestilobulopropriosensory systems and touch. These are needed for remaining balanced and detecting the stimuli that might affect the body's movement and posture. The results also suggest, that the ISO-standards for ride comfort propose somewhat accurate factors that can have an effect on the conscious experience of comfort during an escalator ride. Therefore, it seems justified to propose, that utilising the existing knowledge from psychophysical research and combining that with the heterophenomenological approach can provide even more powerful tools and methods to explore and improve the experience of escalator ride comfort, especially when designing new escalators.

2 THEORETICAL BACKGROUND

When thinking about the escalator ride from the user's, or the passenger's point of view, the first thought about the experience itself is that the escalator ride should go rather unnoticed. In a typical use case it might be that a passenger steps onto the escalator. He or she then assumes that it will transport him or her smoothly and safely to his or her intended direction without any extra mental effort. At first the event might seem a quiet, rather passive standing still on the escalators step (or in some cases when walking on the steps) while the escalator mechanically takes the person from one floor to the next. However, there are several mental processes going on in the passenger's mind, below and above his or her conscious awareness during the ride. These processes can manage for example the unconscious sensorimotor events such as keeping one's balance, or more voluntary and explicit thinking like wondering where to turn on the next floor in order to get to the nearby store. A conscious experience that is related especially to the feeling of comfort of the escalator ride is felt probably only when something out of the ordinary happens and catches one's attention. The attention can also be intentionally focused on the ride and what kind of sensations, feelings and thoughts it brings about. The subjective experience can be seen emerging from things like sensations and memories. It is affected by individual differences in how a person perceives and interprets the information from internal and external sources during the ride. Also individual differences in sensory systems vary a lot between people. Due to the multimodal sensory processing some sensory inputs might be emphasised while others go unnoticed. Memories can have positive or negative emotional associations, depending on what kinds of previous experiences a person has had from using escalators. The escalator ride might precede the commencement of an exciting and fun shopping spree. It can be associated with the great coffee shop close by and the scent of delicious café mocha. It can also remind of an unpleasant event when a person stumbled on the steps after losing their balance. Even the differences in personality and culture might affect the interpretation of the event and what kind of subjective experiences a person reports.

This chapter describes some of the key theories and concepts in cognitive science that should be considered when studying how people experience and perceive their environment. It explains how different things might affect the escalator ride experience, and how the experience of passenger comfort should be researched. The first subchapter is an introduction to how phenomenological approach and heterophenomenology can be utilised when researching the user experience. The following subchapters review concepts of phenomenal conscious experience, mental representation, intention, apperception and affordance. They also describe how personality and culture may impact mental events and the research work itself. Theories about perception, including themes of attention and agency are presented. There is an emphasis on models for how humans perceive and interact with the external world and events. Means for defining and researching comfort and the experience of comfort in escalator ride is discussed in the last section.

2.1 Heterophenomenology as an approach for user experience research

Hartson and Pyla (2012) have defined user experience as "the totality of the effect or effects felt (experienced) internally by a user as a result of interaction with, and the usage context of, a system, device, or product" (Hartson & Pyla, 2012, p. 19). These experiences that are felt internally by the user can be effects due to usability, usefulness or emotional impacts. One important notion is that user experience cannot be designed. Rather it is always an experience that is related to the individual user and to the usage context that occurs in interaction between the user and the design (Hartson & Pyla, 2012). In this sense, user experience tries to portray what is relevant for a user of a design as a human being. "Instead of concerning only in identifying and correcting problems, methods in user experience question about what people do and why they do it." (Beccari & Oliveira, 2011, p.13).

Phenomenology is a science of phenomena — things that happen and are observable. It is used to provide a "philosophical examination of the foundations of experience and action" (Hartson & Pyla, 2012, p. 294). The empirical phenomenological approach attempts to portray the essence and underlying structures of an experience by interpreting the in situ descriptions of the experience. It is the role of the human scientist to determine what an experience means for the person who has had the experience. This means returning to the core of experience, and deriving general and universal meanings from the subject's own descriptions (Moustakas, 1994a). When a phenomenological approach is applied to human-technology interaction there is a shift of focus from viewing how the technology is used to viewing how it is present in the user's everyday life. In the phenomenological approach to interaction the interest is in the meaningful presence of the product: what kinds of meanings, relationships and emotional ties the user has given to the product in his or her personal life. It also means that when experience is studied, it "cannot separate the user, the context, and the experience" (Hartson & Pyla, 2012, p. 296).

Phenomenology represents a scientific approach in human sciences. Moustakas (1994b) has listed the following principles, processes, and methods which summarize the key points in phenomenology as part of human science research:

- Phenomenology focuses on the appearance of things, and return to things just as they are given, removed from everyday routines and biases, from what we are told is true in nature and in the natural world of everyday living.

- Phenomenology is concerned with wholeness, with examining entities from many sides, angles, and perspectives until a unified vision of the essences of a phenomenon or experience is achieved.
- Phenomenology seeks meanings from appearances and arrives at essences through intuition and reflection on conscious acts of experience, leading to ideas, concepts, judgments, and understandings.
- Phenomenology is committed to descriptions of experiences, not explanations or analyses. Descriptions retain, as close as possible, the original texture of things, their phenomenal qualities and material properties. Descriptions keep a phenomenon alive, illuminate its presence, accentuate its underlying meanings, enable the phenomenon to linger, retain its spirit, as near to its actual nature as possible.
- In descriptions one seeks to present in vivid and accurate terms, in complete terms, what appears in consciousness and in direct seeing—images, impressions, verbal pictures, features of heaviness, lightness; sweetness, saltiness; bitterness, sourness; openness, constrictedness; coldness, warmth; roughness, smoothness; sense qualities of sound, touch, sight and taste; and aesthetic properties.
- Phenomenology is rooted in questions that give a direction and focus to meaning, and in themes that sustain an inquiry, awaken further interest and concern, and account for our passionate involvement with whatever is being experienced. In a phenomenological investigation the researcher has a personal interest in whatever she or he seeks to know; the researcher is intimately connected with the phenomenon. The puzzlement is autobiographical, making memory and history essential dimensions of discovery, in the present and extensions into the future.
- Subject and object are integrated—what I see is interwoven with how I see it, with whom I see it, and with whom I am. My perception, the thing I perceive, and the experience or act interrelate to make the objective subjective and the subjective objective.
- At all points in an investigation intersubjective reality is part of the process, yet every perception begins with my own sense of what an issue or object or experience is and means.
- The data of experience, my own thinking, intuiting, reflecting, and judging are regarded as the primary evidences of scientific investigation.
- The research question that is the focus of and guides an investigation must be carefully constructed, every word deliberately chosen and ordered in such a way that the primary words appear immediately, capture my attention, and guide and direct me in the phenomenological process of seeing, reflecting, and knowing. Every method relates back to the question, is developed solely to illuminate the question, and provides a portrayal of the phenomenon that is vital, rich, and layered in its textures and meanings.
  (Moustakas, 1994b, pp. 58-59.).

Humans can have knowledge and feeling of being a person in a subjective "first-person" dimension. In addition, humans can have "second-person" knowledge, to tell another person who they are. Humans can also evaluate others from a "third-person" perspective (Kim, 2001; Dennett, 2003). Typically phenomenology is seen as "the study of consciousness from the first-person perspective – how the world appears to me" (Mather, 2009, p. 39). According to Chalmers (1996), every mental property is either a phenomenal or psychological property or a combination of the two. Their relevant properties and components are co-occurring in common mental concepts. Phenomenal and psychological states run together, both affecting each other and being tied to cognitive processing. The phenomenal concept of the mind sees the mind as conscious experience. Here, the mind is characterized by the way it feels, and where its mental state is a consciously experienced mental state. The psychological concept of the mind sees the mind as the explanatory or causal basis for behaviour. It is characterized by what it does and where its mental state plays an appropriate role in the production of behaviour — whether in a conscious or unconscious state. To investigate the mental causations for behaviour one needs to focus on the psychological properties from third-person aspects. To investigate the conscious experience of mental states, one needs to focus on phenomenal properties from the first-person aspects of mind. (Chalmers, 1996)

However, Dennett (Dennett & Konsbourne, 1992; Dennett, 2003) argues against Chalmers' claim that first-person perspective should be used to study phenomenal properties of the mind. He sees that in order to study intentions, consciousness and the subjective experiences of a human subject, the perspective of research should be shifted to the third-person perspective. In this kind of method human subjects typically collaborate with experimenters by telling or other ways of reporting their subjective thoughts and experiences. The method is called heterophenomenology (Dennett, 2003). According to Dennett (2003), the researcher looks at the subject's point of view from the outside. The researcher collects findings of "what the subject believes to be true about his or her conscious experience" (Dennett, 2003, p. 20). Hence, heterophenomenology is "phenomenology of another not oneself" (Dennett, 2003, p. 19). By using heterophenomenological methods researchers can investigate the subjective and unique conscious experience of the subject (Dennett, 2003).

2.2 Phenomenal conscious experience

Phenomenal consciousness refers to a subjective experience where the phenomenal event or object is included in one's subjective psychological reality (Revonsuo, 2010). The experience is felt or sensed by the organism after a set of causal events and information processing when one perceives, thinks and acts. It creates the phenomenal property of feeling something (Revonsuo, 2010; Chalmers, 1996). According to Dennett (2002), what makes mental phenomena different from physical phenomena is that mental phenomena have meaningful content. Also, each mental phenomenon has its unique description that relates to its meaning. The conscious experience can be seen as the internal aspect of feeling what it is like to be a cognitive agent. A conscious experience is a content-bearing cognitive state, which can be presented as a first-order judgment (Chalmers, 1996).

As a being exists and acts in its dynamic sensory-perceptual world, in interaction with one's internal thoughts and the surrounding world viewed from the first-person's perspective, the phenomenal consciousness forms an embodied self in the world. This embodied self of a person is constantly immersed in experiential qualities. How the experience feels is characterized by the quality of experience, qualia. Qualia seem to have a particular intensity and to appear at different points in perceptual space and time (Revonsuo, 2010). Qualia, or the phenomenal qualities of an experience, can be described as the qualitative feeling of a conscious mental state (Chalmers, 1996). However, the concept of "qualia" is a contested one. Dennett (2015) opposes using the term qualia altogether. In his opinion the information that the mind receives does need to be separately transduced to special "subjective" representations. The properties of the experience are generated directly following hierarchical Bayesian predictions. According to him, humans have Bayesian expectations about what one does, will think and expects the next. When these expectations are met, it confirms that the thing a person is interacting with has the properties it is expected to have. Dennett (2015) uses the cuteness of a baby as an example. There are some expectations for properties of cuteness and when those properties are manifested, it creates the experience of a cute baby. The underlying reasons for different perceptions lay in humans' nervous systems and how they have evolved (Dennett, 2015).

Carruthers (2000) sees that it is the phenomenally conscious state itself that has the subjective and distinctive feeling of "what-it-is-likeness" or "aboutness" of the experience. Qualia should be used in a much narrower meaning. It should refer only to the unconscious intrinsic and phenomenally conscious non-representational properties of mental states. The experience is an intrinsic property of that experience. It possesses such conceptual properties, which a person is then capable of recognising. He also suggests that "there may be concepts of experience which are purely recognitional, and so which are not definable in relational terms" (Carruthers, 2000, p. 187). Carruthers (2000) sees that perceptual contents can be non-conceptual. When the perceptual state becomes available for higher-order thought, the intentional content of the perceptual state is conferred into a phenomenally conscious one. This also means that in order for the experience to become conscious, it has to be available for higher-order thought and have higher-order analogous content. It then activates one's beliefs, desires and memories and is mirrored as subjective representation. Brown (2012) goes even further by suggesting that phenomenal consciousness is a kind of higher-order representation in itself, which emerges from a particular kind of synchronised neural activity in the mind. According to Brown (2012), "phenomenal consciousness is the property of there being something that it is like for one to have a conscious mental state [where] there is a distinctive way that my experience seems to be" (Brown, 2012, p. 213). Bachmann (2011) sees that in conscious experience inputs from different modalities are integrated into a holistic entirety. He sees that there are also some modality-invariant attributes of phenomenal experience. Attributes that describe the experience can be the presence of experience, the subjective clarity such as vividness, and the duration such as short-lived versus longer period. Other attributes can be the post-pertubation delay such as a stimulus perception latency and the veridicality of content in cases where it is distorted or illusory. (Bachmann, 2011)

According to Saariluoma and Oulasvirta (2010), a mental experience emerges as a result of other mental processes. To understand events such as conscious experiences, it is necessary "to understand unconscious processes and include in our explanations emotional, social, and cognitive processes also at the neural level" (Saariluoma & Oulasvirta, 2010, p. 320). Allen and Williams (2011) propose that the consciousness is an interactive, plastic phenomenon which is also influenced by social interaction. They observe that our conscious experience of both ourselves and the external world are based on the individual development of skills, cultural learning, as well as sensorimotor practice. As people engage with the world at different levels of abstraction and using linguistic categorisation, they are also influenced by their cultural context. This dynamic and social interaction with the external world is reflected by a person's unique phylogenetic abilities and skills, between sensorimotor processes, mental representations and a person's sociocognitive history. These effect both their self-narrative and action-control. Allen and Williams (2011) suggest that reflective consciousness and autobiographical narrative are affected by sociocultural learning, and hence shared or different between cultures. Whereas, the sensorimotor consciousness, due to its ontological and evolutionary nature, should ultimately produce similar outcomes despite where the person is located.

An article by Edelman and Fekete (2012) reviews the computational theories of phenomenal experience, especially discussing how time should be considered in the possible explanada. They see that there is an interaction between the time-related requirements of computational tractability and timeliness, as well as, phenomenality's autonomy. Timeliness means that one sees phenomenal experience as "a process that unfolds in time" (Edelman & Fekete, 2012, p. 82). Experience is presumably emerging from mental activities that happen during the same time period. Thus, the theory explaining phenomenal experience should also consider the connection between the timing of the experience and timing of the mental processes. Computational theories of phenomenal experience also assume that computations underlying the emerging experience must be tractable, in the limitations of the mind's systems. First, the computed data should not be something that cannot be solved in principle. Secondly, there may be an appropriate timeframe (but not too long) required to complete the computation of data sets within the transitions between different experiential states. Autonomy of the phenomenality means that because the phenomenal experience must be meaningful to the system which creates it, the experience is intrinsic in the functionality of the mind. This applies whether that system is the mind or another computational environment. Edelman and Fekete (2012) conclude:

> Because experience is massively endogenous and continuous, it must be seen not as convergence to an attractor, but rather as the unfolding of a metastable trajectory through a properly structured space of possible trajectories, as defined by the brain's dynamics. (Edelman & Fekete, 2012, p. 90.).

According to Chalmers (1996), experience comes in a large number of varieties and characters as well as combinations, which often seem to unify into a single experience. He has created a pre-theoretical, impressionistic list to describe some of the aspects of conscious experience:

- Visual experiences, such as colour sensations, shape, size, brightness and darkness and the experience of depth.
- Auditory experiences, such as sound, musical experience and experience of speech. Unlike visual experiences, auditory experiences seem to correspond in an indirect way to any structure in the world.
- Tactile experiences, such as texture. Tactile experiences have ones of the richest quality spaces of experience.
- Olfactory experiences, such as smells. They have rich, intangible and somewhat indescribable nature, which float free of any apparent object.
- Taste experiences, such as sweet, sour, bitter and salt. Together these different dimensions of taste produce a vast variety of possible experiences.
- Experiences of hot and cold
- Pain
- Other bodily sensations, such as headaches, hunger pains, itches, tickles and the need to urinate. Many of the bodily sensations have their unique quality.
- Mental imagery, meaning those experiences that are in some sense generated internally.
- Conscious thoughts. Things we think and believe might have some particular qualitative feel associated with them, especially with explicit, occurring thoughts that one thinks to oneself or that affect one’s stream of consciousness.
- Emotions. The distinctive experiences associated with emotions can affect conscious experience profoundly, colouring the experiences while they last.
- The sense of self. The kind of background hum that is somehow fundamental to consciousness and that transcends all the elements above.
  (Chalmers, 1996, pp. 6-9.).

As Chalmers (1996) has noted, there exists ”no independent language for describing phenomenal qualities” (Chalmers, 1996, p. 20). Generally, attempts are made to investigate phenomenal qualities by using the terms related to associated external properties or causal roles of an object. This means that the reported phenomenal notion is actually reduced to a psychological property. It is usually accompanied by some sort of a conscious experience, even though they are not equally comparable. This is particularly problematic when trying to find out what constitutes the intentional properties such as one’s beliefs and desires of a conscious experience, how they instantiate in cognitive systems and how they affect one’s behaviour and internal reports. In addition, when one becomes aware of an experience it precedes several accompanying functional and cognitive processes, including reflection and subconscious judgments about the world. According to these phenomenal judgments, a person creates beliefs and claims about her conscious experience, such as, ”I believe I see red” after having a red sensation. It is these claims that one can then report (Chalmers, 1996). As Dennett (2002) writes, sometimes a person can be aware of things that are relevant to his or her behaviour; this awareness is something that the person can introspectively report. At other times being aware of something has nothing to do with a person’s behaviour. In some cases “becoming aware of what is directing our behaviour encumbers that behaviour” (Dennett, 2002, p. 117). It means that being of aware of something that might impact behaviour can actually hinder a person’s performance. O'Callaghan (2012) has reviewed studies of perception which utilise phenomenology and first-person methods. According to O’Callaghan (2012), there is a justification for using these methods for scientific research:

> The phenomenology of experience often is not immediately obvious. [...] Responses based on phenomenological reflection should be treated as a kind of performance that might be attributed to a variety of factors apart from accurately reporting perceptual experiences. If reports might be infused with information from other sources, such as one's background beliefs concerning the items in a scene, or some strategy adopted to respond to ambiguous experiences, then perhaps no unique, epistemically privileged level of [...] phenomenology exists. [...] It is, however, compelling to understand introspective reports as data that inform the construction of philosophical and scientific theories of perception. It remains, after all, a goal of investigating perception to explain the seeming. (O’Callaghan, 2012, p. 88.).

2.3 Mental representation and intentionality

The concept of mental representation is one of the key elements when explaining the functions of the mind in cognitive science. A mental representation means the presentation of information that can be for example a system of beliefs, assumptions or some ensemble of knowledge (Saariluoma, 2001). At the heart of representation there is a property of being about something (Frankish & Ramsey, 2012). Explanations referring to mental representations are used when exploring how the cognitive capacities' processes are intelligible based on the sense-making sequence of representations. They are used when, ”explaining why some psychological effects [...] occur in certain experimental tasks [...] because the subject lacked certain representations or represented a target in a certain way” (Von Eckard, 2012, p. 43). Mental representations are subjective and unique to the experiencer. They typically have internal attributes related to emotional and motivational qualities (Saariluoma, 2001). Mental representations are used to explain which cognitive capacities are intentional, when they ”involve representations which, like intentional states, have content” (Von Eckard, 2012, p. 42).

As Von Eckard (2012) writes, in cognitive science humans can be described on a subpersonal, information-processing level. There ”a person's cognitive mind is theorized to be both a computational and representational system” (Von Eckard, 2012, p. 29). The general assumption is that human cognition involves the unconscious and conscious use of mental representations. This representational theory of mind in cognitive science can be compared to Charles Peirce's (1994) general theory of representation. It can be extended above the semantic relations by adding the mental component to the theory. This adds the perspective of the mind to the explanation. In Peirce's (1994) theory a representation involves a triadic relation of a sign or a representamen, an object and its interpretant. A representation is "character of a thing by virtue of which, for the production of a certain mental effect, it may stand in place of another thing" (Peirce, 1994, CP 1.564 Cross-Ref:††). In cognitive science, representations are systems of signs and relations between an organisation of a group of material entities and the information contents that they symbolise (Saariluoma, 2001). A representation is constituted by a representation-bearer as representing an object or having content, and where that representation has significance for an interpreter (Von Eckard, 2012). The representation-bearers can be attached to different contents by their symbolic relation. The same representational content can be constructed by using different sign systems such as writing, speech or in computer memory (Saariluoma, 2001). Hence, the content of the representation is based on the causal role of the representation-bearer, or the vehicle of representation, in the system it is in, not based on the sign or vehicle per se (Revonsuo, 2001).

Typically cognitive scientists conceptualise the mind as working in a similar way to a computer. They see the representation-bearers of mental representations as computational structures or states. According to Von Eckardt (2012), there are two types of relations existing between a representation-bearer and its representational object or content: semantic and ground relations. The former is for representing, referring and expressing. The latter is about similarity or causality where the semantic relations hold. Von Eckardt (2012) states that no systematic semantics for even a fragment of the system of mental representations exist. However, some global semantic features of that system can be concluded:

1. Mental representations are semantically selective. The ″aboutness″ of perception, memory, and linguistic understanding is, typically, experienced as being quite specific.
2. Mental representations are semantically diverse. We can perceive, imagine, and think about many different types of things from concrete to abstract objects, properties and events, set in possible or fictional worlds.
3. Mental representations are semantically complex. The intentionality of our capacities is complex. Not only do the representations of mental representation system have many different kinds of content, many representational tokens have more than one kind of content simultaneously.
4. Mental representations are semantically evaluable. The intentional states involved in our cognitive capacities are propositional attitude states, and such states are evaluable. We can perceive veridically and nonveridically, have true or false beliefs, and carry out our intentions to act either successfully or unsuccessfully. In semantically evaluable representations the often discussed feature is our capacity for misrepresentation, representing a target T that is actually G, as H, with examples like perceptual illusion, false memories and speech errors.
5. Mental representations are compositional. Since the productivity and systematicity of our capacities is not only formal but also semantic, it provides the basis for inferring to the compositionality of mental representational content as well that the content of complex representations is ″composed from″ the contents of their representational constituents. For example the meaning of ″John loves Mary″ is derived from the meanings of the individual words ″John″, ″loves″ and ″Mary″, so the content of the complex representation <<John> <loves> <Mary>> is presumably derived from

> the contents of the constituent representations <John>, <loves> and <Mary> (plus order information).
> (Von Eckardt, 2012, p. 33-35.).

Intentionality means "the directness of actions and the intended effects of those actions" (Saariluoma & Oulasvirta, 2010, p. 320). The mind is aimed or targeted at something, even if that something actually exists or not, and when that something holds a meaning for its content (Saariluoma, 2001). Intentions can function as terminators and prompters to practical reasoning. They coordinate activities of the acting agent over time and with other agents. (Pacherie, 2012)

Intentions are initiating interaction and reactions to external events in a person's environment. They guide goal-driven human actions and monitor the process towards achieving the goal (Pacherie, 2012; Saariluoma & Oulasvirta, 2010). Intentionality, as well as understanding of the world and sharing the world with other people, is achieved "in interaction with the material, social, cultural and historical conditions of the world" (Saariluoma & Oulasvirta, 2010, p. 320). Cognitive personality psychologists often emphasise the importance of expectations and explanations for the causality of events. They happen via mental processing called causal attributions. Causal attributions impact human emotional reactions to events, as well as mould our future expectations and assumptions. In addition, people have beliefs. It means that they have a conviction that something is true or not. There are individual differences between people in their convictions, contents of their beliefs and the emotions associated with these beliefs. Causal attributions and beliefs are both significant cognitive units of personality. (Pervin, 2003)

Intentional goals have a personal significance in a human's life (Saariluoma & Oulasvirta, 2010). An organism is activated and the appropriate response and selected actions are directed by a person's motives. According to Pervin (2003), motives influence "cognition and action, thinking and behaviour" (Pervin, 2003, p. 105). Motivation is the answer to the question of why people do what they do. The concept of motivation presumes that the activation and regulation of behaviour are guided by a person's internal qualities (Pervin, 2003). This suggests that motives are the drivers for achieving a person's intentional goals. Pervin (2003) explains that motivation psychologists have researched universal human motives — whether there are fundamental needs or motives that are shared within all human beings. One suggested universal need is a need to belong, a need to "maintain at least a minimum quantity of interpersonal relationships" (Pervin, 2003, pp. 137-138). Another universal need is handling the death anxiety, meaning "how to deal with the recognition of our mortality" (Pervin, 2003, p. 138). Self-determination theory suggests that there are three needs that are innate, universal human motives. Those are competency, autonomy and relatedness. However, there is a vast variation between individuals, as well as groups of people forming cultures, in what drives their behaviour and acts as an effective source of motivation. So, the question of whether there exists a fundamental basis of motivation remains unsolved. (Pervin, 2003)

2.4 Apperception

Mental representations are not born purely out of perception or attention to the perceived environment. Every perceived object, a physical or an abstract item in its observed context, is combined in a person's mind with the pre-existing information and pre-known concepts related to that object. It then creates a meaningful and unified representational interpretation. This representational component includes all the knowledge of how things are, as well as a prediction for what a person is aiming towards. This is then used for guiding one's actions and behaviour. This concept for construction of abstract representations in interaction with the physical environment and a person's own needs or internal motives is called apperception (Saariluoma, 2004). Saariluoma (2004) has visualised a model for the apperception process, which is illustrated in figure 2.

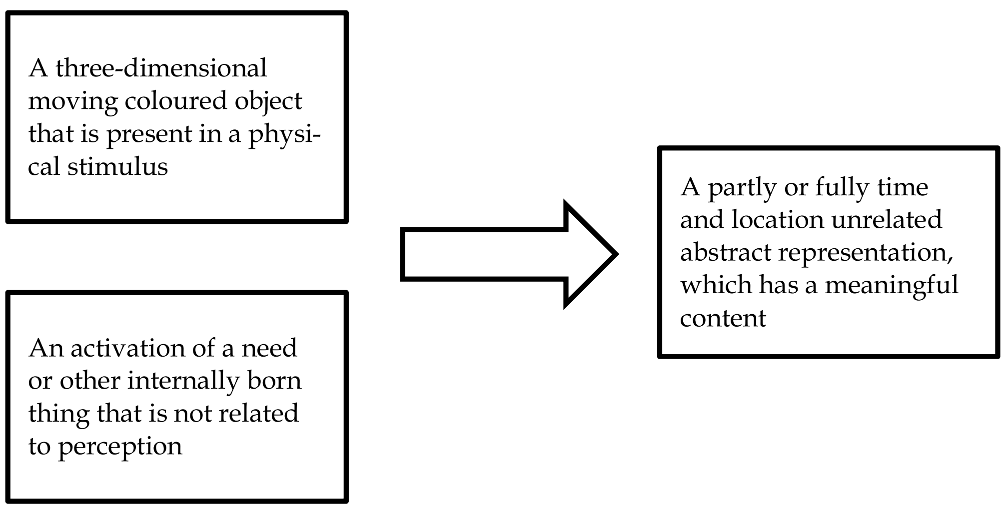

FIGURE 2 Model for the apperception process (Saariluoma, 2004, p. 115).

Examples of types of apperception are a person's attitudes and values. According to Saariluoma (2010), attitudes mean certain learned ways of how a person perceives and interprets different events and situations. They are activated automatically and they change considerably slowly. Attitudes can be seen as systems of beliefs which often relate to the emotional aspects. Values determine what a person thinks is good or worth pursuing. People tend to pick information that is supported by their existing attitudes. Thus, attitudes, values and beliefs are important parts of how a person experiences the world, receives and processes information, and how a person makes different kinds of decisions (Saariluoma, 2010). Because each person has their own personal set of attitudes, values and beliefs, also the apperceptions are subjective and personal. The same object of apperception might seem very different from one person to another. For example, a person who rarely uses escalators but prefers stairs, and who is now riding an escalator in a building he has never visited before, being uncertain of whether the escalator will take him to the right floor, has probably a different apperception of that escalator than a person, who is working as an escalator technician, and who reviews escalators based on their certain technical properties, and who has even fixed that same escalator the previous day.

Anderson (1988) sees that apperception does not include a subjective interpretation, but is something that exists before the subjective reflection. It is a prejudgmental assessment of things, constructing an immediate view of one's environment and objects in it. ”In apperception there is no split between the subjective and the objective, the experience is whole, organic” (Anderson, 1988, p. 118). Anderson (1988) sees, that apperception locates the objects in the world and provides information for further reflection. That in turn helps one place oneself in a mentally organised world.

McRae (1978) has reviewed Leibniz's philosophical theories about the apperception and concludes that apperception is equivalent in its use to the terms “consciousness” and “reflective knowledge”, because ”all three have as their objects both the I and its passing states or perceptions” (McRae, 1978, p. 33). To summarise, in cognitive science, apperception should be seen as one basic process related to the mental representations, along with other cognitive processes like thinking and reasoning. Apperception is one way of describing the relationship between the mental representation construction and its corresponding information content (Saariluoma, 2010).

2.5 Affordance

The concept of affordance, introduced by James Gibson in 1979, comes originally from perceptual psychology. It has since been adopted in, e.g., user psychology and interaction design (Saariluoma, 2004; Hartson & Pyla, 2012). In Gibson's book (1986) he explains that ”the affordances of the environment are what it offers the animal, what it provides or furnishes” (Gibson, 1986, p. 127). The object of affordance is inspected reflecting on its content and how it is used or utilised (Saariluoma, 2004). Simply put, affordance gives a person an explanation of how something is used and what it does. When people observe objects they do not see objects as objects, but rather in terms of what they afford – what those objects can do for the person. For a person moving inside a building, an escalator might be seen as affording quick, effortless transportation from one floor to the next.

Hartson and Pyla (2012) have proposed five types of affordances; cognitive, physical, sensory, functional and emotional affordance. A cognitive affordance is related to cognitive actions such as thinking, learning, and understanding- A physical affordance is related to physical actions such as touching, pushing, clicking and moving things. A sensory affordance is associated with sensory actions by utilising different senses like seeing, hearing and feeling things. A functional affordance is related to the usage of the object or system by physical actions to reach the purpose of doing something. The fifth type of affordance is the emotional affordance, where there is a component that connects the user with the object emotionally. The object of affordance has features that relate to a human's emotional feelings, intuitive and subconscious appreciation of things like pleasure, fun, joy of use, aesthetics, appeal and such. Emotional affordance can also impact the deeper emotional aspects, such as "self-expression, self-identity, a feeling of contribution to the world and pride of ownership" (Hartson & Pyla, 2012, p. 661).

One's experienced affordance is something very subjective and unique to the subject. It is relative to the environment as well as to the person's posture and behaviour at that time. It can concern different substances, objects as well as interactions and have social significance (Gibson, 1986). Affordance emerges from the point of view that is defined by the current activity (Saariluoma, 2004), but the same object might have quite a different meaning depending on the person's individual characteristics and the environment that the person interacts in. There are differences in people's physiologies, and also in their psychological features. Individual differences in people's thinking and behaviour are influenced by each person's personality and unique life experiences. Shared cultural conventions enable people living in the same society to understand the purpose of an object in a similar way. According to Hartson and Pyla (2012), social experience and cultural conventions influence and prejudice the perception of affordances.

2.6 Emotions

An emotion can be viewed as a complex system. An emotional process is seen as including six components: a cognitive appraisal, the subjective experience, thought and action tendencies, internal bodily changes, facial expressions and a response to emotion. It typically begins with a cognitive appraisal, where a person evaluates what is the personal meaning of his or her current circumstance. It is an interpretation of the relationship between a person and his or her environment, affecting the quality and intensity of an emotion. Cognitive appraisals can happen both consciously and on subconscious levels. There are several theories about cognitive appraisal. According to the misattribution of arousal, a theory with good empirical support, a person can mistakenly attribute any lingering physiological arousal to subsequent circumstances, thus increasing the intensity of the person's emotional reaction to the appraised circumstance (Nolen-Hoeksema, Fredrickson, Loftus & Wagenaar, 2009).

A cognitive appraisal cascades into further emotional responses, such as a subjective experience — the private affective state or the tone of the emotion. Subjective experiences of emotions guide a person's behaviour and information processing by modifying evaluations, decisions, judgments and assessments of risk. For example, an emotion can affect how a person evaluates other people, inanimate objects or makes economic decisions. Positive emotions can lead for example, to finding more positive meanings in different circumstances. Whereas, having the negative emotion of fear can make the world seem more dangerous. Emotions also impact attention, memory and learning. They can for example, enhance attention to and learning about things that are feeling-congruent. It means that people attend to events and learn better a material which fit to their current emotion (Nolen-Hoeksema et al., 2009).

A third component includes thought and action tendencies. This means a person's individual tendencies and urges to think and behave in certain ways. Negative emotions typically make people's thought-action tendencies narrow and specific, promoting quick action. In contrast, positive emotions broaden the thought-action tendencies, making them more open to possibilities and thus helping to build up longer-lasting resources. That way they are ensuring the individual's survival over time.

Internal bodily changes and reactions are physiological responses, which especially involve the autonomic nervous system, creating the fourth component of the emotion process. Facial expressions are muscle contractions that result in particular facial landmark configurations such as frowning, raising one's upper lip and partially closing one's eyes while experiencing disgust. The sixth component includes responses to emotion. This means the ways of how people react to and cope with their own emotions or the situation that triggered that emotion (Nolen-Hoeksema et al., 2009).

The basic emotions theory, also called the differential emotions theory, suggests that fundamental or basic, universal emotions exist. Depending on the theory there are proposed to be from 8 to 14 basic emotions. They generally include the following: interest-excitement, enjoyment-joy, surprise-startle, distress-anguish, disgust-revulsion-contempt, anger-rage, shame-humiliation, and fear-terror. They are innate and the result of an adaptive evolution, acting as signals for us and other people that action is needed. Each basic affect is associated with distinct, unique facial expressions that can be seen expressed from infants to adults. They are shared among all people across different cultural groups. However, there are differences in the intensity and appearance of the expression between individuals. That is due to learned rules on how the affect is associated to a certain stimuli. Expression depends also on the cultural norms. These norms are called the display rules, and they steer how and when the emotions should be expressed (Pervin, 2003). It seems that emotional experiences are shaped by different values in individualistic and collectivistic cultures. "Fundamental separateness and individualism" (Nolen-Hoeksema et al., 2009, p. 419) are emphasised in the former and "fundamental connectedness and interdependence among people" (Nolen-Hoeksema et al., 2009, p. 419) in the latter. Although, there are additionally variations in regards to an individuals' gender, social class and ethnicity (Nolen-Hoeksema et al., 2009). Typically, the cultural variations emerge at the "front-end" of the emotion process in differences in assessing the relationship between oneself and environment and in the cognitive appraisal. There are variations at the "back-end" of the emotional process as well; in how and when the emotions are expressed (Nolen-Hoeksema et al., 2009).

Emotions also have a motivational effect. They are capable of maintaining and organising thoughts, memories and actions in terms of how they are associated with the same emotions (Pervin, 2003). Emotions and motives are similar in the sense that they both can activate and direct behaviour. Unlike internally triggered and driven motives, emotions are typically activated by and directed towards external circumstances, creating a readiness to act. Motives are usually responding to a need, whereas emotions can emerge out of a wide variety of different stimuli (Nolen-Hoeksema et al., 2009).

According to Pervin (2003), the experience of an emotion differs in its frequency and intensity among individuals. Emotions are central to personality, as each emotion organises and influences an individual's cognition and actions in relatively unique ways. This results in, "individual differences in the frequency and intensity with which the affects are aroused and expressed" (Pervin, 2003, p. 349).

2.7 Personality

The personality of an individual can be seen as a "person's unique set of mental programs, which are based on genetically inherited traits and partly learned in interaction with the environment and through personal experiences" (Hofstede, Hofstede & Minkov, 1997, p. 7). One of the most agreed models to describe the basic units of personality is the so-called Big Five or the five-factor model of personality. There has been slightly different terminology used to describe the five factors, but according to Pervin (2003, p. 48), those factors can be called "neuroticism", "extraversion", "openness to experience", "agreeableness" and "conscientiousness". They assess the following themes:

- Neuroticism: Assesses adjustment vs. emotional instability. Identifies individuals prone to psychological distress, unrealistic ideas, excessive cravings or urges, and maladaptive coping responses.
- Extraversion: Assesses quantity and intensity of interpersonal interaction; activity level; need for stimulation; and capacity for joy.
- Openness to Experience: Assesses proactive seeking and appreciation of experience for its own sake; toleration for and exploration of the unfamiliar.
- Agreeableness: Assesses the quality of one's interpersonal orientation along a continuum from compassion to antagonism in thoughts, feelings, and actions.
- Conscientiousness: Assesses the individual's degree of organization, persistence, and motivation in goal-directed behaviour. Contrasts dependable, fastidious people with those who are lackadaisical and sloppy.
  (Pervin, 2003, p. 48.).

These personality traits are innate and universal and they endure across a person's life span. These traits result in individual differences in how people behave and react to different situations, interact with other people, feel, think, assess and experience things (Pervin, 2003). According to Adamopoulos & Lonner (2001), the five-factor model of personality, as well as values and morality, how one sees him or herself, and several other theoretical dimensions, "are essentially efforts to search for commonalities in human thought and behaviour" (Adamopoulos & Lonner, 2001, p. 18).

2.8 Culture

Different groups from family to work communities, and larger scale cultures, play an important role in the user's experience (Saariluoma, 2004). Matsumoto (2001) describes the meaning of culture for a person's behaviour using an analogue of what operating systems are to software. He sees that culture is "often invisible and unnoticed, yet playing an extremely important role in development and operation" (Matsumoto, 2001, p. 3). Every person acquires unique patterns of thinking, feeling and actions from the beginning of that person's childhood and throughout his or her whole lifetime. These patterns are created through learning and experiences in person's social environments and they are the sources for the individual's mental programs (Hofstede et al., 1997). Kim (2001) describes culture as "an emergent property of individuals and groups interacting with their natural and human environment" (Kim, 2001, p. 58).

Hofstede, Hofstede and Minkov (1997) have studied the cultural differences among different nationalities across the world using statistical research methods. They have found that societies can be described in six different cultural dimensions, which each influence the mental properties, such as the behaviour and attitudes of people in that society. The first dimension is called the power distance; "the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally" (Hofstede et al., 1997, p. 61). The second dimension is called the individualism – collectivism. In individualistic societies "ties between individuals are loose: everyone is expected to look after him- or herself and his or her immediately family" (Hofstede et al., 1997, p. 92). In opposite, in collectivistic societies "people from birth onward are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty" (Hofstede et al., 1997, p. 92). This dimension impacts for example, how people physically express themselves. It manifests in such ways as how they are encouraged to show happiness or sadness — individualistic societies showing more the first and collectivistic societies the latter. It can effect even how fast people walk, as the tendency to actively get somewhere faster is higher in individualistic societies. The dimension for masculinity-femininity displays differences with emotional gender roles. It is the dimension where national cultures differ from each other dramatically. In a masculine society "men are supposed to be assertive, tough, and focused on material success, whereas women are supposed to be more modest, tender, and concerned with the quality of life" (Hofstede et al., 1997, p. 140). In a feminine society these emotional gender roles overlap, and the distinction between men and women is smaller. "Both men and women are supposed to be modest, tender, and concerned with the quality of life" (Hofstede et al., 1997, p. 140).

The forth cultural dimension is called the uncertainty avoidance, which can also be called, for example, performance-oriented versus cooperation-oriented. It is defined as "the extent to which the members of a culture feel threatened by ambiguous or unknown situations" (Hofstede, 1997, p. 191). This feeling might be expressed for example as "nervous stress and as a need for predictability" (Hofstede et al., 1997, p. 191). It is reflected in, for example, people's self-ratings of health and happiness. It is the most controversial dimension, and an often politically incorrect one in masculine cultures. The fifth dimension is called the long-term versus short-term orientation. Long-term orientation reflects "the fostering of virtues oriented toward future rewards—in particular, perseverance and thrift" (Hofstede et al., 1997, p. 239). Short-term orientation, instead reflects "the fostering of virtues related to the past and present—in particular, respect for tradition, preservation of "face," and fulfilling social obligations" (Hofstede et al., 1997, p. 239). The sixth and the last dimension is for indulgence versus restraint. According to its definition indulgence is "a tendency to allow relatively free gratification of basic and natural human desires related to enjoying life and having fun" (Hofstede et al., 1997, p. 281), where gratification of desires means having fun and enjoying life. The opposite, restraint, "reflects a conviction that such gratification needs to be curbed and regulated by strict social norms" (Hofstede, 1997, p. 281). According to Hofstede, Hofstede and Minkov (1997), indulgence is correlated positively with extraversion and negatively with neuroticism. This means that "indulgent societies are likely to host more extroverted individuals and fewer persons manifesting neuroticism" (Hofstede et al., 1997, p. 289).

2.8.1 Cultural influences on psychological research

There are fundamental cross-cultural differences in the way people view and experience the world. The research about humans and their functioning, whether it is for the study of personality or study of cognitive processes, should always be done as cross-cultural examination (Pervin, 2003). Blank, Biersack and Heimgärtner (2013) have studied intercultural usability engineering and they propose that at least the following aspects should be taken into consideration when developing products:

- World view, Weltanschauung (metaphysical approach) of the end-user
- General knowledge (procedural and factual knowledge) of the end-user
- The context in which the product will be used by the end-user
- The tasks the end-user intends to accomplish by using the product.

(Blank et al., 2013, pp. 20-21.).

Culture has its influence also on how psychological research is done and interpreted. As Adamopoulos and Lonner (2001) aptly remarks, Western academic research is typically "characterized by the legacy of logical positivism. […] Little is known psychologically about vast portions of the rest of the world"

(Adamopoulos & Lonner, 2001, p. 15). This notion is especially important when considering designing and replication of research in different parts of the world, in other contexts and with people (and researchers) from other cultures. According to Kim (2001), the biggest cultural variation exists specifically in phenomenological research approach.

The influence of different cultural dimensions on cross-cultural research can be illustrated with the example of how individualism and collectivism of a society can impact traditional assumptions in psychology:

> The degree of individualism or collectivism of a society affects the conceptions of human nature produced in that society. In the United States the ideas of Abraham Maslow (1908–70) about human motivation have been and are still influential, in particular for the training of management students and practitioners. Maslow's famous "hierarchy of human needs" states that human needs can be ordered in a hierarchy from lower to higher, as follows: physiological, safety, belongingness, esteem, and self-actualization. In order for a higher need to appear, it is necessary that the lower needs have been satisfied up to a certain extent. […] The top of Maslow's hierarchy, often pictured as a pyramid, is occupied by the motive of self-actualization: realizing to the fullest possible extent the creative potential present within the individual. This means doing one's own thing. It goes without saying that this can be the supreme motivation only in an individualist society. In a collectivist culture, what will be actualized is the interest and honor of the in-group, which may very well ask for self-effacement from many of the in-group members. Harmony and consensus are more attractive ultimate goals for such societies than individual self-actualization. The dimension implies that traditional psychology is as little a universal science as traditional economics: it is a product of Western thinking, caught in individualist assumptions. When these assumptions are replaced by more collectivist assumptions, another psychology emerges, and it differs from the former in important respects. (Hofstede et al., 1997, p. 129)

2.9 Perception and agency

Humans are mobile beings, moving through the environment and manipulating objects, making complex plans and using symbols to make decisions. In order to be able to so, a person needs to have information from the outside and to organise it in a meaningful manner to create a coherent model of their environment. This representation of the world is then used to solve different types of problems a person faces, such as navigating, planning and grasping (Nolen-Hoeksema et al., 2009). In cognitive science, perception is typically seen as an information-processing problem of how one constructs a representation of one's environment. It is based on weak signals and sensory stimulation, embedding the demands from thought and action (O'Callaghan 2012).

According to Chalmers (1996), perception can be seen as having both phenomenal and psychological components. The psychological explanation studies the role of environmental stimulation in directing sensory sensitive cognitive processes. Phenomenal perception involves the conscious experience of what is perceived. Perception can be subliminal and underlie implicit processes, but sensation generally is consciously experienced. Sensation has stronger phenomenal component than perception. One way to view these two terms is to see perception as a psychological term and sensation as its phenomenal counterpart. (Chalmers, 1996)

In the next subchapters there is first a review of the concept of perception and perceptual processes. It then follows a rather long set of examples from different sensory systems and their perceptual qualities and how these may differ among people. Then the theories and explanation about attention and attentional systems will be looked at. Finally, a concept of agency is reviewed in the last subchapter.

2.9.1 Perceptual systems and perceiving

Perceptual systems have many functions. They determine which part of the sensory environment to attend to. They localise, recognize or determine where and what objects are. They abstract the critical information from objects and they keep the appearance of objects constant (Nolen-Hoeksema et. al, 2009). As Dennett (2002) describes, "when we perceive something in the environment we are not aware of every fleck of colour all at once, but rather of the highlights of the scene, an edited commentary on the things of interest" (Dennett, 2002, p. 136).

Perceiving involves processes similar to judgment and reasoning, but perceptual systems are more specialised and automatic (O'Callaghan, 2012; Laarni, Kalakoski & Saariluoma, 2001). Perceptual judgments are needed to combine a range of different cues in noise, ambiguity and from multiple sources of information into a sense-making perception (Mather, 2009). Different views exist about how much active modulation of the sensory information is needed before the perception emerges. The input from our sensory systems is usually dispersed and even conflicting, so some active information processing is required (Laarni et al., 2001). Perceptual processes can be seen as unconscious, undeliberate and subpersonal. They are specialised to particular types of tasks and information — processing information in the way of a representational system, as it transforms and constructs sensory information into rich perceptual representations of one's environment (O'Callaghan 2012; Laarni et al., 2001). The content of the perceptual experiences can also be false. One might think he saw something, even though that something does not actually exist. The perceptual experience seems as though something is seen, thus creating an illusory experience which too shares representational content (O'Callaghan 2012).

Describing the architecture of the perceptual systems can help explaining how these systems can complete their functions in the first place. There are at least three principles in the organisation of the perceptual systems. Firstly, the information processing happens in several different, hierarchically organised levels. The information presentation created on each level is based on the one created on the previous level. Secondly, perceptual systems are modular, so that they are constituted of multiple, independent subsystems or modules. Those modules are specialised in different sensory characters such as orientation, movement or colour. Thirdly, a perceptual system has connections between functionally specialised areas. The connections can be forward, backward or sideways, and can create different feedback loops. The connections between perceptual systems and, e.g., memory can therefore help to explain, how the internal effectors can modulate the sensory information processing. (Laarni et al., 2001)

Schemas are used to explain how people in general are able to process the vast information of their perceptual world with human's limited attentional capacity. Somehow a person must focus the limited processing capabilities to the most critical tasks and leave the rest out of the conscious awareness, thus, automating the mental processes as much as possible. In cognitive personality psychology, a schema represents the organisation of information. It influences how people perceive, remember and use that information. Content of schemas and how information is processed differ between individuals. (Pervin, 2003) Originally proposed by Neisser (1976), a schema can be seen as a mental construct that is mediating perception, accepting some chunks of perceptual data and focusing attention to other aspects. Zimring and Gross (1991) see that once the selected schema is activated, it engages automated processes related to memory and actions. According to Zimring and Gross (1991), "schemas seem to provide a construct that both responds to the setting and directs action in it and provide a possible explanation for affective response to settings" (Zimring & Gross, 1991, p. 86). Schemas also explain why sometimes people remember something being present, like a table in an office room, even though in reality it was not. In such cases people rely on the schema of the office constructed from a memory.

Okimoto, Monreal and Bengler (2013) see that culture influences both a person's cognition and perception: "Cultural practices encourage and sustain certain kinds of cognitive processes, which then perpetuate cultural practices" (Okimoto et al., 2013, p. 90). Perceiving and thought include temporal characters, future and past horizons of events, which merge the history and culture of a person into each conscious thought experienced at a specific moment in time. One's later experiences can give new meaning to perceived objects creating new representational wholes of beliefs and thoughts (Merleau-Ponty, 1996 / 2012).

Merleau-Ponty (1996 / 2012) sees that both the perception and the object of perception are paradoxical. We can think about the world only because we have some sort of preceding experience of it and being in it. Through perception we can try to reach something that exists. The object of perception is real for all those subjects who share the same situation, instead of being realistic for all intellectual consciousnesses. To be able to share the subjective experience of perception, one needs to be able to reflect oneself to other subjective beings and understand their behaviour, thoughts and speech. If one recognises the familiar behavioural characteristics that emerge in the shared events, one can confirm that these subjects share similar concepts of the phenomenal content of the world. It is thus creating an intersubjective, objective dimension for the objects of perception (Merleay-Ponty, 1996 / 2012).

Some contemporary models on perception consider perceiving not just as a subpersonal process. There the subject is seen as a dynamic and action-involved character, whose activity affects to the detection of the environment's features. According to these models, perceiving is the way a person constructs the world and comes into contact with the environment in a skilful manner. This is a result of his or her own sensorimotor activity, mediated by the sensory responses from to one's actions and movements (O'Callaghan 2012). Noë (2004) has developed a theory of an enactive approach to perception, where he sees that perceiving has developed to enable action. The environment is reviewed as different possibilities to move and have sensorimotor contingency. He proposes that to perceive is "to experience possibilities of movement and action afforded by the environment" (Noë, 2004, p. 105). While interacting with one's environment, a person gains understanding of the concepts and effects of his movements, thus learning to apply the appropriate sensorimotor knowledge to different situations. This also leads to a task-specific perceptual adaptation. For example, affordances are different for different sized or shaped beings, and for beings with different levels and mastery of bodily and sensorimotor skills (Noë, 2004).

Ernst and Bülthoff (2004) have illustrated the affective interaction between actions and perception with an action-perception loop. Also according to their model, a person perceives in order to be able to act, and perception of the environment is altered by a person's actions. The sensory information alone is not enough to create a full reconstruction of the environment. Thus, one often needs to use unconscious prior knowledge to interpret and estimate the often ambiguous sensory inputs. They suggest that the human mind integrates different sensory signals and by using Bayesian rules, which they call the estimate precision, the mind then weighs and chooses which signals from specific modalities might provide the most reliable information from the environment. This perception-action loop is shown in figure 3.

Dale, Tollefsen and Kello (2012) have reviewed studies about phenomenal consciousness in cognitive science and neuroscience. They propose to use a pluralistic approach in order to cover the complex and diverse mechanisms underlying a phenomenal experience, which can vary on different spatial and temporal scales. They see that there are three key themes that identify aspects from the human nervous system as more abstract cognitive characterisations: the Global Workspace Theory, an action-centred consciousness and the role of social experience and constitutivity. The Global Workspace Theory sees that there is interaction between the mind's different cognitive systems, which then produce experiences of individual events. The inputs can come from internal sources of the organism or from the external world, such as stimulus-specific predictions, which guide a person's actions. Social dimensions have an important role influencing humans' interpersonal, cognitive processes. People act in and are influenced by a broader social and cultural context, which create different narrative structures, thus altering conscious experiences. These different interactions relate to different timescales, from a faster "phenomenological now" to a slower mind-world coupling of events, such as social interactions and extended perceptual events.

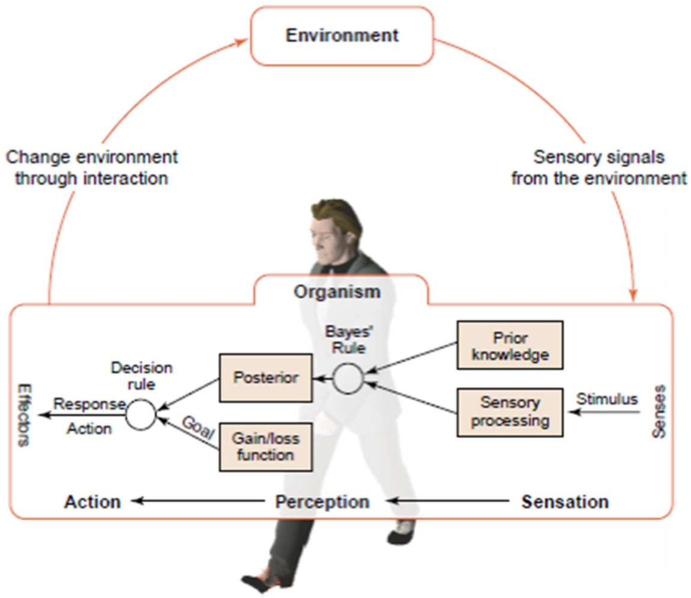

FIGURE 3 The perception-action loop (Ernst & Bülthoff, 2004, p. 164).

The temporal scale of phenomenological experiences, the duration how long humans can hold thoughts in mind, appears to be somewhat between seconds to minutes (Dale et al., 2012). The perception of time seems to be related to the action tendency. It is affected by a person's attention and the amount of how much information is being processed, because the difficulty of a task requires active cognitive processing. The complexity of the sensory stimulus relates to more passive-perceptual processing (Angrilli, Cherubini, Pavese & Manfredini, 1997). There are findings which indicate that also the movement of the stimulus alters the perception of time. More changes in the stimulus during an observed period of time are perceived as longer time intervals. Vice versa, time intervals where there are fewer changes in stimuli are perceived as lasting shorter amounts of time (Brown, 1995). Other factors that change time perception are the two components of emotions, a person's level of arousal and the affective valence (Grondin, 2010; Angrilli et al., 1997). There seems to be a double mechanism for evaluating time that is triggered by different levels of arousal. High-arousal situations trigger an emotion driven, fast mechanism, and low arousal levels trigger an attention-driven mechanism (Angrilli et al., 1997). Shorter or longer temporal periods than the length of a phenomenological experience, can exist only as abstractions of events. There are slower timescales of learning, memory, social interactions, culture and evolution, that shape the dynamics between them and shorter temporal events.

Nevertheless, activities that happen in different timescales all have their impact on conscious experience. (Dale et al., 2012)

2.9.2 Senses and sensory systems

Human senses can be classified into five major groups. Those are: vision, which senses the electromagnetic energy; hearing, which senses the air pressure waves; touch, which senses the tissue distortion; balance which senses gravity and acceleration; and taste and smell, which sense chemical composition. Different types of receptor cells in different sensory organs convert the environmental energy into nerve impulses. The nerves from receptors are then connected to cells in different specialised areas in the brain. Activity in these areas, after the incoming information has gone through several stages of neural processing, is supposed to lead to the conscious perceptual experience. (Mather, 2009)

All sensory systems need to transform the external information from a person's environment into a neural representation in a person's mind. An important dimension of any sensory data is the intensity of the incoming information. The more intense the physical stimulus is the more intense the sensory organ is affected, and the resulting sensation magnitude felt. The minimum magnitude of a stimulus that humans can reliably discriminate from when there is no stimulus at all, is called the absolute threshold. Sensory modalities that respond to different physical stimuli are very sensitive to detect the minimum stimuli. Another kind of threshold of sensitivity is called the difference threshold, or just noticeable difference (jnd). It means the detection in stimulus change. This is measured to determine how much stimulus intensity must be increased from one standard level to another, in order for a person to be able to distinguish the change in stimulus intensity. It seems that the amount of increase of the stimulus intensity that is detected by a human depends on how high the intensity of the standard stimulus is. The relation between the standard stimulus intensity and the detection of its change is proportional and constant. It can be described in a mathematical formula which is known as the "Weber-Fechner law". Typically people are more sensitive to detect changes in sound and light than for example in smell or taste. (Nolen-Hoeksema et al., 2009)

The relations between physical stimuli and the sensory perceived, psychological experiences are commonly studied with psychophysical procedures. These experimental techniques study for example, the detection of the existence or simple changes in the physical stimulus, or the relation between the physical magnitude and resulting psychological response to a stimulus (Mather, 2009; Nolen-Hoeksema et al., 2009). Methods that are used in psychophysical research try to rule out the difficulties that the phenomenological approach might have. There can be limitations in the subject's verbal abilities, individual differences in the way experiences are reported, and diverse individual's expectations, desires and attitudes (Mather, 2009). Psychophysical procedures provide important information for real life applications. For example, in changing a product's physical properties the designer can apply the knowledge of what kinds of levels in physical stimulus are causing a perceived sensation by the user of the product (Nolen-Hoeksema et al., 2009). Phenomenological methods, in turn, are inherently subjective. The scientific validity of phenomenological research is gained by the agreement of the nature of perceptual experience among individuals by intersubjectivity (Mather, 2009).

During an escalator ride a person is receiving sounds from lots of different sources such as from the surrounding areas, surface echoes, escalator's machinery, and any kind of squeaks and scratches, as well as from other people. It seems rather difficult or even impossible for a person to be able to pinpoint the exact source of the sound or separate the auditory "objects" one from another. In order to decode the incoming environmental sounds, the human auditory system uses a process called auditory scene analysis. This process is used to determine where sounds are coming from, where they occur in space, and when they occur. It determines are they simultaneous or does one sound precede another, and what is actually heard — thus recognising what the sound represents. There are some limitations to how the auditory inputs are perceived and decoded, due to humans' limited mental process capacities. For example, when different speech sounds are entering both ears at the same time, attention can be selectively directed to just one of those sound streams. Then again, it seems that there are virtually no limits in the human mind's capacity when it comes to learning and remembering new sound-based items, such as music and people's voices. (Baars & Gage, 2010)

In hearing there is a complex biological sensory system that processes the physical properties of sound signals in order to sense sound. A sound is "the vibration that occurs when an object moves in space, producing an audible sound" (Baars & Gage, 2010, p. 198). Usually different vibrating surfaces produce sounds, because they create fluctuations in air pressure creating sound waves (Mather, 2009). What is heard are in fact the effects of vibration in sound waves when they make contact with person's ears (Baars & Gage, 2010). A simple sound wave can be described mathematically as a sine wave. It has specific physical properties called frequency, intensity and time. Natural sound sources, like machines, do not typically create simple sine waves, but a much more complex variation of the sinusoidal waveforms. However, in theory, with a procedure called Fourier analysis, any complex wave can be decomposed back to the collection of simple sine waves added together. There the form of the complex wave is determined by the sine waves' three properties (Mather, 2009). In addition to the three basic physical features, there are also other qualitative aspects to sounds. One example of sound quality dimensions is the timbre. It allows humans to distinguish the quality of the note, between musical instruments and in human voices (Baars & Gage, 2010).

There are several complex methods and algorithms used in psychophysical research that are used to analyse the properties of complex sound, such as sounds coming from an escalator and its close environment. In their book about psychoacoustics, Fastl and Zwicker (2007) have described the psychophysical methodology to study sounds and acoustics. They write about correlating the hearing sensations with physical characteristics of the stimulus:

> The stimulus can be described by physical means in terms of sound pressure level, frequency, duration and so on. The physical magnitudes mentioned are correlated with the psychophysical magnitudes loudness, pitch, and subjective duration, which are called hearing sensations. However, it should be mentioned that the pitch of a pure tone depends not only on its frequency, but also to some extent on its level. […] Just as we can describe a stimulus by separate physical characteristics, so we can also consider several hearing sensations separately. For instance, we can state "the tone with the higher pitch was louder than the tone with the lower pitch". This means that we can attend separately to the hearing sensation "loudness" on one hand and "pitch" on the other. A major goal of psychoacoustics is to arrive at sensation magnitudes analogous to stimulus magnitudes. For example, we can state that a 1-kHz tone with 20 mPa sound pressure produces a loudness of 4 sone in terms of hearing sensation. The unit "sone" is used for the hearing sensation loudness, in just the same way as the unit "Pa" is used for the sound pressure. It is most important not to mix up stimulus magnitudes such as "Pa" or "dB" and sensation magnitudes such as "sone". (Fastl & Zwicker, 2007, p. 11.).

However, describing and quantifying relationships between measured physical parameters and perceived psychological features of sound is even more complex than it might first seem (Mather, 2009). Physical parameters of a sound can be measured with a rather detailed accuracy, but how individuals perceive the sound is more difficult to determine. For example, where a pitch is concerned, while it is typically described as the highness or lowness of a sound, different people might experience the pitch in different ways. "A highly trained opera singer […] may have a very different sense of the differences in pitch between closely matched sounds than an untrained individual, even though both have normal hearing" (Baars & Gage, 2010, p. 200). The same applies for the subjective perception of loudness. How a person perceives the loudness of sounds depends on several unique characters of an individual, from loss of hearing to personal preferences. These should also be considered when running a psychophysical research. Like Moore (2014) states in his article reviewing the Cambridge loudness models, including the diagram for equal-loudness contours:

> It should be noted that the models do not take into account relatively high-level processes that might influence loudness perception. […] Although such high-level effects are undoubtedly important, they are difficult to model and, to my knowledge, have not yet been taken into account in any loudness model. The models presented here can be considered as characterizing loudness perception under conditions where context and visual cues play a minimal role. (Moore, 2014, pp. 1-2.).

The sound frequency is "the rate of sound wave vibration" (Baars & Gage, 2010, p. 198) and it is measured as hertz (Hz), that means the sinusoid cycles completed per second (Baars & Gage, 2010). Variations in sound frequency relate most to the perceived sound pitch. Low frequencies are typically perceived as deep bass pitches, and high frequencies are usually perceived as high treble pitches, "allowing humans to order sounds on a musical scale" (Mather, 2009, p. 132). It is estimated that the human auditory system can detect sounds between a range of frequencies at 20 to 20000 Hz (Baars & Gage, 2010).

The intensity of a sinusoid reflects the amplitude, which is usually expressed on the decibel scale (dB). This means the displacement of the sound wave within its cycle and over time. It is represented as the height of a wave from its mean to its maximum value in a timescale (Baars & Gage, 2010; Mather, 2009). Humans can hear sounds at a range of intensity between 1 unit to 10^{15} units of intensity (Baars & Gage, 2010). Because of the huge range of intensity, the decibel scale is logarithmic. The decibel scale is also relative. Common ratios which are used to describe hearing intensity are the relative intensity of a sound based on either the sound pressure level (SPL) in the air where hearing is occurring, or based upon the hearing threshold or sensation level (SL) of an individual person (Mather, 2009; Baars & Gage, 2010). In humans hearing ranges from ~ 1 SL to 150 dB SPL. The range of human hearing and the hearing threshold can be illustrated on a scale, where the sound pressure (dB SPL) is presented in the y-scale and the frequency (Hz) of the sound is presented in the x-scale (figure 4) (Baars & Gage, 2010, p. 199).

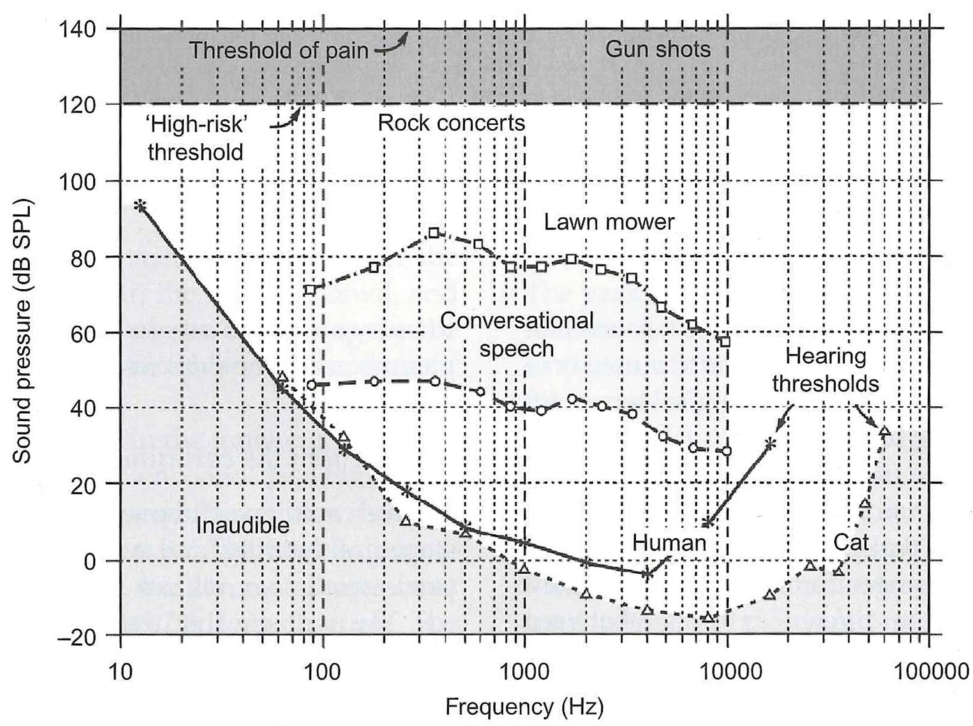

FIGURE 4 Human hearing threshold and range of hearing (Baars & Gage, 2010, p. 199).

A phase refers to a specific timing or position of a sound wave in relation to either a fixed point of reference or to another wave in its sine wave cycle (Mather, 2009). Time is a critical aspect of the auditory processing (Baars & Gage, 2010, p. 197).

For example, in speech the phonemes occur on a scale of 20-30 milliseconds, syllabic stress occurs over approximately 200 milliseconds, and sentences, other key information for speech occur over 1-2 seconds, including the rising intonation and other speech cues. In order for the successful decoding of speech sounds and turning them into understandable meaning, the auditory system must be able to manage and integrate information that is processed during time windows from 20 to 2000 milliseconds (Baars & Gage, 2010).

The sound pressure level measures sound pressure relative to a fixed reference pressure, at 1000 Hz. It is close to the minimum sound pressure that is detectable by humans. The sound pressure level corresponds somewhat roughly with the perceived loudness of a sound. According to Mather (2009), “loudness is the perceptual attribute of a sound that corresponds most closely to its physical intensity” (Mather, 2009, p.129). Typically the loudness of different sounds is studied with two techniques: matching and scaling the loudness. In the loudness matching method, the test subject is asked to adjust the intensity of a tested comparison stimulus sound to match a standard sound with fixed intensity. The difference in frequency between these two sounds is then manipulated to find out how the produced perception of loudness depends on the sound’s frequency. The procedure is then redone for several comparison frequencies. Results can be shown as a plot that displays the comparison between the different sound pressure levels of a sound and the frequencies where it matches with the perceived loudness of a reference sound that has fixed frequency and sound pressure level. The resulting plot of comparison SPLs of sounds as a function of frequency is called the equal-loudness contour (Mather, 2009). When the loudness matching is done for several different sound pressures, results can be put into a diagram that represents matched loudness at different sound levels, creating a model for a family of equal-loudness contours. According to Moore (2014, pp. 1-2), early concepts of loudness were first developed by Fletcher and Munson (1933) and by Stevens (1972). These concepts were later used as a base for models by Zwicker (1958) and Zwicker & Scharf (1965). At University of Cambridge a series of loudness models have been updated with new empirical data and developed further by Moore, Glasberg, Baer, Stone and Chen. Currently, these equal-loudness contours are specified in ISO 226 (2003), but more accurate contour predictions have been proposed by Moore in his models for 1997 and 2006. The updated diagram of equal-loudness contours for different frequencies is illustrated in figure 5. Moore’s 2006 model is also used as the basis for the ANSI 2007 standard, which describes the calculation of the loudness of steady sounds. (Moore, 2014)

According to Mather (2009), loudness scaling aims to measure how rapidly the loudness of a sound increases, or scales, with its intensity. The experimental technique where a test subject is asked to assign numbers to sounds at different intensities is called magnitude estimation. This psychophysical technique is used as a test estimate of a sensory magnitude of a physical stimulus’s intensity and has been applied widely to test sensory stimuli in different senses. In a simple test to measure the detected changes in loudness, a standard tone is given an arbitrary value in a numerical scale, such as the number 100. A second tone appears twice as loud, and the subject is expected to rate the loudness of that tone with the number 200. Loudness does not follow linear increases with intensity, but the sensory magnitude "grows in proportion to stimulus intensity raised to a power" (Mather, 2009, p. 131).

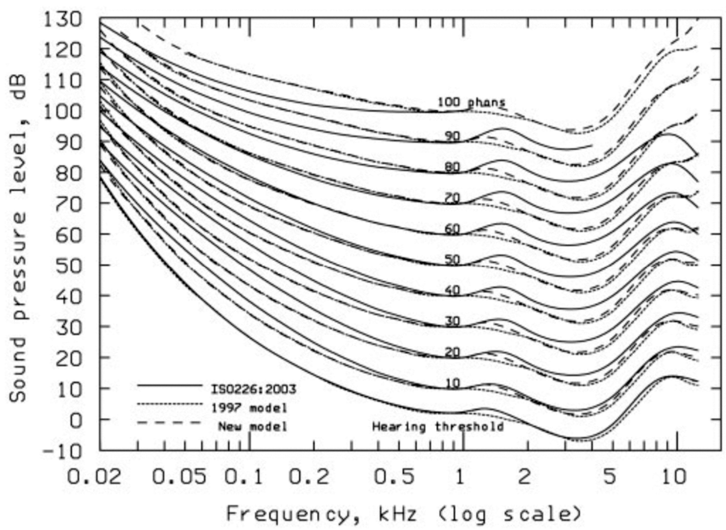

FIGURE 5 A diagram of the family of equal-loudness contours for a range of comparison frequencies (Moore, 2014 p. 7).

The magnitude-sensory estimation can be tested with all magnitudes of sensory modalities, but the rate of increase of magnitude, or the exponent between the perceived psychological magnitude and the increase of the physical magnitude is different among different senses (Mather, 2009; Nolen-Hoeksema et al., 2009). However, when the data of the relationship between different stimulus intensities and sensory magnitudes is plotted on logarithmic axes, the magnitude can be shown as a linear increase. It is following a particular power-law relation between stimulus intensity and sensory magnitude, called Steven's power law (Mather, 2009). An example of the relationships between different stimulus intensities and sensory magnitudes, and how the same data can be plotted on logarithmic axes following the Steven's power law is illustrated in figure 6.

It is important to consider the different exponents that different sensory modalities entail. It is not known why such differences exist. One suggestion is that there is an important evolutionary aspect involved. Signals such as pain, that need quick reactions in order for an organism to survive and avoid injuries and other bodily harm, have greater-than-1 exponents. This means that when the levels of physical intensity increase, they also lead to progressively greater increases in sensation. In other sensory modalities such as sensing the changes in intensity of light or corresponding to loudness, which have less-than-1 exponents, the changes in the detected sensations are smaller in proportion to the changes in the physical stimuli's intensities (Nolen-Hoeksema et al., 2009).

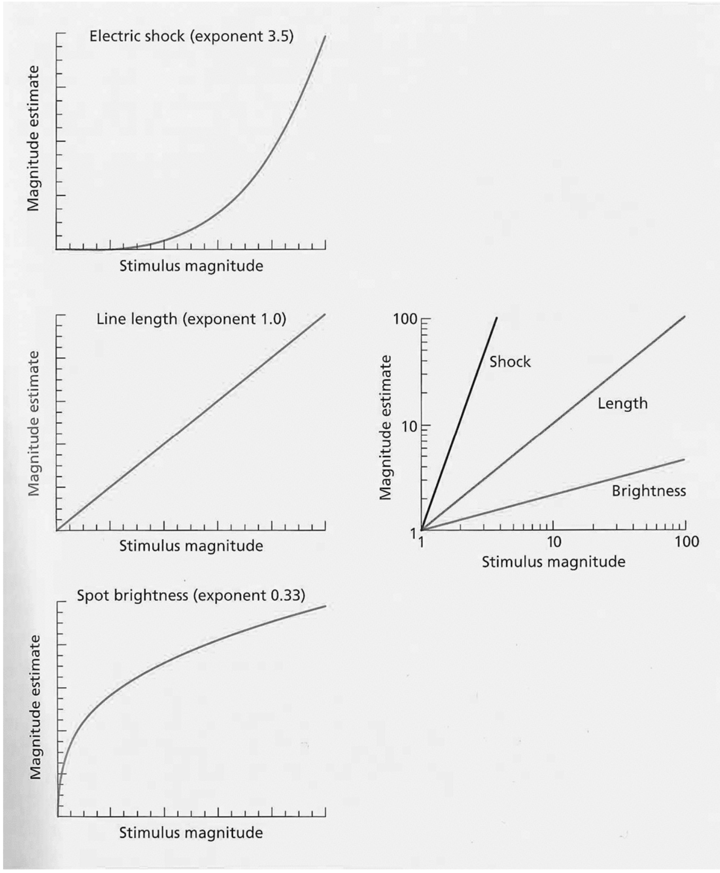

FIGURE 6 An example of the relationships between different stimulus intensities and sensory magnitudes on left, and data plotted on logarithmic scale on right (Mather, 2009, p. 19).

As in any kind of information, also sensory inputs contain "signals", which means the relevant and important part of the sensory information, and "noise", which means the part of the input that is unimportant and irrelevant. Important signals are always embedded in noise that can obscure and hide the signal. People differ in their sensitivity to detect sensory signals. There is also a possibility of people having different kinds of psychological biases, which can affect their detection of a stimulus. A bias can exist due to different reasons, such as individual's expectations. One person might expect to receive a lot of signals, whereas, another person might require much more evidence to state that a signal exists (Nolen-Hoeksema et al., 2009).

How the sensory systems seem to judge different stimuli reveals something important of the functional purposes of the human sensory systems. Like Mather (2009) states: "it seems that the sensory systems provide information about changes in the level of stimulation rather than about the absolute level of stimulation" (Mather, 2009, p. 19). This statement can be reflected to a view where humans are seen as goal-oriented, intentional beings, who interact with the environment. In order to be able to create a subjective perception of the world and adapt one's actions accordingly, what seems to be relevant for a person is in fact to have the sensory information of the changes in the physical environment, not the physical absolutes as such.

Another example of the complexity of the mental correlation between the physical environment and the sensory perception can be taken from how spatial features of the environment are experienced visually. Built spaces can be researched from purely architectural or rather mechanical aspects. They can describe the space with its physical dimensions and investigating how the human senses that environment’s physiological features, such as light and colours. Another way to view the concept of space is to study how a person perceives a space and location as an experience, and what kind of emotions a person then relates to that space (Korpelainen, Kaukonen & Räsänen, 2004).

The human eye has evolved to receive electromagnetic radiation between 397–732 nanometers. Perceived colours are between these light waves, for example, purple between 400-500 nm and red between 610-650 nm (Anttila, 1993). In order to be able to perceive colours and forms there needs to be light directed to the observed object, which reflects to the retina of the eye creating nerve impulses. Those impulses travel through the optical trajectory to the brain. The nerve impulse data is then interpreted in the person’s mind as colours, shapes and forms. Making sense of the colours and forms is dependent on the amount, direction and quality of the light. If the angle between the eye and the light is bad, it can negatively affect how well one perceives the visual inputs. This affects especially the perception of three dimensional objects and differences between an object and its background as their shades, hues and contracts become more difficult to distinguish (Rihlama, 2000). Instead of purely mathematical measures, human senses create their own spatial measures of that space, which affects the perception on an emotional level. Visual features of the space, such as lighting, forms, surface materials and patterns, create optical measures, which do not necessarily equal with the mathematical ones. A light blue ceiling can create an illusion of a higher space than it really is. Different physical, physiological and psychological factors all effect to the experienced visual impression of one’s environment (Rihlama, 2000).

Many of the ride comfort parameters relate to vibrations, jerks and tilts of the moving object — typically of the escalator step and the handrail that the passenger’s body is in contact with. Some of these kinds of features can be sensed with the sense of touch and the proprioception. Touch is sensed with free nerve endings that sense pain, temperature and tickle. Meissner's corpuscles sense light and dynamic touch, Merkel's disks sense static pressure, Panician corpuscles sense pressure and vibration and Ruffini's corpuscles sense stretching of the skin. In human muscles there are spindles, which sense muscle length. Larger muscles that generate coarse movements have fewer muscle spindles than muscles for fine and accurate movements, such as muscles in the hands or around the eyes. Golgi tendon organs in tendons sense the muscle tension. Joint position sensing joint receptors are found in and around the limbs in muscles, tendons or the joints. In the human brain the cortical representation of somatosensation is divided in such a way that a major area is representing those parts where the detailed sensorimotor functioning is required. The representational areas for more coarse functions such as for trunk, hip, leg, foot and toes are quite small related to the areas of representations for e.g. tongue or lips. There are also cells in the somatosensory cortex that respond selectively to movement direction. (Mather, 2009)

Foot vibrations have been found to affect balance, posture and gait both in standing still and while walking or running (Nurse & Nigg, 1999; Thompson, Bélanger & Fung, 2011). Thompson, Bélanger and Fung (2011) have found, that vibrations to the rear foot while quiet and perturbed standing alter a person's balance and postural orientation. It causes a forward tilt of the body. Effects of the vibrations through the feet are not only local, but also the faraway joints and segments are impacted, thus affecting the whole body (Thompson et al., 2011). In a research by Dettmer, Pourmoghaddam, O'Connor and Layne (2013) they found that a human can adapt to the repeated exposure to foot vibration. If more reliable proprioceptive input data and supporting surface characteristics were available, the postural control system would be able to adapt to the vibrations by suppressing unreliable sensory inputs and putting greater emphasis on the more reliable sensory inputs. Furthermore, the effects of the vibrations were even further attenuated, if the supportive surface was not fixed, but was an unstable platform that was swaying or rotating. They see that their findings support theories where the human postural system is able to adapt to the changing external stimuli over time by selecting the most appropriate sensory signals from other senses while suppressing the unreliable inputs. This is by modification of the postural orientation and muscular activity, and by experience and learned motor control (Dettmer et al., 2013).

The sensitivity of the sensory receptors of a foot varies a lot between people. Some people are more sensitive to the pressure and vibrations than others. How these inputs are sensed affects the body's ability to respond to the changes in external sensory data and how to adjust motor functions and posture accordingly. It also affects how different people evaluate different experiences, such as comfort (Nurse and Nigg, 1999). Hämäläinen, Kekoni, Rautio, Matikainen and Juntunen (1992) have found that the vibrotactile sensitivity in hands and feet is very similar. The skin in the palm of the hand is, however, more sensitive to a high-frequency vibration than the sole of the foot. This might be due to different mechanical properties between the palm and the sole of the foot. Malchaire, Rodriguez Diaz, Piette, Gonçalves Amaral and de Schaetzen (1997) have researched the effects of short term exposure to hand-arm vibrations by a set-up, where participants were grasping a vibrating handle for 32 minutes. They found that as the main effects of this exposure the subjects developed paresthesia and numbness, which developed in about three minutes. Though, there were large individual differences. Most of the symptoms of numbness and paresthesia were due to simply holding the handle, but the symptoms increased as the vibration amplitude increased, regardless of the vibration frequency (Malchaire et al., 1997).

Westling and Johansson (1987) researched the skin's mechanoreceptor responses and found that the panician corpuscular units in the skin responded to a high frequency vibration that was above about 50 Hz and at low amplitudes. However, it seems that due to the receptive field properties of the units, the sensation of vibration is poorly located. It also requires quite a long duration time of the stimulus for the perceptual experience to emerge. These same cells seem to also participate in motor control, and especially reacting to the start and stop of a movement (Westling & Johansson, 1987). Sensitivity to vibrations is also impacted by changes to skin temperature. According to Green (1977), both cooling and warming decreased the sensitivity to vibrotactile stimuli. In Green's experiments, he found that sensitivity to vibrations was lowered especially for 150- and 250-Hz stimuli in the former, and less severely but more uniformly across different frequencies between 30-250 Hz in the latter.

When people travel on escalators they typically wear some sort of shoes. Shoe inserts and orthotics are used: in shoes worn by diabetic patients; to adjust flat feet; or are related to some physical deficits such as osteoarthritic knees or rheumatoid foot disease. They are also used in shoes for sport and physical activities, providing an impact cushioning effect. Nigg, Nurse and Stefanyshyn (1999) have suggested that ground reaction force signals, such as the vibrations from the ground, are filtered and dampened by both the sole and the insert of the shoe before the signal reaches the plantar surface of the foot. This improves the comfort. However, the subjective reactions to shoe insert materials and sensing and reacting to the different physical forces varies between individuals. A research by Mündermann, Stefanyshyn and Nigg (2001) indicates that using shoe inserts improves the average comfort ratings compared to shoes without an insert, by adding the softness of the footwear. The perception of comfort is further influenced by a person's individual characteristics, such as the foot sensitivity to vibration, foot arch heights, and the alignment of skeleton, foot and leg. However, what seems to be less of a comfortable shoe on average might still seem the most comfortable choice for a considerable amount of people. Mündermann, Stefanyshyn and Nigg (2001) studied also the footwear comfort with 5 mm thick shoe inserts. Related to their findings, they speculate that the effect of different insole materials on the perception of comfort might be even greater with thicker shoe insert materials.

The vestibular system provides information about the orientation and movement of the body in relation to the external environment. The system is essential for a normal functioning body. It makes it possible for a person to walk and run without falling over, at the same time as allowing them to maintain steady fixation to a stable or moving object. In a human's head there are vestibular receptors that are sensitive to the forces of gravity and acceleration. The sensory information supplied by the vestibular system is used largely to control reflective movements of the eyes and the limbs. Information about the body's position and movement in an environment is available from vision as well. Things like contour orientation and texture gradients work as visual cues about the orientation of the ground plane relative to the body. Information on bodily movement is received in an image of large scale patterns of movement. Vestibular responses are felt as a conscious experience only when there is a mismatch between visual, vestibular and somatosensory information in the central nervous system. The resulting sensations can be very strong and might cause confusion, disorientation and nausea, as well as states like vertigo or motion sickness. (Mather, 2009)

How humans perceive self-motion is based both on the dynamic signals from the body and the limbs. It is also based on the signals about a person's position in the static gravitational field and its relation to the external world. This information is provided by the body's internal proprioceptive system and the vestibular system. By integrating multisensory bodily signals with the vestibular signals, a person achieves a full body representation of one's position and orientation in space. Those are necessary aspects for one's bodily self-awareness (Pfeiffer, Serino & Blanke, 2014). According to Bronstein, Bunday and Reynolds (2009), vestibulopoprioceptive inputs seem to be important especially for stabilising externally imposed postural challenges, rather than those which are internally generated.

Fitzpatrick and McCloskey (1994) have studied how humans perceive body sway while standing. Based on their findings, it seems that the most sensitive information of the postural sway comes from the proprioceptive inputs from the legs. When the velocity of the sway becomes higher, humans also use visual input for perceiving sway during normal standing. The vestibular system provides perceptual information only after there are large disturbances of posture. (Fitzpatrick & McCloskey, 1994)

Surface tilt can be perceived as a haptic perception of slope with fingers and feet. The inclined surface angle is estimated against a horizontal ground plane. However, according to Hajnal, Abdul-Malak, and Durgin (2011), the estimation of the angle of the slope appears to be typically quite exaggerated in a person's mind. Some overestimation happens when a person estimates the angle of the slope with fingers. The angle of the surface inclination is even more over estimated in pedally perceived slopes which are experienced by foot. (Hajnal et al., 2011)

Vision is important for postural control regardless of the age of the person. The level of illumination can affect postural control, with lower levels of lighting leading to a significantly increased postural sway (Rugelj, Gomiščček & Sevšek, 2014). The amount and quality of sensory information decreases with age. It leads to increased attentional demands for the postural control. Older people are requiring and relying more on visual information to maintain postural stability. Research on postural control when standing on a moving platform suggests that in healthy older adults also the type of supporting surface increases the attentional demands (Shumway-Cook & Woollacott, 2000). Postural control is further affected if the situation demands other attentionally demanding cognitive tasks under multitask conditions. In older adults with balance impairments the decrease of sensory information might lead to imbalance and falls (Shumway-Cook & Woollacott, 2000; Woollacott & Shumway-Cook, 2002). There might be several reasons for this. The reason can be an inability to shift attention between tasks or a decreased attentional capacity. There can be impairments in the postural control system which lead to increased demand for attentional resources. The reason can also be some combination of these (Woollacott & Shumway-Cook, 2002).

Reasons for our sensory systems functionality can be explained by evolutionary theories. When concerning the overall functionality of our lower body senses, our proprioceptory and vestibular systems have evolved to sense the changes in the ground in order to be able to move and stay balanced. Information about the surface, the depth and the motion is essential for humans, because errors in that information might lead to accidents that can cause detrimental impairments to a person's ability to move. This suggests that these systems might be more crucial to the organism's survival (Nolen-Hoeksema et al., 2009). However, the perception of the change's magnitude does not have to be physically exact. When a change in an environment is perceived, it initiates more precise motor control programs. For example, when perceiving the ground surface orientation, a person's estimation of the surface tilt does not need to be an exactly accurate physical estimate. It can work more as an initiator for more specific motor programs that are required for postural balance (Hajnal et al., 2011). This way the mind can focus its limited capacity towards those computational processes, which are most relevant for that moment. Motor control and perceptual-motor skills are also further learned during repetition and practice, and saved in an implicit procedural memory (Nolen-Hoeksema et al., 2009).

In a person's mind, the sensory information is both processed separately and independently in sensory specific modules. It is also shared across different sensory modalities. In multisensory processing the brain exploits correlated signals from different senses to create a unified and holistic perceptual experience (Mather, 2009). According to Ernst and Bülthoff (2004), different combination and integration strategies are used depending on the type of information being processed. There seems to be two general strategies for how humans combine information to interpret the sensory signals. The first strategy aims to maximise the information from different sensory modalities. The second tries to increase the reliability of the info by reducing the variance in the sensory estimate. In both cases, the mind utilises the contextual conditions for stimulus presentation and the prior knowledge to reconstruct the perception of one's environment. (Ernst & Bülthoff, 2004)

Multimodal stimulus presentations speeds up reaction times compared to a stimulus from a single sensory modality. This cross-modal queuing might result from the brain receiving more information altogether. It might also provide a better level of confidence to decide whether to detect or discriminate different target stimuli from one sensory modality in support of information from another sensory modality. However, because the perceived location of a sensory event is influenced by other sensory inputs, it can create illusions where different stimuli seem to be coming from the same source. For example, in ventriloquism the speech sounds seem to come from the mouth of the entertainer's doll, but instead comes from the ventriloquist's still lips. Cues from other senses help to identify the information content, improve the perceptual quality and the comprehension of sensory inputs. Examples of perceptual interaction between different modalities, where the perceptual quality of one sensation is altered by the presence of another have been reported in several different cases:

- sound and touch, where sound from rubbing hands together can alter the perception of skin texture.
- smell and color, where strawberry smell of a liquid appears stronger when the color of the liquid is red,
- sound and light, where auditory noise presented with light tends to be perceived as louder than noise alone,
- light and touch, where tactile discrimination thresholds are lower during visual observation,
- McGurk effect, where a heard sound of speech is altered by listener's observation of the speaker's lip movements.
  (Mather, 2009, p. 385.).

Body ownership means that a person feels that his or her own body is the source of sensations. Peripheral signals indicate different states of the body both during voluntary actions and passive states. In passive state they create a local and fragmented proprioceptive sense of body ownership. In contrast, in voluntary actions, signals are integrated into a coherent awareness of the body, thus creating a sense of agency (Tsakiris, Prabhu & Haggard, 2006). According to Ionta, Gassert and Blanke (2011), the multi-sensory integration is a key mechanism for one's self-awareness. Full-body agency is associated with the movement and position of the whole body. A sense of full-body ownership and agency is typical during locomotion, such as gait, which is a cyclic, rarely immediately goal-directed and generally automatic and unconscious action. Because locomotion creates vestibular sensations, it thus affects the perception of one's surrounding space (Kannape & Blanke, 2012). Research by Kannape, Schwabea, Tadia and Blanke (2010) suggests that there are at least partially different information processes behind the creation of one's full-body locomotion and what is experienced consciously regarding goal-directed locomotion and navigation. According to their findings, humans track their body's locomotion and position with quite low accuracy. There is only a little or distorted (and in some cases no) conscious awareness behind one's body movements and positioning in space.

There are differences in the sensorimotor systems involved with body-part movements and full-body agency. Body-part movements include upper limbs and unilateral movements. Full-body agency includes lower limbs and bilateral movements. It seems that humans rely on comparable mechanisms for body-part awareness and a full-body agency (Kannape & Blanke, 2012). For example, Palluel, Aspell and Blanke (2011) have researched the impact of multisensory inputs for bodily self-awareness. They have found that even though the synchrony of tactile and visual inputs affects the self-identification and perceived location of touch, the proprioceptive signals coming from the upper limbs are not relevant for bodily self-consciousness.

In order to make sense of the external physical world and the properties of the different environmental stimuli, the human sensory systems must recode the complex physical signals to biological information. The biological sensory data is processed in complex mental processes, then creating the psychological or phenomenal sensation. Different senses can produce sensations which have their unique kinds of subjectively experienced features. Information from one sensory system also influences how the other sensory information is attended to and processed. The information from different senses is integrated in the mind with other mental properties, such as memories, skills, and emotions, just to mention a few. This creates a unified perception of the world, which then can emerge as a conscious phenomenal experience that also steers an individual's selected responses and further actions.

2.9.3 Differences in the perceptual experience among individuals and groups of people

Research has found that there are differences in sensations and perceptions between individuals and within groups of differently categorised people. On the individual level a person can have physiological abnormalities or impairments such as colour deficiency or synesthesia. There can be even clinical disorders such as anosmia, deafness, scotoma or agnosia, which all alter or create different perceptual experiences. Age-related changes and senescence in both peripheral sensory structures and the brain anatomy itself leads to a decline in perceptual capacity. These can affect for example, a visual acuity, which means the ability to resolve final spatial detail. Aging causes deterioration in hearing levels. It can cause a presbycusis, which means age-related deafness. It also causes deterioration in the peripheral olfactory system that leads to errors in odour identification. Aging also causes a decline in touch discrimination. It might be partly due to the changes in the properties of the skin and the reduction in the number of touch receptors. (Mather, 2009)

The potential differences in perceptual experiences between the sexes have been researched, but the results do not fully agree. The biggest differences are usually found in a mental rotation task. The task requires a manipulation of an internal mental image of a shape that is visualised from different angles. There men usually perform better than women. Some differences have been reported also in cognitive tasks in verbal ability, where females performed better than men. Research on mammals has shown that there are sex differences in spatial abilities and behaviour. However, the difference between the sexes is quite small and subtle. It seems that the deviation between individuals is more important than between sexes. There is also some evidence about the impact of the cultural effects on perception. However, the studies done should be considered with caution, because the evidence is usually quite weak. In most studies the tests have been exposed to bias effects and the data interpretations are quite ambiguous. (Mather, 2009)

Much better evidence for perceptual differences has been collected related to expertise and practice. It seems that expertise alters perception. Musicians can make finer discriminations in auditory features, and artists perform better for example, in shape constancy and identification of blurred or fragmented pictures. Practice has even led to physically detectable differences in the brain anatomy between experts and non-experts (Mather, 2009). The same findings apply for example can be seen in environmental assessments. Clear differences on how the environment is assessed have been found between trained professionals and the public (Evans & Gärling, 1991; Kaplan 1991). Expertise means acquiring a vast amount of knowledge and experience on a subject. On the flip side of expertise, experts usually become ”blinded” in comparison to novices, where they are unable to see or be aware of the differences that the non-experts experience. This means that when doing an environmental assessment, the expert’s perceptions should be balanced with novice perspectives, allowing new and other kinds of insights to emerge. According to Kaplan (1991), even though an expert analysis is important and often essential, including the input from the public and the non-experts strengthens the assumed theories and enables new discoveries. This is also why the role of experts needs to be viewed with caution when doing estimations and assessments. This finding can be important especially when conducting a research on perception and experience of riding escalators. The perception, and thus the experience, of the escalator ride and comfort can differ between a person who rarely (or never) uses an escalator, and a person who uses escalators often (the escalator in question or others), or even more between a novice escalator user and people who themselves design and develop escalator equipment.

2.9.4 Attention

A vast amount of information from the environment is constantly being perceived by our sense organs. However, only a small portion of this information is needed to accomplish the task a person is doing at that moment, whether it was drinking coffee, reading a text message or standing on a moving escalator. The mind and the sensory systems must screen the incoming information to select only the relevant information for perceptual processing in order to get the task done. This ability to selectively attend to a certain amount of incoming information involves three separate processes. One is for keeping a person alert and maintaining that alertness. Another is for orienting resources to the task-relevant information. The third is for making executive decisions on whether to stay attended to an object or switch focus to some other more relevant information. (Nolen-Hoeksema et. al, 2009.)

A person is able to focus one’s attention to a very limited amount of information at any one time. These limitations, which are set by the human neurological system, mean that a person must select the object of attention and focus only on that for the needed amount of time. This means leaving out sensory data which is not relevant for the task at hand (Laarni, Kalakoski & Saariluoma, 2001). Chun, Golomb and Turk-Browne (2011) propose that the attentional system must select and modulate the information that is the most relevant for behaviour and to sustain vigilance. This is because the core characteristics of attention are shared across multiple systems, and because there is too much information to process.

A practical example of attentional selection and what is then consciously attended to, is given by Dennett (2002) of a situation, where a person enters a familiar room:

> In familiar surroundings we do not have to see or pay attention to the objects in their usual places. If anything had been moved or removed we would have noticed, but that does not mean we notice their presence, or even that we had the experience (in any sense) of their presence. We enter a room and we know what objects are in it, because if it is a familiar room we do not notice that anything is missing and thus it is filled with all the objects we have noticed or put there in the past. If it is an unfamiliar room we automatically scan it, picking out the objects that fill it and catch our attention. (Dennett, 2002, p. 139.).

Koralus (2014) suggests that attention is focused to pick out and evaluate things like objects, features and locations, from the perceptual inputs that have a functional interest to a being. It is not clear at what point of the information processing flow the selection of the attention happens. For example, the physical properties of a sound, such as loudness and pitch or the voice characteristics of the speaker, or eye fixations and sudden changes in the visual field, are quite effective criteria for the attentional selection. Sometimes also, the content of the stimuli can affect attention. It can be such as hearing one's own name in a distant conversation or seeing a symbolic cue in one's visual field (Nolen-Hoeksema et al., 2009; Laarni et al., 2001). Exogenous attention is the general term for an involuntary event that is triggered by sensory stimulation. There the attention is focused automatically towards a sudden change in sensory inputs, such as a sudden noise (Mather, 2009).

The difficulty of the task might affect attention, limiting the focus to different objects of attention, as more cognitive capacity is required for the task. It seems that selective attention both diminishes the irrelevant sensory data and reinforces that which is relevant (Laarni et al., 2001; Nolen-Hoeksema et al., 2009). Chun, Golomb and Turk-Browne (2011) categorise attention according to the target of attention. They have made a distinction between internal and external attention. Internal attention reacts to the information that is represented in the mind, recalled from long-term or working memory. External attention refers to the perceptual attention that selects and modulates the sensory information and constitutes a modality-specific representation in a person's mind, with referents to the external world. It includes features of objects, spatial locations and points in time.

It seems that attention is required to select and assimilate the relevant sensory inputs to create a coherent, conscious experience. Attention selects the data from the sensory systems to be further processed in the cognitive systems. These cognitive systems utilise the representational contents of the experience. Because a person can perceive only the data from sensory stimuli, which is bound to the perception and attention processes, everything else that is included in the representational content is the result of a complex information processing. All the sensory, motor and cognitive systems must work together and in a synchronised manner. Describing the functionality of this holistic system is even more difficult than explaining the attentional processes according to individual senses. The missing or conflicting sensory data is filled with mental imagery, which is a perception like representation of specific sensory content. Mental imagery does not require actual sensory input, but they can be built on previous knowledge. They are also heavily affected by one's memories and emotions, thus affecting the apperception process (Laarni et al., 2001). Mental imagery can, therefore, explain why different people might perceive the same sensory input differently or experience it as a totally different sensation.

Attention differs from consciousness. Attention refers to ”the selection of some information for further, detailed processing” (Revonsuo, 2010, p. 77). Therefore, amplifying and filtering out different signals from different levels of sensory information processing, whereas, consciousness refers to the subjective experience. Attention selection and consciousness work in correlation with one another by placing the focus of attention on the centre of consciousness (Revonsuo, 2010; Marchetti, 2012), and leaving other objects in reflective consciousness. There the attention can operate on nonconscious levels of the mind's processes (Revonsuo, 2010) – as a low-level or preliminary attention (Marchetti, 2012). Thus, attention influences the way a person consciously experiences the world (Marchetti, 2012). A person is not consciously aware of the non-attended information, nor is able to remember much about it. But, this attenuated information can be partially processed subconsciously (Nolen-Hoeksema et al., 2009). Findings indicating some more vague phenomenal experiences outside attention implicate, that subjective experiences can also happen outside the centre of the attention, in the phenomenal background of consciousness. Here, the peripheral consciousness is covered by spatial attention. It plays a significant role in creating and maintaining a person's awareness of the perceptual space. (Revonsuo, 2010)

Attention and conscious events can be visualised as a functional framework (Baars & Gage, 2010). Data from the sensory inputs is captured by bottom up attention, which then passes through the sensory buffers. The conscious content of an experience is captured by the top-down voluntary attention. “Bottom-up” attentional capture is engaged if there are intense, surprising or significant sensory events that make a person pay attention. The content is then reflected within the person's stored memories, existing knowledge and skills, leading to a certain selected response through action planning, and specific conscious experiences. This framework is illustrated in figure 7.

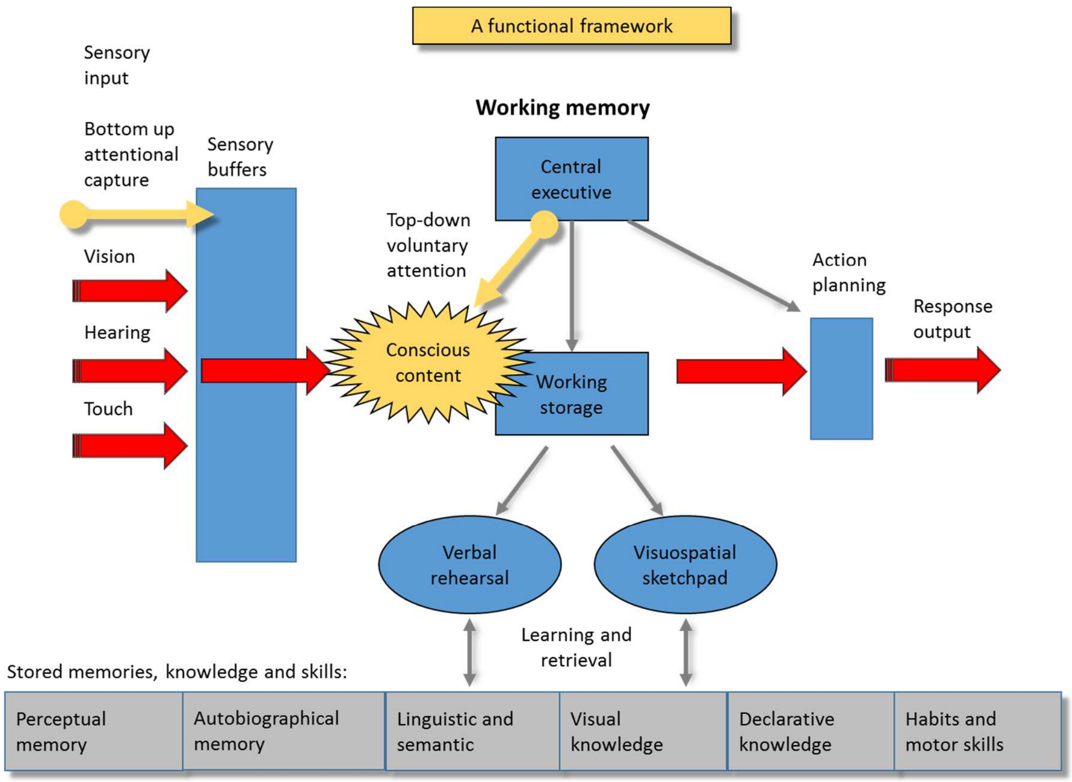

FIGURE 7 A functional framework for attention and conscious events (Baars & Gage, 2010, p. 240).

2.9.5 Agency

Previous subchapters have presented models for perception and attention. They help to explain how a person experiences and interacts with the world. According to these models, a person receives inputs from the environment via the sensory systems, attends to the data that seems to be the most important for the current goal of his or her activity, and then reflects that against his or her memories and previous experiences. Subsequently, an appropriate response is selected in the mind, and this response is manifested as physical behavioural output.

The sense of agency describes the feeling of being in control of one's own body, being the author of one's movements, and that way also controlling events in the external environment. Agency is an important aspect of bodily self-consciousness. It allows a person to separate one's own actions and physical movements from those induced by the environment, and to distinguish one's own movements from those of other agents. A person experiences agency if his or her action execution corresponds with the intended outcome (Kannape & Blanke, 2012; Tsakiris et al., 2006). The sense of agency might be experienced due to an evolutionarily old capacity to learn associations between actions and effects (Haggard, 2005).

The concept of agency inspects the actor and the actions which are guided by mental representations. Through the research of agency it is also possible to try to explain the reasons and contexts where different representations are being used (Saariluoma, 2001). There are several different hypotheses and explanations about the ontological nature, computational models and cognitive processes behind action, agency and motor control. Contemporary theory of the functional architecture of motor cognition sees that there are three key elements involved in motor control. First, central internal representations are the drivers and generators behind voluntary actions. Second, there are internal and external feedback loops structured as inverse models, also known as the controllers, which compute the commands to achieve the desired state. These also exist as forward models, also known as predictive models, which generate a prediction of the consequences of the performance. Thirdly, action is hierarchically organised comprising of three main levels: 1) there is a unit to represent the actions and sub-actions as an abstract concept to reach the overall goal; 2) a level of implementing the steps with the appropriate motor program that fits the goal and the current states of the environment and the agent; and 3), a level where the motor programme parameters are set based according to the input from the sensory information. (Pacherie, 2012)

An intriguing example of a subconscious motor programme is the special mental phenomenon that often occurs when stepping onto a stopped escalator. Research on this "odd sensation when stepping onto a stopped escalator" has indicated that there exists most likely a learned, subconscious, automated motor programme, which is activated involuntarily when a person approaches an escalator. It is an action that cannot be voluntarily prevented, even if the escalator was stopped. The automatic activation of this implicit motor programme causes an anticipatory forward postural adjustment of the body to prepare for stepping onto a normally moving platform. However, because the escalators are not moving, the mismatch with this automatic preparation for the anticipated movement and the lack of actual movement of the escalator steps causes the consciously experienced odd sensation. (Gomi, Sakurada & Fukui, 2014; Fukui, Kimura, Kadota, Shimojo & Gomi, 2009; Bronstein, Bunday & Reynolds, 2009)

Gomi et al. (2014) propose that there is a subconscious association between the visually perceived escalator and the motor programme for riding the escalator. When a person sees an escalator, the involuntary motor programme is triggered automatically. However, the conscious perception indicates that a different motor programme is required. The abnormal situation causes change in the implicitly driven behaviour which differs from the learned and automatically intended motor predictions. This in turn feels less like a self-generated action, causing the odd sensation (Gomi et al. 2014). Research also suggests that a locomotor and gait adaptation to different moving or stopped platforms is relatively independent of higher level cognitive control and from learning models of other types of motor programmes (Reynolds & Bronstein, 2003). A person has a stronger sense of agency in cases when the action is caused directly by him or herself. Also, aftereffects or odd sensations have been found to be stronger when the gait is self-initiated. (Bronstein et al., 2009)

2.10 Measuring passenger comfort on escalators

The following subsections give some explanations for the term comfort, in order to provide a better view of how the experience of comfort should be reflected in this research. Models of what constitutes the feeling of comfort show that it precedes an interactive process between a person and an environment. This involves sensory inputs as well as a person's expectations, emotions and social factors.

The second subsection describes the existing escalator parameters. It is then suggested, that those parameters should not be considered as the only measurements for comfort. Measurements of the physical parameters of certain physical stimuli reflect some of the psychological qualities of the perceived sensations. However, sensory perception is just one part behind the resulting phenomenal experience of comfort. Mental experience is a result of processes in complex systems involving phenomenal aspects. Therefore, it is proposed that psychophysical experiments should be used together with the heterophenomenal and psychological approach when researching the experience of comfort.

The last section explains the model that is created for investigating the experience of comfort as well as other feelings during an escalator ride. The technical ride comfort parameters are interpreted as phenomenal feelings. They are then listed in the escalator ride comfort questionnaire. This section also includes a reflection on the challenges faced when performing an environmental assessment, a process somewhat similar to estimating the ride experience. The following sections conclude how the key concepts and theories can be put together as a holistic framework for research on passenger's experiences of escalator ride comfort.

2.10.1 Definition of comfort

The term comfort has several meanings. In ordinary language, it can mean a relief or cause of a relief from discomfort or something that actively neutralises, or counteracts, the effects of discomfort. Comfort can be seen as the absence of severe discomfort. It can also mean the state of ease and a peaceful contentment, or as whatever makes life easy and pleasurable, thus maximising the individual pleasure. (Kolcaba & Kolcaba, 1991)

Comfort is composed of a complicated structure of multidimensional, personal experiences that can emerge to different degrees of intensity (Kolcaba, 1992). Comfort does not necessarily mean the complete absence of discomfort (Kolcaba & Kolcaba, 1991). Neither does the release of discomfort result automatically in comfort (Vink & Hallbeck, 2012). Negative experiences of comfort can create feelings of discomfort or the feeling of the absence of comfort (Kolcaba, 1992).

Typically comfort can be seen as a pleasant state of mind or a relaxed feeling, and discomfort as the unpleasant state. Typically comfort is felt when one experiences more than one expects (Vink & Hallbeck, 2012). Both comfort and discomfort are subjective, personally experienced feelings or emotions by nature. They are affected by different factors such as the physical, physiological and psychological, as a reaction to one's environment (De Looze, Kuijt-Evers & Van Dieën, 2003; Vink & Hallbeck, 2012). As different factors influence the feelings of comfort and discomfort, they need to be studied as different and complementary entities (De Loonze et al., 2003).

Vink and Hallbeck (2012) have proposed a model for comfort. According to their model, a person is affected by a product's characteristics, by its usage, and by the task for which he or she uses it for. It is all experienced in a certain environment. Their model is illustrated in figure 8. Different phases of how comfort or discomfort emerges are explained as follows:

> The interaction (I) with an environment is caused by the [physical or non-physical] contact between the human and the product and its usage. This can result in internal human body effects (H), such as tactile sensations, body posture change and muscle activation. The perceived effects (P) are influenced by the human body effects, but also by expectations (E). These are interpreted as comfortable (C) or you feel nothing (N) or it can lead to feelings of discomfort (D). There is not one form of comfort or discomfort experience, but it can vary from almost uncomfortable to extremely comfortable and from no discomfort to extremely high discomfort. It could even be that both comfort and discomfort are experienced simultaneously. For instance, you may experience discomfort from your seat but have a feeling of comfort created by a nice flight attendant. The discomfort could result in musculoskeletal complaints (M). There is a circle around E-C as we believe expectations (E) are often linked to comfort (C). If discomfort is too high or the comfort not good enough there is a feedback loop to the person who could do something like shifting in the seat, adapt the product or to change the task/usage. (Vink & Hallbeck, 2012, p. 275.).

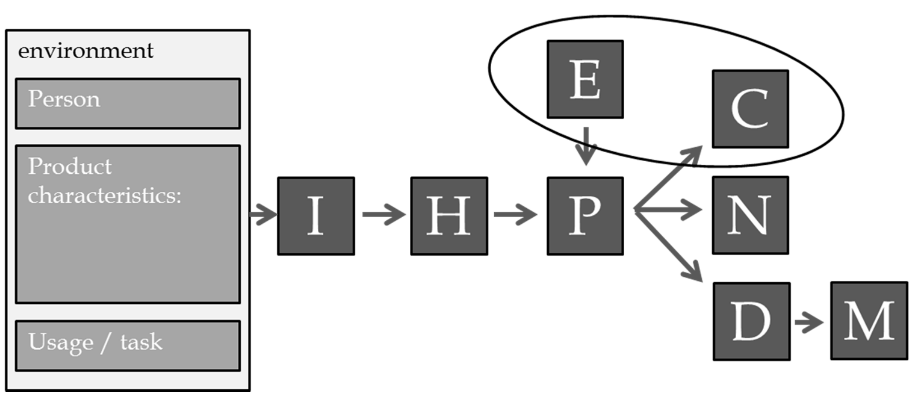

FIGURE 8 A proposed model for comfort (Vink & Hallbeck , 2012, p. 275).

Another theoretical model of comfort has been proposed by De Looze, Kuijt-Evers and Van Dieën (2003). They have used their model to explain how the comfort and discomfort of sitting are felt when a person uses a seat. What is relevant in their model is that they see that there are different factors behind what produces these feelings of comfort and discomfort. Factors of comfort and discomfort exist on three different levels: a context, a product and a human. Discomfort is affected mostly by physical processes such as the physical features of the used product, the physical environment where the task or activity is being executed, and the physical capacity of the person. They see that when a person is exposed to external factors a dose of physical disturbance is produced. This might lead to set of mechanical, biochemical or physiological responses in a person. How these responses are then further processed depends on the individual's physical capacity. In the end it might evoke an experience of discomfort. Their model is illustrated in figure 9.

According to De Looze, Kuijt-Evers and Van Dieën (2003), comfort is assumedly influenced on the context level by both the physical features and psycho-social factors, such as job satisfaction and social support. On the product level, both the physical features and the aesthetics might have their impact on comfort. Individual expectations as well as individual emotions and feelings affect the human level of the comfort model. De Looze, Kuijt-Evers and Van Dieën (2003) also propose that because the link between physical properties and discomfort is more direct, it can be expected that "the relationships of objective measures with discomfort would be stronger than for comfort" (De Looze et al., 2003, p. 988).

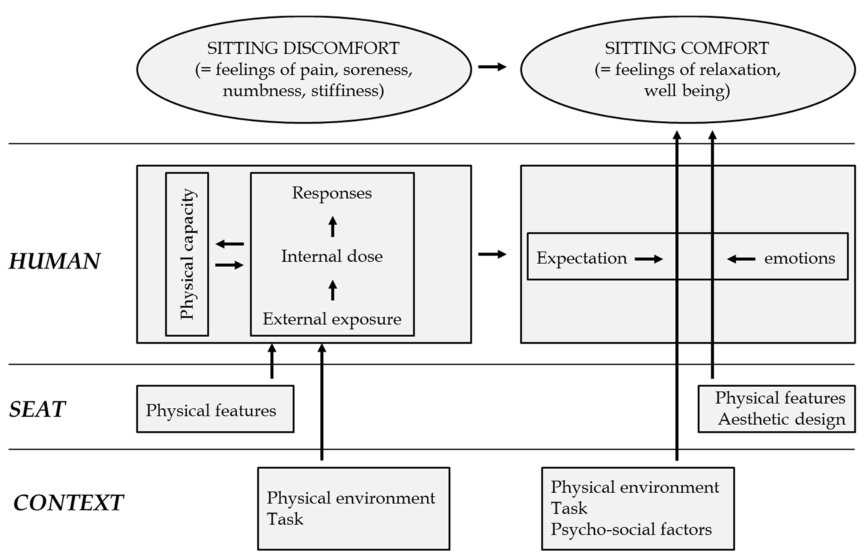

FIGURE 9 Theoretical model of comfort and discomfort and its underlying factors at the human, seat and context level (De Looze et al., 2003, p. 988).

Vink and Hallbeck (2012) suggest that all sensory systems should be considered in the design to create more comfortable and less disruptive products. Also, different body regions and how they are in contact with the product materials need to be thought of. It includes considering also how different product forms follow the human body shapes and individual preferences. Physical load typically creates fatigue and discomfort. So for example, when measuring the lower forces' impact on comfort it is more useful to have long testing periods. In addition, with the physical features, it is important to take into account the soft factors related to personal emotional experiences. Experiments to measure comfort need to take into consideration the context and specific activity that the person is involved in during the experiment. (Vink & Hallbeck, 2012)

2.10.2 Escalator ride comfort parameters

There are eight parameters or metrics which are typically investigated in the escalator ride comfort. Those are: the average and maximum noise at the beginning, middle and end of an escalator; the step vibration; the hand rail vibration; the audio noise tonality; the impulsiveness or modulation of the noise where the maximum noise is compared to the average noise; the balustrade rigidity called "knock and feel"; the tilting or rocking of a step; and the rigidity of the step (Hawkins, 2014).

A few ISO standards are related to these topics. These are such as: ISO 2041 for a vocabulary of vibration and shock; ISO 8041 for measuring instrumentation of human response to vibration; ISO 11201 for acoustics and the noise emitted by machinery and equipment to determine the emission sound pressure levels; and ISO 11205 for acoustics and the engineering methods for determining emission sound pressure levels in situ using sound intensity. ISO 18738-2 is used to define and investigate the vibration and noise signals affecting escalator and moving walks' ride quality. In ISO 18738-2:2012(E) (2012), ride quality is defined as "sound pressure levels at defined locations, and vibration of load carrying unit and handrail relevant to passenger perception, associated with escalator or moving walk operation" (ISO 18738-2:2012(E), 2012, p. 1). It emphasises the importance of how sound pressure levels that correspond with passenger perception are influenced by different sources of noise, and the acoustic characteristics of the location where the unit is installed. Also walls, ceilings and diagonally opposite units can act as sound reflecting surfaces. Thus they may influence the measurement of the sound pressure in the escalator.

The physical parameters that are defined in the ISO-standards for escalator ride comfort reflect some of the factors that presumably impact the experienced feeling of comfort in humans. Different physical parameters can be seen as having their psychological and phenomenal features. By defining the selected physical parameters to appropriate levels, the experience of comfort can additionally be enhanced. It seems that all the defined ride comfort parameters are related to events that can be mostly received as sensory inputs. Emphasis is on senses like hearing, vestibular and proprioceptive senses. Typically sensory perception is researched by using psychophysical methods. Psychophysical research methods are used to provide physical, accurate and precise quantitative measures of different psychological phenomena, that can be used to "establish the limits of perceptual ability, to monitor how these limits change with stimulus conditions, and to test the predictions of perceptual theories" (Mather, 2009, p. 26).

As described in the subchapters for perception and sensation, perception includes multisensory inputs, where the sensory data from one sensory system is computed in the mind's subconscious processes. This is reflected with and influenced by the input from other senses to create a coherent phenomenal sensory perception. It is important to understand how different sensory systems work together and can impact each other in different situations. Especially those that might be faced while riding an escalator, such as while standing, walking or while perceiving tilt or vibrations. Results from the multisensory processing can affect for example, internal motor control, the perceived features of an environment and its objects, and the overall conscious experience of these events. It is also important to understand that sensory perception is just one part underlying the emergence of a conscious experience. There is no doubt that psychophysical methods provide essential evidence and tools for escalator designers for setting and adjusting the physical parameters that affect the sensory perception, thus improving the passenger's feeling of comfort during the escalator ride. However, including heterophenomenological experiment methods to study perceived experiences in the research and design process of a product can provide even better results. They can give deeper understanding regarding the underlying factors behind the experience of comfort. Findings gained by using a heterophenomenological approach can also act as initiators for new psychophysical experiments. According to Mather (2009):

> Phenomenological aspects of perception are often underplayed in psychophysical research, but modern studies would make little sense without assuming the existence of a perceptual experience in the subject that could lead to a phenomenological report. Standard psychophysical techniques typically embed phenomenological experience in an artificial task requiring simple, constrained responses. So phenomenological observation frequently underlies the subject's responses. Indeed, initial interest in a research issue is often triggered by phenomenological observations made by the experimenter. (Mather, 2009, p. 40,).

2.10.3 Measuring the experience of comfort in escalators

A model to describe the common construct of comfort in nursing science has been created by Kolbaca (1992). This proposes that there are four different interrelating concepts in subscales of comfort: physical, psychospiritual, environmental and social. They can be illustrated in a two-dimensional grid. The dimensions are the intensity of met and unmet comfort needs, and the degrees of internal or external comfort needs, which, when met, increase comfort (Kolbaca, 1992).

To research how comfort is experienced in an escalator ride, the same theoretical model demonstrated in Kolbaca's model can be utilised. Instead of physical, psychospiritual, environmental and social, the concepts underlying the escalator ride comfort can be seen as physical, physiological, psycho-cognitive and social. They are construed of the following dimensions:

- physical includes environment, external background, spatial-contextual, physical properties of movement such as angle, speed, force et al.
- physiological includes bodily sensations, sensory systems, multimodality and effects of different senses, physiological sensations from materials in contact with body and forms following human body, physiological functionalities following human body mechanisms, e.g. in gait, and discomfort in physical loading in longer time periods as the physical load increases discomfort,
- psycho-cognitive includes feelings, emotions, mental representations, affordance, apperception, learning, memory, task-oriented context of activity,
- social includes all kind of interaction with other people and related "soft factors" such as personal attention, presence and responsiveness, communication, social context and so on.

These different dimensions can be reflected with the existing ride comfort parameters, and then interpreted in the technical parameters as their phenomenal counterparts. The first items, representing the eight existing ride comfort parameters, are strongly related to the physiological dimension of comfort. The average and maximum noise at the beginning, middle and end of an escalator can be presented as a general factor of loudness. The questions regarding loudness are posed as escalators being quiet versus being loud, escalators being quiet or noisy during the ride, and if there are no disturbing sounds around the escalators versus if the background sounds around the escalators are disturbing. The modulation of sounds is interpreted as how much there are sudden or clearly noticeably appearing sounds. This can be felt as escalator sounds being dim or that there were sharp sounds or hits coming from the escalators, that the sounds in escalators were heard clearly, or that there was a disturbing echo in the escalators.

The vibration of the steps can be put into three questions about the steps moving steadily, steps vibrating disturbingly, and the feeling of vibration in one's feet. The tilting of the steps can be put as the steps being well balanced, the steps being straight, and one's feeling of standing straight. Handrail vibrations are interpreted as the hand rail moving smoothly versus jigged, the handrail vibrating disturbingly, and if the handrail moves at an appropriate speed. Balustrade rigidity is interpreted as the escalator walls feeling steady versus flimsy, walls feeling sturdy, and walls feeling durable versus weak. The rigidity of the step is interpreted as the escalator feeling steady versus flimsy, the escalator movement being steady, and the escalator feeling sturdy. The overall comfort of the escalator ride is interpreted as the escalator ride feeling pleasurable, the ride feeling comfortable, and if riding the escalator is felt as easy or difficult.

The rest of the measured items are more related to physical, psycho-cognitive and social dimensions of comfort, even though they naturally involve the physiological dimension. Seeing one's environment and if it is bright enough is important in navigating through the environment. The surrounding space around the escalators might impact the overall experience of a comfortable environment. Staying in balance is vital when standing on a moving platform. How adapting to one's gait when entering or exiting the escalators might affect one's experience of comfortable moving. It might be, that the movement speed of the escalators itself is felt inappropriate. It might be thus affecting how comfortable the escalator ride is felt when a person experiences its speed and relates it to the time spent on the escalator. The perception of escalator height or angle might differ and affect the comfort.

A less investigated, but sometimes noticed, aspect is the smell of the environment. How roomy or tight the space is felt while being on an escalator can affect the feeling of comfort. The feeling of safety is essential for a person to be able to act and gain positive feelings. Being with other people is related to the social dimension and subconscious interaction with other passengers. Knowing where to go next is related to the navigation, the orientation and the ability to successfully select one's direction. However, in the research setting it was not possible to measure the last item, because in the test the researcher guided the passenger to the selected location.

Evaluating a person's feelings and experiences of the escalator ride has similarities to the situation of when a person is assessing their environment. When asking for a person's evaluation of his or her feelings and notions about the surrounding environment, several things have been found to influence the assessment. Environmental assessments are influenced by the settings' physical characteristics. The most important ones are: the complexity and the variety of different elements of a scene; the coherence of the underlying structure of those elements; the naturalness and the amount of natural elements present; the mystery which means the visibility of areas and spaces; and whether or not the assessed spaces are enclosed, or small and well-defined. These all have been found to have a positive impact on environmental assessments. However, simulation of the environment has limitations compared to real life situations. There are also some methodological problems when using simulations as a research method. (Evans & Gärling, 1991)

It has been found that people have hidden assumptions, which influence how they assess their environment. Hidden assumptions can be, for example, that if something is possible to be counted with a numeric rating system it is likely to be important. There is a risk that these kinds of assumptions are taken for granted without appropriate examination of the other possible domains of underlying categories. This approach might then exclude some other more important psychological dimensions of the investigations (Kaplan, 1991). Also, according to a research review by Evans and Gärling (1991), there are dimensions of certain emotional or psychological factors that affect the assessment. These dimensions are: pleasure such as like and dislike, or approach and avoid; arousal such as boring-interesting; and potency such as spacious-cramped.

Environmental assessments should investigate the psychological and phenomenal effects of the environment. However, they easily fall into investigations of the physical features of the environment, without assessing what is actually important for human thinking and functioning. Recognising and describing the interactions between a human and an environment is a challenging task, and several theories have been proposed. In all cases, frameworks to describe the interactions between a human and his or her environment must ”provide understanding of how different environmental patterns have their diverse effects on human experience, effectiveness, and well-being” (Kaplan, 1991, p. 31). It is quite clear, that the same guidelines apply when a person estimates his or her feelings and experiences of other similar felt properties in the environment, such as features of technology and devices. When investigating the underlying factors behind a person’s experience of an escalator ride, one should consider the underlying mental properties, such as a person’s goals and targets, skills, experience and memories. People have beliefs, assumptions and emotions. The experience is affected by the sensory and cognitive capabilities and properties. Also the social and environmental context should be considered. Researching and evaluating comfort thus requires including physiological, psychological and phenomenological factors and how they are represented in the passenger’s mind.

3 METHODS

Research was done to investigate people's experiences while travelling on an escalator. The emphasis was to measure the experience related to the ride comfort parameters' phenomenal features. Research included both quantitative measurements and a qualitative analysis. Quantitative data was collected by using a questionnaire, where the proposed features for experience of passenger comfort were listed. Some qualitative data was collected to support the quantitative data.

The existing ride comfort parameters are used to define and measure the physical properties of certain physical events, rather than measuring a person's mental experiences or psychological effects of those properties. Hence, the proposed parameters were first converted from the terms of their physical features into the terms of their experienced psychological features. These features were listed as adjective pairs on a semantic differential scale, which scaled from the most positive experience to the most negative experience of that feature.

Each feature was asked with three different adjective pairs, so that those three variables could be summed up to create a common factor representing that feature. Variables related to an experience of comfort formed their own dependent variable. Different factors were then correlated with the comfort factor in the analysis done with the SPSS statistics programme.

The research plan included the following phases: to create a framework based on the literature and the ride comfort parameters; to conduct a survey on-site and a spatial-contextual analysis; to run the analysis using a factor analysis in SPSS; to estimate if any factors could be found and which factors would have a statistical significance predicting the factor for experience of comfort.

3.1 Research question

This research investigated the factors that affect the passenger's experience of escalator ride comfort. The research focused on the following six research questions:

- First, and the most important question, is whether passenger ride comfort in escalators can be researched with the methods presented in this thesis.
- Second question is what kinds of factors can be found which might underlie the experienced feeling of comfort of escalators.
- Third question is whether these factors, and which of them, are statistically reliable when measuring the ride comfort of escalators.
- Fourth question is whether there is a statistically significant relationship with different factors and the experienced comfort factor.
- Fifth question is what kind of relationship there is between the experience of comfort and the different factors.
- Sixth question is whether the factors can be put in a prioritized list of order depending how strongly they predict the experience of comfort in relation with each other.

These questions were researched by a quantitative analysis using a survey questionnaire. The questions regarding different experiences were asked in a scale from most positive to most negative to find out if the proposed features would appear, and to which levels during the tested escalator ride. In addition, the research was supported with qualitative findings from a spatial-contextual analysis. The research locations were evaluated based on their surroundings and the escalator properties.

3.2 Research design

The research data was collected with a survey. The survey data was collected in five different shopping malls located in Southern Finland in Helsinki, Hyvinkää, Hämeenlinna and Espoo. Each location represents a typical Finnish mid- and large size shopping mall. At all selected sites the escalators were considerably new or lately renewed and well working, so that the escalators' technical performance was at a comparably similar level at each location. Tests were run while the escalators were operating at normal usage. On-site research and the surveys were done during June 2015, during late mornings between ten and twelve o'clock. This was so that the escalators were not too busily utilised, and so that participants would have better possibility to concentrate on how they experienced the escalator ride.

The survey was run so that the first participant took an escalator ride either up or down depending on the participant's location and direction when he or she was starting the ride. Immediately after the ride the participant filled in a semi-structured questionnaire. The questionnaire measured the participant's experience of comfort and experienced feelings related to the ride comfort parameters, as well as other possibly emerging experiences, which might predict the experience in comfort in normally operating escalator ride. All participants filled in the same questionnaire. The direction of the ride, whether the escalator was going up or down, was saved in the data. Empirical data was accompanied with a spatial-contextual analysis based on the open question in the questionnaire and researcher's own observations.

3.3 Procedure

A researcher stood close to a selected escalator which seemed to be in active use. To select a participant the researcher approached any person who walked close to the escalators. The researcher asked if the person would like to participate in a user experience test. If a person accepted, a short briefing of the test set up was given. In the briefing the researcher explained that the test is to research the passenger ride comfort in escalators for a cognitive science thesis research, done for University of Jyväskylä.

The participant was instructed to first to ride the escalator and then to fill in the questionnaire. The participant was told that she or he can stop the test at any time. The participant was asked if he or she had any further questions. Also, a note was made that the test is to measure the escalator and not the individual, and that participant's individual personal data is not collected.

Firstly, the participant would ride the escalator. Before entering the escalator, the participant was asked to "act normally" as if it was any typical escalator ride. The researcher followed the participant on the escalators at a few steps distance, so that the presence of the researcher would cause minimal disturbance to the participant's ride experience. Immediately after the ride the participant filled in the emotional questionnaire measuring the experienced adjective pairs related to ride comfort. After filling in the questionnaire the participant was thanked for participation and the test ended.

3.4 Participants

Participants were selected randomly from the people who were walking by or towards the escalators. People with physical limitations and underage people were excluded from tests. Only those people who were able to stand on escalators without any support or crutches, and who seemed to be at least teenagers or older were approached. The questionnaire was in the Finnish language. All participants were visiting or working in the researched shopping malls.

The participants' mean age was 43,03 years (SD = 16,3, between 16-78 years, N = 80). Distribution of means for the participants' age was estimated being approximately normally distributed (figure 10).

56 participants were female and 24 were male (N = 80). In total 80 people participated in the tests (N = 80). The amount of participants was approximately equally distributed among different research sites.

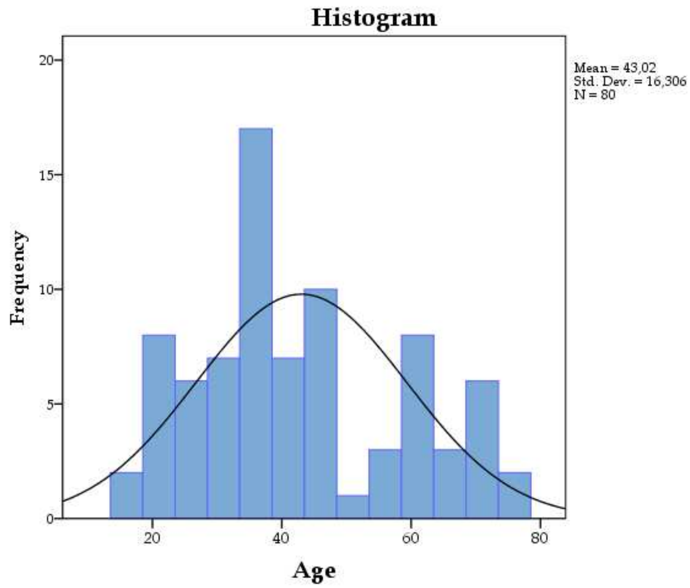

FIGURE 10 Participants' ages.

3.5 Materials and tools

The empirical data was collected with a questionnaire that was asked from every participant in each of the researched sites. The questionnaire was in the Finnish language. Operationalisation of the variables was done by first defining what those different escalator ride comfort parameters would be as subjective phenomenal experiences. The questionnaire started with questions about a person's background information (age, sex). After those, there was a question asking how the participant would describe the escalator ride experience in his or her own words. The passenger's experience of the escalator ride was measured using 40 adjective pairs in a semantic differential scale from one to seven, where one was for the most positive experience and seven for the most negative experience. Each studied parameter was put in three different adjective pairs to create the factor reliably for that parameter. The passenger comfort questionnaire is presented in the Appendix 1.

Qualitative analysis was done by having a spatial-contextual analysis made at each of the tested locations. The spatial-contextual analysis reviewed qualitative and physical aspects of each location, such as space, lighting, general levels of sound and the amount of people, based on the researcher's own estimations.

3.5.1 Survey questionnaire

The received questionnaire answers were analysed using IBM SPSS Statistics (Version 20). The values were recoded to change the scale from 1 being the most positive level of experience to 1 being the most negative level of experience, and from 7 being the most negative to 7 being the most positive level. Value 1 was recoded to 7, 2 to 6, and so on. Some X-data points in the data were missing. Listwise deletion was used in the analyses. Data values where X-data points were missing and new data values where missing values were replaced with means were analysed and no noticeable differences were found. "Research Methods and Statistics in Psychology" from Hugh Coolican (2009) was used as a reference and for guidelines to analyse and report the results according to the APA (American Psychological Association) standards.

The statistical analysis was first done to the complete data, where the effect of the direction was not considered, but all data was analysed as one. Additional analyses were done to the split data from the escalator ride up and the data from the escalator ride down. However, due to the small sample size (*N*=40 in direction up, *N*=40 in direction down) the statistical analysis for the different escalator ride directions did not produce comparable results with the analysis done to the complete data including results from both directions (*N*=80). One rule of thumb for the sample size in a multiple regression analysis suggests, that the minimum number of cases (*N*) should be the number of the predictor variables plus 50 (Coolican, 2009). According to Bartlett, Kotrlik and Higgins (2001), when using multiple regression analysis, the optimal sample size for a conservative ratio of observations is ten observations for each independent variable. In this research, where there were eight presumed factors (each built of three variables). This means that the smallest suggested sample size would then have been 58-80 cases per direction, depending on the suggested observation ratio guidelines, in order to be able to analyse different directions reliably. An additional two factors were identified from the rest of the variables in the exploratory factor analysis, which means that if all these 10 factors were to be researched with multiple regression in the future, the sample size would need to be at least 60-100 per direction. Bartlett, Kotrlik and Higgins (2001) also state that when using factor analysis in a study there should be no less than 100 observations. They state that "assuming an alpha level of .05, a factor would have to load at a level of .75 or higher to be significant in a sample size of 50" (Bartlett et al., 2001, p. 49). In this research the factor loadings with Cronbach's alpha (*a*) over .7 are considered reliable.

A covariance structure was reviewed to find anomalies in the covariances between the variables. An Exploratory Factor Analysis was done to the ride comfort variables to measure the relative weight of each variable inside the factor. Reliability of the factor was checked from Factor Score Covariance Matrix (with accepted values ranging between .7 - .99) and with Cronbach's alpha. Alpha value is used to explain the significance level of the pre-chosen probability of finding the observed results when the null hypothesis is true. The *p*-value indicates a probability which is calculated for the data results. A null hypothesis is typically used in the case when, for example, there is no difference between the observed differences of groups A and B. (Buchan, 2016.) As Hinton (2014) explains, significance level means

> the risk (probability) of erroneously claiming a relationship between an independent and dependent variable when there is not one. Statistical tests are undertaken so that this probability is chosen to be small, usually set at 0.05 indicating that this will occur no more than 5 times in 100. This sets the probability of making a Type I error; that we reject the null hypothesis incorrectly. (Hinton, 2014, pp. 348-349.).

Also, typically in statistical testing the statistically significant *p*-value is referred to as $p < 0.05$ and statistically highly significant as $p < 0.001$. This means that there is less than one in a thousand chance of the null hypothesis being true (Buchan, 2016).

According to Hinton (2014), "a reliable test is one that will produce the same result when repeated (in the same circumstances)" (Hinton, 2014, p. 384). To test the reliability of the questionnaire, the relationships between each three variables for each ride comfort factor were investigated with a Pearson's product-moment correlation coefficient. From all the analysed variable relationships there were anomalies found between variables "Dim sounds", "Clear sounds" and "Echo", which intended to measure the factor for the experience of pitch. There was a statistically significant covariance for "Echo" and "Dim sounds", r (70) = .359, $p \leq .001$ (two-tailed), $N = 80$. "Echo", and "Clear sounds" had a statistically moderate covariance, r (50) =.326, $p \leq .01$ (.003) (two-tailed), $N = 80$. "Dim sounds" and "Clear sounds" did not have statistically significant covariance, $r = .124$, $p > .10$ (.273) (two-tailed), $N = 80$. A Cronbach's a for reliability analysis was not statistically significant, $p > .05$ ($p = .508$). The acceptable value for Cronbach's a is .7-.99, where the closer the value is to one, the more reliably there is a covariance between the three variables. These results indicate that these three questions might be set wrong or they might not be measuring the same concept or common factor.

An Exploratory Factor analysis was done to test the construct validity for ride comfort factors. Questionnaire answers for the ride comfort variables were analysed with an Exploratory Factor analysis (Maximum Likelihood Factoring) using a Regression method. Because the data was relatively normally distributed, Maximum Likelihood was used. According to Fabrigar, Wegener, MacCallum and Strahan (1999)

> Maximum Likelihood allows for the computation of a wide range of indexes of the goodness of fit of the model [and] permits statistical significance testing of factor loadings and correlations among factors and the computation of confidence intervals. (Fabrigar et al., 1999, p. 277.).

The used rotation method was Promax with Kaiser Normalization. According to Costello and Osborne (2005), due to the rotation method Promax, the results of the factor analysis create a more complex factory structure, yet allow factors to correlate. When using oblique rotation such as Promax "the pattern matrix is examined for factor/item loadings and the factor correlation matrix reveals any correlation between the factors" (Costello & Osborne, 2005, p.3).

The rest of the variables were analysed with an Exploratory Factor Analysis (Principal Axis Factoring) to find other emerging factors which would account for the experience of comfort. The used rotation method was Promax with Kaiser Normalization. The results of the factor analysis were used to construct factors, which however were allowed to correlate with each other. Factors were constructed from the items that had a loading of over 0.30, but only if the Cronbach's alpha was over 0.50. Both Pattern matrix and Structure matrix were reviewed and if it seemed that variables' content appeared to be part of the same factor, they were included in the factor. Furthermore, only factors with Eigenvalues over 1.0 were used. Overall, two factors were constructed. These factors were "the visibility" (VisibilityExFact) and "the entry and exit speed & balance & safety" (BalSpeedSafeExFact).

An Exploratory Factor Analysis was done to test the construct validity for the new factor items. Factors were analysed with an Exploratory Factor Analysis (Maximum Likelihood Factoring) using a Regression method. The used rotation method was Promax. Factor loadings for items in each identified factors are listed in table 1.

TABLE 1

Factor loadings for items in Each Identified Factor.

Factor number and short label / Item (Factor long label)	Factor loading
Factor 1: VolumeExFact (Experience of volume) (*a* = .789)	-
Quiet steps	0,07
Quiet ride	0,92
Surrounding sounds	0,03
Factor 2: PitchExFact (Experience of pitch) (*a* = .508)	-
Dim sounds	0,03
Clear sounds	0,02
Echo	0,95
Factor 3: TonalityExFact (Experience of tonality) (*a* = .711)	-
Low sounds	0,19
Squeeky sounds	0,77
Low banging sounds	0,06
Factor 4: StepVibExFact (Experience of step vibrations) (*a* = .863)	-
Steady step movement	0,12
Step vibrations	0,32
Feet vibrations	0,57
Factor 5: StepTiltExFact (Experience of step tilting) (*a* = .879)	-
Step balance	0,02
Step tilting	0,97
Standing tilting	0,01

(to be continued)

Table 1 (continued)

Factor 6: HandSmoothExFact (Experience of handrail smoothness) (*a* = .911)	-
Handrail smoothness	0,99
Handrail vibrations	0,00
Handrail speed	0,00
Factor 7: SturdyWallsExFact (Experience of balustrade sturdiness) (*a* = .963)	-
Steady walls	0,02
Sturdy walls	0,95
Durable walls	0,03
Factor 8: SturdyStepExFact (Experience of step sturdiness) (*a* = .842)	-
Steady steps	0,22
Steady movement	0,16
Sturdy steps	0,65
Factor 9: BalSpeedSafeExFact (Experience of balance, enter and exit speed and safety) (*a* = .935)	-
Balance	0,05
Entering speed	0,56
Exiting speed	0,36
Safety	0,05
Factor 10: VisibilityExFact (Experience of visibility) (*a* = .850)	-
Seeing during the ride	0,64
Lighting	0,22
Surrounding space	0,18
Factor 11: ComfortExFact (Experience of comfort) (*a* = .881)	-
Comfortable	0,16
Nice	0,80
Easy	0,05

Statistical analysis on whether the dependent factor for the experience of comfort can be predicted from the combination of independent variables was done using a Multiple Regression Analysis. A standard multiple regression was performed between the experience of comfort as the dependent variable and the experiences of volume, tonality, pitch, step vibrations, step tilt, handrail smoothness, escalator sturdiness, step sturdiness, visibility, as well as entry and exit, speed, balance and safety as independent variables. A stepwise regression was used as the regression method.

The relationship between the age and the experience of step sturdiness, step vibrations, handrail smoothness or comfort was investigated with Pearson's product-moment correlation coefficient. There were no violations of normality or heteroscedasticity.

The differences between the female and male participants and the experience of step sturdiness, step vibrations, handrail smoothness and comfort were investigated with Independent samples T-test.

The differences between the location and the experiences of step sturdiness, step vibrations, handrail smoothness, and comfort were investigated with one-way unrelated ANOVA analysis.

3.5.2 Open-ended questions and spatial-contextual analysis

The open-ended questions at the beginning of the questionnaire were analysed to find the most common comments regarding the participants' overall experience of the tested escalator ride. Comments were analysed for each location to see if there were some typical "key words" or themes on how the escalator ride was described at that location.

Some overall features of the surroundings around and at the escalators at each of the tested locations were observed by the researcher. There were no specific predefined themes or categorisations for the observations, although a list of issues to concentrate on loosely followed the ride comfort factors, and were fashioned as a check list. The check list included issues related to lighting and visual aspects of the environment as well as the escalator, noises and sounds, the amount of people and how people were using the escalators, the physical properties of the escalators, the location and activities around and at the escalators. The full check list is in Appendix 2 "A check list for observations".

4 RESULTS

The results from the statistical analysis presented in the next subchapters are for the data as a whole, where the ride directions are not analysed separately. In addition, there is a short review of the analysis for the different ride directions. Results of the observations and open-ended questions from the questionnaire are presented at the end of this chapter.

4.1 Descriptives

Table 2 presents the questionnaire items that contributed to the 10 different factors identified in the factor analysis. The three factors for the experience of step sturdiness, the experience of step vibrations, and the experience of handrail smoothness explained 50,9% of the total variance of the items. Note that the scale for factors presents the weighted value of the factor loadings and is not equal to the scale used for individual variables, where values are on a scale of one to seven.

TABLE 2

Reliabilities of the sum variables for measuring parameters, mean (*M*), standard deviation (*SD*) and Factor Score Covariance for Each Identified Factor.

Factor number and short label / Item (Factor long label) (Cronbach's alpha)	*M*	*SD*	Factor Score Covariance
Factor 1: VolumeExFact (Experience of volume) (*a* = .789)	-	-	0,96
Quiet steps	3,18	1,51	
Quiet ride	3,570	1,56	
Surrounding sounds	2,99	1,41	
Factor 2: PitchExFact (Experience of pitch) (*a* = .508)	-	-	0,94
Dim sounds	2,684	1,36	
Clear sounds	3,013	1,47	
Echo	1,99	1,16	
Factor 3: TonalityExFact (Experience of tonality) (*a* = .711)	-	-	0,88
Low sounds	2,66	1,41	
Squeeky sounds	2,25	1,75	
Low banging sounds	2,07	1,27	
Factor 4: StepVibExFact (Experience of step vibrations) (*a* = .863)	-	-	0,91
Steady step movement	1,97	1,34	
Step vibrations	1,83	1,12	
Feet vibrations	1,93	1,19	

(to be continued)

Table 2 (continued)

Factor 5: StepTiltExFact (Experience of step tilting) (*a* = .879)	-	-	0,99
Step balance	1,83	1,27	
Step tilting	1,63	1,13	
Standing tilting	1,69	1,10	
Factor 6: HandSmoothExFact (Experience of handrail smoothness) (*a* = .911)	-	-	0,99
Handrail smoothness	6,077	1,32	
Handrail vibrations	6,090	1,05	
Handrail speed	6,103	1,38	
Factor 7: SturdyWallsExFact (Experience of balustrade sturdiness) (*a* = .963)	-	-	0,97
Steady walls	6,253	1,17	
Sturdy walls	6,190	1,14	
Durable walls	6,114	1,21	
Factor 8: SturdyStepExFact (Experience of step sturdiness) (*a* = .842)	-	-	0,89
Steady steps	6,139	1,20	
Steady movement	6,038	1,07	
Sturdy steps	6,38	0,96	
Factor 9: BalSpeedSafeExFact (Experience of balance, enter and exit speed and safety) (*a* = .935)	-	-	0,97
Balance	6,152	1,08	
Entering speed	6,367	1,17	
Exiting speed	6,346	1,16	
Safety	6,139	1,06	
Factor 10: VisibilityExFact (Experience of visibility) (*a* = .850)	-	-	0,89
Seeing during the ride	6,025	1,21	
Lighting	5,936	1,33	
Surrounding space	5,722	1,12	
Factor 11: ComfortExFact (Experience of comfort) (*a* = .881)	-	-	0,96
Comfortable	5,823	1,26	
Nice	5,975	1,03	
Easy	6,354	1,04	

4.2 Factors predicting experience of comfort on escalators

Three independent factors contributed significantly, or moderately significantly, to the prediction of the experience of comfort: the experience of step vibrations (StepVibExFact) contributed significantly (*beta* = 0.329, $p < .01$), the experience of step sturdiness (SturdyStepExFact) contributed significantly (*beta* = 0.292, $p = .01$) and the experience of handrail smoothness, which contributed moderately significantly (HandSmoothExFact) (*beta* = 0.222, $p < .05$). The coefficients table with all standardised coefficients (beta values), and the excluded variables are in Appendix 3. In multiple regression analysis the *Beta*-value tells about the correlation between the independent and dependent variable, when the other predictors are taken into account (Howitt & Cramer, 2011). As Howitt and Cramer (2011) explain, by using the stepwise multiple regression it is possible to calculate and organise the best predictors of the dependent variable. This is because the calculation method statistically takes into account the influence of the other predictors. In stepwise regression "the order of being chosen determines the relative size of the association between predictor and criterion variable" (Howitt and Cramer, 2011, p. 319). The comparison between predictors is presented in *Beta* coefficient value, which has a maximum value of ± 0 (Howitt and Cramer, 2011).

According to Coolican (2009), in multiple regression procedure it is the R^2 value that "tells the best combination of predictors which account for variance" (Coolican, 2009, p. 466), because it gives "the proportion of variance in the criterion variable that has been accounted for by the predictors taken together" (Coolican, 2009, p. 466). A Multiple Regression Analysis produced values for R = .713, R^2 = .509 and R^2 adjusted = .489. The regression model summary table is in Appendix 3. R for regression was significantly different from zero, F = 26.216, $p < .001$. Regression model explained about 51% of the variance in the dependent variable.

The predictors did not correlate with each other in a way that multicollinearity would be problematic. The variance inflation factors (VIFs) stayed below 2 (see Appendix 3).

4.3 Effects of age

There was not a statistically significant correlation between the scores for age and the experience of step sturdiness r = .035, p > .10 (p = .755); for age and the experience of step vibrations r = -.141, p > .10 (p = .212); or for age and the experience of handrail smoothness r = .145 , p > .10 (p = .200). The scores for age and the experience of comfort did not correlate significantly, r = .142 , p > .10 (p = .208).

In the research sample, there was no statistically significant difference between the participants' age correlation coefficient for the experiences of step sturdiness, step vibrations, handrail smoothness or comfort.

4.4 Effects of gender

For the experience of step sturdiness the female participants produced M = -.086, SD = .949 and the male participants produced M = .201, SD = .921 (figure 11). The difference between means was not significant, t (78) = -1.254, p > .10 (p = .214), two-tailed.

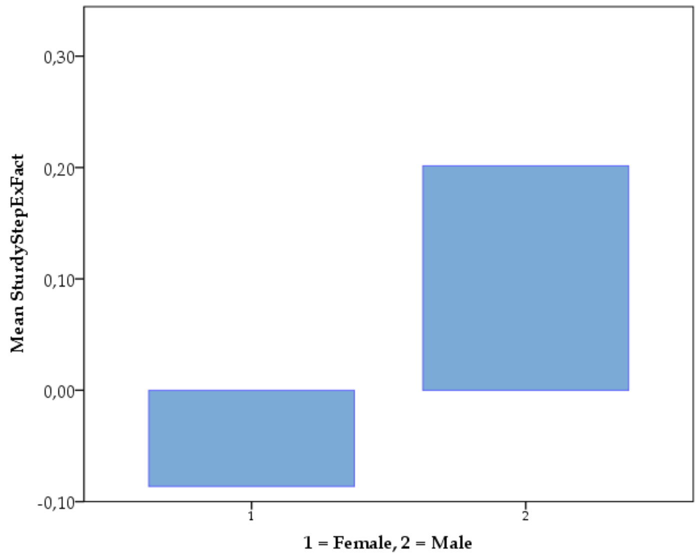

FIGURE 11 Histogram of means for the experience of step sturdiness between female (1) and male (2).

For the experience of step vibrations the female participants produced M = -0.131, SD = 1.027 and the male participants M = .306, SD = .681 (figure 12). The difference between means was not significant, t (78) = -1.913, p > .05 (p = .059), two-tailed.

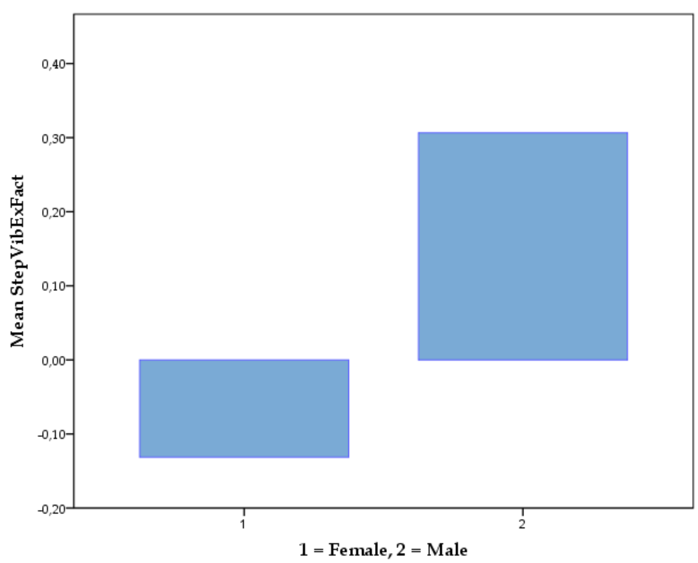

FIGURE 12 Histogram of means for the experience of step vibrations between female (1) and male (2).

For the experience of handrail smoothness the female participants produced *M* = -.097, *SD* = 1.026 and the male participants *M* = .226, *SD* = .680 (figure 13). The difference between means was not significant, *t* (78) = -1.33, $p > .10$ ($p = .187$), two-tailed.

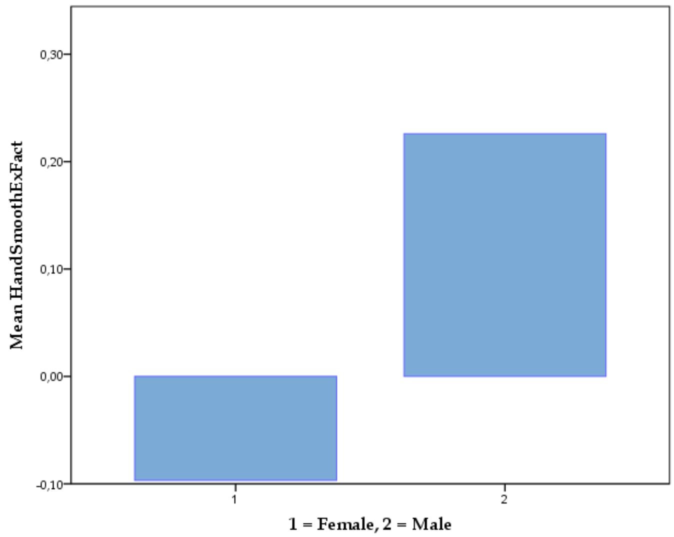

FIGURE 13 Histogram of means for the experience of handrail smoothness between female (1) and male (2).

For the experience of comfort the female participants produced *M* = -.068, *SD* = .978 and the male participants *M* = .158, *SD* = .987 (figure 14). The difference between means was not significant, *t* (78) = -.945, $p > .10$ ($p = .348$), two-tailed.

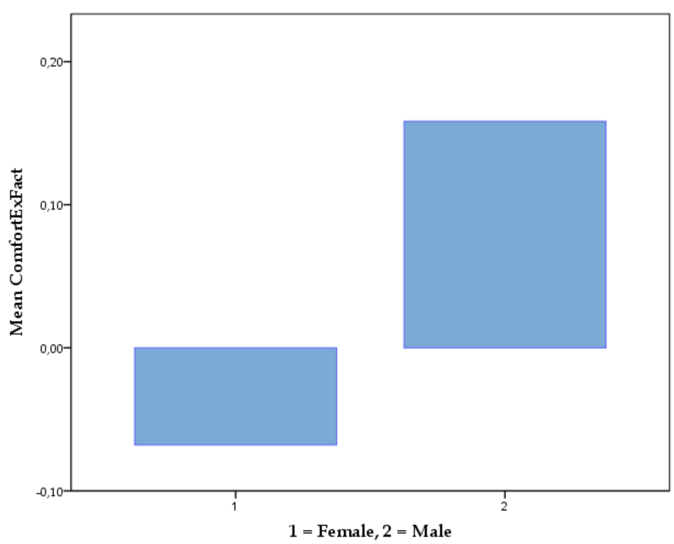

FIGURE 14 Histogram of means for the experience of comfort between female (1) and male (2).

In the research population there was no statistically significant difference between females' and males' mean for the experiences of step sturdiness, step vibrations, handrail smoothness or comfort.

4.5 Effects of location

There was not a statistically significant difference between locations and the experience of step sturdiness as determined by one-way ANOVA (*F* (4) = 1.285, $p > .10$ ($p = .283$). Location means and standard deviations for the experience of step sturdiness were at location 1: *M* = -.365, *SD* = 1.312 (*N* = 20), at location 2: *M* = -.062, *SD* = 1.008 (*N* = 16), in location 3: *M* = .214, *SD* = .827 (*N* = 16), in location 4: *M* = .261, *SD* = .495 (*N* = 16) and at location 5: *M* = .086, *SD* = .593 (*N* = 14) (figure 15).

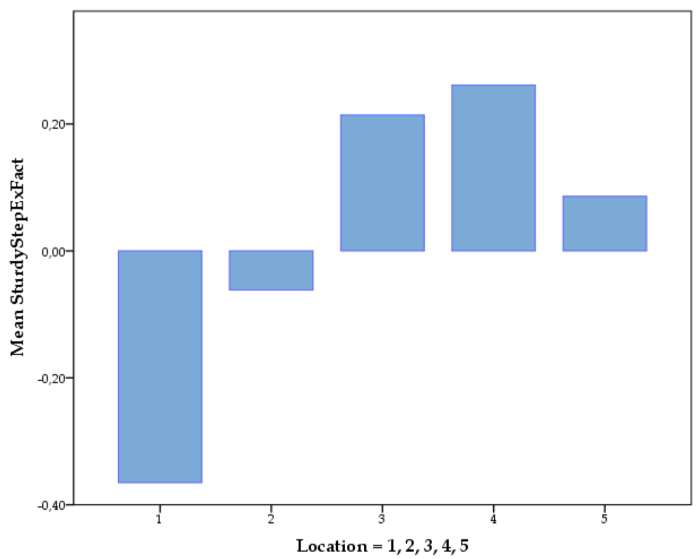

FIGURE 15 Histogram of means for the experience of step sturdiness between locations.

There was not a statistically significant difference between locations and the experience of step vibrations as determined by one-way ANOVA (*F* (4) = 1.967, $p > .10$ ($p = .108$)). Location means and standard deviations for experience of step vibrations were in location 1: *M* = .040, *SD* = .1.009 (*N* = 20), in location 2: *M* = -.175, *SD* = .792 (*N* = 16), in location 3: *M* = -.321, *SD* = .590 (*N* = 16), in location 4: *M* = .572, *SD* = 1.373 (*N* = 16) and in location 5: *M* = -.062, *SD* = .709 (*N* = 14) (figure 16).

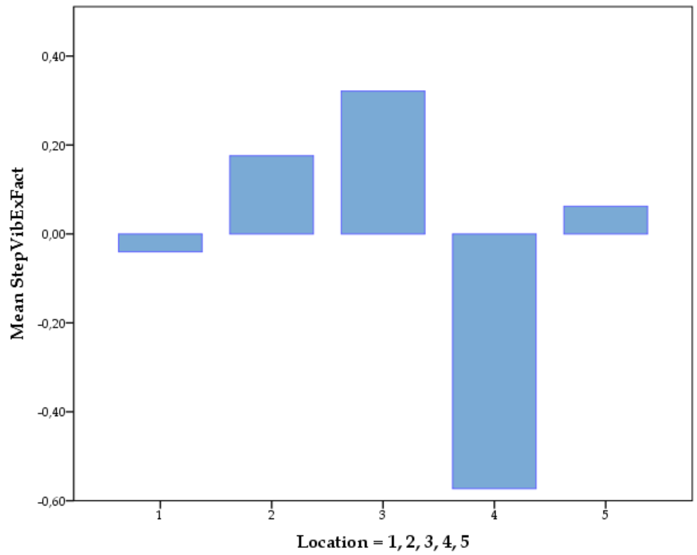

FIGURE 16 Histogram of means for the experience of step vibrations between locations.

There was not a statistically significant difference between locations and the experience of handrail smoothness as determined by one-way ANOVA (F (4) = .568, p > .10 (p = .686)). Location means and standard deviations for experience of handrail smoothness were at location 1: M = -.207, SD = 1.115 (N = 20), in location 2: M = -.058, SD = .997 (N = 16), at location 3: M = .273, SD = .675 (N = 16), in location 4: M = -.058, SD = 1.225 (N = 16) and at location 5: M = .108, SD = .947 (N = 14) (figure 17).

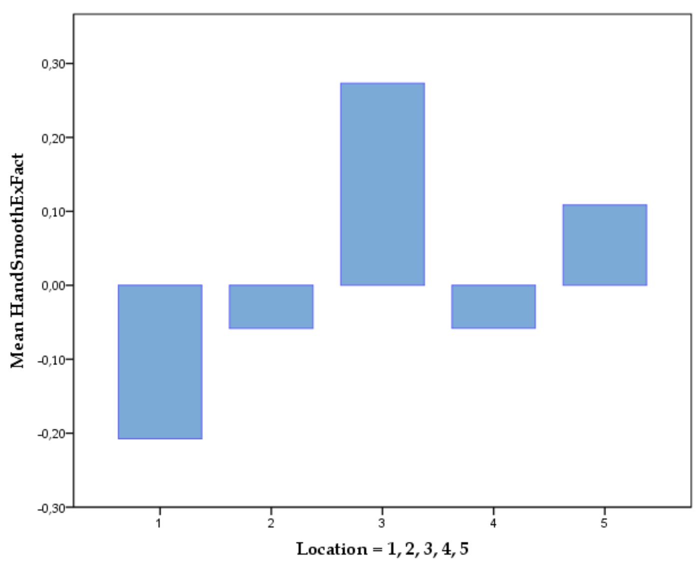

FIGURE 17 Histogram of means for the experience of handrail smoothness between locations.

There was not a statistically significant difference between locations and the experience of comfort as determined by one-way ANOVA (F (4) = 1.974, p > .10 (p = .107)). Location means and standard deviations for experience of comfort were at location 1: M = -.097, SD = 1.207 (N = 20), at location 2: M = .197, SD = .844 (N = 16), at location 3: M = .181, SD = .876 (N = 16), at location 4: M = .581, SD = .791 (N = 16) and at location 5: M = .288, SD = .905 (N = 14) (figure 18).

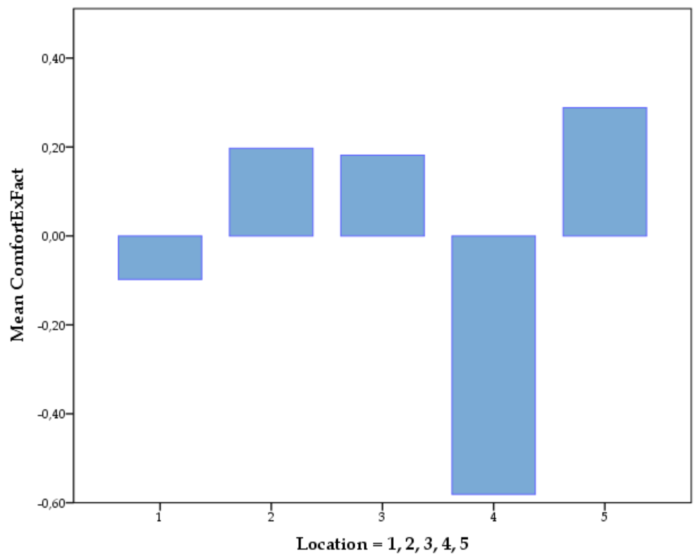

FIGURE 18 Histogram of means for the experience of comfort between locations.

In the research population there was not a statistically significant difference between locations' means for the experiences of step sturdiness, step vibrations, handrail smoothness or comfort.

4.6 Results for directions up and down

As stated at the beginning of this chapter, the sample size was too small to conduct a valid analysis for the data of different ride directions up and down. However, the data was also analysed with a similar analysis procedure so that the data for directions up and direction down were analysed separately. This was done in order to see, if there were apparent deviations with the results between different directions up, down and between the results from the complete data, where the ride directions were not treated as separate data.

4.6.1 Results for ride direction up

A multiple regression analysis was done for the data where only the direction up was included in the analysis. It was found that the statistically significant factors predicting the experience of comfort while riding up were the experience of step sturdiness (SturdyStepExFact) which contributed significantly (*beta* = .422, $p < .01$), the experience of tonality (TonalityExFact) which contributed significantly (*beta* = .386, $p < .01$), and the experience of handrail smoothness (HandSmoothExFact) which contributed moderately significantly (*beta* = .281, $p < .05$).

A Multiple Regression Analysis produced values for $R = .804$, $R^2 = .646$ and R^2 *adjusted* = .616. R for regression was significantly different from zero, $F = 21.889$, $p < .001$. The Regression model explained about 65 % of the variants. However, as stated before, because of the insufficient sample size for having valid results of multiple regression analysis, these results only indicate that there might be differences with which factors predict the experience of comfort when going up compared to the escalator ride in general.

4.6.2 Results for ride direction down

A multiple regression analysis was done for the data where only the direction down was included in the analysis. It was found that statistically a significant factor for predicting comfort while riding down was the experience of step tilt (StepTiltExFact) which contributed significantly (*beta* = .631, $p < .001$).

A Multiple Regression Analysis produced values for $R = .631$, $R^2 = .399$ and R^2 *adjusted* = .383. R for regression was significantly different from zero, $F = 25.199$, $p < .001$. A Regression model explained about 40 % of the variants. However again, because of the insufficient sample size for achieving valid results of a multiple regression analysis, these results only indicate that there might be differences with which factors predict the experience of comfort when going up, down and compared to the escalator ride in general.

4.7 Findings from open-ended questions and a spatial-contextual analysis

There were no major differences between locations, and the escalator ride was typically described as being "normal" or "typical", and in general quite good or comfortable. An exception was for location 4, where the escalators were described as loud and noisy. For location 1 the overall key words were "fluent, pleasant, normal". For location 2 the overall key words were "good, easy, traditional". For location 3 the overall key words were "calm, normal, comfortable". For location 4 the overall key words were "noisy, slow, ordinary". For location 5 the overall key words were "comfortable, normal, safe". All open-ended question results and the analysed key words are listed in Appendix 4 "Open-ended questions".

In general, at all of the locations the escalators were used properly and the people riding the escalators seemed calm and relaxed, even if at some locations there were quite a lot people using the escalators. At the first location, the background music and other noises coming from the announcements and advertisements were quite loud. Overall, the escalators seemed to be tidy and in normal condition. An exception was for the fourth location, where the escalators were especially noisy according to the participants' comments and the researcher observations. At the fourth location, the background music and other ambient sounds were considerably quiet. The entry and exit areas seemed quite spacious at all locations, and even though while riding on the escalators it seemed slightly dim at some of the locations and the escalators themselves were not lit, the visibility to the surrounding areas when entering and exiting seemed good and bright enough. This was especially at the locations where there were lots of natural light available.

The speed of escalators at each location seemed appropriate, although the longer the escalators were, the slower the escalator speed seemed. There were no noticeably disturbing step vibrations or jerks, and the handrail was moving quite smoothly at each location. The escalators seemed a bit steep at locations four and five. The escalators were easy to find, they were located quite centrally and were close to the main lobbies. They were also quite close to the outdoors. However, there were no elevators too near to the escalators. Full research notes from the observations are in Appendix 5 "Observations".

Open-ended questions and observations are concluded in table 5 which is in Appendix 6 "Main conclusions of the spatial-contextual analysis". It includes main findings from both the open-ended questions and the observations listed by each location.

5 DISCUSSION

A feeling of comfort can be seen as an example of a mentally experienced phenomenon. Research on human experience is without a doubt a complex and challenging task. In order to grasp the phenomenal conscious experience that emerges in an escalator passenger's mind, and how it can be researched, we first have to understand the underlying factors that may affect this emerging mental event.

When a human receives physical stimuli from the external world, they are transposed into biological sensory data, which is then further processed in a person's mind. The sensory data can be perceived as sensations. This is what psychophysics investigates – the psychological features of a sensation that relates to the physical properties of its stimulus (Mather, 2009; Fastl & Zwicker, 2007; Moore, 2014). These sensational features can be used as the basis of research on the experience of escalator ride comfort. However, fields in human science such as psychology and cognitive science have proposed that the sensory information is just one part of the "puzzle" in conscious experience.

Experiences are born as a result of mental processing that includes several different components. Components vary from human personality and culture, to cognitive aspects such as memories, learning, emotions, schemas, apperceptions and affordances. They also include goals and expectations, judgements and actions, sensorimotor skills, and so on. At the core is: the mental representation of the phenomenon; the information content of thought, and intentionality; "the directness of actions" (Saariluoma & Oulasvirta, 2010, p. 320); and the expected effects of those executed actions. Also, what is emphasised in the cognitive science, in the science where humans (and other biological or non-biological organisms, which are capable of computations) are seen as information processing organisms, is that human behaviour is driven by sets of needs and goal directed intentions. Humans are action-oriented and their phenomenal experiences are born as a result of interaction with the external physical world and the internal mental world (Saariluoma, 2004; Saariluoma & Oulasvirta, 2010; Hartson & Pyla, 2012; Revonsuo, 2010; Allen & Williams, 2011; Edelman & Fekete, 2012; O'Callaghan 2012; Dale et al., 2012).

In this research the approach is heterophenomenological. It includes the first-person introspection and self-reporting, typically used in phenomenology, plus the third-person analysis by the researcher. Heterophenomenological approach allows for the combination of qualitative and quantitative research methods, such as observations and survey questionnaires. It also makes it possible to conclude the results from analysing the both.

5.1 Conclusions

Based on the statistical analysis, the passenger ride comfort on escalators can be researched with the presented methods. In total, ten different factors were measured for their prediction of comfort on escalators. However, the reliability for the factor of "pitch" was low. Results indicate that the three variables for "Dim sounds", "Clear sounds" and "Echo" were not reliably accounting for the factor of pitch.

Three factors could be found that were statistically significantly predicting the experienced comfort factor: the experience of step sturdiness (SturdyStepExFact); the experience of step vibrations (StepVibExFact); and the experience of handrail smoothness (HandSmoothExFact). About 50 % of the variance in the experience of comfort can be predicted by these three factors. In other words, these three factors accounted for most of the variation in the passengers' experience of comfort. Thus, the statistical analysis results suggest that the experience of comfort can be impacted mostly by altering these factors. The remaining 50 % of the experience of comfort needs to be explained by other reasons. Based on the statistical analysis, the other factors were important as well, but because they vary too much between individuals, they cannot be put in a reliable order of importance as predictors or explanatory items for the experience of comfort. It is also noteworthy, that due to the small sample size in this research the statistically significant predictors are limited to the three factors. With larger sample sizes also some other factors might emerge as statistically significant predictors. This is indicated by the low *p*-value in the factor for "volume", which however, in these research results was not statistically significant.

All ten identified factors were important for the experience of comfort. Despite three predictor factors, the rest of the factors –which were not statistically significantly contributing to the experience of comfort – cannot be put in any order of importance. A diagram to illustrate the resulted *beta*-values from multiple regression analysis is in figure 19. The higher the *beta*-value is to 1, the more it predicts the dependent factor, the experience of comfort. The blue blocks indicate the factors which contributed significantly (the experiences of step vibrations and step sturdiness) or moderately significantly (the experience of hand vibrations) to the prediction of the experience of comfort. The grey blocks cannot be put in a specific order. Therefore, the order in this diagram for these blocks must be seen as arbitrary.

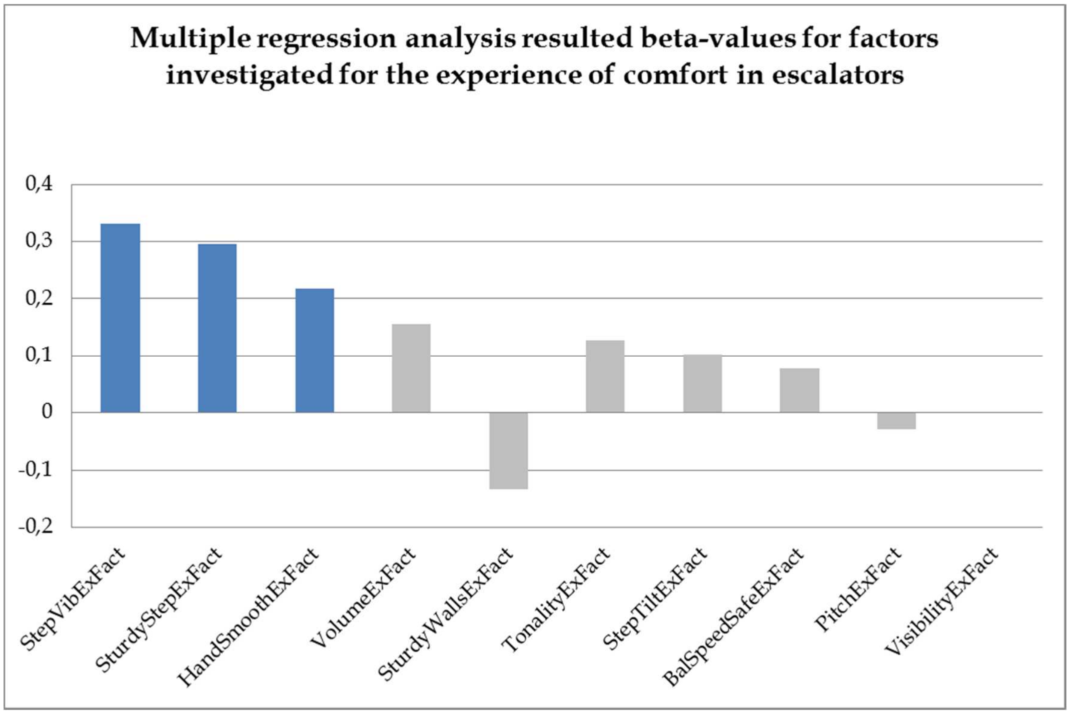

FIGURE 19 Diagram of *beta*-values from multiple regression analysis. Blue blocks indicate the factors which contributed significantly or moderately significantly to the experience of comfort. Grey blocks did not have a statistical significance as predictors of the experience of comfort, so they cannot be but in any specific order.

From the observations and open-ended questions, it can be concluded that at all locations the overall experience of comfort was more positive or neutral than negative. Typically, the escalator ride was described as quite comfortable or "normal". In general, there were no big individual deviations within the comments on how the escalator ride was reported to be felt. Participants' replies were also consistent with the researcher's observations. Especially at location four, where according to the researcher the escalators produced quite a lot of noise, which was also reported by the participants.

At all locations, the escalators were located in a way that they were easy to find. All escalators looked considerably tidy. At some locations the surrounding noises such as background music or the noises coming from the escalators were perceived as loud, while at other locations it was considerably quiet. There was quite a lot of surrounding space with good visibility around the escalator landings. The flow of people was smooth and without any congestion.

The sample size of 40 participants riding up the escalators and 40 participants riding down was insufficient for producing reliable results for the predictors of comfort experience in different directions of the escalator ride. However, results from analysing the directions separately give a clue towards whether or not there might be a difference in the factors that predict the experience of comfort when a passenger travels up or down. The results indeed indicate that there might be different factors involved depending on the direction. Even though the results had statistical significance, because of the unreliability when using a multiple regression method in this small sample size, it is probably not possible to say that the found factors would be the same when the test would be retested with a larger sample size. In other words, it could be speculated that there might be a difference with the factors and ride directions, but what those factors are cannot be concluded from this research.

It should be noted that these findings were all from well-functioning escalators. Therefor the results are especially useful for designing excellent escalators, not fixing bad ones. Also, the selected locations represented just one type of environment and context. They were all shopping malls with new or newly renewed escalators. The surveys were run between late morning and noon, during June. The participants presented only a tiny portion of the world population. More reflection about the results and the benefits and challenges of using a heterophenomenological approach for future research on the experience of comfort is presented in the next subchapters.

5.2 Reflection

The results from the statistical analysis of the research data suggest, that approximately 50 % of the passengers' experience of comfort were predicted by the smooth movement of the steps, the vibrations of the steps and the smooth handrail movement. Different directions were further analysed, but because of the small sample size reliable results could not be drawn. The overall analysis indicated that there are no statistically significant differences, but based on the multiple regression model that was performed on the data it can be speculated, that with larger sample sizes there might be some differences even between the ride directions. According to this data it seemed that while going up the comfort predicting factors were the experiences of step sturdiness, tonality and handrail smoothness, and while going down the predicting factor was the step tilt. Results also indicate that the remaining half of the experience of comfort needs to be explained by other factors which may vary and differentiate between individuals or by other reasons. The open-ended questions and observations conclude, that at all sites the experienced escalator ride was quite a typical one. The ride was described as quite normal and generally comfortable. There were only a few comments about the ride being either nice, dull or nothing special. One exception was at location four, where the escalators kept an exceptionally loud noise. How can these results be reflected and explained with the theoretical background?

When explaining the three found predictor factors, their impact can be reviewed from the physiological and sensorimotor system's functional aspect, as well as, how the sensory perception is created and impacted by different phenomena. It seems that when a person approaches an escalator there is a subconscious, learned motor control program which is activated by the visual inputs. It then prepares a person's posture and gait accordingly to maintain balance and adjusts muscles and joints of the body in addition to the limbs (Gomi et al., 2014; Reynolds & Bronstein, 2003). The movement and position of the person's body creates a sense of full-body ownership. When the body is in a passive state, which might be the case while standing still on the escalator steps, the body ownership is more fragmented and local, than when the actions are voluntary and self-initiated. When the actions are guided by a person's mental representations and when the internally generated sensations are integrated into a coherent awareness of one's body, it creates the sense of agency (Saariluoma, 2001; Tsakiris et al., 2006; Ionta et al., 2011). It seems that there are different sensorimotor systems for the movements of unilateral movements and upper limbs, and the system for bilateral movements and lower limbs which underlie the generation of full-body agency (Kannape & Blanke, 2012; Palluel et al., 2011). This would mean that sensing the handrail movements and vibrations is processed in a different way to sensing the smoothness and vibrations of the escalator step movements.

The vestibular and proprioceptive systems provide data related to vibrations, tilts, orientation and movement (Pfeiffer et al., 2014; Bronstein et al., 2009). Especially the proprioceptory inputs, such as vibrations from the legs and through feet, play an important role for the balance, posture, whole body tilt and sway (Fitzpatrick & McCloskey, 1994; Nurse & Nigg, 1999; Thompson et al., 2011). Moreover, visual signals provide necessary information for maintaining position and balance. Visual information is especially important when a person is standing on a moving platform. It becomes more relevant also when there is age-related deterioration of sensory processing abilities (Mather, 2009; Rugelj et al., 2014; Shumway-Cook & Woollacott, 2000).

The sensitivity to pressure and vibrations vary greatly between individuals (Nurse & Nigg, 1999). The sensitivity to vibrations is further affected by the frequency and amplitude of the vibration (Westling & Johansson, 1987), the exposure time (Malchaire et al., 1997) and the temperature of the skin (Green, 1977). Also, the shoe inserts materials and shoe soles affect how vibrations are sensed, and the feeling of comfort in feet in general (Nigg et al., 1999; Mündermann et al., 2001). Additionally, in case of shoe inserts there is a large variation within people's preferences and what is felt comfortable. That is due to peoples' different individual physiological characteristics (Mündermann et al., 2001).

Sensory information is received through different modalities and combined in a person's mind to create a holistic, unified sensory perception of the external world. The human postural system seems to rely on information from different sensory modalities. The system is able to adapt to different external stimuli, to choose the most relevant information for maintaining posture and suppresses the data that seems irrelevant or conflicting. It is also capable of learning automated motor control programs. Repeated exposure to vibrations through the feet can cause a sensory adaptation where greater emphasis is put on other senses. If the surface that is stood upon is unstable, the effects of vibrations are further diminished (Dettmer et al., 2013). The system is thus similar to the perceptual and attentional systems. They process the incoming sensory data, select the information that seems relevant to that situation and person's goals for further processing, and attenuate the irrelevant or conflicting sensory signals (Nolen-Hoeksema et. al, 2009; Baars & Gage, 2010; Dennett, 2002; Mather, 2009; Laarni et al., 2001; Chun et al., 2011; Koralus, 2014; Revonsuo, 2010). These systems also impact on how the object of perception or attention is consciously experienced (Marchetti, 2012).

It is also suggested that compared to what is consciously experienced during goal-directed navigation and movement, there are different information processes behind the typically unconscious, automatic and less often immediately goal-directed full-body locomotion and the sense of agency. In fact it seems that a person typically has quite low awareness and accuracy of his or her body movements and positioning (Kannape, Schwabea, Tadia and Blanke, 2010). These proposals might then suggest that body movements that are not goal-directed, such as standing passively on the escalator steps are experienced either very vaguely or not at all. They are also experienced in different way than when walking the escalators steps, where the effort is put to the self-initiated, active movement of a person's limbs and body. This also might mean that differences are even stronger when a person rides escalators while relying on automated motor programs and when there is no need for putting too much effort on navigation. As compared to when he or she has to actively navigate and execute movements towards a certain goal. In a mentally and physically more demanding task a person needs to reflect the feedback of the motor functions and sensory inputs against one's internal mental representations, and then actively select and adjust the appropriate motor programs to reach the desired goal.

In other words, the purpose of using the escalators, what kinds of mental representations and mental models, previous experiences and learning a person has, as well as novel and surprising changes in the environment, are all reflected in the apperception and affordance of how the escalators and the escalator rides are sensed and perceived. And, finally this all contributes to what is consciously experienced and reported in the end. In practice, the differences might emerge, for example, when a person is navigating in a building he or she has never visited before and needs to actively concentrate on using the escalators. This is, as compared to a familiar place, where the locomotion is mostly automated. There are stable and coherent environmental signals that support the unconscious processing of full-body movements. This would be in contrast to a busy environment, with lots of varying and unknown physical signals that require active sensory processing, attention and reflection. They are required to pick the relevant stimuli and create a multimodal, uniform internal representation of the environment in order to ensure the person is achieving his or her initial goals of reaching where he or she intended to go. When a person is actively engaged in movement, any surprises or unexpected situations that deviate from the norm, such as stopped escalators when they should be moving, can cause the sensations of something "being off" or uncomfortable. This sensation emerges even stronger than when movements such as gait are initiated by the person him or herself, thus having a stronger sense of agency. (Bronstein et al., 2009)

There are differences between what is consciously experienced during passive motion or more active motion, and goal-directed action — where the actions are guided by the mental representations (Saariluoma, 2001). This might also have an impact on the results of this research. If, in the typical case the lower or full-body awareness while riding an escalator is not very accurate and person's goal-directed actions are towards other things, (e.g., navigating to the next shop or concentrating on typing a text message while being automatically transported from one floor to another) in this research the participants were specifically concentrating on riding the escalators and then answering the questionnaire about the ride. As the representational theory of the mind observes, representations are systems of signs and relations between objects of material entities and their symbolised information content (Saariluoma, 2001). The content of the representation depends on the causal roles of different entities and the information they entail in the whole representational system itself (Revonsuo, 2001). Thus, the participant's mental representation of the event of riding an escalator while being tested was probably different to what the content of a mental representation of travelling on an escalator in real life might have been. Participants' attention and focus was probably more on their internal sensations. There was probably a different kind of awareness of their apparent environment and their apperception of the escalators and in general. They were probably motivated by being tested for a scientific research and aware that they were evaluated by another person, in this case the researcher and her questionnaire. In other words, in addition to the different mental representations, there might have been a certain amount of psychological bias that has impacted the results towards how they have estimated and reported their feelings. However, taking this into consideration, it seems that out of all possible factors, the found ones were the ones that had a statistically significant relation with the experience of comfort. That is, despite the somewhat artificial research setting.

It seems apparent that the sensory systems and how different sensory information is perceived and processed are functioning primarily to ensure that the appropriate environmental (and internal) sensory information is used. This is in order to set the subconscious and learned motor programs towards enabling the active movement of the body such as navigation, grasping and locomotion (Nolen-Hoeksema et al., 2009; Ernst & Bülthoff; 2004; Noë, 2004). The purpose of the whole process is to ensure a person can set targets that are based on his or her internal needs or goals. Person can then actively execute different mental and physical strategies in order to reach those goals (Nolen-Hoeksema et. al, 2009; O'Callaghan 2012; Noë, 2004). Thus, the activity of a person is intentional – there is mental and purposeful content in the intention (Pacherie, 2012; Saariluoma & Oulasvirta, 2010). Subjective goals, motivations and needs that activate certain behaviour depend on an individual. However, there can be some more general reasons for why these found factors in particular predicted the experience of comfort among all participants. It seems that all these found factors underlie senses that are important for the more general everyday survival of humans, at least in the evolutionary sense. In order to survive, a person needs to be able to sense the changes in the environment and adjust the movement of limbs and torso to fit the changing environmental conditions. That is, while keeping his or her balance while standing, walking or running. For this type of movement a person needs to be able to sense his own body and limb movements and the vibrations, formations and movement of the ground, as well as other surfaces that his or her body is in contact with. Without these abilities a person is at high risk of injury which can have even fatal consequences (Nolen-Hoeksema et al., 2009). An example of the importance of propriovestibular senses for balance and movements can be seen in age-related changes of these systems. While aging, the sensory organs and the capability to process the sensory information deteriorates. It thus leads to more falls and balance impairments in older people (Shumway-Cook & Woollacott, 2000; Woollacott & Shumway-Cook, 2002).

Due to the mind's limitations of the cognitive processing capacity, only a certain amount of information can be processed at any given time. Because of this, the mind has to evaluate and make selections in order to facilitate further processing of purely the data that seems to be the most relevant for alertness and behaviour (Nolen-Hoeksema et. al, 2009; Chun et al., 2011). The data can have also other functional interest to the person (Koralus, 2014). This seems to apply for the attentional process as well as the perceptual process. Thus, it is no surprise that as being the part of both of these processes, the sensory data is also filtered on the subconscious level. Only a selected, small portion if it is processed further (Laarni et al., 2001). What is selected for further processing is the data that seems the most relevant for the organism's survival (Nolen-Hoeksema et al., 2009). Hence, when riding an escalator, the most relevant information seems to be then the sensory data that is related to staying balanced and keeping one's posture. The sensory data does not need to be exact, but it can act as an initiator for further processing events.

A sudden change in environment and sensory input can also cause involuntary focus to the possible source of the change (Mather, 2009). This seems to apply also in this research, when at the test location four there was an escalator that made exceptionally squeaky and loud noises. The noises that were emerging from the escalator were frequently mentioned in the open-ended questions. This implies that when a sensory signal is strong enough or different from the typical use case, it draws a person's attention towards the source and is perceived consciously, as suggested by the theories of attention and perception (Baars & Gage, 2010).

Then, what about the rest of the 50% for explaining the experience of comfort? Half of the comfort may be explained by individual differences among participants from their physical differences to their unique mental properties. There may other reasons, as well, that we don't know. People are feeling, thinking, learning beings with their individual personalities, skills and previous experiences gained through one's lifetime (Revonsuo, 2010; Chalmers, 1996; Dennett, 2002, 2015; Carruthers 2000; Brown 2012). A mental experience is an event that emerges from interaction with the environment and the person himself or herself (Hartson & Pyla, 2012; Revonsuo, 2010; Chalmers, 1996; Dennett, 2002; Carruthers, 2000; Brown, 2012; Saariluoma & Oulasvirta, 2010; Allen & Williams, 2011; Edelman & Fekete, 2012.). Inputs from the sensory systems are received on the subconscious level and further processed against a person's individual mental properties such as apperceptions (Saariluoma, 2004; Anderson, 1988; McRae, 1978; Saariluoma, 2010) and affordances (Saariluoma, 2004; Hartson & Pyla, 2012; Gibson, 1986). The interaction does not include only physical objects of the world. Every person is immersed in their social and cultural environment. This is a dimension that deeply impacts the core beliefs, attitudes, values and judgements of a person.It also affects one's behaviour and their way of interpreting experiences (Saariluoma, 2004; Matsumoto, 2001; Hofstede et al., 1997; Kim, 2001).

The representational theory of the mind explains how the internal "content" of the mind, a person's subjective presentation of information, influences how a person makes sense of the world. Mental representations include content such as knowledge, expectations or assumptions. Mental representations impact how the information received in interaction with the external world is interpreted by a person. Thus, mental representations have an essential role when explaining a person's unique phenomenal conscious experience (Saariluoma, 2001; Von Eckard 2012; Revonsuo, 2001). Humans actively target their actions towards achieving something that is important in their personal life. This goal-driven activity is guided by intentionality. It initiates and coordinates a person's responses with the environment for reaching a goal with meaningful content for that person (Saariluoma & Oulasvirta, 2010; Frankish & Ramsey, 2012; Pacherie, 2012). Interaction inputs are reflected in the person's mind against his or her unique goals – born out of needs, thinking and expectations. They are also modulating the functionality of the perceptual system. Because human activity is action-oriented, only the information that seems to be important for reaching the person's goal at that time is picked and processed further in the mind. This cognitive processing involving the attentional system creates a perception. The phenomenal conscious experience is born out of the perception that reaches a person's awareness, together with mental representation and intentionality. This kind of experience has representation-bearing content for the phenomenon, including internal attributes that relate to their informational, emotional and motivational content. It also includes intentionality, where the mind is targeted at some meaningful content. Further interaction and responses with the environment are initiated by intentionality to achieve the intended results.

Perceptual processes and sensations that help a person assess his or her environment is a complex system of different cognitive functions and processes. Physical signals entering the sensory organs are recoded into raw sensory data, which is then processed in the person's mind. How the data is noticed, assessed and processed depends on things like its intensity and importance to the person. Much of the sensory data is left out of what is perceived consciously. The overall experience can include features that are ambiguous and difficult, even impossible, to reduce to one source of sensory inputs. (Mather, 2009)

Theoretical models of perception and action reviewed in this research emphasise the meaning of interaction with the individual and the world. Interaction with the external environment impact on how a person views the world, evaluates it, and what kinds of behavioural responses a person chooses to activate.

When a person interacts with the world, he or she gains new memories, experiences and knowledge, which he or she then uses when reflecting the perceived information to his or her internal mental models and expectations (Saariluoma, 2004; Saariluoma & Oulasvirta, 2010; Allen & Williams, 2011; Pacherie, 2012; Gibson, 1986; Ernst & Bülthoff, 2004; Dale et al., 2012; Vink & Hallbeck, 2012; Kaplan, 1991).

One can speculate as to whether changing the environmental conditions or escalator properties would change the felt experience of escalator ride comfort. For example, if there were ambiguous or conflicting visual signals in the environment that would decrease the sense of balance and also impact what people perceive and report. In general, the introspective reflection of experiences that largely relate to sensory information might result in incorrect reports. People might interpret and associate the feeling of a certain kind, say a noisy environment or optically ambiguous surface material in the escalator balustrade, to other sense properties, say the feeling of vibration, because they subconsciously feel that something is impacting the feeling of comfort. While at the same time they cannot correctly pinpoint what that something is. When people report their feelings of comfort it can also be speculated as to whether they report something they feel in situ, or whether they are reporting feelings or assumptions that are actually emerging from their memories. Thus, the reports that people give could be more a reflection of their own mental schemas.

Additionally, defining the concept of comfort is not an easy task. A person's subjective feeling of comfort is based on a complex and multidimensional structure of experiences, which emerge in different intensities (Kolcaba, 1992). Comfort and discomfort are not the opposite poles of the same scale. They should be seen as different feelings which can override, counterbalance or co-exist (Kolcaba & Kolcaba, 1991). Comfort is constructed of different dimensions from physiological to social. A person's emotions and personality can impact how he or she assesses different phenomena. Even the culture in which the person is immersed can affect the content and quality of their phenomenological evaluations and introspection (De Looze et al., 2003; Vink et al., 2012). Reducing the complex emotional construct of experience of comfort into possible variables, which could be combined as factors requires delicate and careful design. They need to be operationalized into a questionnaire in a way that they are hopefully understood by participants in a similar fashion, as the researcher attempted them to be understood.

The duration of experiences seems to be from seconds to minutes (Dale et al.., 2012). This affects the research of experience – how can we ensure that the reported experience is an "authentic" one, and not something that is a reflection of a memory? Then again, does it really matter? Is it the remembered experience of comfort or discomfort, which then creates the lingering memory that is what ride comfort should focus on, not the "in situ" feeling? In any case, the experience of comfort includes probably a combination of all these different timely events. The temporarily short time of experience at the specific time of the actual event, the quality and description of that experience that is saved in the memory, and in the long term how the experience is remembered later on. Probably these all impact the overall apperception and attitude towards escalator rides. Maybe one way to find out if there are relevant differences between a priori felt experiences and experiences people later describe as having, is to compare the report results gained from in situ tests with reports collected from surveys that have been conducted later. These would be surveys where the participant is asked to describe what he or she sees as important while riding an escalator. The results might also expose what people assume to be the properties of the experience of ride comfort on an escalator.

If the method presented in this research is replicated and if the results then indicate that there are statistically significant factors that reliably precede the experience of comfort, it might suggest, that those factors are something more universal, biological in nature and relating to the ontological properties of human species. This is in contrast to differences in for example people's personalities, culture, intentions, goals or beliefs. If the point is to discover what people find comfortable, the report they give should reflect those things that they genuinely feel as being important for their subjective experience of comfort.

5.3 Further research

When a psychological or heterophenomenological approach is used, the research always has to be adapted to the local culture, context and overall user case. Reflecting on the theoretical background, it seems that the context in which the escalators are used will probably affect the felt experiences of how comfortable the ride seems. It seems apparent that individual differences between ages and skills have to be taken into account when running the tests and analysing the results. Aging changes the sensory perception and cognitive processing of sensory stimuli. People with no previous experience of using a certain technology can have very different experiences compared to highly skilled and experienced experts. These are people who might have a psychological bias as to what they attend to. It might also affect how they interpret their environmental events and technology. There can be vast variations to perception, assessment of the event and the resulting conscious experience due to the individual's emotions and personality. Different cultures impact greatly on the results and how the experiment itself should be conducted. They impact for example, a person's beliefs, values, attitudes, assessments and behaviour. The overall concept of ”comfort” needs to be considered in these terms. Differences between individuals, as well as more generally within and between cultures, impact how the experience of comfort is interpreted. Furthermore, they affect what is understood as being comfortable. Therefore, it is extremely important to review the unique variables as well as the potential factors that might be assumed to mentally and psychologically relate to the experience of comfort. Further, in the case of a comfortable escalator ride, in order to ensure the reliability of the questionnaire and the validity of the overall results for each defined escalator use case, the factors need to be scrutinised.

For example, this research tested the escalators in Finnish shopping malls between late morning and noon. Participants were selected randomly, so that those people who had time and enthusiasm to participate were the ones giving the reports. Also, a few of the participants associated the escalators with a known Finnish escalator company and described them according to their belief that the company's brand and products were known to be good. What if the context and the role of the participant were somewhat different? For example, what would the results be like if the surveys were run in busy metro stations in the greater London area, where the escalator steepness and length were much higher and the escalators were built underground inside a cave-like, dimly lit cove? And, where the people's goal is not to go shopping or for a cup of coffee during a relaxed summer day, but quickly reach the next train while navigating in a complex transportation system in crowded and hectic underground locations? What if the escalators were associated with a company that the person did not like for one reason or another, thus creating an unconscious, negative emotional bias towards the escalators and the ride? Also, how can we confirm that what people reported was what they actually were feeling? What if we could read the minds of all the people who were using the escalators and really hear what they are feeling and experiencing? Would the people who are not by nature willing to participate in any tests just for the sake of it (those kinds of people were encountered in this research, as well) give similar reports to those who were eagerly participating to evaluate comfort? In other words, what kinds of bias would there be with the internal experience and the reported one? Maybe the only way to find out is to rerun the test presented in this research with as many participants as possible, in as many locations and situations as possible.

Another noticeable concern is to provide the adequate sample size in the research. As was found from the results of this study, the sample size was too small to analyse for example for the differences between escalator ride directions. In order to use the multiple regression method the sample size should have been between 60-100 samples per direction. If new, emerging factors are sought by using an explorative factor analysis, the minimum sample size of observations should be at least 100 (Coolican, 2009; Bartlett et al., 2001).

These guidelines apply for just one kind of research case. For example, if the research was about a certain type of usage (e.g. metro stations escalators) at a certain location (e.g. in Singapore). When conducting more tests for different kinds of use cases and locations, the results will probably also provide more accurate statistical data about which factors predict comfort regardless of the different settings and external variables. Increasing the sample size allows for the analysis of possible differences between the experience of comfort and its underlying predictors between different ride directions. Even though in this research the statistical analysis did not find statistically significant differences between the ride directions, it is definitely worthwhile testing this in further research with an adequate sample size.

The parameters to study and test in the research were mostly the ones that are listed in the ISO-standards for testing the ride comfort. In the ISO-standards the recommended testing methods to research the ride comfort are rather technical and complex ones. They are measuring the physical properties of the escalator and its surroundings. Typically, the measuring instruments consist of transducers to measure acceleration with characteristics for measuring the vibration for whole body and hand-arm, and transducers to measure sound pressure and sound intensity levels (ISO 18738-2:2012(E)). In addition, a special evaluation software called "the Physical Measurement Technologies EVA" can be used to transfer the physical measurements into the quantitative parameters for humans senses by using different filters (Hawkins, 2016). Thus, test results are seen as corresponding with the assumed passenger's sensory perception, based on findings from psychophysical research.

This research focused on investigating the passenger's experience of escalator ride comfort using the heterophenomenal approach. In addition to answering the six research questions, the overall goal has been to try to create a sufficient method to study the mental experience of a passenger in real life technology usage. This is instead of using technical measurement instruments or a psychophysical approach, which concentrate more on the individual sensory perceptions. Also, in psychophysical research the findings are generally based on rather artificial and even laboratory settings. A heterophenomenological approach can be used as a foundation to provide a more human-centred method towards studying the passenger's experience of ride comfort as user experience. In future research it would be very interesting to use the heterophenomenological research method together with the technical ride comfort measurement methods. Findings from the research on user experience that include the psychological and cognitive aspects of human functioning in the analysis could then be reflected with the results from the physical measurements. Some of the possible outcomes from this kind of research could be whether the findings support each other, or whether one factor might seem more important than the other. Even totally new phenomenal events and items that differ between people due to currently unknown reasons might emerge. Those findings would also prompt potential new hypotheses and explanations for what underlies passenger comfort when it is seen as a holistic user experience.

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APPENDIX 1 A PASSENGER COMFORT QUESTIONNAIRE

Taustatiedot: Ikä:________ Sukupuoli: Nainen____ Mies____

Kysymys 1: Millaisin omin sanoin kuvailisit liukuporrasmatkaa?

Kysymys 2: Miten arvioisit oman tämänhetkisen mielialasi asteikolla 1-7 negatiivisesta positiiviseen?

Kysymys 3: Arvioi matkan aikaista kokemustasi alla olevien adjektiiviparien avulla. Ympyröi mielestäsi sopivin vaihtoehto.

Liukuportaat olivat hiljaiset	Liukuportaat olivat kovaääniset
Matkan aikana oli hiljaista	Matkan aikana kuului meteliä
Liukuportaiden ympäriltä ei kuulunut häiritseviä ääniä	Liukuportaiden ympäriltä kuuluva taustahäly oli häiritsevää
Liukuportaiden äänet olivat vaimeita	Liukuportaista kuului teräviä ääniä tai kolahduksia
Liukuportaissa äänet kuuluivat selkeinä ja kirkkaina	Liukuportaissa äänet kuuluivat epäselvinä
Liukuportaissa ei kaikunut häiritsevästi	Liukuportaissa kaikui häiritsevästi
Liukuportaista kuului matalia ääniä	Liukuportaista kuului korkeita ääniä
En kuullut häiritseviä vikiseviä ääniä liukuportaista	Liukuportaat pitivät häiritsevän vikisevää ääntä
En kuullut häiritsevää matalaa kolinaa liukuportaista	Kuulin häiritsevää matalaa kolinaa liukuportaista
Liukuportaiden askelmat liikkuivat tasaisesti	Liukuportaiden askelmat liikkuivat epätasaisesti
Liukuportaiden askelmat eivät tärisseet häiritsevästi	Liukuportaiden askelmat tärisivät häiritsevästi
En tuntenut jaloissani häiritsevää tärinää	Tunsin jaloissani häiritsevää tärinää
Liukuportaiden askelmat olivat hyvin tasapainossa	Liukuportaiden askelmat olivat epätasapainossa
Liukuportaiden askelmat olivat suorassa	Liukuportaiden askelmat olivat vinossa
Tunsin seisovani suorassa	Tunsin seisovani kallellaan
Käsikaide liikkui sulavasti	Käsikaide liikkui nykivästi
Käsikaide ei tärissyt	Käsikaide tärisi häiritsevästi
Käsikaide liikkui sopivaa vauhtia	Käsikaide liikkui väärää vauhtia
Liukuportaiden seinät tuntuivat vakailta	Liukuportaiden seinät tuntuivat huterilta
Liukuportaiden seinät tuntuivat tukevilta	Liukuportaiden seinät eivät tuntuneet tukevilta
Liukuportaiden seinät tuntuivat kestäviltä	Liukuportaiden seinät tuntuivat heikoilta
Liukuportaat tuntuivat vakailta	Liukuportaat tuntuivat huterilta
Liukuportaiden liike oli tasaista	Liukuportaat liikkuivat epätasaisesti
Liukuportaat tuntuivat tukevilta	Liukuportaat eivät tuntuneet tukevilta
Liukuporrasmatka tuntui miellyttävältä	Liukuporrasmatka tuntui epämiellyttävältä
Liukuporrasmatka tuntui mukavalta	Liukuporrasmatka tuntui epämukavalta
Liukuportailla matkustaminen tuntui helpolta	Liukuportaissa matkustaminen tuntui hankalalta

Näin hyvin ympärilleni liukuporrasmatkan aikana	Minun oli vaikea nähdä ympärilleni liukuporrasmatkan aikana
Liukuportaissa oli tarpeeksi valoisaa	Liukuportaissa oli liian hämärää
Matkan aikana liukuportaiden ympärillä oleva tila tuntui miellyttävältä	Matkan aikana liukuportaiden ympärillä oleva tila tuntui epämiellyttävältä
Liukuportaissa oli helppo pysyä tasapainossa	Liukuportaissa oli vaikea pysyä tasapainossa
Liukuportaat liikkuivat sopivaa vauhtia, joten niihin oli helppo tulla	Liukuportaat liikkuivat väärää vauhtia, joten niihin oli vaikea tulla
Liukuportaiden vauhti oli sopiva, joten niistä oli helppo poistua	Liukuportaiden vauhti oli väärä, joten niistä oli vaikea poistua
Liukuportaat liikkuivat liian hitaasti	Liukuportaat liikkuivat liian nopeasti
Liukuportaat tuntuivat matalilta	Liukuportaat tuntuivat korkeilta
Liukuportaat tuntuivat loivilta	Liukuportaat tuntuivat jyrkiltä
Liukuportaissa tuoksui hyvältä	Liukuportaissa haisi pahalta
Liukuportaissa oli tilavaa	Liukuportaissa oli ahdasta
Tunsin oloni liukuportaissa turvalliseksi	Tunsin oloni liukuportaissa turvattomaksi
Oleminen liukuportaissa muiden ihmisten kanssa tuntui mukavalta	Liukuportaissa olevat ihmiset häiritsivät minua
Tiesin mihin minun piti mennä poistuessani liukuportaista	En tiennyt mihin minun pitäisi mennä poistuessani liukuportaista

APPENDIX 2 A CHECK LIST FOR OBSERVATIONS

Surroundings:

- Lighting (bright, dark et al.),
- ambience (calming, busy, stressful et al.),
- amount of people,
- visual clutter around escalators like big advertisement boards,
- is there any info boards close to the escalators,
- is there any background noises (music, advertisements, announcements et al.),
- what things might draw attention,
- what activities are close (what kind of shops, kiosks, sitting places, cafeterias, parking lot et al.),
- how much and what kind of space is around escalators,
- what is the escalator location like,
- does the escalator area look tidy and clean,
- are escalators easy to find,
- are there any doors or entry or exit points close to the escalators (from outside or parking lot or other),
- are escalators close to elevators,
- are there queues around the escalators,
- other.

Escalators:

- escalator length and speed,
- are there walls around the escalators and what kind of visibility there is from escalators,
- how much is there room around the escalator platforms to enter and exit,
- do the escalators keep some noise,
- do they look tidy or worn-out,
- is there any lighting (led et al.) in the escalators,
- how spacious the escalators seem,
- how wide are the escalators,
- is the handrail moving properly,
- what kind of balustrades are in the escalators,
- do the steps vibrate much,
- are there any special materials in the escalators,
- how do people seem to behave in the escalators,
- do people take carriage in the escalators,
- do people play in the escalators,
- does it look that people need to stop before the escalators,
- does it look that people need to stop after the escalators,
- other.

APPENDIX 3 THE STANDARDISED COEFFICIENTS (BETA VALUES) AND THE EXCLUDED VARIABLES; A REGRESSION MODEL FOR MULTIPLE REGRSSION ANALYSIS; MULTICOLLINEARITY AND A VARIANCE INFLATION FACTOR

TABLE 3 The standardised coefficients (Beta values)

Standardized Coefficients.

	Beta	*t*	*Sig.*
StepVibExFact	,33	3,18	,002
SturdyStepExFact	,29	2,63	,010
HandSmoothExFact	,22	2,17	,033

TABLE 4 The excluded variables

Exluded variables.

	Beta In	*t*	*Sig.*
VolumeExFact	,16	1,8	,074
SturdyWallsExFact	-,13	-1,12	,266
TonalityExFact	,13	1,5	,151
StepTiltExFact	,10	,76	,452
BalSpeedSafeExFact	,07	,52	,602
PitchExFact	-,03	-,28	,783
VisibilityExFact	,00	,03	,978

TABLE 5

Regression model for multiple regression analysis.

R	*R Square*	*Adjusted R Square*	*Std. Error of the Estimate*
,713[c]	,509	,489	,70
,713[c]	,509	,489	,70

TABLE 6

Multicollinearity and VIF (variance inflation factor).

Model		Collinearity Statistics	
		Tolerance	*VIF*
1	SturdyStepExFact	1.000	1.000
2	SturdyStepExFact	.637	1.569
	StepVibExFact	.637	1.569
3	SturdyStepExFact	.525	1.904
	StepVibExFact	.604	1.655
	HandSmoothExFact	.616	1.624

APPENDIX 4 OPEN-ENDED QUESTIONS

TABLE 7

Open-ended questions

Loca-tion	How would you describe the escalator ride with your own words?	Current mood	Other comments, notes	Most common description for the escalator ride in that location
1	Normaali, hyvä vauhti	5		Sujuva, miellyttävä, normaali
1	Ihan ok	1		
1	Kone on tehnyt hyvää työtä, hyvä mennä.	6	Participant was using crotches	
1	Sujuva, melko hidas	6		
1	Sujuva	3		
1	Rauhallisen miellyttävä	6		
1	Lyhyt ja nopea.	5	Participant didn’t use the hand rail	
1	Sujuva, rauhallinen	6		
1	Hidas	-		
1	Miellyttävä	7		
1	Miellyttäväksi, helpoksi	7		
1	Tavallinen liukuporrasmatka, musiikki kauppakeskuksessa kiinnitti huomiota	2		
1	Helppo	-		
1	Jouheva	6		
1	Automaattiset. Keksitty ettei ihmisten tarvii kävellä portaita.	5		
1	Normaalit liukuportaat, kolinaa ja ääntä oli liikaa.	5		
1	Lyhyt matka, kova taustahäly	4		
1	Sujuva, normaalit	5		
1	Lyhyt matka, sujuvat, normaalit	5		
1	Tavanomainen, kova taustamelu	5		
2	Helppo, nopea.	7	Participant didn’t use the hand rail	Hyvä, helppo, perinteinen
2	Toimiva ja hyvä	-		
2	Arkinen, mukava	6		
2	Rentouttavaa	5		
2	Ihan okei	-		

2	Tavallinen / tylsät.	7	Participant didn't use the hand rail. Participant walked the half of the ride.	
2	Rauhallinen, tasainen	7		
2	Ihan mielekäs kokemus, helpostihan se matka siinä menee.	7		
2	Hyryttelin alaspäin hyvässä seurassa.	-	Participant didn't use the hand rail	
2	Perinteinen	4		
2	Erittäin hyvä täällä.	-	Participant didn't use the hand rail. Participant walked the half of the ride.	
2	Melko hidas	4		
2	Hyvät	5		
2	Hyvä matka	6		
2	Hyvä, pitkähkö	5		
2	Ihan hyvä	6		
3	Liukuportaat jotenkin laitettu "väärin päin", joutuu aina kiertämään koko "sydeemin" kun haluaa mennä seuraavaan kerrokseen.	-	Participant had disability in her right foot.	Rauhallinen, normaali, mukava
3	Ihan rauhallinen	7		
3	Mukava	7		
3	Ihan ok!	5		
3	Normaali	-		
3	Rauhallinen, ei paljon menijöitä. Voisi ehkä mennä nopeammin.	-		
3	Lyhyt ja nopea matka.	5		
3	Mukava tapa laskeutua seuraavaan kerrokseen kauppakeskuksessa Järkevä tapa liikkua kerroksesta toiseen. Voi kerätä voimia mennessä seuraavaan liikkeeseeen :)	7		
3	Erittäin rauhallinen ja mukava.	4		
3	Meluisa, mutta muuten suht. Miellyttävä. Kivat valot portaiden alla hauska yksityiskohta.	3		
3	Normaali, tasainen, hiljainen	6		

3	Aika hämärä, lyhyt matka, jonkin verran taustahälyä, vähän ahtaan tuntoiset portaat	5		
3		5		
3	Vähän hämärä, muuten ok, lyhyt matka	5		
3	Ihan normaali	6		
3	Normaali, tasainen, hiljainen	6		
4	Ennättää ajatella mihin on menossa, rauhallinen	6		Äänekäs, hidas, tavallinen
4	Tavallista äänekkäämpi. Portaat natisevat ja pitävät vinkuvaa ääntä.	3		
4	Äänekkäämpi, mutta nopeampi tapa portaisiin verraten	6		
4	Hidas, kovaääninen	7		
4	Hidas, nariseva	-		
4	Ihan hyvä, ei mitään erityistä	-		
4	Vähän "muhkurainen meno, tärisytti	-		
4	Mukava	7		
4	Tylsäksi	5		
4	Hyvin toimivat	-		
4	Pientä epätasaisuutta tuntui jaloissa, yläpäässä kova meteli liukuportaista, valoisa ja avara	5		
4	Ihan ok mutta kovat äänet	5		
4	Portaiden yläpäässä kuului kolinaa ja kirskuntaa, jaloissa tuntui pieni tärinä ja muhkuroita	6		
4	Tavallinen	6		
5	Miellyttävä	6		Mukava, normaali, turvallinen
5	Pakollinen mutta kivemmat kuin portaat :)	6		
5	Mukava ja tasainen	7		
5	Miellyttävä, helppo, turvallinen	6		
5	Mukava normaalisti, kainalosauvojen kanssa haastavaa	7		
5	Ihan mukava, voisin sanoa normaali	-		
5	Lyhyt ja ruuhkaton	5		
5	Kaikin puolin turvallisen tuntuista, vaikka portaat olivat jyrkät	6		
5	Normaali, ei muista liukuporrasmatkoista poikkeava	4		

5	Normaali tapa päästä kerroksesta toiseen kauppakeskuksessa. Ihan tasaista ja tilavaa kyytiä.	-		
5	Tavanomainen, kapeat portaat	5		
5	Nopea, tavallinen	5		
5		6		
5	Ok	6		

APPENDIX 5 OBSERVATIONS

Location 1

SURROUNDINGS:

- Lighting: 3rd floor was bright, spacious, calm
- 3rd floor shops with children clothes
- music was loud
- 2nd floor was moderately bright or slightly dim, escalators were quite dim
- Ambience: Going down in 2nd floor the space was calm, escalators were in the end of the building
- Entering the escalators was more active especially during the lunch time
- Exiting to the main floor was most active or busy area
- Amount of people: quite little amount of people, families with children
- Visual clutter: 3rd floor no big marketing screens / billboards, 2nd floor no billboard, the space was very spacious. In 2nd floor there was big touch screen next to the escalators
- Background noises: 3rd floor the music and announcements were loud, in 2nd floor clothes store had a loud music coming from inside the store
- Activities close by: 3rd floor children clothes stores, hardware store, 2nd floor none
- Space around escalators: 3r floor quite a lot of space
- Escalator location: crossing escalators for both directions, two escalators in the both ends of the building
- Tidiness: yes the area looked tidy
- Escalator appearance: escalators looked ordinary
- Easy to find: yes the escalators were easy to find
- Entry or exit points close by: none
- Close to elevators: no
- Queues to escalator: no
- Other notes: the escalators are next to a big open inside hall, in the ground floor they are close to large glass outdoors

ESCALATORS:

- Length & speed: quite short, quite fast or normal speed
- Walls around and visibility: glass balustrade but no walls around escalators, escalators were quite dim, crossing with escalators going other direction so the visibility to other side was limited to the next escalators,
- Room & space to enter escalators: quite a lot in both cases
- Noise: 3rd floor a steady hum and small clanking (kolina) but not too bad
- Tidiness: looks tidy, platforms (tasanne) bit worn out
- Escalator appearance: doesn't look that modern, bit worn out
- Lighting: not in escalators
- Spaciousness: to 3rd floor quite spacious, normal width, didn't appear too "tight" or narrow
- Handrail movement: quite smooth, people didn't generally use handrail very much; older keep hand in handrail but especially younger people use their mobile phones during escalator ride
- Balustrades: see through plex

- Step vibrations: small vibrations, but in general quite smoothly, couple noticeable bumps
- People behaviour: calm, standing still (not too busy or much walking)
- Carriages in escalators: couple times people took baby carriage in the escalators
- Entering and exiting escalators: people look down at the steps when they are entering the escalators but not generally anymore when exiting. People pause when entering escalators that are going down. Exiting is smooth and the exit area is spacious and bright

Location 2

SURROUNDINGS:

- Lighting: bright
- No background music in the shopping mall
- Not loud sounds coming from inside the shops
- Quite a few people, very calm area
- 1st floor there was an info board
- High ceiling, lots of space around escalators and very good visibility
- There was no other escalators nearby, exit was behind the escalators but not too close
- 2nd floor there were restaurants nearby, 1st floor there were restaurants, shops, market
- Escalator area was tidy and clean
- Escalators seemed quite modern
- Escalators were very easy to find, centrally located
- Escalators were not close to elevators
- Queues: not really, except during the lunch time because the escalators were the central ones and closest to the restaurants

ESCALATORS:

- Escalator has see through plex balustrades
- Long escalators
- Quite tidy
- Handrail was jerking when going down, otherwise quite smooth and good
- Length & speed: quite long escalators, seemed quite slow
- A lot of space around the escalators in both ends
- A little noise coming from the escalators
- Not any separate lighting in the escalators
- Escalators seemed quite spacious
- People seemed very calm
- Entering and exiting escalators: People entered escalators smoothly without pausing, when exiting down they seemed to pause a little

Location 3

SURROUNDINGS:

- Nearby was hair salon, small shops and post office, and coffee shop
- Quite strong scent of food and bakery
- There was an Info board in few meters

- In 1st floor there was door to the parking lot, in 2nd door the hallway led to supermarket
- There were no loud background music, but the noise got bigger when going to the 2nd floor
- The location was quite calm
- There were no queues
- Escalators were located in quite small area
- Escalators were crossing with other escalators

ESCALATORS:
- Escalators were quite short, normal speed
- Escalator lighting was quite dim, but it got a bit brighter when exiting escalators
- Escalators were quite spacious
- Balustrades were see through plex
- Visibility from escalators to sides was not good because the building floor blocks the visibility
- Escalators seemed quite tidy and not too much worn out
- 1st floor around escalators was decent (large) space
- Also normal staircase was quite close to the escalators and they were used quite a lot
- Elevators were not very close
- No lighting in escalators
- When going up there was little jerking in the steps
- Handrail was very smooth, only small vibrations when going down
- Quite quiet escalators

Location 4

SURROUNDINGS:
- 1st floor lobby area seemed quite busy and active
- 1nd floor there was autowalk to the parking floor, close to the escalators
- 1nd floor there was cafeteria, seats, big billboards hanging from the ceiling
- 2nd floor was very bright and exit area was really large
- 2nd floor there were clothes stores
- There was quite quiet background music
- When going up the other side of the escalators opened to the hall area
- No queues
- Quite a lot of people

ESCALATORS:
- Escalators moved normal speed, quite fast and good speed
- Escalators seemed quite steep
- Quite tidy, except the platform where there were marks and stains quite a lot
- In the upper part of the escalators there was a loud squeaky noise that was quite disturbing
- Escalators were quite loud
- There were few bumps and vibrations during the ride
- Especially when going up there were quite a lot of disturbing bumps, jerks and vibrations
- Handrail was quite smooth
- Balustrades were see through plex

- The escalators seemed wide and spacious
- There was lots of space around the escalators when entering and exiting
- Not that many people were in the escalators at the same time
- Really good visibility and bright, good lighting with a lots of natural light

Location 5

SURROUNDINGS:

- 1st floor there was clothing store, infoboard next to the escalators, cafeteria and restaurants
- Exit was quite near
- 1st floor was quite dim
- When going down it appeared dimmer and next to the escalator exit there was a big infoboard next to the escalators
- 2nd floor exit was to a spacious and wide walking path, that was quite bright
- In 2nd floor area there were seats and waiting space next to the escalators, with very good visibility to the whole floor
- Lot of people using the escalators
- No queues

ESCALATORS:

- Quite narrow and steep escalators
- Speed was good and appropriate
- Balustrades were see through plex, other side was against the building wall and other opening up to the lobby area
- Escalators were quite dim but when going down the visibility was good
- When going up there was wall on the other side and escalators in the other side
- There was no lighting in the escalators
- Escalators were quite clean, small stains in the platform
- Handrail was quite smooth in both directions
- Not much vibrations but a small bump in the end of the escalators
- Visibility when going down was good and the ride seemed bright, especially 2nd floor there was lots of natural light

APPENDIX 6 THE MAIN CONCLUSIONS OF THE SPATIAL-CONTEXTUAL ANALYSIS

TABLE 8

Main conclusions of the contextual analysis

Location	Visual properties	Sounds and noises	General ambience	People, crowding, space	Escalator lengt and speed	Vibrations, jerks and smoothness of steps	Vibrations, jerks and smoothness of handrail	Passengers' overall comments
1	Good lighting, bright surroundings, lighting in escalators was a bit dim.	Loud noises and music coming from around space and shops, escalators were quiet	Calm, easy to find, easy to enter and exit the escalators. Tidy escalators and surroundings.	Not too much people, steady flow of passengers, didn't seem crowded, spacious areas around escalators	Escalators seemed quite short and fast	Quite smooth and only little vibrations. Few very small bumps.	Handrail was moving quite smoothly.	Fluent, pleasant, normal.
2	Bright area and very good visibility,.	No background music, quite quiet surroundings. Small noises coming from the escalators.	Very calm area, escalators easy to find, easy to enter and exit the escalators. Tidy and clean escalators and surroundings.	Very spacious around and in escalators, small queues during the lunch hour, people behaved calmly.	Escalators seemed long, speed seemed slower than normal	Smooth, not noticeable vibrations or jerks.	Noticeable handrail jerks while going down.	Good, easy, traditional.
3	Not too bright surroundings, in escalators it seemed quite dim and not too good visibility. Visibility around landing areas was quite good.	Quite loud background music, especially when going to the second floor. Escalators were quite quiet.	Quite strong scent of food coming from nearby bakery. Quite calm. Escalators were tidy.	No queues, the close by stairs were used quite a lot. Escalators were built in a quite narrow area, but escalators itself and the area around seemed spacious.	Normal length, speed seemed normal.	Little jerks felt when going down.	Handrail was moving quite smoothly, only small vibrations when going down.	Calm, normal, comfortable (/nice).

4	Very bright, good visibility, good lighting with lot of natural light.	Quiet background music, but the escalators kept quite loud noise and squeaking.	Busy and active area around escalators. Quite tidy escalators but at the platform there were some stains and wearing out. Surroundings looked tidy.	Quite a lot of people, but no queues or crowding in the escalators. Lots of space around and in escalators.	Escalators seemed steep. Normal length, speed seemed bit fast.	Few bumps and vibrations, which felt disturbing especially when going up.	Handrail was moving quite smoothly.	Noisy, slow, ordinary.
5	Lighting varied from dim to bright between floors. Good visibility around and in escalators.	No loud background sounds or noises from escalators.	Quite busy area, but quite easy entry and exit at the escalators. Escalators looked quite clean.	Lot of people but no queues or too much crowding.	Quite steep and narrow escalators, but the speed was good.	Not much of vibrations, some small bumps.	Handrail was moving quite smoothly.	Comfortable (/nice), normal, safe.