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Analysis of Human Behavior, in Everyday-Life Contexts, for the Development of New Technologies, in Support of the Improvement of Life Quality and Wellbeing

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A papà Giancarlo e a mamma Maria Grazia, le mie due anime indissolubili.
Grazie per essere stati sempre presenti, per avermi sostenuta in ogni mia scelta e, soprattutto, per aver costantemente creduto in me.
Vi amo.

A mia sorella Simona, perché ciò che ci lega è eterno e so che sempre potremo contare l'una sull'altra.
Ti amo.

A Polverozzo, una delle creature più speciali che io abbia mai incontrato.

“The major problems in the world are the result of the difference between how nature works and the way people think.”

Gregory Bateson

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Introduction

The present research project fits into a Eureka program supported by the Italian region Marche, the University of Macerata and MAC srl, a company based in Recanati, Italy.

MAC designs, develops and produces cutting-edge electronic systems and devices by placing final users' needs at the core of its actions and striving for a higher quality of life characterized by trust and safety. The present research builds on a conceptual and methodological framework that Mr. Luigi Mandolini (CEO of MAC) has developed and validated over the years and that underlies all of the company's projects. With a U-turn on the traditional view that people need to adapt to technological advancements, innovations and their surrounding environment by merely reacting to the various inputs coming from machines, a new approach places the human being at the center of the picture, with technology serving humans by providing the right products or services for users and their environments. After all, technology's purpose should be helping people to better manage their daily lives through a selection of ethical products and services.

Both the University of Macerata and MAC – each from its own perspective – agree that studying human beings and human behavior is the starting point of research and inspiration for innovation. Both partners constantly commit themselves to bridging the gap between humanities and technologies, as the technical side cannot be separated from the human side. Domotics and smart home technology are in close touch with the final users' minds and ways of perceiving, paying attention, understanding, learning, remembering and communicating. Studying these thought processes from the perspective of lifespan can help develop smart devices. With that in mind, MAC strongly supported the idea of a research study which could help gain an insight into the different aspects of human behaviors in everyday-life environments, in order to develop and experimentally assess cutting-edge technological products that are aimed at improving both final users' quality of life and perception of well-being.

The analysis of human behaviors in real everyday-life situations starts from the assumption that people who act on *indoor devices* (related to temperature, lighting, sound, etc.), at home and in offices alike, all too often are not entirely conscious of the functioning of these systems and cannot actually achieve well-being as intended. Actively interacting with a device in order to adapt technology to one's specific needs at a given time can result in non-negligible physical and cognitive efforts in weaker subjects. Precisely for this reason, such systems should "interpret" users' behaviors based on the latter's perceptions of thermal, luminous, acoustic, etc. comfort and/or discomfort in everyday-life indoor environments. Based on these considerations, with a joint

research project with the University of Macerata in mind, MAC responded to an announcement by the Marche region, which in recent years has promoted cooperation between local companies, universities and the local government. A project named "Analysis of human behavior in everyday life's contexts for the development of new technologies, in support of the improvement of life quality and wellbeing" was presented. More than three years of research in this field have been invested. In the early stages, the aim was observation in natural contexts. Subsequently, the focus became Ambient Assisted Living.

Starting from a review of the theoretical framework and business evaluation, the following research question was developed: "*Is it possible to create the best comfort possible (at thermal, luminous, acoustic level among others) in an indoor environment with minimized activity by final users, at any time?*". The present project focuses on a vision of technology meant to favor users' well-being and comfort, especially in more vulnerable subjects, notably non-self-sufficient older people. With final users in mind, regarded as sensors leading research and development of smart devices, the final aim is understanding human beings and human development over the course of life, to develop systems that can make the interaction between humans and machines as simple and effective as possible, and to provide people with special needs with adequate comfort (in terms of temperature, lighting, sound, etc.) inside their everyday-life environments.

In the first phase, through field observations in multiple indoor environments, both public and private (homes, offices, universities, etc.) in Italy and abroad (Europe and US), data were collected pertaining to the different reactions that users can experience in an indoor environment that is perceived as uncomfortable from a thermal point of view. A number of questions on how subjects behave whenever they feel (excessively) hot or (excessively) cold in a given environment at given indoor and outdoor temperatures were investigated: more specifically, which are their physical reactions, how do they express their discomfort (verbal communication), what kind of actions are directed towards oneself and/or one's environment. This information can be useful to plan smart and multifunctional indoor devices.

Ongoing dialogue and exchange of information between the University of Macerata and MAC and a joint review of the challenges and strengths of this study laid the groundwork for the next stage of the PhD program, namely the focus on Ambient Assisted Living. People with special needs, most notably senior people and people with disabilities, can benefit from an aptly structured home environment. An assisted living space aims at improving life for everyone on the long-term. It does so a) providing devices that can make life easier and empower individuals to remain relatively autonomous; b) enhancing the capabilities of users with special needs with regard to their

integration into work and community life; c) compensating for functional limitations, be it mobility, sight, sound, intelligence or speech and language impairment, and facilitating home care. The purpose of the project was extended to reaching the most vulnerable categories, providing comfort (at thermal, luminous, acoustic level among others) which for a number of reasons cannot be achieved autonomously inside private and institutional indoor environments. The need for field observations and the collection of data from people with special needs and their contexts made it possible to get in touch with a number of local healthcare facilities (nursing homes and rehabilitation centers) and with several professionals who are specialized in seniors care.
Every step of this project has been shared, shaped and re-adjusted jointly with MAC staff, who provided for the clear vision of a sound enterprise that keeps up with the times, the needs and the practices of the business world.

The strengths of the present research lie in the fact that it is centered on the human being in its entirety and complexity, and that an analysis in the field of human behavior has been carried out in everyday-life environments, in a constant effort to make humanities and technologies interact and communicate.

CHAPTER 1
THEORETICAL FRAMEWORK

The theories detailed in the present chapter serve as theoretical framework and starting point for the research project described in the following chapters. A number of theories underpin the research project, namely lifespan psychology, Kurt Lewin's field theory and Urie Bronfenbrenner's ecological systems theory.

1. Lifespan psychology

The present research study focuses on human behaviors in everyday-life environments. The theoretical framework that underpins it is known as *lifespan psychology*, whereby "lifespan" refers to an individual's cycle of development over time, as well as his/her family's and his/her surrounding environment's respective developments. Lifespan psychology traces its roots back to Erik Erikson's contribution to the field of psychology (Erikson, 1951, 1959, 1968), Elder's well-known study "Children of the Great Depression: Social Change in Life Experience" (1974) and D. J. Levinson, Darrow, Klein, M. H. Levinson & McKee's "The Seasons of a Man's Life" (1978). These works mark a departure point, moving away from the traditional vision of human development which sees adult age as the final step of an individual's transformation, and consequently senior age as the individual's decline. In addition to that, these works place the individual's development in an extensive network of "linked lives", all with their respective moments in time. In the life cycle, the notion of non-chronological age – transcending biological factors and the individual's position inside his/her lifespan – is of the utmost importance: it is based on one's self-perception, social and functional factors (e.g. ability and stability towards one's contemporaries).

At the core of this theory lies the assumption that development extends across the entire life course and it is marked by an alternation of processes of acquisition and skill loss, with remarkable case-by-case variability in terms of evolution and change patterns, and with no maximum level of mental development being ever attained, but rather a number of diverse contexts in which each individual need to develop different adaptive approaches. Development is intrinsically complex, and is formally structured in a flexible pattern of phases or steps. Each phase includes moments of growth and decline, which need to be regarded as joint processes. Mental development is co-determined by personal, domestic and environmental factors. It can take many forms depending on one's living conditions from a historical, social and cultural point of view.

Among the main models founded on the notion of lifespan, Erikson's (1951) and Levinson et al.'s (1978) should be noted. Erikson's model creatively combines clinical and social perspective, backed by contributions from the fields of anthropology, sociology and history. The scholar sees each step of one's lifespan − infancy, early childhood, play age, school age, adolescence, young adulthood, middle adulthood and late adulthood – as marked by specific psycho-social crises, veritable cornerstones and initiators of developmental dynamics. These crises are triggered by adaptive – to varying degrees – resolutions of the clash between two predominant features in each stage of development. Erikson's model interestingly crosses over to the social dimension, notably from an intergenerational and historical perspective. Each life phase in its own right feeds into the "ongoing cycle of generations", which is crucial to maintain ever-evolving social structures. Erikson's theory of psycho-social development deserves recognition for taking the whole human lifespan into account, including those moments of transition and re-structuring of one's identity in each of these phases. It additionally stresses the importance of society's role in defining developmental normativity.

Drawing inspiration from Erikson, Levinson also investigated life stages, particularly adulthood. In Levinson's view, the course of life is marked by phases of change and consolidation, each lasting approximately 7 years and each carrying definite developmental commitments. Levinson argues that life structure evolves in a relatively fixed pattern, with a number of stable periods (aimed at "building" one's life) followed by transitional periods, where the structure itself is subject to change. If developmental commitments of a given phase are aptly taken by an individual, he/she can attain – depending on the key choices made during the transitional period – a "satisfactory" structure, i.e. a structure suited to oneself and applicable within one's social environment. Life structure can present disorder and fragmentation, which over time lead to further changes. In Levinson's "seasons of life theory", developmental commitments mean fundamentally making choices, implementing them and accepting their consequences, with consideration for the past, present and future of an individual and one's surrounding environment(s). Transitional moments are linked to crucial choices, which lead to structural changes during one's lifetime. During transitions, the individual lives with the consequences of his/her choice. Each transitional period marks the end of a life structure and the early beginning of a new one. Decision-making is the backbone of one's life structure, with life paths being neither universal nor unchangeable, as they are influenced by countless variables.

The early shift from the individual nature to the social nature of the lifespan focused on the family unit, regarded as the primary learning environment and the place of ongoing negotiation between

parents and children to assert one's identity. The notion of family life cycle – a concept borrowing from sociology – made its way into psychology in the 1970s, notably in Haley's work (1973). Family lifespan indicates that there is a tight interdependence between the individual life cycles of various family members.

Possibly, the most recognized and successful formalization of lifespan is that of Baltes (1978, 1987). Baltes argues that, despite the existence of constant underlying processes in the mental functioning, human development requires a number of subsequent adjustments as a reaction to various changes that the individuals face and experience. Through a depiction of the human lifespan as a curve displaying the impact of some factors on the lifespan itself, Baltes mentions *normative or age-graded changes* (i.e. influenced by one's biological age strictly speaking, with underlying factors shared by all or almost all individuals, namely physical changes or those steps of social life regulated by law), *seminormative or history-graded changes* (i.e. influenced by history; though not inescapable, these changes are widespread in the population) and *nonnormative changes* (i.e. personal experiences or experiences that are shared by only a segment of society and which do not constitute obliged or predictable turning points).

Consequently, lifespan psychology puts forward *a vision of humans as ever-changing beings*, both in what is referred to as the age of development and during later stages. The following phases were once considered insignificant in terms of notable changes. By contrast, every phase of human life is marked by cumulative processes, i.e. it builds up on background experience, and innovative processes, i.e. it relies on turning points which lead to the acquisition of new knowledge and skills. Generally speaking, changes are caused by body transformation (physical growth / decline), psychological characteristics (e.g. knowledge-based skills), relationships with other people (e.g. parenting) and the interaction with one's physical environment (e.g. accidents and injuries). Other changes are based on the social group(s) that the individuals join or leave (e.g. education, work, retirement). Each change, be it caused by one's body transformation or one's social environment, has psychological repercussions, its causal relationship being articulate and bidirectional. In addition to that, due to the principle of "timing of lives" (Elder, 1998), each event has a different impact according to the moment in which it occurs in one's lifetime, and is a transformational factor of the individual overall. A number of factors deserve attention: these are the element responsible for triggering the change, timing (e.g. the awareness of being "out of time" compared to society's expectations is a cause of distress), assessment of the situation and one's perceived control over the situation, roles (e.g. humans play different roles simultaneously all along their lives), the duration of an event (temporary and/or permanent), previous experience the individual can tap into, and finally

stress (which can also be due to concurrent situations). In this regard, Reese & Smyer (1983) address the notions of life event dimensions, i.e. the objective characteristics of events, perception dimensions - i.e. subjective evaluation of events - and effect dimensions - i.e. visible outcomes and consequences of events. The two scholars further make a distinction between type of event (socio-cultural, personal, biological and physical-environmental events) and contexts (self, family, social relations, work, etc.). In changes, both for the better and for the worse, the kind and magnitude of the available resources are pivotal. Resources are more in the event of age-graded or historical-graded changes, since individuals can tap into a database of guidelines and shared experiences, whereas when facing and supposed to change in relation to nonnormative events, individuals have fewer resources at their disposal. One's resources can originate from oneself, i.e. demographic, personal and psychological features (maturity, personality, commitment and values), support, i.e. social networks of people, places, things, ideas and organizations, and strategies, which can be divided into environment-focused coping strategies (i.e. action aimed at altering situations and/or claims) and personality-focused coping strategies (i.e. development of additional strategies and/or skills, in order to alter one's perception and assessment of situations). Life paths are a patchwork of stability and change areas, and yet *continuity* is perceived by individuals. To sum up, in accordance to lifespan psychology, development is a process which can be described in its nature as: *multidimensional* (as it covers various domains and its pace and timing can change all along); *multidirectional* (as it is not a progressive, linear process all along one's lifetime: it can alternatively show signs of improvement and worsening, and include gains and losses at intra-personal, inter-personal and professional level); *interactive* (individuals and their environments are subject to interaction and mutual influence: understanding development can therefore be achieved only through investigation of psychological factors together with environmental factors at different levels); *plastic* ("intra-individual plasticity" reflects the fact that one's life course is not always necessarily dependent from early experiences, but rather it can take different forms, and to a certain extent it is possible to act on development patterns already underway and change them). Very importantly, lifespan psychology investigates changes occurring all along one's life course, from birth to death. It ushered in *a new vision of elderly people and ageing*, moving away from an imagery of decay, decline and loss to embrace old age as a phase in which re-structuring and change are still possible. During senior age, psychological decline and progress go hand in hand: "precisely the conditions of loss and constriction can push for new forward-looking strategies and loss-control strategies to be learned" (Castelli & Sbattella, 2008, p. 284, author's translation). The works of Baltes, Lindenberger and Staudinger (1998) are based on the observation of various cases of elderly

people within society. It is shown that cognitive decline is not inescapable, but rather linked to a set of living conditions at domestic, social and professional level. Based on these results, and acknowledging that individual culture and social culture can compensate for reduced biological functions, P.B. Baltes & M.M. Baltes (1990) promote a positive culture of old age: ageing is regarded as a heterogeneous process (both within single people and across people of the same age) implying decay of fluid intelligent (i.e. speed of perception, memory capacity, problem-solving) in which, conversely, crystallized intelligence-based skills (including cultural intelligence, language and social skills based on experience and expertise) can be enhanced all along one's lifespan. Older people consequently act by making use of mechanisms of *selective optimization with compensation*, i.e. they select where to invest new energies to discover or investigate a new domain, striving for self-improvement, and counterbalance some skill loss by re-adjusting some of their goals, using already acquired and consolidated strategies and looking for new resources. Cristini, Cipolli, Porro & Cesa-Bianchi (2012) point out that this narrative does not reject age-induced involutions, but rather testifies to the presence of enhancement and upgrades, also in senior people experiencing serious physical and mental decline. This awareness can often help to better envisage and implement recovery measures. During old age, many skills can actually be developed. An ongoing growth process can be witnessed, in which people display their own characteristics and specificities more effectively, providing for a role continuity at micro-systemic and macro-systemic level and consequently a strong and stable sense of inner identity.

Drawing from Adler's theory of individual psychology (1921) on the subjects of inferiority and superiority complexes as well as hyper-compensation mechanisms, Vygotsky (1986) argues that *compensation* is the "law of psychic life": a skill deficiency is partially or completely compensated by the enhancement of a different skill, with deficit spurring compensation. In the event of a deficit (e.g. blindness, deafness, mental retardation due to cerebral palsy), an extremely diverse array of creative forms of development are triggered, some of them being extremely original and, according to Vygotsky himself, not witnessed in the standard development of a normal child. According to this dynamic approach, "weakness gives way to strength, impairment to ability". A lack of resources generates substitution processes aimed at paving alternative ways to development. This casts a positive light on deficit, which is regarded as a source of strength and a toolkit of possibilities: according to Vygotsky, deficits had been previously regarded statistically as mere flaws and the positive forces triggered by deficits had been neglected in the field of education. In Vygotsky's view, analysis should not focus on deficit per se, but rather on the individual as a whole and everything that he/she does in order to overcome difficulties. Vygotsky provides various

examples to corroborate this statement: he frequently refers to visual impairment and mentions children who are blind from birth. Blindness to them is natural and not pathologic. It is context that prompts these children to think that they are not only different, but even inferior to other children. The problem lies not so much in the deficit itself, but rather in the social depiction of deficit by one's environment: Vygotsky claims that deficit is fundamentally a social product. Based on this assumption, he believes that helping subjects channel their strengths in an attempt to hypercompensate deficit is a task that must take the subjects' social environment into account. In line with this thought, Vygotsky highlights that personality needs to be considered not so much as an organism determined by its own background, but rather as a forward-looking organism striving for socio-psychological fulfillment (Vygotsky, 1986, p. 50).

This clearly shows the extent to which the scholars dealing with the notion of lifespan have drawn influence from the line of research on the historical-cultural paradigm, in particular Vygotsky (1934). He argued that the individual's psychic processes need to be placed within the individual's own historical, cultural and social context in order to be properly understood. From this perspective, development is deeply anchored in a given historical-cultural context, and results from the interaction between the individual and the environment. In his social-cultural approach, Vygotsky stresses the influence of culture, peers and adults in child development. He notably reproached his contemporaries for studying individual behaviors in laboratories, detached from society, as he viewed development as an internalization of forms and sets of cultural belief occurring through relationships with other people. Social interaction becomes a factor serving to define the development of thought and behavior alike, causing ongoing step-by-step changes. Development is a social process mediated by language, which is used by the child to communicate with its reference people, language being the most important tool to propagate one's culture and, crucially, to plan one's action, consider past events and plans for the future. According to Vygotsky, thought and language have different origins, but eventually mix and influence each other. Language has originally a social function, but with time an intra-personal function comes into play: while language is acquired through adult models and social relationships, it is progressively internalized to become a guide to one's thoughts and behaviors. For Vygotsky, the inter-psychological level is more important than the intra-psychological one: children's cultural development is based on it. The intra-psychological level depends on timing, an individual's specific historical-cultural context, and the extent to which he/she is allowed to master his/her own cultural instruments. Every social-cultural context has its own timeline that can be divided as follows: 1) phylogenetic level (development of the human species); 2) historical-cultural level (historical and cultural development

of mankind); 3) ontogenetic level (development of a single human being); 4) microgenetic level (development of a single psychological process). Every group / culture shapes meanings through interaction, with contents being added to what has been known and thought before. According to this view, change can vary considerably from one culture to another, with the focus on individual differences which are regarded as a value to be treasured by the community / culture.

Vygotsky's socio-cultural theory strongly influenced Bruner (1990), who argues that every mental process has a social foundation and that culture influences human cognition through symbols, artifacts and beliefs. This influence is achieved through the social relationships that a child establish early on with its reference people. The world is seen and interpreted through a number of factors, including learning, experience, environment and culture. Bruner states that every knowledge act starts from the mind, which shapes culture. The specific culture in which knowledge is expressed shapes in turn the mind. Culture is therefore considered a shared an social interpretation of reality, whereas the mind is an inter-subjective organ evolving due to and through relationships with other human beings. The set of beliefs and values of a culture is disseminated through language, particularly through storytelling. This pertains to the psychic reality and is based on the intrinsic logic of human actions (desires, feelings, affections and beliefs) and interactions among individuals (social rules and grounds). Storytelling organizes experience and shapes and passes on meanings. The social domain has an impact not only on the way humans shape representations, but also the contents of representations, i.e. shared notions and categories that comply with a given culture.

To conclude, the notion of individual, domestic and social lifespan is a response to the recent need of social sciences to focus more on processes than outcomes, on longitudinal investigation more than cross-sectional investigation, and to acknowledge the complexity of variables that concur to define human development and human systems. Cognitive, emotional, affective and social elements are tightly interconnected and are subject to mutual interactions.

2. Kurt Lewin's field theory

The present research project draws considerably on the relevant notion of "field". Field theory was developed by Kurt Lewin (1936, 1951): he described psychology as a social science, with the human being – with its behaviors and needs – and the environment at the core of its analysis. One key concept of his theory is permeability between a subject's inner world and the outside world. Action is in the foreground as a means to influence both the outside world and the individual. People can change the structure of the world surrounding them and can in turn be changed by it. In Lewin's view, human behavior gains significance and can be studied as part of a system of

relationships between people. This system can be described in every single situation as a complex psychological force field, as expressed by the well-known formula: B = f (p, e), meaning that behavior is studied as determined by personal and environmental factors. The basic statements underpinning these theory are: "a) Behavior must be derived from a totality of coexisting facts; b) These coexisting facts make up a "dynamic field", which means that the state of any part of the field depends on every other part of it" (Lewin, 1972, p. 44). An individual's behavior is, in other words, correlated to the interaction between the individual him/herself and the context he/she finds him/herself in at a given time. Inside a group, each individual can be seen as a source of actions whose behavior alters every member of the group and the group itself, which can be seen as a psychological field. At the same time, the subject is in turn influenced by every single member and by the group as a whole. The group's structure is continuously altered due to the changes in the individuals making up the group and their relationships. The psychological field (also described as "life-space") is a comprehensive dynamic system encompassing one person, one environment and one behavior. These three elements are crucial to build and qualify the field itself. The psychological environment must be regarded functionally as "a part of one interdependent field, the life-space, the other part of which is the person" (ibid. p. 191). Each element is in its own right a field: a person is defined through his/her relations with the environment; the environment is determined through the relation that a person establishes with all of the surrounding world; and behavior originates from every change made to the field. According to Lewin, "a group can be characterized as a dynamic whole. This means that a change in the state of any subpart changes the state of any other subpart" (ibid. p. 252). Consequently, the rules governing a field do not originate from the singularity of each member, but rather from the structure and interrelations of the field itself. The highly significant *notion of interdependence* comes into play, as it is the foundation for the field to be established: if one "characterizes an object or event by the way it affects the situation, every type of fact is placed on the same level and becomes interrelated with any other fact which affects the situation" (ibid. p. 201). The field includes a representation of space relations between its psychological events. Lewin defines the geometrical representation of space relations between psychological factors as "hodological space". All this occurs within a limited field, at a given time, and can be explained through the field properties at the moment in which a given event occurs. The notion of *coincidence in time* is pivotal, as each behavior or any other change within a psychological field "[…] thus depends on the configuration of the psychological field at a given time" (ibid. p. 70).

Simultaneity emerges as a pivotal notion underpinning Lewin's "Action Research" methods. At the time when a collective phenomenon is investigated, this is subject to change. This notion does not imply an underestimation of a subject's background experiences, but rather "[…] a behavior B at time t is a function of a situation S only at a time t (S including of course both the person and his/her psychological environment), B (t) = f (S(t)), and not also a function of past or future situations S (t-n) or S (t+n)" (ibid. p. 73). The notion of "*situation at a given time*" does not refer to a moment in time which has no extension, but rather to a given period of time. Lewin additionally stresses that past has an indirect effect on behaviors: "[…] the past psychological field is one of the "origins" of the present field and this, in turn, affects behavior" (ibid. p. 91). A link can be established between the behavior and the past field only if there is sufficient knowledge on how past event has altered the field at the time a given behavior occurred only if any events are known that have further modified field in the meantime. Of course, a person's behavior does not depend merely on the current situation: "[…] his mood is deeply affected by his hopes and wishes and by his views of his own past." (ibid. p. 105). Morale and sense of security seem to depend more on future expectations than present situations. Lewin defines the whole of one's individual's viewpoints on one's past and one's future at a given time as "*temporal perspective*". This phenomenon, as well as all other elements in the field, is dynamic in its nature and ever-expanding as the individual's development continues. Moreover, temporal perspective is closely linked with valence changes (both positive and negative valences) and of goals, which depend on the individual's level of aspiration. There can be positive or negative valences whenever an attractive or repelling force, respectively, operates with varying intensities. Lewin defines the *notion of change* as moving up from the present level to the next, the one that the individual strives for. He argues that an effective change in a given field requires a connection with the field conditions at a given time and an all-round analysis of circumstances. "The structure of the life space determines which locomotions are possible at a given time". (ibid. p. 329). Changes actually depend from a constellation of psychological forces. At a given point in time, each force dictates the direction and intensity of a change trend. Additionally, a relation between the type of valence and needs exists, as any element that satisfies a subject's needs acquires a positive valence to him/her, whereas if it does not, it acquires a negative valence. Valence is not permanent in its nature, i.e. a valence that is now positive may over time become negative, and the opposite can also be true. Considering that many objects or situations in our environment bear valences from our own viewpoint, conflict may frequently be experienced. Conflict arises whenever a subject is faced with at least two elements, both bearing either positive or negative valence. Elements need to have a coincidence in time,

implying mutual exclusion, and the same intensity, i.e. the two objects must have equally strong attracting forces.

3. Urie Bronfenbrenner's ecological systems theory

The "ecological model" draws from Lewin's field theory (1936, 1951) and harks back to the basics of systemic theory, which sees systems as made up of a number of parts in a mutual relation, with a change of one part forcibly implying a change in all other parts. The main contributor to the ecological theory of human development has been Bronfenbrenner (1979). He developed the PPCT Model ("Process-Person-Context-Time"), which was presented for the first time in his book "The Ecology of Human Development". The PPCT Model is based on the analysis of processes regulating interaction between the individual and the environment. Individual as well as contextual components are taken into account. The main assumption of Bronfenbrenner's work is that human abilities and their progressive evolution do not rely on single elements and are not in a linear cause-effect relation; conversely, they are deeply tied to the social and institutional context – in a broader sense – in which individual activities take place. Individual development, group, environment and learning are therefore strictly correlated and interdependent. Bronfenbrenner's ecological model is "as a set of nested structures, each inside the other like a set of Russian dolls" (Bronfenbrenner, 1986, p. 31). An analytical distinction is made between different types of "ecological environment" as inhabited and experienced by people and to which they are directly or indirectly bound. Ecological environments are depicted as a series of nested structures: microsystem, mesosystem, exosystem and macrosystem. At the core of this configuration of elements lies the microsystem, i.e. the set of various environmental contexts that engage the developing subject and are directly experienced by him/her (e.g. household, family, school, friends, social group etc.). A microsystem is made up of relationships, roles and activities: these determine and influence human development the most. The next level (mesosystem) is made up of relations, links and ties between different life environments that the developing subjects engages in. The third level (exosystem) is made up of the interconnection between two or more social contexts, one of them at least being out of the subject's direct scope of action (e.g. institutions) but having nevertheless an indirect influence on him/her. The last level, known as macrosystem, is made up of laws, sets of values, political, moral, religious and cultural aspects characterize every society. It is the organizational, ideological and cultural macro-context that gives coherence to the whole system, as if "matrices" identify and qualify all structures based on particular isomorphisms. The "ecological environment" is not steady, as it evolves over time according to what Bronfenbrenner deems a chronosystem: both the subjects and

the ecological systems experience progressive development and mutual and constant influence. Every event, action and/or emotion is experienced from the micro level to the macro level.

4. Conclusions

As acknowledged in the conceptual framework outlined above, from deterministic and mono-causal models (Freud, 1896; Watson, 1930) – which deterministically trace back human development and behavior to one or a few (environmental and/or biological) causes – a shift towards probabilistic and multi-causal models occurred – which by contrast advocate a systemic vision of development, seen as the result of an individual's actions in a context. Such actions trigger changes not only in the individual him/herself, but also in the developmental environment, mutually and continuously over time. In addition to that, the evolutionary model known as "person-context theory" by Magnusson and Stattin (1998) is based on the theoretical assumption that an individual and his/her environment are inseparable parts making up an integrated and dynamic system where they experience mutual influence. The notion of dynamic interaction underpins those processes within mindset, biological and behavioral patterns and the individual's behaviors, as well as processes within life contexts and processes triggered in the relation between individual and environmental factors. The mutual relationship that develops over time between the person and the environment and the structural role of the individual's actions through cognitive activity are pivotal. In this dynamic interaction, what may seem a cause (or independent variable) at a given time can *over time* become an effect (or dependent variable) in its own right. Just like individuals change in their inwardness, context too changes along with development, its alterations being determined by significant historical and social shifts as well as the action of individuals that shape the environment they inhabit. The scope of the individual's actions is both at the proximity (e.g. family, school, peers group, etc.) and the distant level (i.e. the social and cultural environment at large). They operate through systems of shared signs and symbols, most importantly language, since individuals are responsible for shaping culture and social life (e.g. politics, work life, trends). The environment is a database of information which is assessed and processed by people: in holistic interactionism, investigating perceived environments is preferred, as the individual's representations and mental constructions are responsible for guiding people's behavior – though investigating objective environments is still much needed.

Lifespan psychology is based on a dynamic interaction between humans and environments: it introduces *a vision of humans as ever-changing beings*, both in what is commonly referred to as the age of development and during later stages, which were once considered insignificant in terms of

changes. Lifespan psychology additionally advocates *a new vision of elderly people and ageing*, moving away from the narrative of decay, decline and loss while embracing a new framework of re-structuring and advances. With individual and social culture being able to compensate for reduced physiological functionality, P.B. Baltes and M.M. Baltes (1990) promote a positive vision of old age, in which ageing is a heterogeneous process (both within single people and across people of the same age) implying decay of fluid intelligent (i.e. speed of perception, memory capacity, problem-solving) in which, conversely, crystallized intelligence-based skills (including cultural intelligence, language and social skills based on experience and expertise) can be enhanced all along one's lifespan. Cristini, Cipolli, Porro & Cesa-Bianchi (2012) point out that this narrative does not reject age-induced involutions, but rather testifies to the presence of enhancement and upgrades, also in senior people experiencing serious physical and mental decline. This awareness can often help to better envisage and implement recovery measures. During old age, many skills can actually be developed. An ongoing growth process can be witnessed, in which people display their own characteristics and specificities more effectively, *providing for a role continuity at micro-systemic and macro-systemic level* and consequently a strong and stable sense of inner identity.

In this theoretical framework, the present research project focuses on technology enhancing users' well-being, especially in more vulnerable subjects, with particular emphasis on non-self-sufficient senior people. Actively interacting with smart devices in order to adapt technology to one's specific needs at any given time can result in non-negligible physical and cognitive efforts in vulnerable subjects. In this regard, the present study aims at understanding human beings and their development through the lifespan, detecting and assessing their actions and physical reactions in order to make the human-machine relation as simple and effective as possible so that users can feel at ease and can attain a high level of comfort in their real-life, everyday-life indoor environments.

CHAPTER 2
SMART HOME: AN OVERVIEW OF SCHOLARLY SOURCES

Investigating human behaviors in everyday-life environments starts with the notion of technology specifically meant to ensure users' well-being and comfort, especially in more vulnerable subjects, notably non-self-sufficient senior people. Over time, people have always had to adapt to technological developments, innovations and their surrounding environment by simply reacting to inputs provided by the machines. All too often, people acting on *indoor devices* (related to temperature, lighting, sound, etc.) – at home and in offices alike – are not entirely conscious of these systems' impact and cannot actually achieve well-being as intended. With thermal comfort in mind, it can be observed that all too often users must endure indoor thermal systems, as they frequently cannot take control to regulate a level of temperature that is 2-3°C above or under their comfort threshold. For instance, even if users feel hot, they do not take action to overcome their discomfort: hardly ever would they act directly on the devices, other than opening the window or taking off their coat, also because any alteration made on the surrounding environment would imply a cost in terms of energy savings. At the present time, heating systems are mostly used incorrectly, leading to gratuitous discomfort and considerable thermal shocks, with consequent energy and money waste and environmental damage.

Moreover, active interaction with devices in order to adapt technology to one's needs at a given time can result in significant physical and cognitive efforts in most vulnerable subjects. Precisely for this reason, such systems "interpret" users' behaviors based on the latter's perceptions of thermal, luminous, acoustic, etc. comfort and/or discomfort in everyday-life indoor environments. Users would feel more actively involved, as they would not feel like they are passively enduring a given situation with no control over thermal systems, especially those subjects experiencing reduced autonomy. As detailed in the following chapters, the user's feeling of control over devices is crucial for people's comprehensive well-being. The aim of this study is understanding human beings through the detection and assessment of their actions and reactions, taking their real-life and every-day life environments into account in order to develop devices that can truly ensure comfort, predicting users' needs with no need from the users to say and/or do anything – thus transcending the users' direct inputs.

The present chapter will focus from a scientific perspective the notions of smart home or Domotics and Indoor Environment Quality (IEQ). More specifically, the "temperature parameter" and the notion of thermal comfort lie at the heart of the present research, with regard to gender differences.

Assisted living for specific target groups is also addressed within the framework of active ageing and the relation between ageing, thermoregulation and lighting.

1. Domotics: meanings and main definitions

Smart home, home automation and domotics are three different way to refer to the same concept, namely a living space where electric and electronic systems exchange information in order to improve quality of life, safety and domestic spending of the residents a given environment. The term “domotics” originates from a contraction of the Latin "domus" (house) and the adjective "automatic". Domotics is a multidisciplinary field of research stemming from the integration of applications developed in the fields of information technology, electronics and telecommunications applied to construction, aimed at improving the occupants’ quality of life. A house where assisted living devices have been installed during construction works can aspire to become a “smart home”: with simplification of use in mind, a computer or control unit makes elements, devices and indoor electronic systems interact (these include windows, shutters, blinds, screen curtains; entrances such as gates, doors and garage; video surveillance systems, door entry videophones and intrusion alarms; heating and cooling systems; lighting system; awnings, canopy roofs and any sun shield). Smart homes boost the occupants’ quality of life, simplify a number of repetitive actions, help saving energy, monitor spending, use natural and artificial lighting optimally, protect people and ensure safety through alarm systems or incident detection and response tools (smoke, flooding, power surges, etc.). Wireless assisted living systems can be controlled via phone and the web. This means that people can access and control their home systems from a long distance, and a number of options such as e-mail or text message services can be activated in the event of alarm situations, e.g. when a burglar alarm is activated or a gas leak is detected. Domotics aims fundamentally at controlling every part of a house, both indoor and outdoor, without the need from the resident to stand up from his/her chair or use tools, in real time and with no difficulties. The main advantage of domotics is delegating control of a number of devices to the house itself, so that people can avoid having to manage heating, power, cooling etc. systems themselves. The house automatically deciphers information coming from various rooms and environments, and consequently regulate them via its connected devices. Domotics is applicable in both homes and public spaces such as offices, shopping centers and/or industry plants (the latter case is known as building automation).

2. Indoor Environmental Quality (IEQ)

Physical and environmental parameters such as temperature, relative humidity, acoustic quality, air quality, lighting and ventilation concur to defining Indoor Environmental Quality (IEQ). These parameters are all interconnected, with *comfort* being a combination of responses that the human brain provides to one's senses in relation to a set of environmental factors (physical environment and services) and individual physiological conditions, including but not limited to health, social relations and economic status.

Planning, building and managing buildings with high-level environmental quality is a challenge for the future, not least because IEQ often clashes with the need to save money. On the other hand, IEQ is gaining significant recognition in evaluating sustainability and price of property, with remarkable profits in terms of productivity for workers operating in those buildings. Quality management in indoor environments requires an integrated monitoring strategy, with assessment and optimization of the various components of the said environment, from design to construction and maintenance.

To assess the level of IEQ, which crucially ensures good health conditions to a building's occupants or residents, a number of parameters have been identified. These are *thermal comfort, air quality, acoustic quality, quality and intensity of lighting*.

In this regard, it is important to stress that the sunlight is at the core of all human activities: not only does it allow to see one's surrounding environment, but it regulates our body's functioning. Sunlight and artificial light sources have a big impact on our bodies: the functioning rate of all human organs follows the daylight/darkness cycle over twenty-four hours. Positive effects of sunlight on our bodies are: 1) *longevity*: most of the vitamin D present in those people exposed to much sunlight can have positive effects on the well-being of the heart-circulation system; 2) *sleep and wakefulness pattern*: sunlight influences our circadian rhythm. Exposure to sunlight during the day is a way to communicate to the brain that it is expected from it to remain active; conversely, when the sun goes down, the body knows that it is expected from it to enter rest mood. Sun exposure is therefore important for our sleep and wakefulness; 3) *weight control*: in relation to circadian rhythm, sunlight exposure in the early morning normally results in sleeping better and having a better body mass index; 4) *mood*: sunlight is good for our mood. People who experience much sunlight exposure and spend much time outdoors during the day are less likely to suffer from depression; 5) *skeletal health*: the human body produces vitamin D when exposed to the sunlight, which is responsible also for helping the body to absorb calcium, which crucially helps skeletal health.

This being said, it is important to stress that work, study and some of our leisure activities normally take place in indoor environments, with most light exposure being that to artificial lighting. New findings in the fields of biology and technological developments in the field of illumination design helped shape the notion of *Human Centric Lighting*, i.e. an approach centered around a single project aimed at investigating the impact of lighting on the human body. The aim of making lighting a crucial technology to support health, comfort and productivity is also shared with Lighting Europe, an association that represents the lighting industry in Europe. At present, indoor artificial lighting can enjoy a more balanced relation with outdoor natural lighting, resulting in a more consistent illumination which can ensure comfort and is in tune with the natural body rhythm. Actually, regulatory systems can even ensure a varying lighting all along the day to imitate the natural sunlight pattern, or change intensity to match individual needs, e.g. to boost concentration after meals or to make people more active early in the morning. The production of serotonin, an hormone contributing to feelings of well-being, comes into play in the relation between light spectrum and physical and mental. Lighting design must therefore take into account two fundamental aspects: color rendition and color temperature. Clearly distinguishable colors together with the right color temperature lead to relax and enhanced comfort, also in an attempt to match furnishings.

2.1 IEQ: an overview

A number of scholarly articles on IEQ have been used for this research. They describe surveys which took place in the following countries: Australia, China, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Korea, Malaysia, the Netherlands, Portugal, Spain and the US.

These articles indicate that the scope of IEQ lies in its impact on energy consumption in buildings and people's comfort, health and productivity. IEQ is deeply tied to cognitive functions, which considerably enhance wholesomeness of the building, and the notion of overall well-being, i.e. approval of sunlight and artificial lighting, room temperature (hot / cold) and air quality (dry / wet) (MacNaughton, Satish, Cedeno Laurent, Flanigan, Vallarino, Coull, et al., 2017).

Occupants' behaviors are closely tied to multiple factors originating from various features at physical, social, cultural, psychological level among others (Lee et al., 2011, 2012). Relations between perceived indoor environment and occupants' comfort vary according to one's socio-cultural context, personal features (gender, age and effort reward imbalance index) and characteristics of the building (e.g. type and location) (Sakellaris et al., 2016). Links between the factors above can be extremely complex and have an impact on individuals in the short and long

term (Babisch, 2008; Fisk et al., 2007; Lewtas, 2007). The term 'behavior' refers to any direct or indirect action implemented by a resident or occupant to achieve the best comfort possible according to his/her judgment in an indoor environment. The residents' behavior is not only a physical response, but also a psychological one in relation to environmental conditions. Understanding residents' behaviors can help foreseeing indoor energy consumption (Asadi, Mahyuddin, & Shafigh, 2017). Habits can influence in their own right the residents' adaptive responses. Sometimes, inappropriate adaptive behaviors are put into place, which can influence the residents' subsequent coping with their environment (Liu, Yao, & McCloy, 2013).

Four parameters are advocated to determine IEQ. These are Thermal comfort (TC), Visual Comfort (VC), Indoor Air Quality (IAQ) and Acoustic Comfort (AC) (Clausen & Wyon, 2008; De Giuli et al., 2012).

Acoustic comfort as detected inside buildings is the ability to protect occupants from noise and guarantee an acoustic environment which is compliant with the purposes for which a building has been constructed in the first place (Greek Legislation, 1989). Inside business buildings, a direct relation exists between acoustic comfort and the residents' productivity (Landstrom et al., 1995). A thorough analysis of parameters indicates that comprehensive comfort is most frequently associated with comprehensive noise level inside a workplace (e.g. phone calls, chattering colleagues, copy machines, etc.) by its occupants. Office arrangement (together with the notion of privacy) is the second parameter most frequently associated with comprehensive comfort (Sakellaris et al., 2016).

Visual comfort pertains to illumination and frontage of one's post, and is crucial for both well-being and productivity inside buildings (Leech et al., 2002; Serghides et al., 2015). Various studies focused on the importance of visual comfort on work performances, productivity, comfort and overall satisfaction (Veitch, 2001). Windows, sunlight and a natural view (a good view from the windows of the surrounding area) have a therapeutic impact on one's physiological and mental well-being (Aries, 2005; Xue, Mak, & Cheung, 2014). Artificial lighting seems to be connected with eroded levels of luminous comfort; insufficient lighting and reflected light result in reduced ability to clearly see objects and details (Leech et al., 2002). The perception of light uniformity is the main factor influencing residents' sensations, as it helps them see better. Sunlight normally has a positive impact on people's mood (Sakellaris et al., 2016; Xue, Mak, & Cheung, 2014).

As argued by Zhao, Kim, & Srebric (2015), ventilation is the most important parameter in assessing environmental quality satisfaction. General cleanliness and fresh air in particular are deemed important: people seem not to endure stale are for a long time.

As indicated by an analysis of scholarly articles, both temperature and noise rank as the key IEQ parameter to define indoor environmental comfort. Temperature seems easier to be defined as a parameter than noise (Huang, Zhu, Ouyang, & Cao, 2012; Quang et al., 2014; Sakellaris et al., 2016).

People feel happier and overall more satisfied with regard to the building they spend time in whenever they feel that they can exert a certain degree of *control over their environment*, with the notion of "control" pertaining to the perceptions of confidence self-efficacy and subjective well-being. Reduced capabilities or possibility to interact with one's environment, e.g. not being able to open a window, often triggers an increasing number of physiological reactions, including increased levels of temperature and skin hydration (Schweiker, Brasche, Bischof, Hawighorst, & Wagner, 2013).

The limitations of these studies include a limited number of perceptive being taken into account, a limited number of studies having been carried out in Italy and a large number of research studies having taken place in offices, schools and climate-controlled rooms (laboratories) rather than apartments or houses. Additionally, it is paramount from a scientific point of view that the occupants' behaviors and habits are addressed in order to strive for comfort if the analysis is carried out from the perspective of technology or information science (Kcomt Ché et al., 2010). Also in those cases where a psychological perspective is applied, most of the times self-assessment is asked from respondents (e.g. questionnaires), which may represent the investigated situation partially or not objectively. Self-assessment questionnaires require mnemonic effort to bring back to mind specific personal and/or environmental perceptions, as they are not necessarily experienced while filling in the questionnaires. The answers may therefore not entirely reflect all perceptions experienced in all given situations.

2.2 Temperature and thermal comfort

IEQ must be considered in its entirety, taking a number of measurable parameters into account by means of specific instruments. To accurately assess IEQ, all parameters concurring to determine thermal comfort must be taken into account. These are: air temperature, wall surface temperature, relative humidity, air velocity, clothing, activities carried out by the occupants and their own adaptability.

One of the first goals of those studies carried out in relation to well-being at temperature and humidity level was identifying a single parameter which could encompass people's perception inside given environments. PMV and PPD indices, as defined in UNI EN ISO 7730, are the main

indicator of overall indoor environmental quality. They result from statistical analysis carried out in Denmark on representative samples of population and indoor climate conditions.

• PMV (Predicted Mean Vote): it sets a comfort scale ranging from -3 (sensation of cold) to +3 (sensation of heat), with 0 being thermal neutrality.

• PPD (Predicted Percentage Dissatisfied): the percentage of dissatisfied people represent in relative terms the incidence of people who report thermal dissatisfaction.

PMV and PPD indices are determined by means of specific tools (microclimate control units), as described in UNI EN ISO 7726. These control units must be installed in a location which is representative of one environment: inside offices, they must be placed at the employees' desks. The following parameters are duly recorded: air temperature, mean radiant temperature, relative humidity, air velocity and relative standard deviation. Time and place, the clothes that people are wearing and their activities must be noted as well.

According to standards ASHRAE 55 (2010) and ISO 7730 (1994), thermal comfort is defined as ones' mental condition of satisfaction in relation to the microclimate of one's own environment. According to Al horr et al. (2016) and Quang et al. (2014), Thermal Comfort (TC) is most likely the single most important and most easily detected IEQ parameter. It is based on the thermal adaptability of single subjects, and it is linked to a number of factors such as location, climate, time of the year, gender, race and age. Thermal comfort is influenced by six factors: four of them, namely air temperature, mean radiant temperature, relative humidity and air velocity can be classified as environmental parameters. Two additional factors are classified as personal: these are the metabolic rates of the human body and clothing insulation (Katafygiotou & Serghides, 2015). The human body tries to keep its temperature at 37°C through heat exchange between the body and the environment, the three transfer methods being convection, radiation and evaporation (ASHRAE 55, 2010). Gender, age and climate conditions all have an impact on the occupants' thermal comfort (Nicol & Humphreys, 2002; Smolander, 2002). Thermal adaptation in an occupant of a given environment and his/her perception of comfort are determined by three factors: behavioral adaptation, physiological adaptation and psychological adaptation or expectation, as defined by Nikolopoulou & Steemers (2003) e Zhang et al. (2014). Location and type of building, together with outdoor climate conditions and season can also have an impact on thermal comfort (Frontczak & Wargocki, 2011). The perception of comfort differs according to climates and is additionally influenced by culture (Lovins, 1992).

Moreover, an increasing level of person control over one's work environment is linked with higher levels of thermal comfort and general satisfaction (Schellen, Loomans, de Wit, & van Marken

Lichtenbelt, 2013). Frontczak, Andersen, & Wargocki (2012) also stress the importance of users' perception of control: in relation to temperature, both manual and automated control seem to be equally accepted by users. A number of studies also pointed out that ones' perceived ability / inability to actively act towards one's field (house, office, etc.) has a psychological impact, which needs to be considered in calculations and measurements in relation to thermal comfort inside buildings (Brager & de Dear, 1998; Leaman & Bordass, 2007; Simonson et al., 2002).

The limits of the reviewed researches are: 1) in most cases, the occupants' behaviors were detected via self-assessment questionnaires, which may not extensively and accurately reflect the investigated situation; 2) most times, when the occupants' behaviors in relation to temperature were recorded, the sample was very small.

2.3 Gender differences in relation to thermal perceptions

According to Kim, de Dear, Candido, Zhang, & Arens (2013), small differences exist between women and men in relation to the overall satisfaction about one's work environment. Women are consistently less satisfied about single IEQ parameters, specifically about environmental thermal conditions, tidiness and indoor air quality (they complain of stale air, drafts and dust). Skin temperature – which is linked to the thermal perception of hands and arms – is crucially related to the overall (body-wise) temperature perception, especially in women. With equal environmental conditions, women seem to be less at ease and satisfied than men (Schellen, Loomans, de Wit, & van Marken Lichtenbelt, 2013). With regard to temperature as a parameter, men and women dress differently, women displaying a lower metabolic rate than men while carrying out a sedentary activity. Women additionally experience menstruation and regulatory hormones that have an impact on their thermal comfort, thermoregulation and thermogenic thresholds. They display differences in their hormone levels compared to men (Genazzani, Begliuomini, Lenzi, & Bernardi, 2005; Kim, de Dear, Candido, Zhang, & Arens, 2013).

Additionally, as the outcomes of other studies carried out in various indoor environments indicate (Choi, Aziz, & Loftness, 2010; Karjalainen, 2007, 2012; Kcomt Ché, Pardons, Vanrompay, Preuveneers, & Berbers, 2010; Kim, de Dear, Candido, Zhang, & Arens, 2013; Parsons, 2002; Zalejska-Jonsson & Wilhelmsson, 2013), *women are less satisfied with room temperatures and generally prefer higher temperatures than men, with discomfort in relation to both heat and cold being reported much more frequently in women than men*.

3. Smart Home and Ambient Assisted Living from the perspective of lifespan

Home automation for the elderly and people with disabilities refers to particular branch of Domotics providing customized solutions for older adults and people with disabilities. People with special needs can benefit from an aptly structured home environment. Caregivers, on the other hand, can enjoy more control on what happens within a given environment, thus attaining a higher level of safety. An assisted living space aims at improving life for everyone on the long-term. It does so a) providing devices that can make life easier and empower individuals to remain relatively autonomous; b) enhancing the capabilities of users with special needs with regard to their integration into work and community life; c) compensating for functional limitations, be it mobility, sight, sound, intelligence or speech and language impairment, and facilitating home care. Two specific goals can in turn be attained: 1) promoting users' autonomy and self-determination, particularly in people with special needs, striving for empowerment, providing user-friendly tools to interact, work, enjoy free time, feel secure, protected and self-sufficient in carrying out simple every-day tasks. All of the above contributes considerably to improving the overall quality of life; 2) reducing and preventing clinical treatment of senior and/or people with disabilities via innovative forms of home living that contrast social isolation and exclusion and dislocation from one's community.

According to scholarly estimates (Baldewijns, Debard, Mertens, Devriendt, Milisen, Tournoy, Croonenborghs, & Vanrumste, 2013; Coughlin, D'Ambrosio, Reimer, & Pratt, 2007; Demiris, Rantz, A. Aud, D. Marek, W. Tyrer, Skubic, & A. Hussam, 2004; Dohr, Modre-Osprian, Drobics, Hayn, & Schreier, 2010; Kleinberger, Becker, Ras, Holzinger, & Müller, 2007; Krafft & Coskun, 2009; Losardo, 2014; Mishra, 2015; Mohammadi, 2010; Motta, 2015; Portet, Vacher, Golanski, Roux, & Meillon, 2012; Sun, De Florio, Gui, & Blondia, 2009), senior people cite reliability, user-friendliness, emergency detection, reduced user's input, low maintenance costs, low invasiveness (privacy) and voice interface technology (audio input) as the main characteristics of smart devices. Their underlying needs are safety and proactivity, health monitoring and user's confidence. *Acceptance* by senior users is reportedly a key factor in integrating new technologies into already existing houses. The success of new technological devices lies not only in the tools per se, but also in the assistance and training that is provided.

This feeds into the notion of *Ageing in Place*, by which senior people can exert control over their own environment and daily activities to improve their perceived autonomy, health, well-being and dignity.

Lifespan psychology promotes a new vision of the ageing process, moving away from a narrative of decay, decline and reduced adaptability while embracing a framework of new learning and re-structuring possibilities, and advocating revamped social and health policies, with a shift from looking at seniors as passive subjects to acknowledging each person's right and duty to play an active role within their communities all along their lives. More specifically, a mind shift is advocated from ageism – i.e. stereotyping older people as weak, needy, lonely and senile – to inclusive policies oriented at age-integrated participation (Deluigi, 2014).

WHO (World Health Organization) defines "Active Ageing" as "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" (2002, p. 12). In this regard, WHO draws a world map reporting six determinants of active ageing, with gender and culture being taken into account (ibid. p. 19). These determinants are: 1) *Determinants Related to Health and Social Service Systems*: to promote active ageing, collaboration and coordination between health and social service systems is essential to promote integrated actions with regard to health promotion, disease prevention and long-term care; 2*) Behavioral Determinants*, which are important for one's lifestyle: "engaging in appropriate physical activity, healthy eating, not smoking and using alcohol and medications wisely in older age can prevent disease and functional decline, extend longevity and enhance one's quality of life" (ibid. p.22); 3) *Determinants Related to Personal Factors*, influence by both genetics and biology. If on the one hand the ageing process is naturally determined at a biological level and genes may be involved in the causation of disease, one's environment and lifestyle play a crucial role. On the subject of psychological factors, Baltes (1978, 1987) sees human development as a mixture of gain and loss. WHO also states: "During normal ageing, some cognitive capacities (including learning speed and memory) naturally decline with age. However, these losses can be compensated by gains in wisdom, knowledge and experience" (ibid. p.26); 4) *The Physical Environment*, including both outdoor environments such as urban or rural areas and kind of housing, together with a number of conditions that can ensure older people's well-being, whereas physical barriers in one's life environment, injuries from fall and a number of other causes can worsen older people's vulnerability; 5) *Determinants Related to the Social Environment*, including social support, education and training from the perspective of lifelong learning, protection from violence and abuse, can ensure health, safety and participation to the community life; 6) *Economic Determinants, such as* work (work activities which are not arduous or stressful can help physic and mental well-being), income and social protection (programs run by countries to benefit old people who require help to live their lives decently and self-sufficiently).

3.1 Ageing and thermoregulation

The human body has the remarkable skill of keeping temperature within security limits to ensure health. Perspiration is a response to lower body temperature when we feel hot, while the chills – involuntary muscular contractions – that we experience when we feel cold generate heat. Goosebumps generally manifest when we feel cold (actually, a number of small muscles lift hair body to increase its thickness). The average body temperature is around 37°C, with a degree of inter-individual variability (approximately ± 0.4°C). In addition to that, body temperature notably fluctuates over the day, with the lowest level being in the early morning, around 4 a.m., and the highest peak being in the evening, at around 6 p.m.. Night body temperature changes with sleep: it normally sinks as we fall asleep to ensure rest. A series of boy temperature variations depend on multiple factors, including *physical constitution* (e.g. obesity), *age* (body temperature is lower in older people, especially in those subjects that are bedridden), *gender* (e.g. women are influenced by their menstrual cycle: progesterone, secreted during ovulation, increases temperature by 0.3 - 0.6°C), exposure to high temperatures, known as "*acclimatization*", *degree of environmental humidity* (perspiration increases with humidity) and *outdoor temperature*, *clothing* (e.g. warm and dark clothes), *recent activity*, *food/drink consumption* and *digestion*, *time of the day*, *health conditions* that hinder perspiration (e.g. diabetes, cardiac, pulmonary and renal abnormalities), any *drug therapies*, together with other particular situations. Hypothermia can manifest at 35°C and lower, a low-grade fever between 37,1 and 37,9°C, and hypothermia, a fully-fledged fever, with a temperature of 38°C or higher. The latter is not a disease in its own right, but rather a defense mechanism of the human body, which slows down the growth of bacterial pathogens and activates white blood cells to fight infections.

Thermoregulatory responses inside the brain are a key integration process of the hypothalamus, which contains two thermoregulatory centers. In the frontal hypothalamus (the area which mostly influences thermoregulation), there is a thermolytic center, i.e. a cluster of neurons which are sensitive to increases of temperature of 1-2°C and can react to the said increases activating thermal variation mechanisms. Damage of the frontal hypothalamus causes hyperthermia. Inside the lateral and posterior hypothalamus, there is a thermogenic center, which is made up of neurons that are influenced by reduced environment temperatures and respond activating mechanisms of heat conservation and production to contrast body temperature decreases. The latter center alters muscular activity (increasing muscle tone and triggering shivering) decreasing the temperature of blood that supplies it and through a reflex mechanism through impulse from thermoreceptors responding to cold. The latter mechanism importantly stimulates the activity of the thermogenetic

center and heat production, and it prevents the central temperature to decrease. Heat conservation or heat dispersion are activated whenever a discrepancy occurs between thermoregulation and thermoreceptors' inputs. With high body temperature, the hypothalamus stimulates perspiration and directs the blood flow towards the skin to expel excessive heat in the air. Conversely, in the event of low environment temperature, the coldest part of blood which reaches neurons sensible to temperature in the hypothalamus can trigger two responses, an early one and later one. The autonomous nervous system is responsible for the early response, stimulating peripheral vasoconstriction, behavioral adapting responses and the endocrine system, while the later one occurs via the extrapyramidal system causing shivering. Thermoregulation is therefore the balance between thermogenesis and thermal dispersion. Infections, hyperthyroidism, fever symptoms, drug abuse (sedatives, amphetamines and antidepressants), forms of psychopathy and severe/chronic alcohol can increase body temperature (hyperthermia). Conversely, long-term exposure to lower temperature or frostbite, sever alcohol abuse (ethanol causing vasodilation), hypoglycaemia, cachexia, myxedema and hypoxemia (both pulmonary and cardiac) tend to bring body temperature lower than 35°C (hypothermia).

If the thermoregulatory system is not functional, life functions are jeopardized, posing a serious threat to health. This is even more true for senior people, as ageing can easily jeopardize protection mechanisms, causing thermal dispersion higher than heat production, and consequently hypothermia. Thermoregulatory damages at the hypothalamus level, specific diseases and/or impairments of the automatic nervous system can also lead to some forms of hyperhidrosis (C. Angeli, 2018).

Scholarly sources outline the following features of senior age: a) reduced mobility, which can be assessed notably based on the progressive decrease of walking pace, in standard conditions and in the presence of obstacles; percentage of senior people who are able to walk a given distance; increasing number - in relation to age - of senior people who do not leave their homes anymore; b) physical inactivity, which is in turn due to reduced body flexibility and decreased muscle mass and muscle strength among others, triggering loss of confidence in the senior people's own functional capabilities, with further impact on their mobility. Moreover, reduced thermoregulation can be observed in older people. Together with other changes in their body composition, reduced thermoregulation is linked to a decrease in the total water inside a senior person's body (Franceschi, Pauletto, A. Incalzi, & M. Fabbri, 2011). Pierpaoli (2010) also focuses on insufficient thermoregulation and rapid dehydration. Additionally, a number of authors (Bouchama & Knochel, 2002; Dinarello & Porat, 2008; Pontieri, 1998) have dealt with the subject of pathophysiology of

thermoregulation, with the hypothalamus as the thermoregulatory center of the human body. If the thermoregulatory system is damaged and does not work effectively, a person's health can be seriously affected. Senior people seem to be most exposed to risk because of their age-induced thermoregulatory impairment. More specifically, a loss of lean body mass, reduced mobility, inadequate eating habits, reduced cold-induced chills and reduced vasoconstriction result in reduced heat generation capacity. (Bragagni, Alberti, Castelli, & Lari, 2012). Body temperature is consequently lower in senior people, their perception of cold being one symptom of ageing, especially in bedridden and non-self-sufficient subjects. In impaired senior people, environmental temperatures being only a few degrees lower than their body temperature can lead to hypothermia. Most cases of hypothermia are triggered by environment temperatures which are lower than 15,5°C, but seriously impaired older people can experience hypothermia also at home with a temperature of 22-24°C. Additionally, a number of pathological conditions such as cerebrovascular diseases, neoplasms of the central nervous system, Parkinson's disease, uremia, sepsis, heart failure, hypothyroidism, hypopituitarism, adrenal failure, alcohol abuse, diabetes mellitus and hypoglycaemia can jeopardize thermoregulation. Various drugs (barbiturates, opiates, tricyclic antidepressants, benzodiazepines, phenothiazine, alpha blockers, clonidine, lithium) can cause central thermoregulation deficits and interfere with peripheral vasoconstriction. Social and environmental factors must be particularly considered, including location and type of house and lifestyle of senior subjects. As they experience reduced mobility, senior people often cannot fulfill and are less capable of showing their needs (e.g. fluid intake) to their caregivers, which makes care even more difficult.

3.2 Ageing and lighting

Senior people and, more specifically, people with senile dementia offer report vision and generic perception problems. Bearing in mind that older people spend most of the day at home, the way proper environment lighting can help them live an autonomous life with no barriers is a key issue. Proper lighting may therefore help reduce the risk of fall injuries and half their lack of confidence and fear to fall which originate from inappropriate lighting: moving shadows and other optical illusions may be perceived as a threat by older people, triggering fear and anxiety. The shadows resulting on other people's faces may lead to uncertainty and uneasiness, especially in people suffering from eye trouble; the reflections on the floor may be mistaken for spots of water; dark ceilings can be perceived as heavy and stuffy. All this may limit and/or inhibit senior people in their

movements, making them lazy and passive: by contrast, adequate lighting helps residents to better orient, boosts their confidence and spurs them to be more active.

Diffuse, homogeneous and non-direct illumination therefore is pivotal to help senior people from falling in those areas that are more risky, such as staircases. Also shades in potentially treacherous areas such as passageways connecting bedrooms and bathrooms – especially at night – need to be avoided through exposure to uniform lighting. Potential risk factors inside bedroom are lacking night lights and/or switches that are difficult to reach. For this last problem, modern technology plays a crucial role: for instance, sensors can be installed inside indoor environments. In this case, firstly, senior users need to be accepting of new technological devices, and secondly, they need adequate support to be able to use the devices correctly.

4. Conclusions

The main advantage of Domotics is delegating to smart devices – that are capable of "interpreting" and "learning" – control of a specific equipment, so that the responsibility of managing heating, cooling and power systems to name a few does not lie with the resident(s) of house. Information coming from different environments are deciphered and regulated accordingly through connected devices. Among the parameters of Indoor Environmental Quality (IEQ), four are widely recognized: these are Thermal Comfort (TC), Visual Comfort (VC), Indoor Air Quality (IAQ) and Acoustic Comfort (AC). A review of various studies indicates that temperature and noise rank are the single most influential IEQ parameters to define indoor environmental comfort. The present research project focuses mainly on the notion of thermal comfort. In accordance with a number of two standards, these being ASHRAE 55 (2010) and ISO 7730 (1994), thermal comfort is defined as a "condition of mind that expresses the individual's satisfaction with the thermal microclimate". In its definition, a number of factors play a crucial role in the occupants' perceptions: these are gender, age, outdoor climate conditions and season, behavioral adaptation, physiological adaptation and psychological adaptation (or expectation), location and type of the building, and culture. A review of additional scholarly articles indicates that remarkable differences are noticeable in the thermal perceptions of men and women. Women, in addition to dressing differently and experiencing menstruation, seem to be less satisfied with indoor temperature, and generally prefer higher temperatures compared to men. Women's perception of discomfort, both in relation to heat and cold, is more frequent compared to that of men. This information is important to help develop indoor devices.

In addition to that, home automation for the elderly and people with disabilities provides customized made solutions for senior people and people with disabilities. People with special needs can benefit from an aptly structured home environment. *Acceptance* by senior users is reportedly a key factor in integrating new technologies into already existing houses. The success of new technological devices lies not only in the tools per se, but also in the assistance and training that is provided in the early stage of use. This feeds into the notion of *Ageing in Place*, by which senior people can exert control over their own environment and activities to improve their perceived autonomy, health, well-being and dignity. Lifespan psychology promotes a new vision of the ageing process, moving away from the narrative of decay, decline and reduced adaptability of older people while embracing a framework of new learning and re-structuring possibilities, together with a more active role within their communities all along their lives.

Lastly, a final analysis of data pertaining to ageing, thermoregulation and lighting indicates that senior people display age-induced impaired thermoregulation, their body temperature being lower than that of other individuals and their enhanced perception of cold being a symptom of ageing especially in bedridden, non-self-sufficient subjects. In addition to that, senior people, and more specifically, people with senile dementia, suffer from impaired vision and generic perception problems. Bearing in mind that older people spend most of the day at home, the way cutting-edge devices – providing both adequate temperatures for comfort and proper room lighting – can help them live an autonomous life with no barriers is a key issue.

With the limits of previous studies in mind, the present research project deliberately starts from the human being and the analysis of human behaviors in everyday-life environments, using a series of research instruments. In addition to self-assessment questionnaires, naturalistic inquiry and interviews were carried out. Investigation of indoor everyday-life environments took place with the aim of providing a picture of reality as accurate as possible, with particular focus on population groups that are normally regarded as more vulnerable.

To conclude, a culture of technology is advocated in which technological innovations: a) improve the quality of life of human beings and other living beings through a process of customization to target response in relation to someone's needs; b) are positioned within an *evolutionary framework* all along the course of life; c) are meant and implemented to serve everybody, especially most vulnerable categories, with the value in mind of reducing the digital divide.

CHAPTER 3
METHODS AND RESEARCH INSTRUMENTS

The first part of the present chapter addresses the theoretical paradigm and the methodological system that underpin this research, while the second focuses on the different phases of the research projects and describe the research instruments that have been used during each part.

1. Theoretical paradigm and methodological system

The present research is based on a constructivist theoretical paradigm. It starts from a relativist assumption, according to which not one but multiple realities exist. Reality is seen as a mental construction founded on social factors and personal experience. However, different reality constructions may have a common ground, i.e. shared structures, social institutions and personal experiences. At the epistemological level, research based on the constructivist paradigm rejects the notion of independence and separation between the object of investigation and the researcher; even more, it claims that interaction between the aforementioned parts occurs to such an extent that what is considered to be a finding (or outcome) is actually a joint construction due to the interaction itself. Clearly, no distinction can be made here between ontological and epistemological level. If the object of investigation is subject to variation and lies in the minds of people, this must be brought to the surface, it must be summoned by means of the subject/researcher interaction, and interactions among subjects and among researchers. The numerous reality constructions need to undergo interpretative (hermeneutical) procedures and dialectical comparisons in order to attain a new, more sophisticated construction of reality compared to both that of the subjects and that of the researcher (Mannetti, 2001, p. 22). Basically, constructivism sees the researcher's role as that of a participant and broker of understanding and re-structuring of life constructions that are typical of the subjects of investigation. The researcher is considered with his/her peculiarities as an individual belonging to a culture, a society, a group, a specific category, with a set of beliefs, opinions, values and drives that cannot be neglected during the research, but can conversely be used as a major instrument of analysis (Cicognani, 2003). Additionally, constructivism draws from a philosophical vision of hermeneutics that sees no distinction between understanding and interpreting, i.e. it is impossible for the researcher to understand the meaning as intended by the subject who produced the message in the first place, as understanding is bound to the researcher's own interpretation (Mannetti, 2001, p. 44). Since the object of investigation is made of meanings: "[…] to assess them, interpretative and conceptualization activities which cannot lie (or cannot lie entirely) with conventional measurement instruments are advocated, the researcher's intervention with his/her skills and

interpretative resources (due to study, experience, personal intuition, etc.) being inevitable" (Cicognani, 2003, p. 19, author's translation). This methodology is marked by the fact every component of research can be re-considered and altered as the research evolves and/or as a consequence of changes triggered by some other component (Maxwell, 1996). Consequently, this process can be deemed as *circular* (Gobo, 1998; Marshall & Rossman, 1995). The plan of research is built in accordance with *situationality* (Zucchermaglio et al., 2013) with neither methods nor instruments being subjugated by research itself, but rather helping achieve the latter's goals. As a result, for the present projects different instruments have been used for each phase. A detailed account of these instruments is provided in the following sections, where the single phases of the research are outlined.

2. Phases of the research project

The first step of the research project has been assessing the state of the art. Information and data have been collected through bibliographic and online research. Sources addressed the notions of Domotics and Indoor Environmental Quality (IEQ), temperature as a parameter and the notion of Thermal Comfort, gender differences in the perception of general comfort and more specifically of thermal comfort, assisted living for senior and people with disabilities and active ageing, the notions of thermoregulation and lighting in relation to the age group of older senior people (75-89 years and more).

The research project evolved over four phases:

1) Field observations in generic indoor environments;
2) Field observations in five healthcare centers (nursing homes and rehabilitation centers);
3) Interviews with a number of professional workers in the field of healthcare who are familiar with the topic of ageing;
4) Questionnaires administered to a randomized sample of respondents belonging to five different age groups.

PHASE 1. In the first phase, field observations in multiple indoor environments, both public and private (homes, offices, universities, etc.), were carried out in Italy and abroad (Europe and US), aimed at detecting behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication which can be interpreted as display of sensations of heat and/or cold as perceived by people in their everyday-life environments. An ad-hoc checklist on temperature (Appendix 1) has been devised to conduct observations. In addition to the detected behaviors, date and place of observations, time of the day, age and gender of monitored subjects,

indoor and outdoor temperatures were all recorded. The following step was analyzing all detected behaviors in relation to both heat and cold. These were divided into unambiguous and ambiguous behaviors, the latter being those behaviors who are only seemingly triggered by one's sensation of heat / cold. In addition to that, the sentences uttered by the subjects in relation to their perception of heat / cold were recorded during observations and later analyzed. These have been divided into four categories: impersonal and first-person statements, action-related sentences and general statements. Data related to the sensations of both heat and cold were studied in relation to gender, season and age group. Subsequently, an analysis of data linkage of age groups, seasons and genders followed. Data collection lasted more than two years during the PhD program. Subsequent data analysis provided for an insight into a number of frequent displays of thermal discomfort (hot / cold) as experience by people in their daily lives.

PHASE 2. Later in the research, specific field observations with focus on ageing were carried out in five different healthcare centers (nursing homes and rehabilitation centers) located in the Marche region, Italy, in order to detect behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as display of any discomfort at thermal (hot / cold) and luminous level as perceived by senior residents inside these facilities. Two checklists were used, the one on the topic of temperature (Appendix 1) being the same that had been devised for observations in generic indoor environments and the other on the topic of lighting (Appendix 2) which was created ad-hoc. In addition to the detected behaviors, data and place of observations, time of the day, age and gender of monitored subjects as well as indoor and outdoor temperatures of the environments were all recorded. The following step was a descriptive analysis of all behaviors detected in the five healthcare facilities in relation to both temperature and lighting, with attention given also to gender differences. Additionally, the sentences uttered by a some of the subjects in relation to their perception of heat / cold / light were recorded during observations and later analyzed. These have been divided into impersonal statements, first-person statements and action-related sentences. Lastly, a global analysis of all behaviors detected in all five facilities in relation to temperature, lighting and other categories followed, with attention given to gender too. Data collection lasted eight months during the PhD program. Subsequent data analysis provided for an insight into frequent displays of thermal and luminous discomfort experienced by senior people in their everyday-life environments, that they are not able to verbalize to the healthcare staff who takes care of them.

PHASE 3. In the third phase, interviews were conducted with different representatives of healthcare professions, namely doctors, professional social educators, physiotherapists, nurses, nursing

assistants and psychologists, who are all familiar with ageing and work in Central Italy. The aim of the interviews was collecting information and opinions based on the professionals' first-hand experience in relation to their professional environments and the senior people with whom they interact on a daily basis. A structured interview (Appendix 3) based on the checklist used for observations in generic indoor environments was devised ad hoc. Respondents among healthcare professionals were asked to go through a list of behaviors related to temperature, lighting and safety that a senior person may display in any everyday-life indoor environment, and to identify from a clinical perspective those behaviors that could be assessed as symptoms and link them to specific situations of onset of pathological processes. Experts were also asked to express their own potential reactions if faced with some of the symptoms and to report any difference based on the senior people's age and/or gender. Date and time of the interview, date of birth, gender, nationality, professional role and workplace of each respondent were recorded. The following step was an analysis through NVIVO software of each behavior in the list. Subsequently, potential connections were established with other behaviors from the list, and specific symptoms / diseases were listed based on data linkage. Gender differences reported by professionals have been analyzed, together with other comments and remarks that were made during interviews. Data collection lasted for one year and a half during the PhD program. Subsequent analysis provided for an insight into some display of thermal, luminous and emotional discomfort experienced by senior people in their daily lives and seen through the eyes of the professionals who take care of them.

PHASE 4. To understand whether the single behaviors detected during generic indoor environments could be deemed as unambiguous or ambiguous (the latter being those behaviors that could not be necessarily triggered by the subject's sensation of heat and/or cold, with other potential factors coming into play and some behaviors being displaying in relation to both heat and cold), a questionnaire (Appendix 4) was devised during the last phase of the research. Questionnaires were administered in the provinces of Macerata and Fermo (Marche region, Italy) to a randomized sample of common people belonging to five different age groups. The sample contained the same number of male and female respondents for each of the age groups. The questionnaires use a frequency scale from "Never" to "Always". Respondents were asked to report their own usual behaviors whenever they feel (excessively) hot or (excessively) cold in an indoor everyday-life environment, in order to determine the frequency of the detected behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of thermal (hot / cold) discomfort as experienced by a number of individuals in their daily life. Date and place of completing, birth year and gender of

respondents were recorded. The following step was an analysis of all behaviors in relation to both heat and cold. They were sorted by each of the four occurrences based on the highest frequencies. Of all collected data, in relation to both heat and cold, a specific analysis by gender and age group was carried out. Subsequently, an analysis of data linkage of age groups, occurrences and gender followed. Data collection lasted for a bit longer than three months during the PhD program. Subsequent analysis provided for an insight into the perceptions of people that had been monitored during field observations in multiple indoor environments.

3. Research instruments

The following section contains a detailed account of the research instruments used during the different phases of the research project. Before being used, all instruments were tested during experiments, discussed and re-adjusted based on feedback provided at company and university level.

3.1 The naturalistic observation

Naturalistic observation aimed at investigating real society and ways of life from the point of view of an "outsider". Researchers observe phenomena as they spontaneously manifest, in the most unbiased and objective way possible, with no interventions to alter the natural course of events and/or people's behaviors. Naturalistic observation is defined as a "systematic description of events, behaviors and artifacts" within an investigated social context (Marshall & Rossman, 1995). Over the course of field observations, a strive for systematic assessment of a number of features of human behaviors in their natural environment, i.e. daily real-life situations, in the least intrusive way possible. Non-intrusiveness implies that observers remain neutral and do not manipulate variables to pursue their own interests. A minimum degree of control is exerted on the subjects of their studies, with the efforts focusing on following and recording events as they unfold and behaviors as they are displayed, as they spontaneously manifest, with no interruption, to avoid influencing them. Behaviors and interactions take place as they normally would without an observer's presence. Naturalistic observations implies "looking at context", but heterogeneous approaches and techniques have been systematized and largely applied in the past (Cicognani, 2003, p. 40).

The method of naturalistic observation has been adopted for multiple indoor environments, public and private (houses, offices, universities, etc.) in Italy and abroad (Europe and US), in order to collect data pertaining to a number of behaviors (directed towards oneself and one's environment),

physical reactions and occurrences of verbal communication that can be interpreted as a display of heat and/or cold as perceived by a number of people in their everyday-life environments. To record one's observations, one of the most widely used instrument is the checklist (i.e. a predefined score sheet), which is usually made by the observer and requires the latter's presence when the phenomenon to observe occurs. For the present research paper, a checklist on the matter of temperature (Appendix 1) has been devised ad hoc. The checklist is made up of two lists of potential behaviors, the first one on the sensation of heat and the second on the sensation of cold. Additionally, date and place of observations, time of the day, age and gender of monitored subjects and indoor and outdoor temperatures of the monitored environments were all recorded.

At the same time, field observations were carried out inside five healthcare facilities (nursing homes and rehabilitation centers) located in the Marche region (Italy). The healthcare centers had been selected based on their geographical position and their interest in joining the project. These facilities are: I.R.C.E.R. Foundation - Assunta in Recanati (Province of Macerata), Villa Letizia in Civitanova Marche (Province of Macerata), the "Santo Stefano" rehabilitation institute in Porto Potenza Picena (Province of Macerata), Casa Hermes in Loreto (Province of Ancona) and the "Casa di Ospitalità" care home in Castelraimondo (Province of Macerata). All facilities had been previously notified in writing on the purposes of observation and of the research project and the use of collected data. At the early stage of observations, knowing the environments through explorative tours was important: the researcher was able to get to know the context that was about to be observed. The first meeting in all facilities helped to identify reference professionals and to negotiate times and places of observations based on each facility's management and specific times of the day in which care and treatment procedures are administered. To detect a number of behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of discomfort at thermal and/or luminous level perceived by residents, two checklists were used, the one on the topic of (Appendix 1) being the same used for generic indoor environments, and a new one on the topic of lighting (Appendix 2). The first part of the second checklist pertained to insufficient illumination, the second one to excessive illumination. In addition to the detected behaviors, data and place of observations, time of the day, age and gender of monitored subjects as well as indoor and outdoor temperatures of the environments were all recorded.

Before they were used, both instruments (Appendixes 1 and 2) had been tested by the PhD students of Psychology, Communication and Social Sciences, and subsequently discussed and re-adjusted based on feedback.

3.2 The structured interview

Structured interviews are aimed at understanding respondents' viewpoints and views of the world, i.e. sets of values and meanings that are given to one's experiences regardless from the researchers' expectations and theoretical assumptions. Using interviews starts from the assumption that the respondent's perspective is relevant, knowable and communicable. Qualitative interviews can be defined as a form of professional conversations, with their own rules and technicalities, as well as an exchange of views between two people who address a common topic based on honesty, aiming at increasing knowledge (Kvale, 1996). In line with this definitions, the interviewer does not listen to the speaker with neutrality, but rather he/she actively engage in an exchange. The human side of the encounter and the relation is stressed, with no threats to professionalism being implied (Cicognani, 2003, p. 47).

Structured, face-to-face one-to-one interviews were preferred, in which the questions and their order is unaltered for all interviewees: each interviewee is asked the same questions and goes through the same pattern with the same kind of language being used as for everybody else. In this case, all respondents can be classified are "experts" of a specialty field, namely ageing. Information was solicited concerning their particular expertise domain, and has subsequently been organized and categorized. More in details, ten professionals were interviewed for each of the following six categories: doctors, professional social educators, physiotherapists, nurses, nursing assistants and psychologists. Professionals were selected based on their geographical proximity (all of them work in Central Italy) and their willingness to join the project. All professionals were duly notified on the purposes of the interview and of the research project, and the use of collected data. Whenever possible, respondents were interviewed inside their respective *work environment*. The aim of the interviews was to collect information and impressions based on the respondents' first-hand experience with their professional environments and the senior people with whom they interact on a daily basis. Starting from the checklist intended for observations in generic indoor environments, a structured interview was devised (Appendix 3), based on which all healthcare professionals were asked to assess a list of behaviors that senior people may display in any everyday-life indoor environment in relation with temperature, lighting and safety, and to specify – based on their own clinical understanding – which behaviors could be perceived as possible symptoms of the onset of any particular disease process. Healthcare professionals were additionally asked to detect any differences in the behaviors based on age and gender. Date and place of each interview as well as birth date, gender, nationality, professional role and healthcare environment of each respondent have all been recorded.

Before interviews started, a pilot interview was tested on dr. Roberto Catalini, head of the department of internal medicine at Macerata Hospital on November 21st, 2016. Dr. Catalini provided feedback on the structured interview, pointing out that only at a constant temperature can symptom combination be indicative of the onset of a disease. Additionally, age and gender are reportedly key elements in assessing a senior person's symptoms. Insights into the person's life cycle therefore help making diagnosis and consequently providing adequate output.

3.3 The questionnaire

Questionnaires are probably the most widely used research instrument in the field of psychology and social sciences, particularly to detect attitudes, opinions and lines of thoughts. Questionnaires are normally structured, with rigidly organized items, a set of definite questions with generally multiple choice answers. It can be conventionally stated that questionnaires are "cloze": this provides for greater standardization of questions and answers (Guala, 1999, p. 171). This way, information can be collected at large scale, on research objects that can be very different from each other and also reaching out to large segments of population. To understand whether the behaviors detected through observations in generic indoor environments could be deemed as unambiguous or ambiguous, a questionnaire including a frequency scale was devised (Appendix 4). Questionnaires were administered in the provinces of Macerata and Fermo (Marche region, Italy), to a randomized sample of people belonging to five age groups: each group was made up of an equal number of male and female respondents. The following age groups have been considered: 15-29 (young people) / 30-44 (young adults) / 45-59 (adults) / 60-74 (younger senior people) / 75-89 (older senior people). Questionnaires provided for self-assessment, with limited answers available to questions. They were handed over in print to respondents, who filled them in later and handed them back in one week's time. In the questionnaires, respondents were asked to report their usual behaviors whenever they feel (excessively) hot or (excessively) cold in any everyday-life indoor environment, in order to detect the frequencies of a number of behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of thermal discomfort as perceived by these individuals in their daily lives. The items of the questionnaires were divided into two sections, one pertaining to heat and the other to cold, the items being the same behaviors listed in the checklist for observations in generic indoor environments. Respondents were asked to tick the frequency with which they display each of the behaviors or physical reactions or the occurrences in which they voice their perception of

discomfort, choosing one option between “Never”, “Rarely”, “Often” and “Always”. Date and place of completing, birth year and gender of respondents were recorded.

Respondents were asked to report their own usual behaviors whenever they feel (excessively) hot or (excessively) cold in an indoor everyday-life environment, in order to determine the frequency of the detected behaviors (directed towards oneself and one’s environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of thermal (hot / cold) discomfort as experienced by a number of individuals in their daily life.

Before being administered, from February 12th to April 12th 2018 the questionnaires were tested by students attending the course “Enquiry Methods and Techniques of Psychological Processes” (L-39), held by Professor Paola Nicolini at the University of Macerata.

4. Conclusions

This chapter provided an account of the methods and instrument of research used for the present project. A constructivist theoretical paradigm was adopted, with a vision of the researcher as an active participant and broker of understanding and re-structuring of life constructions that are typical of the subjects of investigation. The researcher is considered with his/her peculiarities as an individual belonging to a culture, a society, a group, a specific category, with a set of beliefs, opinions, values and drives that cannot be neglected during the research, but can conversely be used as a major instrument of analysis.

Starting from a review of the theoretical framework and business evaluation, the following research question has been developed: “*Is it possible to create the best comfort possible (at thermal, luminous, acoustic level among others) in an indoor environment with minimized activity by final users, at any time?*”. The first step to finding an answer to this question has been assessing the state of the art. Information and data have been collected through bibliographic and online research. Sources addressed the notions of Domotics and Indoor Environmental Quality (IEQ), temperature as a parameter and the notion of Thermal Comfort, gender differences in the perception of general comfort and more specifically of thermal comfort, assisted living for senior and people with disabilities and active ageing, the notions of thermoregulation and lighting in relation to the age group of older senior people (75-89 years and more).

The project unfolded in four different phases. In the first phase, field observations in multiple indoor environments, both public and private (homes, offices, universities, etc.) in Italy and abroad (Europe and US), aimed at detecting behaviors (directed towards oneself and one’s environment), physical reactions and occurrences of verbal communication which can be interpreted as a display

of sensations of heat and/or cold as perceived by people in their everyday-life environments. An ad hoc checklist on the matter of temperature was devised. At the same time, field observations were carried out inside five healthcare facilities (nursing homes and rehabilitation centers) located in the Marche region (Italy) to detect a number of behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of discomfort at thermal or luminous level perceived by senior residents. With this in mind, two checklists were used, one on the topic of temperature, the same that had been used for generic indoor environments, and one on the topic of lighting (which was devised ad hoc). In the third phase, interviews were conducted with a number of representatives of healthcare professions, namely doctors, professional social educators, physiotherapists, nurses, nursing assistants and psychologists, who are all familiar with ageing and work in Central Italy. The aim of the interviews was collecting information and opinions based on the professionals' first-hand experience in relation to their professional environments and the senior people with whom they interact on a daily basis. A structured interview (Appendix 3) based on the checklist used for observations in generic indoor environments was devised ad hoc to understand some displays of thermal, luminous and emotional discomfort as experienced by people in their daily lives and seen through the eyes of those professionals that take care of them. Lastly, to understand whether the behaviors detected in generic indoor environments could be deemed as unambiguous or ambiguous, questionnaires were administered in the provinces of Macerata and Fermo (Marche region, Italy) to a randomized sample of people belonging to five different age groups. The aim was detecting the frequencies of a number of behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication interpreted as display of thermal discomfort perceived by a number of people in their everyday-life environments. Data crossing of survey data and observation data provided for an insight into the perceptions that had been detected previously.

The strengths of the present research project lie in the fact that it is centered on the human being in its entirety and complexity, and that an analysis in the field of human behavior has been carried out in everyday-life environments, in a constant effort to make humanities and technologies interact and communicate. This study starts from a notion of technology meant to favor users' well-being and comfort, especially in more vulnerable subjects, notably non-self-sufficient older people. With final users in mind, regarded as sensors leading research and development of smart devices, a flexible and integrated use of the aforementioned instruments made it possible to collect a wide range of data, that builds up to form a comprehensive project.

CHAPTER 4
DESCRIPTIVE AND CORRELATIONAL ANALYSIS OF OBSERVATIONS IN GENERIC INDOOR ENVIRONMENTS BASED ON THE CHECKLIST

The present research project focuses on technology enhancing users' well-being and comfort, especially in more vulnerable subjects, notably non-self-sufficient senior people. Over time, people have always had to adapt to technological developments, innovations and their surrounding environment by simply reacting to inputs provided by the machines. The analysis of human behaviors in real everyday-life situations starts from the assumption that people who act on *indoor devices* (related to temperature, lighting, sound, etc.), at home and in offices alike, all too often are not entirely conscious of the functioning of these systems and cannot actually achieve well-being as intended. Actively interacting with a device in order to adapt technology to the specific needs any given time can lead to non-negligible physical and cognitive efforts in weaker subjects. Precisely for this reason, such systems should "interpret" users' behaviors based on the latter's perceptions of thermal, luminous, acoustic, etc. comfort and/or discomfort in everyday-life indoor environments. The aim of this study is understanding human beings through the detection and assessment of their actions and physical reactions, taking their real-life and every-day life environments into account in order to develop devices that can truly ensure users comfort.

The following data were collected during our survey by the use of a checklist. The aim was investigating those behaviors that can be interpreted as display of people's perceptions of heat and/or cold in everyday-life environments.

1. The sample

With final users in mind, regarded as sensors leading research and development of smart devices, a checklist has been devised in order to detect different behaviors (both directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be regarded as a display of a specific kind of thermal discomfort (hot / cold), as perceived by a number of subjects in their real-life indoor environments.

From April 21st 2016 to July 12th 2018, *800 observations* took place in relation to heat and cold in various indoor environments both public and private (homes, offices, universities, etc.), in Italy and abroad (Europe and USA). Dates and places of observations, time of the day, age and gender of monitored people as well as indoor and outdoor temperatures in the monitored settings have all been recorded.

The research sample includes *400 male* and *400 female participants*.

In chart 1, the settings in Italy and abroad where observations took place are presented, together with their respective frequencies.

Chart 1. Settings where observations took place

ITALY[1]	**FREQUENCIES**
Restaurants (MO, MC, AR, FI, RE, CI, PO, SI)	141
Universities (AN, MC)	120
Professional offices (RE, AN, MC)	112
Conferences (AN, FI)	60
Healthcare centers (LO, RE, PPP, CI)	34
Trains (PE, RI, BO, AR, RM)	25
High school (MC)	17
Private homes (AN, PPP)	17
Church (AM)	16
Senate Council Hall (RM)	10
Hospital (AR)	7
ANFASS Rehabilitation Center (MC)	6
ISTAO Business School (AN)	6
CASB – University Library (MC)	5
Medical practice (PPP)	5
Buonaccorsi Palace (MC)	4
Bus (AP)	3
Flower shop (PPP)	3
Post office (PPP, CI)	3
Auto body shop (AR)	2
Marche Region Building (AN)	2
Bar (PPP)	1
Police headquarters (MC)	1
SUBTOTAL	**600**
ABROAD[2]	**FREQUENCIES**
Professional offices (SC, LIS)	43
Universities (MA, LEU, LIS, SC)	35
Trains (LIS, POR)	32
Conferences (AM, LEU, POR)	21
Restaurants (LIS, POR)	20
Private home (LIS)	15
University canteen (LIS)	15
University snack bar (LIS)	10
Hotel (SC)	3
Ice-cream parlor (POR)	2
Taxi (LIS)	2
Nursing home (LEU)	1
Supermarket (LIS)	1
SUBTOTAL	**200**
TOTAL	**800**

600 observations took place in Central Italy and 200 observations took place abroad, both in public (500) and private places (300). Restaurants (141), universities (120) and professional offices (112)

[1] Abbreviations are used to refer to the following Italian locations:
AM = Amelia; AN = Ancona; AP = Ascoli Piceno; AR = Arezzo; BO = Bologna; CI = Civitanova Marche; FI = Florence; LO = Loreto, MC = Macerata; MO = Morrovalle; PE = Pesaro; PO = Portonovo; PPP = Porto Potenza Picena; RE = Recanati; RI = Rieti; RM = Rome; SI = Siena

[2] Abbreviations are used to refer to the following locations outside of Italy:
AM = Amsterdam, Leu = Leuven, LIS = Lisbon, MA = Maastricht, POR = Porto, SC = St. Cloud

rank as the settings in Italy with the most recorded behaviors. Abroad, the highest frequencies have been recorded in professional offices (43), universities (35) and trains (32).

2. Data collection

In this section, data collected from observations are presented and commented. Data have been sorted by heat and cold, gender, setting, season and age group.

2.1 Analysis of data pertaining to the sensation of heat

Chart 2 lists heat-related behaviors with their frequencies sorted by gender and setting (Italy – abroad / Public space – Private space).

Chart 2. 18 heat-related behaviors as detected during observations

SENSATION OF HEAT	**FREQUENCY**						
BEHAVIORS	**M**	**F**	**ITALY**	**ABROAD**	**PUBLIC**	**PRIVATE**	**TOTAL**
Taking off one's clothes	95	53	106	42	91	57	**148**
Fanning oneself with hand/piece of paper	17	72	85	4	73	16	**89**
Opening the door/window	26	23	35	14	32	17	**49**
Wiping off sweat from one's face with hands/handkerchief	25	19	44	0	36	8	**44**
Rolling up one's shirt/jumper sleeves	26	5	25	6	22	9	**31**
Drinking repeatedly	29	2	6	25	14	17	**31**
Verbal communication occurring	10	18	25	3	12	16	**28**
Pulling up one's sleeves	7	13	16	4	11	9	**20**
Unbuttoning/unzipping one's coat/jacket	14	3	6	11	10	7	**17**
Unbuttoning one's shirt	15	0	14	1	14	1	**15**
Tying up one's hair	0	9	9	0	7	2	**9**
Leaving the room	4	2	6	0	4	2	**6**
Pulling one's sweater/jumper/jacket collar	0	4	4	0	1	3	**4**
Regulating the heater	3	1	3	1	2	2	**4**
Turning dehumidifier /fan/air conditioner on	3	1	3	1	2	2	**4**
Touching one's face	0	3	2	1	3	0	**3**
Flushing	0	3	2	1	3	0	**3**
Moving away from the sunlight (streaming through the window pane)	1	0	1	0	0	1	**1**
TOTAL	**275**	**231**	**392**	**114**	**337**	**169**	**506**

A total of 18 heat-related behaviors have been detected. Three behaviors which had been originally included in the checklist have eventually never been detected during observations. These are "Sitting down" and "Laying down" among actions directed towards oneself, and "Closing the curtains / shutters (to keep off the heat)" among actions directed towards one's environment. The most frequent behaviors (>10 frequency) are ranked hereafter: "Taking off one's clothes", "Fanning oneself with hand/piece of paper", "Opening the door/window", "Wiping off sweat from one's face with hands/handkerchief", "Rolling up one's shirt/jumper sleeves", "Drinking repeatedly", "Verbal

communication occurring", "Pulling up one's sleeves", "Unbuttoning/unzipping one's coat/jacket" and "Unbuttoning one's shirt".

2.2 Analysis of data pertaining to the sensation of cold

Chart 3 lists cold-related behaviors with their frequencies sorted by gender and location (Italy – abroad / Public space – Private space).

Chart 3. 16 cold-related behaviors as detected during observations

SENSATION OF COLD	**FREQUENCY**						
BEHAVIORS	**M**	**F**	**ITALY**	**ABROAD**	**PUBLIC**	**PRIVATE**	**TOTAL**
Putting on one's clothes	23	120	126	17	76	67	**143**
Sneezing	53	45	63	35	47	51	**98**
Coughing	37	6	27	16	22	21	**43**
Rubbing one's hands/arms/shoulders	3	30	29	4	23	10	**33**
Closing the door/window	12	12	15	9	14	10	**24**
Verbal communication occurring	2	19	18	3	14	7	**21**
Shivering	3	13	14	2	11	5	**16**
Rubbing/cleaning one's nose with tissue	10	2	3	9	3	9	**12**
Pulling up one's jacket/jumper collar	4	3	7	0	3	4	**7**
Opening the door (to contrast conditioned air)	4	3	4	3	2	5	**7**
Buttoning up one's shirt	4	2	6	0	4	2	**6**
Pulling down one's sleeves	5	0	3	2	3	2	**5**
Drinking repeatedly	1	4	3	2	3	2	**5**
Regulating the heater	3	1	4	0	1	3	**4**
Opening curtains/shutters (to let the heat in)	0	2	2	0	2	0	**2**
Pulling up one's hood	0	1	0	1	1	0	**1**
TOTAL	**164**	**263**	**324**	**103**	**229**	**198**	**427**

A total of 16 cold-related behaviors have been detected. Seven behaviors which had been originally included in the checklist have eventually never been detected during observations. These are "Pulling down one's jumper/jacket/coat sleeves", "Getting closer to the heater" "Curling up", "Tapping one's feet" and "Running in place" as for actions directed towards oneself, "Getting rid of drafts" as for actions directed towards one's environment and, finally, "Making one's teeth chatter" as for physical reactions.

The most frequent behaviors (>10 frequency) are ranked hereafter: "Putting on one's clothes", "Sneezing", "Coughing", "Rubbing one's hands / arms / shoulders", "Closing the door / window", "Verbal communication occurring", "Shivering" and "Rubbing/cleaning one's nose with a handkerchief / tissue".

2.3 Unambiguous and ambiguous behaviors

In charts 4 and 5, heat-related and cold-related behaviors are sorted by unambiguous and ambiguous behaviors. Their respective frequencies are shown.

Chart 4. Heat-related unambiguous and ambiguous behaviors

UNAMBIGUOUS BEHAVIORS	**FREQUENCIES**
Taking off one's clothes	148
Fanning oneself with hand/piece of paper	89
Opening the door/window	49
Wiping off one's sweat with hand/handkerchief	44
Rolling up one's shirt/jumper sleeves	31
Verbal communication occurring	28
Pulling up one's sleeves	20
Unbuttoning/unzipping one's coat/jacket	17
Unbuttoning one's shirt	15
Pulling one's sweater/jumper/coat collar	4
Regulating the heater	4
Turning dehumidifier/fan/air conditioner on	4
Moving away from the sunlight (streaming through the window pane)	1
AMBIGUOUS BEHAVIORS	**FREQUENCIES**
Drinking repeatedly	31
Tying up one's hair	9
Leaving the room	6
Touching one's face	3
Flushing	3

All behaviors detected in relation to heat have been divided into unambiguous and ambiguous behaviors, the latter only appearing to be connected to the subjects' perception of heat. Ambiguous behaviors are not necessarily triggered by a subject's perception of heat, but rather may depend on other factors. For instance, "Leaving the room", "Touching one's face" and "Flushing", together with behaviors that can be displayed in relation to both heat and cold, e.g. "Drinking repeatedly" and "Tying up one's hair", all fall into this category.

Chart 5. Cold-related unambiguous and ambiguous behaviors

UNAMBIGUOUS BEHAVIORS	**FREQUENCIES**
Putting on one's clothes	143
Closing the door / window	24
Verbal communication occurring	21
Shivering	16
Pulling up one's jacket/jumper collar	7
Buttoning up one's shirt	6
Rolling down one's shirt sleeves	5
Regulating the heater	4
Opening the curtains/shutters (to let the heat in)	2
Pulling up one's jacket hood	1
AMBIGUOUS BEHAVIORS	**FREQUENCIES**
Sneezing	98
Coughing	43
Rubbing one's hands/arms/shoulders	33
Rubbing/cleaning one's nose with handkerchief/tissue	12

Opening the door (to contrast conditioned air)	7
Drinking repeatedly	5

Cold-related behaviors have also been divided into unambiguous and ambiguous behaviors. Ambiguous behaviors are those behaviors which are not necessarily triggered by the subjects' perception of cold, but rather may depend on other factors. These are "Sneezing", "Coughing", "Rubbing one's hands / arms / shoulders" and "Rubbing / cleaning one's nose with tissue", together with those behaviors that can be displayed in relation to both the sensations of heat and cold, e.g. "Opening the door (to contrast conditioned air)" and "Drinking repeatedly".

Unambiguous behaviors are prevalent in relation to both heat and cold. Interestingly, though overall more heat-related behaviors than cold-related behaviors have been detected, the number of ambiguous behaviors is higher among cold-related behaviors.

2.4 Verbal communication occurrences

Charts 6 and 7 show the remarks that were uttered by the subjects and recorded during observations in relation to heat and cold, respectively.

Chart 6. Heat-related remarks

CATEGORY	FREQUENCY	OBSERVATION NUMBER	QUOTE
Impersonal statements	**15**	7	"Che caldo" [How hot]
		12	"Qua è caldo" [This place is hot]
		13	"Caldo qua dentro" [Hot in here]
		22	"Che caldo qua dentro" [How hot in here]
		45	"Mamma mia, che caldo che fa!" [Oh my Gosh, it is hot indeed!]
		119	"Qui è decisamente caldo!" [This place is definitely hot!]
		133	"It's too hot!"
		155	"It's too hot!"
		156	"It's too warm, isn't it?!"
		160	"Ah, mamma che caldo!" [Oh, gosh, it is really hot!]
		172	"È caldo qui da noi" [It's hot where we are right now]
		177	"Qui è un po' caldino" [It is quite warm in here]
		179	"Qui dentro però è caldo" [Well, it is hot in here]
		241	"Qua dentro è sempre più caldo" [It's getting hotter and hotter in here]
		426	"Caldo qua dentro, eh!" [Hot in here, isn't it?]
First-person statements	**8**	9	"C'ho caldo" [I am feeling so hot]
		56	"C'ho un caldo!" [I am feeling so hot!]
		93	"Io, invece, c'ho un caldo adesso" [I'll tell you, I am feeling quite hot right now]
		94	"Sto in quella condizione, sudo/non sudo, ma ho caldo!" [I am in that sweating / not sweating mode, but I definitely feel hot!]
		125	"Io c'ho caldo!" [I am feeling hot!]
		161	"Va beh, io sento caldo qui!" [Come on, I am really feeling hot in here]
		218	"Sento caldo!" [I'm feeling hot!]
		697	"A me, pare tanto caldo qui dentro!" [I find it particularly hot in here!]
Action-related sentences	**3**	43	"Autista, accendi il motore, fa troppo caldo!" [Driver, will you start the engine? It's too hot!]
		253	"Metti un po' il vasistas che qua non si respira!" [Open the

			hopper window, will you? No one can breathe in here!]
		463	"Apri un po' la finestra" [Open the window, will you?]
Generic statements	**2**	120	"Caldo oggi, tu stai pure senza maglia!" [It's hot today, you don't need to wear your sweater]
		169	"Qua dentro non si respira" [No one can breathe in here]

The total number of remarks uttered in relation to heat is 28. They have been divided into four categories: impersonal and first-person statements, action-related sentences and generic statements. Impersonal statements are sentences using or implying the pronoun 'it' (e.g. "Hot in here"), whereas in first-person statements the pronoun 'I' is used (e.g. "I am feeling so hot"). In action-related sentences, a number of actions that should be carried out in relation to the heat by the speaker him/herself or by someone else are put forward. Generic statements include all other remarks that do not fit in any of the previous categories.

In relation to heat, verbal communication mostly occurs in the following environments: private home, professional office, medical practice, bus, university, nursing home / rehabilitation center, high school and flower shop.

Chart 7. Cold-related remarks

CATEGORY	FREQUENCY	OBSERVATION NUMBER	QUOTE
Impersonal statement	**11**	3	"It's cold"
		19	"Freddino oggi" [Quite cold today]
		110	"Freddo oggi" [Cold today]
		128	"Che aria fredda!" [The air is so cold!]
		153	"Oggi è freddo qua dentro" [This place is cold today]
		213	"Che freddino che fa qua dentro" [It is quite cold in here]
		224	"Che freddo che fa!" [It's so cold!]
		249	"Che freddo fa qua dentro!" [It's so cold in here!]
		334	"Che freddo" [How cold]
		414	"Comunque, qua dentro è proprio freddo!" [By the way, it is really cold in here!]
		504	"Freschino qua dentro, eh!" [Quite cold in here, don't you think?]
First-person statements	**7**	122	"Io pure c'ho un freddo.." [I am also feeling really cold…]
		145	"C'ho un po' di brividi" [I feel like I have chills]
		187	"Io c'ho un freddo!" [I'm feeling really cold!]
		221	"C'ho freddo" [I'm feeling cold]
		222	"C'ho i brividi, è sempre freddo qua dentro!" [I've got chills, this place is cold all the time!]
		266	"I'm freezing now.. Oh my Gosh, 20 degrees.."
		415	"Io sento un po' freddino qua dentro" [I am feeling rather cold in here]
Action-related sentences	**2**	109	"Sento freddo qua, metto la maglia" [I am feeling cold in here, I'll put on my jumper]
		267	"They have turned on the air.."
Generic statements	**1**	764	"C'avevano paura che ci squagliavamo!" [They were afraid that we melt!]

The total number of remarks uttered in relation to cold is 21. They have been divided into the same four categories as for heat-related remarks.

In relation to cold, verbal communication mostly occurs in the following environments: conference, professional office, train, restaurant and university.

Impersonal statements (sentences using or implying 'it') show the highest frequency overall compared to the other categories, both for heat-related (15) and cold-related remarks (11).

2.5 Data analysis in relation to gender

In charts 8 and 9, heat-related and cold-related behaviors are sorted by gender. Their respective frequencies are shown.

Chart 8. Heat-related behaviors sorted by gender

BEHAVIORS	**M**	**F**	**TOTAL**
Taking off one's clothes	95	53	**148**
Fanning oneself with hand/piece of paper	17	72	**89**
Opening the door/window	26	23	**49**
Wiping off one's sweat with hand/handkerchief	25	19	**44**
Rolling up one's sleeves	26	5	**31**
Drinking repeatedly	29	2	**31**
Verbal communication occurring	10	18	**28**
Pulling up one's sleeves	7	13	**20**
Unbuttoning/unzipping one's coat/jacket	14	3	**17**
Leaving the room	4	2	**6**
Regulating the heater	3	1	**4**
Turning the dehumidifier/fan/air conditioner on	3	1	**4**
Unbuttoning one's shirt	15	0	**15**
Tying up one's hair	0	9	**9**
Pulling one's sweater/jumper/coat collar	0	4	**4**
Touching one's face	0	3	**3**
Flushing	0	3	**3**
Moving away from the sunlight (streaming through the window pane)	1	0	**1**
TOTAL	**275**	**231**	**506**

The frequencies of heat-related behaviors have been sorted according to the gender of subjects and have been ranked from most frequent to least frequent for both genders. Behaviors most frequently detected for both genders are at the top of the chart, whereas behaviors more typical of either men or women can be found at the bottom of the chart.

Prevalently male behaviors are ranked hereafter: *"Taking off one's clothes" (95)*, "Drinking repeatedly", "Rolling up one's sleeves", "Opening the door / window", "Wiping off one's sweat with hand/handkerchief", "Unbuttoning one's shirt", "Unbuttoning/unzipping one's coat/jacket", "Leaving the room" and "Moving away from the sunlight (streaming through the window pane)". Prevalently female behaviors are ranked as follows: *"Fanning oneself with hand / piece of paper" (72)*, "Verbal communication occurring", "Pulling up one's sleeves", "Tying up one's hair", "Pulling one's sweater/jumper/coat collar", "Touching one's face" and "Flushing". Men seem to

direct their actions towards the environment ("Opening the door / window", "Regulating the heater" and "Turning dehumidifier / fan / air conditioner on") more than women do.

Chart 9. Cold-related behaviors sorted by gender

BEHAVIORS	M	F	TOTAL
Putting on one's clothes	23	120	**143**
Sneezing	53	45	**98**
Coughing	37	6	**43**
Rubbing one's hands/arms/shoulders	3	30	**33**
Closing the door / window	12	12	**24**
Verbal communication occurring	2	19	**21**
Shivering	3	13	**16**
Rubbing/cleaning one's nose with handkerchief/tissue	10	2	**12**
Pulling up one's jacket/jumper collar	4	3	**7**
Opening the door (to contrast conditioned air)	4	3	**7**
Buttoning up one's shirt	4	2	**6**
Drinking repeatedly	1	4	**5**
Regulating the heater	3	1	**4**
Rolling down one's shirt sleeves	5	0	**5**
Opening the curtains/shutters (to let the heat in)	0	2	**2**
Pulling up one's jacket hood	0	1	**1**
TOTAL	**164**	**263**	**427**

The frequencies of cold-related behaviors have been sorted by gender of subjects and have been ranked following the same criteria as in chart 8.

Predominantly female behaviors are ranked hereafter: *"Putting on one's clothes" (120)*, "Rubbing one's hands / arms / shoulders", "Verbal communication occurring", "Shivering", "Drinking repeatedly" and "Pulling up one's jacket hood". Behaviors and physical reactions frequent among men are ranked as follows: *"Sneezing" (53)*, "Coughing", "Rubbing/cleaning one's nose with handkerchief/tissue", "Rolling down one's shirt sleeves", "Buttoning up one's shirt" and "Pulling up one's jacket / jumper collar". Closing the door/window seem to be rather equally split between male and female subjects. Both "Opening the door (to contrast conditioned air)" and "Regulating the heater" have been predominantly detected in male subjects, whereas "Opening the curtains / shutters (to let the heat in)" predominantly among female subjects. Considering total frequencies, it is safe to say that actions directed towards the environment are equally split between male and female subjects.

2.6 Analysis of data sorted by season

The most frequent heat- and cold-related behaviors (frequency >10) have been analyzed according to their seasonal shifts. The four seasons in the Northern Hemisphere are *spring* (from March 1st to May 31st), *summer* (from June 1st to August 31st), *autumn* or *fall* (from September 1st to November 30th) and *winter* (from December 1st to February 28th).

2.6.1 Analysis of data collected in the spring

Chart 10 shows the most frequent behaviors for the spring-time and their respective frequencies sorted by collection year and gender of subjects. In the spring, observations took place from April 21st – May 31st 2016, March 2nd – May 31st 2017 and March 13th – May 31st 2018.

Chart 10. Most frequent behaviors in spring

SPRING-TIME										
Heat-related										
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**2018**	**M**	**F**	**TOTAL**
Taking off one's clothes	22	15	7	14	9	5	41	31	10	**77**
Drinking repeatedly	4	3	1	0	0	0	20	20	0	**24**
Opening the door/window	6	2	4	5	1	4	9	8	1	**20**
Fanning oneself with hand/piece of paper	5	1	4	6	1	5	6	1	5	**17**
Rolling up one's sleeves	7	5	2	1	1	0	7	7	0	**15**
Pulling up one's sleeves	3	1	2	4	0	4	4	4	0	**11**
Unbuttoning/unzipping one's coat/jacket	0	0	0	1	0	1	9	9	0	**10**
Verbal communication occurring	7	5	2	2	0	2	0	0	0	**9**
Wiping off one's sweat with hand/handkerchief	3	2	1	3	3	0	0	0	0	**6**
Unbuttoning one's shirt	5	5	0	1	1	0	0	0	0	**6**
SUBTOTAL	**62**	39	23	**37**	16	21	**96**	80	16	**195**
Cold-related										
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**2018**	**M**	**F**	**TOTAL**
Putting on one's clothes	18	2	16	20	0	20	13	2	11	**51**
Sneezing	1	0	1	10	0	10	22	22	0	**33**
Coughing	0	0	0	8	3	5	10	10	0	**18**
Rubbing one's hands/arms/shoulders	6	1	5	6	2	4	0	0	0	**12**
Verbal communication occurring	2	0	2	6	0	6	1	0	1	**9**
Closing the door / window	3	0	3	0	0	0	5	5	0	**8**
Rubbing/cleaning one's nose with handkerchief/tissue	0	0	0	2	0	2	1	1	0	**3**
Shivering	0	0	0	1	0	1	0	0	0	**1**
SUBTOTAL	**30**	3	27	**53**	5	48	**52**	40	12	**135**
TOTAL C + F	**92**	42	50	**90**	21	69	**148**	120	28	**330**

Chart 10 indicates that the single heat-related behavior with the highest frequency is *taking off one's clothes (77),* while *putting on one's clothes (51)* ranks highest among cold-related behaviors. Taking off some clothes has been prevalently detected among male subjects, whereas putting on more clothes has been detected far more often among female subjects. Moreover, "Taking off one's clothes" (77) is the single behavior most frequently detected in all seasons. Interestingly, a number of behaviors and physical reactions are remarkably frequent among males: in relation to heat, these are "Drinking repeatedly" (24) and "Opening the door / window" (20), whereas "Sneezing" (33) ranks high in relation to cold. In the spring, "Verbal communication occurring" ranks highest by far compared to all other seasons, both in relation to heat (9) and cold (9). In the former case, it is slightly more frequent among male subjects, while in the latter there is a clear female prevalence.

2.6.2 Analysis of data collected in the summer

Chart 11 lists the most frequent behaviors in the summer-time with their respective frequencies, sorted by year of detection and gender. Observations concerning this season have been carried out from June 4th to July 11th 2016, from June 1st to August 31st 2017, and from June 1st to July 29th 2018.

Chart 11. Most frequent behaviors in the summer

SUMMER-TIME										
Heat-related behaviors										
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**2018**	**M**	**F**	**TOTAL**
Fanning oneself with hand/piece of paper	9	1	8	21	1	20	30	12	18	**60**
Taking off one's clothes	16	3	13	4	1	3	21	21	0	**41**
Wiping off one's sweat with hand/handkerchief	3	0	3	24	9	15	9	9	0	**36**
Opening the door/window	3	0	3	3	3	0	11	11	0	**17**
Rolling up one's sleeves	2	1	1	8	8	0	3	3	0	**13**
Unbuttoning one's shirt	0	0	0	9	9	0	0	0	0	**9**
Pulling up one's sleeves	3	0	3	1	0	1	2	2	0	**6**
Drinking repeatedly	0	0	0	0	0	0	5	5	0	**5**
Verbal communication occurring	3	1	2	1	0	1	1	1	0	**5**
Unbuttoning/unzipping one's coat/jacket	0	0	0	0	0	0	5	5	0	**5**
SUBTOTAL	**39**	6	33	**71**	31	40	**87**	69	18	**197**
Cold-related behaviors										
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**2018**	**M**	**F**	**TOTAL**
Sneezing	6	1	5	21	7	14	24	14	10	**51**
Putting on one's clothes	6	1	5	6	2	4	15	7	8	**27**
Coughing	0	0	0	2	2	0	16	16	0	**18**
Rubbing one's hands/arms/shoulders	0	0	0	11	0	11	0	0	0	**11**
Shivering	0	0	0	9	1	8	0	0	0	**9**
Rubbing/cleaning one's nose with handkerchief/tissue	0	0	0	0	0	0	8	8	0	**8**
Closing the door / window	1	0	1	2	1	1	4	3	1	**7**
Verbal communication occurring	0	0	0	3	2	1	1	0	1	**4**
SUBTOTAL	**13**	2	11	**54**	15	39	**68**	48	20	**135**
TOTAL C + F	**52**	8	44	**125**	46	79	**155**	117	38	**332**

Among all seasons, the highest number of behaviors has been detected in the summer *(332)*. As chart 11 shows, the heat-related behavior with the highest total frequency is *fanning oneself with hand / piece of paper (60)*, whereas the cold-related reaction most frequently detected is *sneezing (51)*. In both cases there is a prevalence among female subjects. Additional notable heat-related behaviors are "Taking off one's clothes" (41), predominantly male, and "Wiping off one's sweat with hand/handkerchief" (36), equally divided between male and female subjects. Other frequent cold-related behaviors are "Putting on one's clothes" (27), more typically witnessed among female subjects. Both in the spring and the summer, which are normally warm seasons, a significant number of behaviors and physical reactions connected to the sensation of cold have been recorded. This may indicate that in indoor environments monitored during this study a very low temperature

was set, causing for a non-negligible thermal shock between indoor and outdoor environments and, consequently, physical discomfort for people.

2.6.3 Analysis of data collected in the autumn

Chart 12 lists the behaviors most frequently detected during the autumn-time, together with their respective frequencies, sorted by year of collection and gender. For this season, observations were carried out from September 15th to November 29th 2016, and from September 5th to October 9th 2017.

Chart 12. Most frequent behaviors in autumn

AUTUMN-TIME							
Heat-related behaviors							
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**TOTAL**
Taking off one's clothes	4	2	2	12	7	5	**16**
Opening the door/window	4	0	4	3	0	3	**7**
Verbal communication occurring	4	2	2	1	0	1	**5**
Fanning oneself with hand/piece of paper	4	0	4	0	0	0	**4**
Wiping off one's sweat with hand/handkerchief	1	1	0	1	1	0	**2**
Rolling up one's sleeves	2	1	1	0	0	0	**2**
Drinking repeatedly	2	1	1	0	0	0	**2**
Pulling up one's sleeves	2	0	2	0	0	0	**2**
Unbuttoning/unzipping one's coat/jacket	0	0	0	0	0	0	**0**
Unbuttoning one's shirt	0	0	0	0	0	0	**0**
SUBTOTAL	**23**	7	16	**17**	8	9	**40**
Cold-related behaviors							
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**TOTAL**
Putting on one's clothes	21	1	20	10	7	3	**31**
Sneezing	2	1	1	10	8	2	**12**
Coughing	0	0	0	7	6	1	**7**
Rubbing one's hands/arms/shoulders	3	0	3	3	0	3	**6**
Closing the door / window	1	0	1	3	2	1	**4**
Verbal communication occurring	4	0	4	0	0	0	**4**
Shivering	2	1	1	2	1	1	**4**
Rubbing/cleaning one's nose with handkerchief/tissue	0	0	0	1	1	0	**1**
SUBTOTAL	**33**	3	30	**36**	25	11	**69**
TOTAL C + F	**56**	10	46	**53**	33	20	**109**

Chart 12 indicates that the single heat-related behavior with the highest total frequency is *taking off one's clothes (16)*, while *putting on one's clothes (31)* ranks highest among col-related behaviors. The former case shows a male prevalence, while the latter a female one. Additional notable physical actions and reactions are "Opening the door / window" (7) – with a clear female prevalence – in relation to heat, and "Sneezing" (12) and "Coughing" (7) – both typically male – in relation to cold.

2.6.4 Analysis of data collected in the winter

Chart 13 list the most frequent behaviors in the winter-time with their respective frequencies, sorted by year of collection and gender. For this season, observations took place from December 1st to December 15th 2016, and from January 26th to February 27th 2017.

Chart 13. Most frequent behaviors in the winter

WINTER-TIME							
Heat-related behaviors							
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**TOTAL**
Taking off one's clothes	2	0	2	12	6	6	**14**
Verbal communication occurring	2	0	2	7	1	6	**9**
Fanning oneself with hand/piece of paper	2	0	2	6	0	6	**8**
Opening the door/window	1	1	0	4	0	4	**5**
Unbuttoning/unzipping one's coat/jacket	0	0	0	2	0	2	**2**
Rolling up one's sleeves	0	0	0	1	0	1	**1**
Pulling up one's sleeves	0	0	0	1	0	1	**1**
Wiping off one's sweat with hand/handkerchief	0	0	0	0	0	0	**0**
Drinking repeatedly	0	0	0	0	0	0	**0**
Unbuttoning one's shirt	0	0	0	0	0	0	**0**
SUBTOTAL	**7**	1	6	**33**	7	26	**40**
Cold-related behaviors							
BEHAVIORS	**2016**	**M**	**F**	**2017**	**M**	**F**	**TOTAL**
Putting on one's clothes	8	0	8	26	1	25	**34**
Closing the door / window	1	1	0	4	0	4	**5**
Rubbing one's hands/arms/shoulders	2	0	2	2	0	2	**4**
Verbal communication occurring	2	0	2	2	0	2	**4**
Sneezing	0	0	0	2	0	2	**2**
Shivering	2	0	2	0	0	0	**2**
Coughing	0	0	0	0	0	0	**0**
Rubbing/cleaning one's nose with handkerchief/tissue	0	0	0	0	0	0	**0**
SUBTOTAL	**15**	1	14	**36**	1	35	**51**
TOTAL C + F	**22**	2	20	**69**	8	61	**91**

Among all seasons, the lowest number of behaviors has been detected during the winter *(91)*. Chart 13 indicates that the heat-related behavior ranking highest in frequency is *taking off one's clothes (14)*, while *putting on one's clothes (34)* ranks highest among cold-related behaviors. Both cases show a female prevalence. Additional noteworthy, typical female heat-related behaviors are "Fanning oneself with hand / piece of paper" (8), whereas among cold-related behaviors and physical reactions "Closing the door / window" (5) ranks high. In the winter, "Verbal communication occurring" ranks quite high (9) among heat-related behaviors and seems to be a predominantly female behavior. Moreover, for autumn and winter alike, which are normally cold seasons, taking off some clothes ranks highest in terms of frequency among heat-related behaviors. This may indicate that the monitored indoor environments were excessively heated and/or that the subjects under observation were wearing too many clothes and/or that they might have previously exerted some kind of physical effort (e.g. walking, climbing stairs, running, etc.).

2.7 Analysis of data sorted by age group

The most frequently detected behaviors (frequency >10) in relation to both heat and cold have been taken into account, and their shifts have been investigated in relation to different age groups. The following age groups have been considered: 15-29 (younger people) / 30-44 (young adults) / 45-59 (adults) / 60-74 (younger seniors) / 75-89 (older seniors). The average ages of each groups are: 24.05 / 37.24 / 51.40 / 64.66 / 78.45 years.

2.7.1 Analysis of data recorded for age group 15-29

Chart 14 lists the most frequent behaviors among younger people sorted by gender, with their respective frequencies.

Chart 14. The most frequent behaviors in age group 15-29

AGE GROUP 15-29			
Heat-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Taking off one's clothes	29	18	**47**
Drinking repeatedly	15	1	**16**
Opening the door/window	9	3	**12**
Fanning oneself with hand/piece of paper	2	8	**10**
Rolling up one's sleeves	3	2	**5**
Pulling up one's sleeves	2	2	**4**
Verbal communication occurring	0	3	**3**
Wiping off one's sweat with hand/handkerchief	1	1	**2**
Unbuttoning one's shirt	1	0	**1**
Unbuttoning/unzipping one's coat/jacket	0	0	**0**
SUBTOTAL	**62**	**38**	**100**
Cold-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on one's clothes	2	30	**32**
Sneezing	13	11	**24**
Rubbing one's hands/arms/shoulders	0	6	**6**
Coughing	4	1	**5**
Verbal communication occurring	0	4	**4**
Rubbing/cleaning one's nose with handkerchief/tissue	4	0	**4**
Closing the door / window	1	1	**2**
Shivering	0	1	**1**
SUBTOTAL	**24**	**54**	**78**
TOTAL C + F	**86**	**92**	**178**

As chart 14 shows, the most frequently detected heat-related behavior is *taking off one's clothes (47)*, with predominance among male subjects, while *putting on one's clothes (32)* ranks highest among cold-related behaviors with a clear predominance among female subjects. Additional predominantly male behaviors and physical reactions are "Drinking repeatedly" (16) and "Opening the door / window" (12) in relation to heat, "Sneezing" (24) in relation to cold.

2.7.2 Analysis of data recorded for age group 30-44

Chart 14 lists the most frequent behaviors among young adults sorted by gender with their respective frequencies.

Chart 15. The most frequent behaviors in age group 30-44

AGE GROUP 30-44			
Heat-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Taking off one's clothes	28	15	**43**
Fanning oneself with hand/piece of paper	7	29	**36**
Opening the door/window	10	12	**22**
Wiping off one's sweat with hand/handkerchief	12	7	**19**
Verbal communication occurring	5	10	**15**
Rolling up one's sleeves	11	1	**12**
Drinking repeatedly	10	0	**10**
Pulling up one's sleeves	1	7	**8**
Unbuttoning one's shirt	8	0	**8**
Unbuttoning/unzipping one's coat/jacket	6	1	**7**
SUBTOTAL	**98**	**82**	**180**
Cold-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on one's clothes	8	68	**76**
Sneezing	22	27	**49**
Rubbing one's hands/arms/shoulders	2	17	**19**
Coughing	11	2	**13**
Verbal communication occurring	2	10	**12**
Shivering	1	7	**8**
Closing the door / window	5	2	**7**
Rubbing/cleaning one's nose with handkerchief/tissue	4	1	**5**
SUBTOTAL	**55**	**134**	**189**
TOTAL C + F	**153**	**216**	**369**

In age group 30-44 the highest number of behaviors has been detected *(369)* compared to all other age groups. As shown in chart 15, the single behaviors with the highest frequencies are *taking off one's clothes (43)* in relation to heat and *putting on one's clothes (76)* in relation to cold. The two cases show a male prevalence and a neat female prevalence, respectively. Additionally, "Putting on one's clothes" (76) ranks highest in terms of frequency among all age groups. Additional notable heat-related behaviors and physical reactions include "Fanning oneself with hand / piece of paper" (36) and "Opening the door / window" (22), which are more frequent among female subjects, and "Wiping off one's sweat with hand/handkerchief" (19), which is predominant among males. Among cold-related behaviors, "Sneezing" (49) and "Rubbing one's hands / arms / shoulders" (19), both prevalently female, and "Coughing" (13), mainly a male reaction, rank highest. "Verbal communication occurring" ranks highest by far in this age groups compared to other groups, both in relation to heat (15) and cold (12). In both cases, this behavior is mainly detected among female subjects. Generally speaking, this age group displays mainly female frequencies.

2.7.3 Analysis of data recorded for age group 45-59

Chart 16 shows the most frequent behaviors as recorded in adult people sorted by gender, together with their respective frequencies.

Chart 16. The most frequent behaviors in age group 45-59

AGE GROUP 45-59			
Heat-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Taking off one's clothes	28	13	**41**
Fanning oneself with hand/piece of paper	3	17	**20**
Wiping off one's sweat with hand/handkerchief	8	4	**12**
Rolling up one's sleeves	9	1	**10**
Opening the door/window	4	5	**9**
Unbuttoning/unzipping one's coat/jacket	5	2	**7**
Verbal communication occurring	3	3	**6**
Pulling up one's sleeves	3	3	**6**
Drinking repeatedly	3	0	**3**
Unbuttoning one's shirt	3	0	**3**
SUBTOTAL	**69**	**48**	**117**
Cold-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on one's clothes	9	15	**24**
Sneezing	12	5	**17**
Coughing	13	3	**16**
Closing the door / window	6	8	**14**
Shivering	1	4	**5**
Rubbing one's hands/arms/shoulders	1	3	**4**
Verbal communication occurring	0	2	**2**
Rubbing/cleaning one's nose with handkerchief/tissue	0	0	**0**
SUBTOTAL	**42**	**40**	**82**
TOTAL C + F	**111**	**88**	**199**

Chart 16 indicates that the single heat-related behavior with the highest total frequency is *taking off one's clothes (41)* – with a clear male predominance – while *putting on one's clothes (24)* - with a female predominance – ranks highest among cold-related behaviors. Additional noteworthy heat-related behaviors and physical reactions are "Fanning oneself with hand / piece of paper" (20) – more predominantly observed in female subjects - and "Wiping off one's sweat with hand/handkerchief" (12) – predominantly observed in male subjects. In relation to cold, "Sneezing" (17) and "Coughing" (16) – both mainly male reactions – rank highest. Generally speaking, this age group displays mainly male frequencies.

2.7.4 Analysis of data recorded for age group 60-74

Chart 17 list the most frequent behaviors pertaining to younger senior people with their respective frequencies, sorted by gender.

Chart 17. The most frequent behaviors in age group 60-74

AGE GROUP 60-74			
Heat-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Fanning oneself with hand/piece of paper	5	18	**23**
Taking off one's clothes	10	7	**17**
Wiping off one's sweat with hand/handkerchief	4	6	**10**
Opening the door/window	3	3	**6**
Rolling up one's sleeves	3	1	**4**
Verbal communication occurring	2	2	**4**
Unbuttoning one's shirt	3	0	**3**
Drinking repeatedly	1	1	**2**
Pulling up one's sleeves	1	1	**2**
Unbuttoning/unzipping one's coat/jacket	2	0	**2**
SUBTOTAL	**34**	**39**	**73**
Cold-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on one's clothes	3	6	**9**
Sneezing	2	6	**8**
Coughing	7	0	**7**
Rubbing one's hands/arms/shoulders	0	4	**4**
Verbal communication occurring	0	3	**3**
Shivering	1	1	**2**
Rubbing/cleaning one's nose with handkerchief/tissue	1	0	**1**
Closing the door / window	0	0	**0**
SUBTOTAL	**14**	**20**	**34**
TOTAL C + F	**48**	**59**	**107**

Chart 17 shows that the most frequent heat-related behavior is *fanning oneself with one's hand / piece of paper (23)*, whereas *putting on one's clothes (9)* ranks highest among cold-related behaviors. In both cases, a female prevalence can be observed. Additional noteworthy heat-related behaviors and physical reactions are: "Taking off one's clothes" (17) – predominantly male – and "Wiping off one's sweat with hand/handkerchief" (10) – predominantly female. Among cold-related behaviors and physical reactions, "Sneezing" (8) – with a female prevalence – and "Coughing" (7) – more typical among men – rank highest.

2.7.5 Analysis of data recorded for age group 75-89

Chart 18 shows the most frequent behaviors recorded among older senior people sorted by gender, with their respective frequencies.

Chart 18. The most frequent behaviors in age group 75-89

AGE GROUP 75-89			
Heat-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Wiping off one's sweat with hand/handkerchief	0	1	**1**
Unbuttoning/unzipping one's coat/jacket	1	0	**1**
Taking off one's clothes	0	0	**0**
Fanning oneself with hand/piece of paper	0	0	**0**
Opening the door/window	0	0	**0**

Rolling up one's sleeves	0	0	**0**
Drinking repeatedly	0	0	**0**
Verbal communication occurring	0	0	**0**
Pulling up one's sleeves	0	0	**0**
Unbuttoning one's shirt	0	0	**0**
SUBTOTAL	**1**	**1**	**2**
Cold-related behaviors			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on one's clothes	1	1	**2**
Coughing	2	0	**2**
Rubbing/cleaning one's nose with handkerchief/tissue	1	1	**2**
Closing the door / window	0	1	**1**
Sneezing	0	0	**0**
Rubbing one's hands/arms/shoulders	0	0	**0**
Verbal communication occurring	0	0	**0**
Shivering	0	0	**0**
SUBTOTAL	**4**	**3**	**7**
TOTAL C + F	**5**	**4**	**9**

In the age group 75-89 the lowest number of behaviors has been detected compared to all other age groups *(9)*. As chart 18 shows, the only noteworthy cold-related behaviors and physical reactions are the following: "Putting on one's clothes" (2), "Coughing" (2) and "Rubbing/cleaning one's nose with handkerchief/tissue" (2). In this age group, taking some clothes off has never been recorded (0). This may indicate that this behavior is not typical of senior people, despite the fact that this specific behavior ranks highest in terms of frequency among all. Moreover, no verbal communication occurred in relation to either heat or cold.

2.8 Analysis of data linkage of age groups, seasons and genders in relation to heat

Charts 19 to 28 show data linkage of the five different age groups, the four seasons and gender in relation to the most frequent heat-related behaviors (>10 frequency). For each examined behavior, the total frequency and the gender prevalence as well as age groups and seasons with the highest frequencies are presented.

Chart 19. "Taking off one's clothes": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Taking off one's clothes	15-29	**23**		**12**		**7**		**5**		**47**	
		16M	7F	4M	8F	6M	1F	3M	2F	29M	18F
	30-44	**25**		8		6		4		**43**	
		18M	7F	6M	2F	2M	4F	2M	2F	28M	15F
	45-59	**22**		13		2		4		**41**	
		17M	5F	9M	4F	1M	1F	1M	3F	28M	13F
	60-74	**7**		8		1		1		**17**	
		4M	3F	6M	2F	0M	1F	0M	1F	10M	7F
	75-89	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**77**		**41**		**16**		**14**		**148**	
		55M	22F	25M	16F	9M	7F	6M	8F	95M	53F

Chart 19 indicates that taking off some clothes has a total frequency of 148 and is typical to males (95). The predominant age group is 15-29 (47), whereas the prevalent season is the spring (77).

Chart 20. "Fanning oneself with hand/piece of paper": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Fanning oneself with hand/piece of paper	15-29	2		**5**		1		2		**10**	
		1M	1F	1M	4F	0M	1F	0M	2F	2M	8F
	30-44	**7**		**25**		**1**		**3**		**36**	
		2M	5F	5M	20F	0M	1F	0M	3F	7M	29F
	45-59	3		**15**		1		1		**20**	
		0M	3F	3M	12F	0M	1F	0M	1F	3M	17F
	60-74	5		**15**		1		2		**23**	
		0M	5F	5M	10F	0M	1F	0M	2F	5M	18F
	75-89	0		**0**		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**17**		**60**		**4**		**8**		**89**	
		3M	14F	14M	46F	0M	4F	0M	8F	17M	72F

Chart 20 indicates that fanning oneself with one's hands or a piece of paper has a total frequency of 89 and is typical to females (72). The predominant age group is 30-44 (36), whereas the prevalent season is the summer (60).

Chart 21. "Opening the door/window": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Opening the door / window	15-29	**6**		5		1		0		**12**	
		4M	2F	5M	0F	0M	1F	0M	0F	9M	3F
	30-44	**8**		**8**		**3**		**3**		**22**	
		4M	4F	5M	3F	0M	3F	1M	2F	10M	12F
	45-59	**6**		1		1		1		**9**	
		3M	3F	1M	0F	0M	1F	0M	1F	4M	5F
	60-74	**0**		3		2		1		**6**	
		0M	0F	3M	0F	0M	2F	0M	1F	3M	3F
	75-89	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**20**		**17**		**7**		**5**		**49**	
		11M	9F	14M	3F	0M	7F	1M	4F	26M	23F

Chart 21 indicates that opening the door or the window has a total frequency of 49 and is typical to males (26). The predominant age group is 30-44 (22), whereas the predominant season is the spring (20).

Chart 22. "Wiping off one's sweat with hand/handkerchief": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Wiping off one's sweat with hand/handkerchief	15-29	0		**2**		0		0		**2**	
		0M	0F	1M	1F	0M	0F	0M	0F	1M	1F
	30-44	**5**		**13**		**1**		**0**		**19**	
		4M	1F	7M	6F	1M	0F	0M	0F	12M	7F
	45-59	1		**10**		1		0		**12**	
		1M	0F	6M	4F	1M	0F	0M	0F	8M	4F
	60-74	0		**10**		0		0		**10**	
		0M	0F	4M	6F	0M	0F	0M	0F	4M	6F
	75-89	0		**1**		0		0		**1**	

		0M	0F	0M	1F	0M	0F	0M	0F	0M	1F
	TOTAL	**6**		**36**		**2**		**0**		**44**	
		5M	1F	18M	18F	2M	0F	0M	0F	25M	19F

Chart 22 indicates that wiping off one's sweat with one's hands or a handkerchief or tissue has a total frequency of 44 and is typical to males (25). The predominant age group is 30-44 (19), whereas the predominant season is the summer (36).

Chart 23. "Rolling up one's sleeves": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Rolling up one's sleeves	15-29	**3**		0		1		1		**5**	
		2M	1F	0M	0F	1M	0F	0M	1F	3M	2F
	30-44	**5**		**7**		**0**		**0**		**12**	
		5M	0F	6M	1F	0M	0F	0M	0F	11M	1F
	45-59	**5**		5		0		0		**10**	
		4M	1F	5M	0F	0M	0F	0M	0F	9M	1F
	60-74	**2**		1		1		0		**4**	
		2M	0F	1M	0F	0M	1F	0M	0F	3M	1F
	75-89	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**15**		**13**		**2**		**1**		**31**	
		13M	2F	12M	1F	1M	1F	0M	1F	26M	5F

Chart 23 indicates that rolling up one's shirt / jumper sleeves has a total frequency of 31 and is typical to males (26). The predominant age group is 30-44 (12), whereas the predominant season is the spring (15).

Chart 24. "Drinking repeatedly": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Drinking repeatedly	15-29	**12**		**4**		**0**		**0**		**16**	
		11M	1F	4M	0F	0M	0F	0M	0F	15M	1F
	30-44	**9**		0		1		0		**10**	
		9M	0F	0M	0F	1M	0F	0M	0F	10M	0F
	45-59	**2**		1		0		0		**3**	
		2M	0F	1M	0F	0M	0F	0M	0F	3M	0F
	60-74	**1**		0		1		0		**2**	
		1M	0F	0M	0F	0M	1F	0M	0F	1M	1F
	75-89	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**24**		**5**		**2**		**0**		**31**	
		23M	1F	5M	0F	1M	1F	0M	0F	29M	2F

Chart 24 indicates that drinking repeatedly has a total frequency of 31 and is typical to males (29). The predominant age group is 15-29 (16), whereas the predominant season is the spring (24).

Chart 25. "Verbal communication occurring": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Verbal communication occurring	15-29	**0**		1		1		**1**		**3**	
		0M	0F	0M	1F	0M	1F	0M	1F	0M	3F
	30-44	**6**		**3**		**2**		**4**		**15**	
		3M	3F	1M	2F	1M	1F	0M	4F	5M	10F

	45-59	**2**		1		0		**3**		**6**	
		1M	1F	1M	0F	0M	0F	1M	2F	3M	3F
	60-74	**1**		0		2		**1**		**4**	
		1M	0F	0M	0F	1M	1F	0M	1F	2M	2F
	75-89	**0**		0		0		**0**		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**9**		**5**		**5**		**9**		**28**	
		5M	4F	2M	3F	2M	3F	1M	8F	10M	18F

Chart 25 indicates that communicating verbally one's perception of heat has a total frequency of 28 and is typical to females (18). The predominant age group is 30-44 (15), whereas the predominant seasons are the spring (9) and the winter (9).

Chart 26. "Pulling up one's sleeves": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Pulling up one's sleeves	15-29	**3**		0		1		0		**4**	
		2M	1F	0M	0F	0M	1F	0M	0F	2M	2F
	30-44	**5**		**1**		**1**		**0**		**7**	
		1M	4F	0M	1F	0M	1F	0M	0F	1M	6F
	45-59	**2**		**5**		**0**		**0**		**7**	
		1M	1F	2M	3F	0M	0F	0M	0F	3M	4F
	60-74	**1**		0		0		1		**2**	
		1M	0F	0M	0F	0M	0F	0M	1F	1M	1F
	75-89	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**11**		**6**		**2**		**1**		**20**	
		5M	6F	2M	4F	0M	2F	0M	1F	7M	13F

Chart 26 indicates that rolling up the sleeves of any item of clothing has a total frequency of 20 and is typical to females (13). The predominant age groups are 30-44 (7) and 45-59 (7), whereas the predominant season is the spring (11).

Chart 27. "Unbuttoning/unzipping one's coat/jacket": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Unbuttoning / unzipping one's coat / jacket	15-29	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	30-44	**5**		**2**		**0**		**0**		**7**	
		4M	1F	2M	0F	0M	0F	0M	0F	6M	1F
	45-59	**3**		**2**		**0**		**2**		**7**	
		3M	0F	2M	0F	0M	0F	0M	2F	5M	2F
	60-74	**1**		1		0		0		**2**	
		1M	0F	1M	0F	0M	0F	0M	0F	2M	0F
	75-89	**1**		0		0		0		**1**	
		1M	0F	0M	0F	0M	0F	0M	0F	1M	0F
	TOTAL	**10**		**5**		**0**		**2**		**17**	
		9M	1F	5M	0F	0M	0F	0M	2F	14M	3F

Chart 27 indicates that unbuttoning or unzipping one's coat or jacket has a total frequency of 17 and is typical to males (14). The predominant age groups are 30-44 (7) and 44-59 (7), whereas the predominant season is the spring (10).

Chart 28. "Unbuttoning one's shirt": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Unbuttoning one's shirt	15-29	0		1		0		0		**1**	
		0M	0F	1M	0F	0M	0F	0M	0F	1M	0F
	30-44	**3**		**5**		**0**		**0**		**8**	
		3M	0F	5M	0F	0M	0F	0M	0F	8M	0F
	45-59	1		2		0		0		**3**	
		1M	0F	2M	0F	0M	0F	0M	0F	3M	0F
	60-74	2		1		0		0		**3**	
		2M	0F	1M	0F	0M	0F	0M	0F	3M	0F
	75-89	0		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**6**		**9**		**0**		**0**		**15**	
		6M	0F	9M	0F	0M	0F	0M	0F	15M	0F

Chart 28 indicates that unbuttoning one's shirt has a total frequency of 15 and is clearly typical of males (26). The predominant age group is 30-44 (8), whereas the predominant season is the summer (9).

Finally, chart 29 shows totals of the most frequent heat-related behaviors sorted by season and gender.

Chart 29. Overview of heat-related behaviors sorted by season and gender

BEHAVIORS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Taking off one's clothes	**77**		**41**		**16**		**14**		**148**	
	55M	22F	25M	16F	9M	7F	6M	8F	95M	53F
Fanning oneself with hand/piece of paper	**17**		**60**		**4**		**8**		**89**	
	3M	14F	14M	46F	0M	4F	0M	8F	17M	72F
Opening the door/window	**20**		**17**		**7**		**5**		**49**	
	11M	9F	14M	3F	0M	7F	1M	4F	26M	23F
Wiping off one's sweat with hand/handkerchief	**6**		**36**		**2**		**0**		**44**	
	5M	1F	18M	18F	2M	0F	0M	0F	25M	19F
Rolling up one's sleeves	**15**		**13**		**2**		**1**		**31**	
	13M	2F	12M	1F	1M	1F	0M	1F	26M	5F
Drinking repeatedly	**24**		**5**		**2**		**0**		**31**	
	23M	1F	5M	0F	1M	1F	0M	0F	29M	2F
Verbal communication occurring	**9**		**5**		**5**		**9**		**28**	
	5M	4F	2M	3F	2M	3F	1M	8F	10M	18F
Pulling up one's sleeves	**11**		**6**		**2**		**1**		**20**	
	5M	6F	2M	4F	0M	2F	0M	1F	7M	13F
Unbuttoning/unzipping one's coat/jacket	**10**		**5**		**0**		**2**		**17**	
	9M	1F	5M	0F	0M	0F	0M	2F	14M	3F
Unbuttoning one's shirt	**6**		**9**		**0**		**0**		**15**	
	6M	0F	9M	0F	0M	0F	0M	0F	15M	0F
TOTAL	**195**		**197**		**40**		**40**		**472**	
	135M	60F	106M	91F	15M	25F	8M	32F	264M	208F

Total frequencies indicate that men physically act and react more than women do in relation to their perception of heat, especially in the spring (135) and in the summer (106). The highest male frequency has been recorded in the spring.

To conclude, the analysis of data linkage of age groups, seasons and genders in relation to the sensation of heat shows that taking off some clothes (148), the age group 30-44 (180) and the summer (197) show the highest frequencies.

2.9 Analysis of data linkage of age groups, seasons and genders in relation to cold

Charts 30 to 37 show the data linkage of the five different age groups, the four seasons and gender in relation to the most frequent cold-related behaviors (>10 frequency). For each examined behavior, the total frequencies and the gender prevalence as well as age groups and seasons with the highest frequencies are presented.

Chart 30. "Putting on one's clothes": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Putting on one's clothes	15-29	**12**		7		5		8		**32**	
		0M	12F	1M	6F	1M	4F	0M	8F	2M	30F
	30-44	**32**		**5**		**17**		**22**		**76**	
		3M	29F	1M	4F	4M	13F	0M	22F	8M	68F
	45-59	**7**		9		5		3		**24**	
		1M	6F	6M	3F	1M	4F	1M	2F	9M	15F
	60-74	**0**		4		4		1		**9**	
		0M	0F	1M	3F	2M	2F	0M	1F	3M	6F
	75-89	**0**		2		0		0		**2**	
		0M	0F	1M	1F	0M	0F	0M	0F	1M	1F
	TOTAL	**51**		**27**		**31**		**34**		**143**	
		4M	47F	10M	17F	8M	23F	1M	33F	23M	120F

Chart 30 indicates that putting on some clothes has a total frequency of 143 and is typical to females (120). The prevalent age group is 30-44 (76), whereas the prevalent season is the spring (51).

Chart 31. "Sneezing": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Sneezing	15-29	9		**14**		1		0		**24**	
		7M	2F	5M	9F	1M	0F	0M	0F	13M	11F
	30-44	**16**		**23**		**8**		**2**		**49**	
		9M	7F	8M	15F	5M	3F	0M	2F	22M	27F
	45-59	5		**10**		2		0		**17**	
		3M	2F	7M	3F	2M	0F	0M	0F	12M	5F
	60-74	3		**4**		1		0		**8**	
		3M	0F	2M	2F	1M	0F	0M	0F	6M	2F
	75-89	0		**0**		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**33**		**51**		**12**		**2**		**98**	
		22M	11F	22M	29F	9M	3F	0M	2F	53M	45F

Chart 31 indicates that sneezing has a total frequency of 98 and is typical to males (53). The prevalent age group is 30-44 (49), whereas the prevalent season is the summer (51).

Chart 32. "Coughing": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Coughing	15-29	**2**		**3**		0		0		**5**	
		1M	1F	3M	0F	0M	0F	0M	0F	4M	1F
	30-44	**2**		**8**		3		0		**13**	
		0M	2F	8M	0F	3M	0F	0M	0F	11M	2F
	45-59	**10**		**3**		**3**		**0**		**16**	
		8M	2F	3M	0F	2M	1F	0M	0F	13M	3F
	60-74	**2**		**4**		1		0		**7**	
		2M	0F	4M	0F	1M	0F	0M	0F	7M	0F
	75-89	**2**		**0**		0		0		**2**	
		2M	0F	0M	0F	0M	0F	0M	0F	2M	0F
	TOTAL	**18**		**18**		**7**		**0**		**43**	
		13M	5F	18M	0F	6M	1F	0M	0F	37M	6F

Chart 32 indicates that coughing has a total frequency of 43 and is typical to males (37). The prevalent age group is 45-59 (16), whereas the prevalent seasons are the spring (18) and the summer (18).

Chart 33. "Rubbing one's hands/arms/shoulders": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Rubbing one's hands / arms / shoulders	15-29	**3**		2		1		0		**6**	
		0M	3F	0M	2F	0M	1F	0M	0F	0M	6F
	30-44	**5**		**7**		**4**		**3**		**19**	
		2M	3F	0M	7F	0M	4F	0M	3F	2M	17F
	45-59	**3**		1		0		0		**4**	
		1M	2F	0M	1F	0M	0F	0M	0F	1M	3F
	60-74	**1**		1		1		1		**4**	
		0M	1F	0M	1F	0M	1F	0M	1F	0M	4F
	75-89	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**12**		**11**		**6**		**4**		**33**	
		3M	9F	0M	11F	0M	6F	0M	4F	3M	30F

Chart 33 indicates that rubbing one's hands / arms / shoulders has a total frequency of 33 and is typical of females (30). The predominant age group is 30-44 (19), whereas the predominant season is the spring (12).

Chart 34. "Closing the door / window": data linkage of age groups, seasons and genders

	AGE GROUPS	SPRING		SUMMER		AUTUMN		WINTER		TOTAL	
Closing the door / window	15-29	**1**		1		0		0		**2**	
		1M	0F	0M	1F	0M	0F	0M	0F	1M	1F
	30-44	**0**		3		2		2		**7**	
		0M	0F	2M	1F	2M	0F	1M	1F	5M	2F
	45-59	**7**		**2**		**2**		**3**		**14**	
		4M	3F	2M	0F	0M	2F	0M	3F	6M	8F
	60-74	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	75-89	**0**		1		0		0		**1**	
		0M	0F	0M	1F	0M	0F	0M	0F	0M	1F
	TOTAL	**8**		**7**		**4**		**5**		**24**	

		5M	3F	4M	3F	2M	2F	1M	4F	12M	12F

Chart 34 indicates that closing the door / window has a total frequency of 24, with equally split frequencies in male (12) and female subjects (12). The predominant age group is 45-59 (14) whereas the predominant season is the spring (8).

Chart 35. "Verbal communication occurring": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Verbal communication occurring	15-29	**0**		2		2		0		**4**	
		0M	0F	0M	2F	0M	2F	0M	0F	0M	4F
	30-44	**5**		**2**		**2**		**3**		**12**	
		0M	5F	2M	0F	0M	2F	0M	3F	2M	10F
	45-59	**2**		0		0		0		**2**	
		0M	2F	0M	0F	0M	0F	0M	0F	0M	2F
	60-74	**2**		0		0		1		**3**	
		0M	2F	0M	0F	0M	0F	0M	1F	0M	3F
	75-89	**0**		0		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**9**		**4**		**4**		**4**		**21**	
		0M	9F	2M	2F	0M	4F	0M	4F	2M	19F

Chart 35 indicates that voicing one's perception of cold has a total frequency of 21 and is typically a female behavior (19). The predominant age group is 30-44 (12) whereas the predominant season is the spring (9).

Chart 36. "Shivering": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Shivering	15-29	0		**1**		0		0		**1**	
		0M	0F	0M	1F	0M	0F	0M	0F	0M	1F
	30-44	**1**		**5**		**1**		**1**		**8**	
		0M	1F	1M	4F	0M	1F	0M	1F	1M	7F
	45-59	0		**3**		2		0		**5**	
		0M	0F	0M	3F	1M	1F	0M	0F	1M	4F
	60-74	0		**0**		1		1		**2**	
		0M	0F	0M	0F	1M	0F	0M	1F	1M	1F
	75-89	0		**0**		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	TOTAL	**1**		**9**		**4**		**2**		**16**	
		0M	1F	1M	8F	2M	2F	0M	2F	3M	13F

Chart 36 indicates that shivering has a total frequency of 16 and is typically a female reaction (13). The predominant age group is 30-44 (8) whereas the predominant season is the summer (9).

Chart 37. "Rubbing/cleaning one's nose with handkerchief/tissue": data linkage of age groups, seasons and genders

	AGE GROUPS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Rubbing/cleaning one's nose with handkerchief/tissue	15-29	1		**3**		0		0		**4**	
		1M	0F	3M	0F	0M	0F	0M	0F	4M	0F
	30-44	**1**		**4**		**0**		**0**		**5**	
		0M	1F	4M	0F	0M	0F	0M	0F	4M	1F

	45-59	0		**0**		0		0		**0**	
		0M	0F	0M	0F	0M	0F	0M	0F	0M	0F
	60-74	0		**0**		1		0		**1**	
		0M	0F	0M	0F	1M	0F	0M	0F	1M	0F
	75-89	1		**1**		0		0		**2**	
		0M	1F	1M	0F	0M	0F	0M	0F	1M	1F
	TOTAL	**3**		**8**		**1**		**0**		**12**	
		1M	2F	8M	0F	1M	0F	0M	0F	10M	2F

Chart 37 indicates that rubbing or cleaning one's nose with a handkerchief or tissue has a total frequency of 12 and is typically a male behavior (10). The predominant age group is 30-44 (5) whereas the predominant season is the summer (8).

Finally, chart 38 lists the totals of the most frequent cold-related behaviors, sorted by season and gender.

Chart 38. Overview of cold-related behaviors sorted by season and gender

BEHAVIORS	**SPRING**		**SUMMER**		**AUTUMN**		**WINTER**		**TOTAL**	
Putting on one's clothes	**51**		**27**		**31**		**34**		**143**	
	4M	47F	10M	17F	8M	23F	1M	33F	23M	120F
Sneezing	**33**		**51**		**12**		**2**		**98**	
	22M	11F	22M	29F	9M	3F	0M	2F	53M	45F
Coughing	**18**		**18**		**7**		**0**		**43**	
	13M	5F	18M	0F	6M	1F	0M	0F	37M	6F
Rubbing one's hands/arms/shoulders	**12**		**11**		**6**		**4**		**33**	
	3M	9F	0M	11F	0M	6F	0M	4F	3M	30F
Closing the door / window	**8**		**7**		**4**		**5**		**24**	
	5M	3F	4M	3F	2M	2F	1M	4F	12M	12F
Verbal communication occurring	**9**		**4**		**4**		**4**		**21**	
	0M	9F	2M	2F	0M	4F	0M	4F	2M	19F
Shivering	**1**		**9**		**4**		**2**		**16**	
	0M	1F	1M	8F	2M	2F	0M	2F	3M	13F
Rubbing/cleaning one's nose with handkerchief/tissue	**3**		**8**		**1**		**0**		**12**	
	1M	2F	8M	0F	1M	0F	0M	0F	10M	2F
TOTAL	**135**		**135**		**69**		**51**		**390**	
	48M	87F	65M	70F	28M	41F	2M	49F	143M	247F

Total frequencies indicate that women physically act and react much more than men in relation to their perception of cold, in all seasons. The highest male frequency has been recorded in the spring (87). In the winter, a clear female prevalence can be witnessed (49 females out of a total of 51 frequencies).

To conclude, the analysis of data linkage of age groups, seasons and gender in relation to the sensation of cold indicates that putting on some clothes (143), the age group 30-44 (189), the spring (135) and the summer (135) display the highest frequency.

2.10 Discussion of the results

Total frequencies are rather equally split between heat (506) and cold (427). Concerning both sensations, *actions directed towards oneself* are more common than actions directed towards one's environment.

The single heat-related behavior with the highest total frequency is taking off one's clothes (148), while the most frequently recorded cold-related behavior is putting on one's clothes (143). While the former behavior is predominantly male, the latter is clearly predominantly female. The single behavior with the highest frequency overall is *taking off one's clothes (148).*

Verbal communication occurs more frequently in relation to heat (28) than cold (21). In both cases, it seems to be rather typical among female subjects, who tend to voice their perceptions of heat and cold much more often than their male counterparts do.

Moreover, a number of physical reactions (flushing, sneezing, coughing and shivering) have been witnessed. Based on field observations, these can also be ascribed to the sensations of either heat or cold.

2.10.1 Discussion of the results related to the sensation of heat

Chart 2 shows that the single heat-related behavior with the highest total frequency is *taking off one's clothes (148)*.

Chart 8 indicates that rather typical male behaviors are: *"Taking off one's clothes" (95)*, "Drinking repeatedly", "Rolling up one's shirt / jumper sleeves", "Opening the door / window", "Wiping off one's sweat with hand/handkerchief", "Unbuttoning one's shirt", "Unbuttoning / unzipping one's coat or jacket", "Leaving the room" and "Moving away from the sunlight (streaming through the window pane)". The following behaviors and physical reactions are on the other hand more typical among female subjects: *"Fanning oneself with hand / piece of paper" (72)*, "Communicating verbally", "Pulling up one's sleeves", "Tying up one's hair", "Pulling one's sweater/jumper/coat collar", "Touching one's face" and "Flushing". Men seem to display behaviors aimed at the environment ("Opening the door / window", "Regulating the heater" and "Turning dehumidifier / fan / air conditioner on") more than women do.

Chart 2 also shows that higher frequencies are recorded in public spaces, with the exception of "Drinking repeatedly", "Communicating verbally", "Pulling one's sweater/jumper/coat collar" and "Moving away from the sunlight (streaming through the window pane)" which record higher frequencies in private places.

To sum up, with regard to the sensation of hot, men tend to carry out more actions and therefore seem to endure heat less than women do *(275).* The most frequent behaviors are carried out for the most part by men. Men would therefore endure heat less than women *(275).* On this very subject, table 29 also suggests that men act and react physically more than women in relation to the sensation of hot, especially in the spring (135) and in the summer (106). The highest male frequency has been recorded in the spring. Interestingly enough, in relation to heat women seem to act and react physically more than men in the autumn and in the winter. This may indicate that rather high temperatures are normally set in indoor environments during the colder seasons and women tend to move more and be – generally speaking – more active than men. Additionally, physiological features also play a fundamental role. According to scientific literature, men and women dress differently in relation to temperatures, with women having a lower metabolic rate than men while carrying out a sedentary activity. Women additionally experience menstrual cycle and are exposed to other regulatory hormones which affect their reactions to thermal comfort, thermoregulation and thermogenic thresholds. With regard to hormone levels, women display differences as compared to men (Kim, de Dear, Candido, Zhang, & Arens, 2013).

Lastly, the analysis of data linkage of age groups, seasons and gender in relation with heat shows that “taking off one’s clothes" (148), the age group 30-44 (180) and “summer” (197) rank highest in frequency in their respective categories.

2.10.2 Discussion of the results related to the sensation of cold

Chart 3 shows that the single cold-related behavior with the highest total frequency is *putting on one’s clothes (143)*.

Chart 9 indicates the following behaviors and physical reactions as more typical female: *“Putting on one’s clothes” (120)*, “Rubbing one’s hands / arms / shoulders”, “Communicating verbally”, “Shivering”, “Drinking repeatedly” and “Pulling up one’s jacket hood”. The following physical reactions and behaviors, conversely, are more typical of male subjects: *“Sneezing” (53)*, “Coughing”, “Rubbing/cleaning one’s nose with handkerchief/tissue”, “Rolling down one’s shirt sleeves”, “Buttoning up one’s shirt” and “Pulling up one’s jacket / jumper collar”. Closing the door / window is equally split in its frequency between male and female subjects. “Opening the door (to contrast conditioned air)” and “Regulating the heater” are seemingly male behavior, whereas “Opening the curtains / shutters (to let the hat in)” is more typically female. A look at the total frequencies however indicate that the actions directed towards the environment are almost equally split between male and female subjects.

As chart 3 shows, higher frequencies have been recorded in public places, with the exception of "Sneezing", "Rubbing/cleaning one's nose with handkerchief/tissue", "Opening the door (to contrast conditioned air)", "Pulling up one's jacket / jumper collar" and "Regulating the heater", all behaviors that display higher frequencies in private places. Last but not least, coughing is seemingly almost equally split between public and private places.

To sum up, women seem to feel cold much more than men. Female subjects tend to wear warmer clothes and to voice their discomfort more often *(263)*. In this regard, chart 38 indicates that women act and physically react much more often than men in connection to the sensation of cold, and this in all seasons. The highest female frequency has been recorded during the spring (87). In the winter-time, there is a clear female prevalence (49 female out of 51 total frequencies). Interestingly enough, in the spring (135) and the summer (135) the highest number of behaviors has been detected compared to other seasons, despite these being the warmer seasons of the year. This may indicate that air conditioners set at very low temperature are commonplace in indoor environments during the warmer seasons. Moreover, as seasons change, especially as spring approaches with a contrast in temperature perception from the winter, the human body feels the need for a new balance. People tend to wear too many clothes or clothes that are too warm and display such behaviors, possibly following the winter pattern, which may be not perfectly in line with the real temperature of an indoor environment at a specific time.

To conclude, data linkage of age groups, seasons and genders in relation to the sensation of cold indicate that putting on one's clothes (143), age group 30-44 (189), the spring (135) and the summer (135) rank highest in terms of frequency.

2.10.3 Environments abroad

Observations outside of Italy took place from April 2016 to June 2018 in the following locations: Amsterdam and Maastricht (Netherlands), Leuven (Belgium), St. Cloud (Minnesota – USA), Lisbon and Porto (Portugal).

Chart 1 shows that professional offices (43), universities (35) and trains (32) are the places outside of Italy where most frequencies have been detected. Charts 2 and 3 show that occurrences of verbal communication, physical reactions and actions directed towards oneself and one's environment have been recorded abroad in relation to both the sensation of heat and cold. The frequencies are balanced between heat (114) and cold (103) and also between public (120) and private places (80).

Abroad, the single heat-related behavior with the highest total frequency is *taking off one's clothes (42)*, whereas *sneezing (35)* ranks highest among cold-related behaviors, both behaviors being

typical of male subjects. More specifically, *wiping off one's sweat with hand/handkerchief* has never been detected in monitored settings outside of Italy (0). Conversely, *drinking repeatedly (25)* and *rubbing / cleaning one's nose with handkerchief/tissue (9)* both display higher frequencies abroad than in Italy.

2.10.4 Seasons

A look at behavioral changes in the four different seasons shows that the *summer* is the single season with the most detected behaviors (332) and *winter* is the single season with the least behaviors (91).

In relation to the heat, the most frequently recorded behaviors for all four seasons: "Taking off one's clothes" (77 – spring / 16 – autumn / 14 – winter) and "Fanning oneself with one's hand / piece of paper"(60 / summer). Both behaviors are actions directed towards oneself. In relation to cold, the most frequently recorded behaviors for all four seasons are: "Putting on one's clothes" (51 – spring / 31 – autumn / 34 – winter) and "Sneezing" (51 – summer); the former is an action directed towards oneself, while the latter is a physical reaction.

In the springtime, "Taking off one's clothes" (77) and "Verbal communication occurring" in relation to both heat (9) and cold (9) display the highest frequencies overall compared to all other seasons.

In the spring and the summer, the highest number of behaviors has been detected compared to other seasons, despite these are the warmer seasons of the year. This may indicate that air conditioners set at very low temperature are commonplace in indoor environments during the warmer seasons, causing from thermal shock in subjects switching from an outdoor to an indoor environment. Moreover, for autumn and winter alike, which are normally cold seasons, taking off some clothes ranks highest in terms of frequency among heat-related behaviors. This may indicate that the monitored indoor environments were excessively heated and/or that the subjects under observation were wearing too many clothes and/or that they might have previously exerted some kind of physical effort (e.g. walking, climbing stairs, running, etc.).

2.10.5 Age groups

A look at behavioral changes between the five age groups shows that in *age group 30-44* the highest number of behaviors has been detected *(369)* compared to all other age groups, whereas in *age group 75-89* the lowest number of behaviors has been detected (9).

In relation to heat, the most frequently recorded behaviors for all age groups are: "Taking off one's clothes" (47 – age group 15-29 / 43 – age group 30-44 / 41 – age group 45-59), "Fanning oneself

with one's hand / piece of paper" (23 / age group 60-74), "Wiping off one's sweat with hand / tissue" and "Unbuttoning / unzipping one's coat / jacket" (1 / age group 75-89). These behaviors are all actions directed towards oneself. In relation to heat, the most frequently recorded behaviors for all age groups are: "Putting on one's clothes" (32 – age group 15-29 / 76 – age group 30-44 / 24 – age group 45-59 / 9 – age group 60-74 / 2 – age group 75-89), "Coughing" and "Rubbing / cleaning one's nose with a handkerchief/tissue" (2 – age group 75-89). Two of these are actions directed towards oneself, while one is a physical reaction.

In age group 30-44 "Putting on one's clothes" (76) and "Verbal communication occurring" in relation to both heat (15) and cold (12) display the highest frequency overall compared to all other age groups. It is interesting to notice that for this age group the detected frequencies seem to be more typically female. Conversely, in age group 45-59 frequencies seem rather typically male. Finally, in age group 75-89 no frequencies (0) have been detected for taking off one's clothes and voicing one's perception of either heat or cold. This may indicate that these behaviors are not typical of elderly people.

3. Conclusions

The present chapter outlined data resulting from field observations that were carried out in multiple indoor environments, both public and private (homes, offices, universities, etc.) in Italy and abroad (Europe and US), aimed at detecting behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication which can be interpreted as display of sensations of heat and/or cold as perceived by people in their everyday-life environments. All the detected behaviors were analyzed in relation to both heat and cold and were divided into unambiguous and ambiguous behaviors, the latter being those behaviors who are only seemingly triggered by one's sensation of heat / cold. In addition to that, the sentences uttered by the subjects in relation to their perception of heat / cold were recorded during observations and later analyzed. These have been divided into four categories: impersonal and first-person statements, action-related sentences and general statements. *Impersonal statements* rank highest in terms of frequency among all other categories, in relation to both heat (15) and cold (11). All data related to the sensations of both heat and cold were studied in relation to gender, season and age group. Subsequently, an analysis of data linkage of age groups, seasons and genders followed.

These analyses show that total frequencies are rather equally split between heat (506) and cold (427). Concerning both sensations, *actions directed towards oneself* are more common than actions directed towards one's environment. The single heat-related behavior with the highest total

frequency is taking off one's clothes (148), with putting on one's clothes (143) ranking highest among cold-related behaviors. The former behavior displays a male prevalence, whereas the latter rather a clear female prevalence. The single behavior with the highest frequency overall is *taking off one's clothes (148).*

In relation to the sensation of heat, *"Taking off one's clothes" (95)* is the single behavior most typical of male subjects, whereas *"Fanning oneself with hand / piece of paper" (72)* is the most typical of female subjects. In relation to the sensation of cold, *"Putting on one's clothes" (120)* is the single behavior most typical of female subjects, while *"Sneezing" (53)* is the most typical of male subjects. Men physically act and react more than women do in relation to their perception of heat, especially in the spring (135) and in the summer (106). The highest male frequency has been recorded in the spring. Men seem therefore to endure heat less easily than women *(275).* Conversely, women seem to perceive cold much more than men do, in all seasons. The highest female frequency has been recorded in the spring (87). As a matter of fact, women typically put on more clothes and voice their discomfort more than men do *(263).* Verbal communication is more frequent in relation to heat (28) than cold (21). In both cases, it seems to be more typically female. Women tend to voice their perceptions of heat and cold much more often than men do. These data are in line with the outcomes of other studies carried out in various indoor environments (Choi, Aziz, & Loftness, 2010; Karjalainen, 2007, 2012; Kcomt Ché, Pardons, Vanrompay, Preuveneers, & Berbers, 2010; Kim, de Dear, Candido, Zhang, & Arens, 2013; Parsons, 2002; Zalejska-Jonsson & Wilhelmsson, 2013), which indicate that *women are less satisfied with room temperatures and generally prefer higher temperatures than men, with discomfort in relation to both heat and cold being reported much more frequently in women than men*.

A look at behavioral changes in the four different seasons shows that the *summer* is the single season with the most detected behaviors (332) and *winter* is the single season with the least behaviors (91). In the springtime, "Taking off one's clothes" (77) and "Verbal communication occurring" in relation to both heat (9) and cold (9) display the highest frequencies overall compared to all other seasons. Based on total frequencies in relation to both heat and cold, it is safe to say that men seem to act more frequently in the spring and in the summer, while women seem to act more frequently in the autumn and in the winter.

A look at the most frequent behavioral changes in the five different age groups shows that in the single *age group 30-44* most behaviors have been detected (369), whereas the least behaviors (9) have been detected in *age group 75-89*. Additionally, in age group 30-44 "Putting on one's clothes" (76) and "Verbal communication occurring" in relation to both heat (15) and cold (12) display the

highest frequency overall compared to all other age groups. Finally, in age group 75-89 no frequencies (0) have been detected for taking off one's clothes and voicing one's perception of either heat or cold. This may indicate that these behaviors are not typical of elderly people. In this regard, scholarly sources suggest that elderly people display a reduced thermoregulatory capability, which is linked – together with additional changes of one's body composition – to a decrease of the total of water in the human body (Franceschi, Pauletto, A. Incalzi, & M. Fabbri, 2011). Additionally, a number of authors (Bouchama & Knochel, 2002; Dinarello & Porat, 2008; Pontieri, 1998) have dealt with the subject of pathophysiology of thermoregulation, with the hypothalamus as the thermoregulatory center of the human body. If the thermoregulatory system is damaged and does not work effectively, a person's health can be seriously affected. Senior people seem to be most exposed to risk because of their age-induced thermoregulatory impairment. More specifically, a loss of lean body mass, reduced mobility, inadequate eating habits, reduced cold-induced chills and reduced vasoconstriction result in reduced heat generation capacity (Bragagni, Alberti, Castelli, & Lari, 2012).

To sum up, data linkage of age groups, seasons and genders in relation to the sensation of heat indicates that taking off one's clothes (148), the age group 30-44 (180) and the summer (197) show the highest number of frequencies. In relation to cold, on the other hand, most frequencies have been recorded for putting on one's clothes (143), the age group 30-44 (189), the spring (135) and the summer (135).

Data collection lasted more than two years during the PhD program. Subsequent data analysis provided for an insight into a number of frequent displays of thermal discomfort (hot / cold) as experience by people in their daily lives that in most cases they cannot overcome. The aim of this study is understanding human beings through the detection and assessment of their actions and reactions, taking their real-life and every-day life environments into account in order to develop devices that can truly ensure users comfort and well-being.

To conclude, to better understand whether the behaviors detected by the use of the checklist are unambiguous or ambiguous (a number of behaviors may not necessarily be triggered by the subjects' perceptions of heat and/or cold, but may depend on other factors, e.g. "Sneezing" and/or "Coughing", while other behaviors may be displayed in relation to both heat and cold, e.g. "Drinking repeatedly" and/or "Tying up one's hair"), administering a series of questionnaires to common people of different age groups was deemed necessary in order to compare and contrast data resulting from the checklist to data resulting from the questionnaires, thus gaining more insight into the monitored people's perceptions. For an analysis of questionnaires, see chapter 7.

CHAPTER 5
DESCRIPTIVE ANALYSIS OF OBSERVATIONS IN FIVE HEALTHCARE CENTERS BASED ON THE CHECKLIST

The present research project focuses on technology enhancing users' well-being and comfort, especially in more vulnerable subjects, with particular emphasis on non-self-sufficient senior people. Actively interacting with devices in order to adapt technology to one's specific needs at any given time can result in non-negligible physical and cognitive efforts in vulnerable subjects. Precisely for this reason, such systems should be able to "interpret" users' behaviors based on the latter's perceptions of thermal, luminous, acoustic, etc. comfort and/or discomfort in everyday-life indoor environments. The aim of this study is understanding human beings through the detection and assessment of their actions in order to develop devices that can truly ensure comfort in their everyday-life environments.

The following survey data have been collected by means of a checklist. Observations took place with the aim of investigating a number of behaviors and physical reactions that can be interpreted as a display of comfort and/or discomfort in senior residents of a number of healthcare centers.

1. The healthcare facilities participating in the project

5 healthcare centers – more specifically, nursing homes and rehabilitation centers – located in the Italian region Marche took part in the present project. Selection took place based on geographical proximity and availability to join the project.

Chart 1 lists the healthcare centers that participated in the present project, together with their respective location, healthcare categories and number of residents.

Chart 1. Healthcare facilities joining the project

NAME	TOWN	HEALTHCARE CATEGORY	N. OF RESIDENTS
I.R.C.E.R. Foundation – Assunta di Recanati	Recanati (Province of Macerata)	Care home Nursing home	65
Villa Letizia	Civitanova Marche (Province of Macerata)	Care home Temporary relief facility	57
Santo Stefano	Porto Potenza Picena (Province of Macerata)	Long-term care facility	40
		A3 ward	33
Casa Hermes	Loreto (Province of Ancona)	Care home Nursing home	72
Casa di Ospitalità	Castelraimondo (Province of Macerata)	Care home Nursing home Day care center	40

The healthcare centers are: I.R.C.E.R. Foundation - Assunta in Recanati (Province of Macerata), Villa Letizia in Civitanova Marche (Province of Macerata), the "Santo Stefano" rehabilitation institute in Porto Potenza Picena (Province of Macerata), Casa Hermes in Loreto (Province of Ancona) and the care home "Casa di Ospitalità" in Castelraimondo (Province of Macerata).

1.1 Methods and research instruments

Inside these healthcare centers, a total of *75 field observations* (15 for each healthcare center) have been carried out in relation to mainly temperature and lighting. Observations took place from October 26th 2016 to July 4th 2017, spanning all four seasons. Two checklist have been devised to conduct field observations. For temperature, the same checklist devised for generic indoor environment observations was used, whereas a new checklist was specifically devised for lighting. Both checklist aim at detecting behaviors (directed towards both oneself and one's environment), physical reactions and occurrences of verbal communication which can be read as a display of discomfort, both at thermal (hot / cold) and luminous (lighting) level, as felt by senior residents inside these centers. Dates and places of observations, time of the day, age and gender of monitored subjects as well as indoor and outdoor temperatures in every location have all been recorded.

2. Data collection

In the present section, all five healthcare centers are presented together with their respective data as recorded during field observations.

2.1 I.R.C.E.R. Foundation – Assunta, Recanati

The staff of this healthcare facility consists of 1 General Manager, 1 social services and health coordinator, 2 nursing coordinators, 3 nurses, 5 basic care operators, 1 cook, 1 person in charge of laundry and wardrobe, and 3 generic workers.

This large, multi—story facility is equipped with an alarm system and surveillance cameras. Additionally, a system alerts staff workers in event of opening of gates seemingly connected to attempts to escape of one of the residents. The attending specifically receives a text message with the number of the gate that has been accidentally or illicitly opened. The care home accommodates approximately 60 people, approximately 20 of them suffering from senile dementia. The nursing home accommodates only 5 residents. Common spaces – canteen, gym, etc. – are shared by care home and nursing home residents. Most residents experience impaired mobility. Generally, all of them still have their own general practitioner. Every day, the center hosts a number of activities by

contractors, including – but not limited to – physiotherapy, music therapy, pet therapy and painting sessions.

In the autumn, the indoor temperature is set at approximately 18/19°C. On a daily basis, health workers care for room ventilation and stand up patients and place them by the windows so that they can receive enough sunlight exposure.

In the canteen, most residents eat with the help of healthcare workers. An attached hall hosts about ten seniors who are more self-sufficient, including the residents of the nursery home.

The facility also hosts a day care center. It operates approximately 4 hours per day, and hosts mainly people with Alzheimer's disease.

In the Villa Teresa neighborhood in Recanati, the foundation runs an additional number of care apartments in the form of single or double rooms. They are home to approximately 20 senior residents who are entirely self-sufficient.

2.1.1 Observations

From October 26th 2016 to February 15th 2017, 15 observations took place at this facility. The residents sample consists of 0 male and 15 female subjects. The average age of the subjects displaying any of the detected behaviors is 89.3 years.

Chart 2 shows both heat- and cold-related behaviors recorded at I.R.C.E.R Foundation sorted by gender, with their respective frequencies.

Chart 2. Frequencies sorted by gender of behaviors detected at I.R.C.E.R. Foundation

Heat			
BEHAVIORS	**M**	**F**	**TOTAL**
Taking off one's clothes	0	5	5
Pulling up one's sleeves	0	3	3
Wiping off one's sweat with hand/handkerchief	0	1	1
SUBTOTAL	**0**	**9**	**9**
Cold			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on ones' clothes (also on shoulders only)	0	3	3
Pulling down one's jumper sleeves	0	2	2
Rubbing/cleaning one's nose with handkerchief/tissue	0	1	1
SUBTOTAL	**0**	**6**	**6**
TOTAL	**0**	**15**	**15**

Only actions directed towards oneself (as opposed to one's environment) have been recorded, as displayed by women only. The single most frequent heat-related behavior is taking off one's clothes (5), whereas putting on one's clothes ranks highest among cold-related behaviors (3). Two female frequencies have been detected inside the canteen (#14 and #15), where indoor temperature was

high; it is however unclear whether the two women in question pulled up their sweater sleeves because of their perception of heat or rather because they were simply about to start eating.
This is the only facility where the largest number of behaviors has been recorded in relation to heat, regardless of the fact that observations took place in the colder part of the year (autumn / winter). Probably, the heater is set at a rather high temperature inside this facility, and the temperature is perceived as hot by residents themselves. Additionally, the least variety of behaviors among all facilities has been recorded here.

2.2 Villa Letizia, Civitanova Marche

The staff of this healthcare facility consists of 1 social and health manager, 1 social assistant, 1 social and health coordinator, 5 nurses, 21 basic care operators, 1 cook, 1 person in charge of laundry and wardrobe and 2 generic workers. The canteen service is outsourced.
This facility is aimed at offering in-house social, health and care services as well as integrated territorial socio-sanitary interventions. In accordance with the legislation, these are identified as follows:

- *care home*, a care and assistance solution for non-self-sufficient elderly people, whose health conditions or local service networks make it impossible for them to stay at their homes. Care home recovery is crucial in the case of multiple functional, chronic and degenerative diseases which require clinical and medical treatment combined with continuous care;
- *temporary relief facility*. Recovery lasts to a maximum of 30 days, providing relief to the patients' families. Repeated cycle admissions throughout the year are also possible.

At the moment, the facility accommodates 57 residents in its care home (with different diseases), including 6 people who were forced to temporarily leave their houses due to the earthquake that hit Central Italy. Admission can be short-term or permanent. Services are available 365 days per year, 24/7, their quality complying with standards set by the regional legislation on seniors facilities. They include, aside from basic care and tutelary assistance, hotel and special services. The tuition covers day-time and night-time tutelary assistance, personal care and hygiene, board and lodging, food (with room service for those residents who are temporarily not autonomous), laundry and wardrobe for personal clothes, room and furniture cleaning and maintenance, administration of treatments prescribed by general doctors, nursing care, professional social service, outdoor trips, celebrations, participation to social, cultural and entertainment activities in the local community,

and religious assistance. General and specialist medical assistance is covered by the Italian National Healthcare System (SSN).

2.2.1 Observations

15 observations took place at this facility from January 24th to March 3rd 2017. The residents sample consists of 2 male and 13 female subjects. The average age of the subjects who displayed any of the detected behaviors is 83.9 years.

Chart 3 shows the behaviors recorded at Villa Letizia sorted by gender, with their respective frequencies.

Chart 3. Frequencies sorted by gender of behaviors detected at Villa Letizia

Heat			
BEHAVIORS	**M**	**F**	**TOTAL**
Verbal communication occurring	0	3	**3**
Taking off one's clothes	0	2	**2**
Unbuttoning/unzipping one's coat	1	0	**1**
Taking off lap blanket	0	1	**1**
SUBTOTAL	**1**	**6**	**7**
Cold			
BEHAVIORS	**M**	**F**	**TOTAL**
Rubbing/cleaning one's nose with handkerchief/tissue	0	2	**2**
Putting on ones' clothes (also on one's shoulders only)	0	1	**1**
Sipping from a hot drink	1	0	**1**
Getting closer to the heater (also on wheelchair)	1	0	**1**
Verbal communication occurring	0	1	**1**
Sneezing	0	1	**1**
Coughing	0	1	**1**
SUBTOTAL	**2**	**6**	**8**
Lighting			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on one's spectacles	0	1	**1**
SUBTOTAL	**0**	**1**	**1**
Various			
BEHAVIORS	**M**	**F**	**TOTAL**
Wiping off/rubbing one's eyes with handkerchief/hands	0	1	**1**
SUBTOTAL	**0**	**1**	**1**
TOTAL	**3**	**14**	**17**

Occurrences of verbal communication, actions directed towards oneself and physical reactions have been detected, most of them being displayed by women. The only three female behaviors are "Unbuttoning/unzipping one's coat", "Sipping from a hot drink" and "Getting closer to the heater (also on wheelchair)". The single most frequent heat-related behavior is voicing one's perception of heat (3), whereas the single most frequent cold-related behavior is rubbing / cleaning one's nose with a handkerchief or tissue (2). The most frequent behavior related to the lighting is putting on one's spectacles (1). Two cold-related physical reactions have been detected, namely sneezing and

coughing. One of the detected behaviors does not fit into either the temperature or the lighting category, namely cleaning / rubbing one's eyes with a tissue / one's hands.

Chart 4 lists the heat- and cold-related sentences uttered by the residents of Villa Letizia during observations.

Chart 4. Villa Letizia: sentences uttered in relation to heat and cold

Heat			
CATEGORY	**FREQUENCIES**	**OBSERVATION NUMBER**	**QUOTE**
Impersonal statements	2	12	"Oggi è caldo, ieri era freddo, c'avevo questo, e questo, e la sciarpa" [It is hot today, yesterday it was cold, I had this and this on, and my scarf too] (resident pointing at his/her clothes)
		15	"Madonna, che caldo!" [My God, it's so hot!]
First-person statements	1	1	"Sento caldo!" [I am feeling hot!]
Cold			
CATEGORY	**FREQUENCIES**	**OBSERVATION NUMBER**	**QUOTE**
Impersonal statements	1	11	"È freddo" [It's cold]

A total of 4 female occurrences of verbal communication have been detected, 3 in relation to heat and 1 in relation to cold. They have been divided into impersonal statements, those using or implying the pronoun 'it', and first-person statements. Interestingly, in the middle of winter, three women voiced their perception of heat, probably because the indoor heating system is set at a rather high temperature with consequences in the residents' perceptions. It is important to stress that for observation # 11 as the senior patient exclaimed "It's cold" and put her blanket on her shoulders, a healthcare worker argued: "It's not cold at all! It's hot!". As this episode indicates, perceptions differ greatly between senior people and their caregivers.

2.3 "Santo Stefano" rehabilitation institute, Porto Potenza Picena

Observations took place in two different wards: 1) *Long-term care (Pavilion D: extensive non hospital)* and 2) *A3 ward (intensive non hospital).*

Long-term care patients are predominantly male in this facility, which accommodates approximately 40 senior people with disabilities. It reflects old-fashioned hospitals with large open rooms, shared bathrooms, etc. The staff consists of 1 medical officer, 1 social assistant, 1 head nurse, 5 nurses, 3 nursing assistants, 2 physiotherapists (1 morning shift and 1 afternoon shift) and 3 social educators.

The A3 ward accommodates approximately 33 people needing rehabilitation treatments for various reasons, admissions lasting to a maximum of six months. The staff consists of 5 nurses, 11 nursing assistants, 4 physiotherapists and 2 social educators.

2.3.1 Observations

From February 1st to March 30th 2017, 15 observations took place at this facility. The residents sample consists of 3 male and 12 female subjects. The average age of all people displaying any of the detected behaviors is 81.3 years.

Chart 5 shows the behaviors recorded at Santo Stefano sorted by gender, with their respective frequencies.

Chart 5. Frequencies sorted by gender of behaviors detected at Santo Stefano

Heat			
BEHAVIORS	**M**	**F**	**TOTAL**
Taking off one's clothes	0	2	**2**
Fanning oneself with one's hand/piece of paper	0	2	**2**
Unbuttoning one's shirt/sweater	1	0	**1**
Pulling one's collar	0	1	**1**
Pulling up one's sleeves	0	1	**1**
Verbal communication occurring	0	1	**1**
SUBTOTAL	**1**	**7**	**8**
Cold			
BEHAVIORS	**M**	**F**	**TOTAL**
Coughing	1	4	**5**
Sneezing	0	1	**1**
Putting on ones' clothes (also on one's shoulders only)	1	0	**1**
Rubbing/cleaning one's nose with handkerchief/tissue	0	1	**1**
Getting closer to the heater (also on wheelchair)	0	1	**1**
SUBTOTAL	**2**	**7**	**9**
Various			
BEHAVIORS	**M**	**F**	**TOTAL**
Yawning	0	2	**2**
Snoring	0	1	**1**
SUBTOTAL	**0**	**3**	**3**
TOTAL	**3**	**17**	**20**

At Santo Stefano, the lowest average age among all facilities has been recorded, probably due to the fact that rehabilitation wards accommodate patients of all age groups, from young adults to older seniors. Actions directed towards oneself, occurrences of verbal communication and physical reactions have been recorded, most of them being displayed by female subjects. One of the wards where observations took place accommodates mostly male patients; nevertheless, the only three behaviors displayed by male subjects are "Unbuttoning one's shirt/sweater", "Coughing" and "Putting on ones' clothes". The most frequent heat-related behaviors are taking off one's clothes (2) and fanning oneself with one's hand/piece of paper (2). The most frequent among cold-related behaviors is coughing (5). Two of the detected behaviors do not fit into the temperature category, namely yawning and snoring. Compared to all other facilities, the greatest variety of behaviors has been recorded here, probably also due to the fact that two different wards have been taken into account.

Two significant episodes occurred during observations: 1) one social educator said to a patient while touching him: "You're wearing your shirt under your jumper, don't you feel hot?!". The patient answered back with emphasis: "No!". This episode suggests how senior patients' perceptions can differ from those of their caregivers; 2) one physiotherapist asked a patient who had suffered from a stroke: "Do you feel hot? Do you feel cold?". The patient answered no to both questions. This episode suggests how comfort and/or discomfort in those patients whose health is more seriously affected is for the most part filtered by healthcare workers' questions and own perceptions.

Chart 6 shows the single sentence uttered by one resident at Santo Stefano in relation to her perception of heat as recorded during observations.

Chart 6. Santo Stefano: sentence uttered in relation to heat

Heat			
CATEGORY	**FREQUENCIES**	**OBSERVATION NUMBER**	**QUOTE**
First-person statements	1	3	"Sento caldo oggi" [I'm feeling hot today]

One heat-related occurrence of verbal communication by one female resident has been recorded. The woman in question had suffered from a stroke five months prior to this observation, and had difficulties speaking. This episode seem to suggest that communicating one's need prevails over one person's mental and physical difficulties.

2.4 Casa Hermes, Loreto

This facility is home to approximately 72 residents. The staff consists of 1 manager, 1 personnel manager, 1 psychologist, 1 social assistant, 4 nurses, 22 nursing assistants, 2 laundry operators, 5 cooks, 3 ushers and 1 driver.

2.4.1 Observations

From March 2nd to June 22nd 2017, 15 observations were carried out at this faculty. The residents sample consists of 0 male and 15 female subjects. The average age of residents displaying any of the detected behaviors is 85.8 years.

Chart 7 shows the behaviors recorded at Casa Hermes sorted by gender, with their respective frequencies.

Chart 7. Frequencies sorted by gender of behaviors detected at Casa Hermes

Cold

BEHAVIORS	M	F	TOTAL
Coughing	0	6	**6**
Rubbing/cleaning one's nose with handkerchief/tissue	0	4	**4**
Verbal communication occurring	0	2	**2**
Getting away from the door/window	0	1	**1**
SUBTOTAL	**0**	**13**	**13**
Lighting			
BEHAVIORS	**M**	**F**	**TOTAL**
Putting on one's spectacles	0	1	**1**
SUBTOTAL	**0**	**1**	**1**
Various			
BEHAVIORS	**M**	**F**	**TOTAL**
Rubbing/scratching one's chest	0	1	**1**
Yawning	0	1	**1**
SUBTOTAL	**0**	**2**	**2**
TOTAL	**0**	**16**	**16**

Casa Hermes has a larger number of female residents compared to their male counterparts. No heat-related actions have been recorded, despite the fact that observations took place in the warmer time of the year (spring / summer). A possible explanation is that this facility is equipped with air conditioning systems. Overall, physical reactions, actions directed towards oneself and occurrences of verbal communication have been detected, most being displayed by female subjects. One cold-related physical reaction has been recorded, namely coughing (6), two actions directed towards oneself, namely "Rubbing / cleaning one's nose with a handkerchief/tissue" (4) and "Moving away from the door / window" (1) and finally two occurrences of verbal communication. In this regard, scholarly sources indicate that the thermoregulatory system is altered with age. Senior people generally experience a decrease in their own body temperature without even being aware of it, as their bodies are not capable of boosting heat production and reducing dispersion. More in details, their capability of generating heat after a decrease of lean body max is reduced is compromised. Reduced mobility, unhealthy eating habits, cold-induced chills and reduced vasoconstriction are all consequences (Bragagni, Alberti, Castelli, & Lari, 2012). One behavior in relation to lighting has been detected, namely putting on ones' spectacles. Two behaviors do not fit into either the temperature category nor the lighting category, namely rubbing/scratching one's upper body and yawning.

Chart 8 lists those remarks uttered by residents of Casa Hermes in relation to cold as detected during observations.

Chart 8. Casa Hermes: sentences uttered in relation to cold

Cold			
CATEGORY	**FREQUENCIES**	**OBSERVATION NUMBER**	**QUOTE**
Impersonal statements	1	12	"Qui c'è corrente" [There's a draft here!]

Action-related sentences	1	13	"Mi chiudi questa finestra che sono piena di raffreddore?! [Will you close this window here? 'cause I've got a bad cold!] (to a healthcare worker)

2 occurrences of cold-related verbal communication by female subjects have been detected: one is an impersonal statement, while the other is an action-related sentence. Impersonal statements use or imply the pronoun 'it', whereas action-related sentences refer to actions that need to be implemented by the speaker him/herself or someone else in relation to the temperature.

2.5 Casa di Ospitalità, Castelraimondo

This healthcare facility self-identifies as a care home, nursing home and day care center. It accommodates approximately 47 people. Most of them suffer from Alzheimer's disease and senile dementia. 5 suffer from psychiatric conditions. 7 are self-sufficient. The staff consists of 1 facility director, 1 administration manager, 1 psychologist, 3 nurses, 14 nursing assistants, 1 social educator, 1 person holding a degree in Physical Education (in charge of gymnastics activities), cleaning staff and kitchen staff.

2.5.1 Observations

From March 7th to July 4th 2017, 15 observations were carried out at this facility. The residents sample consists of 2 male and 13 female subjects. The average age of senior residents displaying any of the detected behaviors is 89.4 years.

Chart 9 shows the behaviors recorded at Casa di Ospitalità sorted by gender, with their respective frequencies.

Chart 9. Frequencies sorted by gender of behaviors detected at Casa di Ospitalità

Heat			
BEHAVIORS	**M**	**F**	**TOTAL**
Verbal communication occurring	0	2	**2**
Pulling up one's trouser legs	0	1	**1**
Touching one's face	1	0	**1**
SUBTOTAL	**1**	**3**	**4**
Cold			
BEHAVIORS	**M**	**F**	**TOTAL**
Verbal communication occurring	1	6	**7**
Putting on ones' clothes (also on one's shoulders only)	0	1	**1**
Rubbing/cleaning one's nose with handkerchief/tissue	0	1	**1**
SUBTOTAL	**1**	**8**	**9**
Lighting			
BEHAVIORS	**M**	**F**	**TOTAL**
Verbal communication occurring	0	1	**1**
SUBTOTAL	**0**	**1**	**1**
Various			
BEHAVIORS	**M**	**F**	**TOTAL**
Wiping off/rubbing one's eyes with handkerchief/hands	1	0	**1**

SUBTOTAL	**1**	**0**	**1**
TOTAL	**3**	**12**	**15**

At Casa di Ospitalità there are more female residents than male residents. Only occurrences of verbal communication and actions directed towards oneself have been detected, most of them by female subjects. The only three behaviors displayed by men are "Touching one's face", "Verbal communication occurring" (in relation to cold) and "Cleaning/rubbing one's eyes with tissue/ one's hands". Verbal communication occurrences are more frequent than any other behaviors, in relation to heat (2), cold (7) and also lighting (1). The largest number of verbal communication occurrences among all facilities has been recorded here (10), and also the average age of monitored residents is the highest. One of the detected behaviors does not fit into either the temperature or lighting category, namely cleaning or rubbing one's eyes with a tissue or with one's hands. As concerns observation #11, it is questionable whether touching one's face is mainly due to the senior person's perception of heat or any other factor.

Chart 10 shows the sentences uttered in relation to temperature and lighting by residents of Casa di Ospitalità as recorded during observations.

Chart 10. Casa di Ospitalità: sentences uttered in relation to temperature and lighting

Heat			
CATEGORY	**FREQUENCIES**	**OBSERVATION NUMBER**	**QUOTE**
Impersonal statements	1	5	"Qui c'è caldo adesso" [It is hot in here right now]
Action-related sentences	1	10	"Mi sono spogliata, perché era caldo. Adesso sì che si sta bene!" [I took my clothes off 'cause it was hot. Now it feels much better!] (to a healthcare worker)
Cold			
CATEGORY	**FREQUENCIES**	**OBSERVATION NUMBER**	**QUOTE**
Impersonal statements	4	2	"Qua dentro è freddo, io c'ho pure la maglia leggera" [This place is cold, and I'm wearing a light jumper too]
		6	"È freddo, eh!" [It's cold, isn't it?]
		9	"È freddo qua dentro!" [This place is cold!]
		15	"C'è corrente!" [There's an air draft!]
Action-related sentences	3	1	"Chiudi la porta che è freddo!" [Close the door, it is cold!] (to a healthcare worker)
		8	"Chiudi questa porta! Senti quanta aria c'è!" [Close that door! Can't you feel the drafts?] (to a healthcare worker)
		14	"Chiudi la porta, per favore!" [Close the door, please] (to a healthcare worker)
Lighting			
CATEGORY	**FREQUENCIES**	**OBSERVATION NUMBER**	**QUOTE**
Action-related sentences	1	12	"Mi sposti che c'ho tutta la luce negli occhi?!" [Will you get me away from here? The light's blinding me!] (to a healthcare worker)

2 heat-related occurrences of verbal communication have been detected, while 7 of them have been detected in relation to cold, and 1 in relation to lighting. They have been divided into impersonal

statements and action-related sentences. Impersonal statements use or imply the pronoun 'it', whereas action-related sentences contain references to actions that need to be implemented by the speaker him/herself or by somebody else. Remark #1 is the only cold-related occurrence of verbal communication by a man, whereas remark #6 has been made by a 100-year-old woman who, despite her old age, felt the need to voice her perception of cold. Finally, it is interesting to notice that all 7 cold-related occurrences verbal communication took place during the warmer time of the year (spring / summer) and inside a healthcare facility equipped with ceiling fans. Here again, impaired thermoregulation linked with advanced age had an impact on the residents' perception of temperature.

2.6 Analysis of the overall data

Chart 11 is an overview of all behaviors related to heat, cold, lighting and various factors. Their respective frequencies are sorted by gender.

Chart 11. Overview of all detected behaviors: frequencies are sorted by gender

BEHAVIORS	**M**	**F**	**TOTAL**
HEAT			
Taking off one's clothes	0	9	**9**
Verbal communication occurring	0	6	**6**
Pulling up one's sleeves	0	4	**4**
Fanning oneself with one's hand/piece of paper	0	2	**2**
Wiping off one's sweat with hand/handkerchief	0	1	**1**
Unbuttoning/unzipping one's coat	1	0	**1**
Taking off lap blanket	0	1	**1**
Unbuttoning one's shirt/sweater	1	0	**1**
Pulling one's collar	0	1	**1**
Pulling up one's trouser legs	0	1	**1**
Touching one's face	1	0	**1**
SUBTOTAL	**3**	**25**	**28**
COLD			
Coughing	1	11	**12**
Verbal communication occurring	1	9	**10**
Rubbing/cleaning one's nose with handkerchief/tissue	0	9	**9**
Putting on ones' clothes (also on shoulders only)	1	5	**6**
Pulling down one's jumper sleeves	0	2	**2**
Getting closer to the heater (also on wheelchair)	1	1	**2**
Sneezing	0	2	**2**
Sipping from a hot drink	1	0	**1**
Getting away from the door/window	0	1	**1**
SUBTOTAL	**5**	**40**	**45**
LIGHTING			
Putting on one's spectacles	0	2	**2**
Verbal communication occurring	0	1	**1**
SUBTOTAL	**0**	**3**	**3**
VARIOUS			
Yawning	0	3	**3**
Wiping off/rubbing one's eyes with handkerchief/hands	1	1	**2**
Snoring	0	1	**1**

Rubbing/scratching one's upper body	0	1	**1**
SUBTOTAL	**1**	**6**	**7**
TOTAL	**9**	**74**	**83**

The detected behaviors amount to a total of 83. Generally speaking, female residents are much more than their male counterparts inside these healthcare facilities. Consequently, this may have an impact on the fact that most detected behaviors are female ones (74). Actions directed towards oneself are more frequent than physical reactions and occurrences of verbal communication. No action directed towards one's environment has been detected. The single heat-related behavior with the highest frequency is taking off one's clothes (9), with coughing ranking highest among cold-related behaviors (12). In relation to lighting, putting on one's spectacles ranks highest (2), whereas the category "various" is dominated by yawning (3). *Coughing* (12) is the single reaction with the highest frequency. Most occurrences of verbal communication are related to the sensation of cold (10); among these, there is also one male occurrence. *Third-person statements* display the highest frequency compared to other categories, in relation to both heat (3) and cold (6). As shown in chart 11, *both men and women seem to act and react to, and voice their perceptions more in relation to cold than heat (45).* Inside these healthcare facilities, cold-related behaviors are more than heat-related ones, the ratio being 4 to 1. The one and only facility where most detected behaviors are related to heat is I.R.C.E.R. Foundation, despite the fact that observations there took place during the colder part of the year (autumn / winter). It is safe to say that the indoor heating system there is probably set at a very high temperature, as reflected in the perceptions of senior residents. At I.R.C.E.R. Foundation, moreover, the lower variety of behaviors has been recorded, with the larger variety being at Santo Stefano. At Santo Stefano, the largest number of behaviors has been detected compared to all other healthcare facilities (20), presumably because two different wards have been monitored. The highest average age among residents has been recorded at Casa di Ospitalità (89.4 years), while the lowest has been recorded at Santo Stefano (81.3 years), probably due to the fact that generally people from all age groups enter rehabilitation centers like this one, from young adult to older seniors.

3. Conclusions

The present chapter outlined data resulting from field observations on the subject of ageing which took place in five healthcare facilities (nursing homes and rehabilitation centers) in the Marche region (Italy), in order to detect behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as display of any discomfort at thermal (hot / cold) and luminous level as perceived by senior residents inside

these facilities. The following step was a descriptive analysis of all behaviors detected in the five healthcare facilities in relation to both temperature and lighting, with attention given also to gender differences. Additionally, the sentences uttered by the subjects in relation to their perception of heat / cold / light were recorded during observations and later analyzed. These have been divided into impersonal statements, first-person statements and action-related sentences. *Impersonal statements* display the highest frequency compared to all other categories, both in relation to heat (3) and cold (6). Lastly, a global analysis of all behaviors detected in all five facilities in relation to temperature, lighting and other categories followed, with attention given to gender too.

Observations indicate that, generally speaking, in these facilities the number of female residents is much larger than that of men, which is probably the reason why more female behaviors have been recorded (74). *Actions directed towards oneself are more frequent than physical reactions and occurrences of verbal communication, and no action directed towards one's environment has been recorded*. The single heat-related behavior with the highest frequency is taking off one's clothes (9), while the single cold-related behavior with the highest frequency is coughing (12). The single most frequently detected behavior in relation to lighting is putting on one's spectacles (2), whereas the category "various" is dominated by yawning (3). *Coughing* (12) is the single reaction with the highest frequency. Most occurrences of verbal communication are linked to the sensation of cold (10); they include a male occurrence. Moreover, *both men and women seem to act, physically react and voice their discomfort more in relation to cold (45). Women additionally tend to act much more than men, and they are normally sensitive to temperature and choose more carefully the right clothes* based on indoor and outdoor temperatures.

Scholarly sources suggest that elderly people display a reduced thermoregulatory capability, which is linked – together with additional changes of one's body composition – to a decrease of the total of water in the human body (Franceschi, Pauletto, A. Incalzi, & M. Fabbri, 2011). Body temperature is therefore lower in senior people, their perception of cold being one symptom of ageing, especially in bedridden and non-self-sufficient subjects. Also in relation to temperature, men and women dress differently. Women have a lower metabolic rate than men during sedentary activities, and their regulatory hormones affect their reactions with regard to their thermal comfort, thermoregulation and thermogenic thresholds, as women have different hormone levels as compared to men (Kim, de Dear, Candido, Zhang, & Arens, 2013). Additionally, as the outcomes of other studies carried out in various indoor environments indicate (Choi, Aziz, & Loftness, 2010; Karjalainen, 2007, 2012; Kcomt Ché, Pardons, Vanrompay, Preuveneers, & Berbers, 2010; Kim, de Dear, Candido, Zhang, & Arens, 2013; Parsons, 2002; Zalejska-Jonsson & Wilhelmsson, 2013),

women are less satisfied with room temperatures and generally prefer higher temperatures than men, with discomfort in relation to both heat and cold being reported much more frequently in women than men.

Based on observations, the behaviors displayed by senior people residing in healthcare facilities seem to indicate their discomfort in relation to both temperature and lighting. A huge gap seem to exist between the perceptions of senior people and those of the healthcare workers that take care of them. Two occurrences of verbal communication, namely by the woman who suffered from a stroke and the 100-year-old woman, respectively, indicate that the need to communicate one's need transcends physical and mental conditions and age alike. This shows that also those senior whose health is most heavily affected cannot help – insofar as possible – voicing their discomfort.

Data collection lasted eight months during the PhD program. Subsequent data analysis provided for an insight into frequent displays of thermal and luminous discomfort experienced by senior people in their everyday-life environments, that they are not able to verbalize to the healthcare staff who takes care of them. These data can be used to plan devices that can effectively ensure comfort and improve the quality of life of individuals, including more vulnerable categories such as non-self-sufficient senior people. In this regard, while planning these devices, it will be crucial to consider what a number of scholarly sources (Baldewijns, Debard, Mertens, Devriendt, Milisen, Tournoy, Croonenborghs, & Vanrumste, 2013; Coughlin, D'Ambrosio, Reimer, & Pratt, 2007; Demiris, Rantz, A. Aud, D. Marek, W. Tyrer, Skubic, & A. Hussam, 2004; Dohr, Modre-Osprian, Drobics, Hayn, & Schreier, 2010; Kleinberger, Becker, Ras, Holzinger, & Müller, 2007; Krafft & Coskun, 2009; Losardo, 2014; Mishra, 2015; Mohammadi, 2010; Motta, 2015; Portet, Vacher, Golanski, Roux, & Meillon, 2012; Sun, De Florio, Gui, & Blondia, 2009) cite as the most important characteristics of smart devices for senior people: these are reliability, user-friendliness, emergency detection, reduced user's input, low maintenance costs, low invasiveness (privacy) and voice interface technology (audio input). *Acceptance* by senior users is reportedly a key factor in integrating new technologies into already existing houses. The success of new technological devices lies not only in the tools per se, but also in the assistance and training that is provided. This feeds into the notion of *Ageing in Place*, by which senior people can exert control over their own environment and daily activities to improve their perceived autonomy, health, well-being and dignity.

CHAPTER 6
QUALITATIVE ANALYSIS OF INTERVIEWS WITH HEALTHCARE PROFESSIONALS

The following data have been collected using structured interviews with representatives of six categories of healthcare professionals. The interviews aimed at collecting information and impressions based on the respondents' first-hand experience with their professional environments and the senior people with whom they interact on a daily basis.

1. Data collection

For the present survey, *60 interviews* with different professionals were conducted. Ten people were interviewed for each of the following six categories: doctors, social educators, physiotherapists, nurses, nursing assistants and psychologists.

1.1 Methods and research instruments

Healthcare professionals were selected according to their territorial proximity and availability to join the project. All of them work in Central Italy. The series of interviews began on November 21st, 2016 and ended on May 30th, 2018. Date and place of each interview as well as birth date, gender, nationality, professional role and healthcare environment of each respondent have all been recorded. Starting from the checklist intended for observations in generic indoor environments, a structured interview was devised, based on which all healthcare professionals were asked to assess a list of behaviors that senior people may display in any everyday-life indoor environment in relation with temperature, lighting and safety, and to specify – based on their own clinical understanding – which behaviors could be perceived as possible symptoms of the onset of any particular disease process. Healthcare professionals were additionally asked to express their potential reactions if faced with some of the symptoms and to report any differences in the behaviors based on age and gender.

On November 21st 2016, before the series of interviews started, the pilot interview was tested on Dr. Roberto Catalini, head of the department of internal medicine at Macerata Hospital. Dr. Catalini provided feedback on the structured interview, pointing out that only at a constant temperature can symptom combination be indicative of the onset of diseases. Additionally, age and gender are reportedly key elements in assessing a senior person's symptoms. Insights into the person's life cycle therefore help making diagnosis and consequently providing adequate output.

1.2 Respondent group

Chart 1 shows the respondents' gender and average age.

Chart 1. Gender and average age of respondents

HEALTHCARE PROFESSIONALS	M	F	AVERAGE AGE
Doctors	6	4	54.9
Social educators	0	10	44.8
Physiotherapists	0	10	45.9
Nurses	4	6	49.1
Nursing assistants	1	9	47.3
Psychologists	1	9	47.7
TOTAL	**12**	**48**	**48.28**

The respondents are 48 female and 12 male healthcare professionals. Their average age is 48.28 years. More specifically, the doctors are 6 males and 4 females, their average age being 54.9 years. Social educators and physiotherapists are all females, their average ages being 44.8 and 45.9, respectively. The nurses are 4 males and 6 females, their average age being 49.1. Lastly, both the groups of nursing assistants and psychologists are made up by 1 male and 9 females, their respective average ages being 47.3 and 47.7.

1.2.1 Specialties of respondents

Six doctors – including the head and the deputy chief of geriatric medicine at the San Donato Hospital in Arezzo – reported a specialty in Geriatrics. The other four physicians hold specialties in Public Health and Preventive Medicine, Surgery and Gastroenterology, Internal Medicine and Rheumatology, and General Medicine, respectively.

Among the social educators, one is a healthcare coordinator. Among the physiotherapists, five are freelancers. Among the nurses, three are healthcare coordinators, while one of the nursing assistants is a unit coordinator. As far as the psychologists are concerned, six hold a specialty in psychotherapy, while four are healthcare coordinators in nursing homes and rehabilitation centers.

1.3 Affiliations

Most respondents are affiliated to healthcare centers located in Central Italy. Some of them were interviewed at their respective centers of affiliation, which joined our project from October 2016 to July 2017. Here, field observations were carried out in order to collect information concerning residents' behaviors (see chapter 5).

Chart 2 lists the respondents' affiliations.

Chart 2. Affiliation of respondents

AFFILIATION	Doctors	Social educators	Physiotherapists	Nurses	Nursing assistants	Psychologists
Arezzo Hospital	7	0	1	1	5	1
Santo Stefano	0	4	4	0	2	0
Casa Hermes	0	0	0	2	3	1
AssCoop	0	1	0	0	0	5
I.R.C.E.R.	1	0	0	3	0	0
Villa Letizia	0	1	0	3	0	0
Macerata Hospital	0	1	0	0	0	1
Other retirement homes	0	3	0	1	0	2
Freelancers	2	0	5	0	0	0
TOTAL	**10**	**10**	**10**	**10**	**10**	**10**

In details, the medical centers involved are the geriatric ward of the San Donato Hospital in Arezzo, Santo Stefano rehabilitation institute (wards and clinic in Porto Potenza Picena), the I.R.C.E.R. in Recanati, Villa Letizia in Civitanova Marche, Casa Hermes in Loreto, the non-profit social cooperative society AssCoop and the General Provincial Hospital in Macerata.

2. Data analysis

In a total of 60 interviews, healthcare professionals were asked to read a list of 20 behaviors related to temperature, lighting and safety, to assess single behaviors, make associations with other behaviors described in the list, detect specific symptoms and ascribe them to potential diseases.

The data resulting from the qualitative analyses were processed using NVIVO software and are presented and discussed in the following sections.

2.1 Analysis of the behavior "Pulling up one's sleeves"

Chart 3. "Pulling up one's sleeves": Behavior frequency as detected by professionals

Behavior	Professionals who detected it	Total Frequency
Pulling up one's sleeves	7 Doctors	30
	3 Social Educators	
	5 Physiotherapists	
	6 Nurses	
	3 Nursing Assistants	
	6 Psychologists	

Chart 4. "Pulling up one's sleeves": Frequency of single symptoms/diseases associated with this behavior as detected by professionals

Single associated symptoms/diseases	Frequency of single associated symptoms	Healthcare Professionals
(Body) heat	2	2 Nurses
Shoulder arthrosis	1	1 Physiotherapist

Chart 5. "Pulling up one's sleeves": Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases

Associated behaviors	**Frequency of behavior association**	**Professionals**	**Symptoms/diseases linked to the behavior mixes**	**Symptoms frequency**
Taking off one's clothes	22	6 Doctors 3 Social Educators 4 Physiotherapists 3 Nurses 3 Nursing Assistants 3 Psychologists	- Excessive (room/body) heat - Fever or defervescence (increased/decreased blood pressure) - Hypo-hyperglycaemic reaction / Glycaemic imbalance - Alzheimer's disease / Senile dementia - Breathing problems - Anxiety (restlessness) - Neurological condition / brain tumor - Panic attack - Allergy - Itching - Organic diseases - Psychosis (in a cold room)	14 4 4 4 3 2 2 1 1 1 1 1
Unbuttoning one's shirt	22	5 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 3 Nursing Assistants 5 Psychologists		
Rolling up one's sleeves	19	5 Doctors 3 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 4 Psychologists		
Fanning oneself	17	5 Doctors 2 Social Educators 4 Physiotherapists 2 Nurses 2 Nursing Assistants 2 Psychologists		
Wiping off one's sweat	13	4 Doctors 2 Social Educators 4 Physiotherapists 1 Nurse 1 Nursing Assistant 1 Psychologist		
Opening door/window	9	1 Doctor 1 Social Educator 2 Physiotherapists 2 Nurses 1 Nursing Assistant 2 Psychologists		
Asking somebody to stay next to them	1	1 Physiotherapist		
Drinking repeatedly	1	1 Physiotherapist		
Sneezing	1	1 Nursing Assistant		

"Pulling up one's sleeves" has been reported by 30 healthcare professionals. The most associated behaviors are "Taking off one's clothes" (22) and "Unbuttoning one's shirt" (22), while the most frequently associated symptom is excessive room and/or body temperature (14).

Gender differences:

According to two psychologists, this is a predominantly male behavior. A woman pulling up her sleeves may prompt others to think that she had a rural upbringing and is used to labor.

2.2 Analysis of the behavior "Taking off one's clothes (e.g. scarf, jumper, jacket, coat)"

Chart 6. "Taking off one's clothes": *Behavior frequency as reported by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Taking off one's clothes	8 Doctors	38
	7 Social Educators	
	4 Physiotherapists	
	8 Nurses	
	5 Nursing Assistants	
	6 Psychologists	

Chart 7. "Taking off one's clothes": Frequency of single symptoms/diseases associated with this behavior as detected by professionals

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
(Room) heat	3	1 Doctor 2 Nurses
Feeling of tightness	1	1 Social Educator
Alzheimer's disease	1	1 Nurse

Chart 8. "Taking off one's clothes": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Pulling up one's sleeves	22	6 Doctors 3 Social Educators 4 Physiotherapists 3 Nurses 3 Nursing Assistants 3 Psychologists	- Excessive (room/body) heat - Fever or defervescence (increased/decreased blood pressure) - Alzheimer's disease / Senile dementia - Breathing problems/ feeling of choking - Hypo- or hyperglycaemic reaction / Glycaemic imbalance / Diabetes - Anxiety (+ restlessness) - Loss of consciousness/fainting - Excessive perspiration - Neurological condition / brain tumor - Heart attack - Ischaemic event - Dizziness	14 7 7 6 6 3 2 2 2 1 1 1
Unbuttoning one's shirt	21	5 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 4 Nursing Assistants 3 Psychologists		
Fanning oneself	19	5 Doctors		

		2 Social Educators 4 Physiotherapists 4 Nurses 2 Nursing Assistants 2 Psychologists	- Allergy - Itching - Organic diseases - Psychosis (in a cold room)	1 1 1 1
Wiping off one's sweat	18	4 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 2 Nursing Assistants 3 Psychologists		
Rolling up one's shirt/sweater sleeves	18	5 Doctors 3 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 3 Psychologists		
Opening the door/window	11	1 Doctor 2 Social Educators 1 Physiotherapist 3 Nurses 3 Nursing Assistants 1 Psychologist		
Putting on one's clothes	3	1 Social Educator 1 Nursing Assistant 1 Psychologist		
Drinking repeatedly	3	1 Physiotherapist 1 Nurse 1 Nursing Assistant		
Closing the door/window	2	1 Social Educator 1 Nursing Assistant		
Opening/closing the curtains	1	1 Social Educator		
Opening/closing the shutters	1	1 Social Educator		
Putting on/taking off one's spectacles/sunglasses	1	1 Social Educator		
Turning the light on and off	1	1 Social Educator		
Sneezing	1	1 Nursing Assistant		
Rubbing one's hands	1	1 Psychologist		
Repeatedly drawing attention	1	1 Psychologist		

"Taking off one's clothes" has been reported by 38 respondents. The most associated behavior is "Pulling up one's sleeves" (22), while the most frequently associated symptom is excessive room/body heat (14).

According to a social educator, elderly people wearing too many clothes (e.g. scarf, coat, jacket) develop a feeling of tightness. As a consequence, they tend to take those clothes off more easily.
One nursing assistants claims that this is very common among senior patients, as they generally wear many clothes and the temperature inside healthcare centers is normally quite hot.
One nurse points out that this behavior is also typically connected with people suffering from Alzheimer's disease. They may get naked during the winter.
According to one of the psychologists, putting on / taking off one's clothes is a typical symptom of senile dementia: the senior person is not able to recognize his or her actions.
Another psychologist claims that being more prone to feeling hot is common as people age.

Gender differences:
As pointed out by one female social educator and one female psychologist, men take off their clothes more easily whenever they feel hot compared to women, who are generally more reticent.

2.3 Analysis of the behavior "Unbuttoning one's shirt"

Chart 9. "Unbuttoning one's shirt": *Behavior frequency as reported by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Unbuttoning one's shirt	8 Doctors	38
	6 Social Educators	
	6 Physiotherapists	
	4 Nurses	
	7 Nursing Assistants	
	7 Psychologists	

Chart 10. "Unbuttoning one's shirt": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Breathing problems / Air hunger / Dyspnea	7	1 Doctor 2 Nurse 2 Nursing Assistants 2 Psychologists
(Room) heat	2	1 Nursing Assistant 1 Psychologist
Rheumatoid arthritis	1	1 Physiotherapist
Heart condition	1	1 Nurse
Claustrophobia	1	1 Psychologist

Chart 11. "Unbuttoning one's shirt": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of**	**Healthcare**	**Symptoms/diseases linked to**	**Frequency of**

	behavior association	**Professionals**	**different behavior mixes**	**symptoms**
Pulling up one's sleeves	22	5 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 3 Nursing Assistants 5 Psychologists	- Excessive (room/body) heat - Breathing problems/ choking - Alzheimer's disease (restlessness/fidgeting) / Senile dementia - Fever or defervescence (increased/decreased blood pressure) - Hypo- or hyperglycaemic reaction / Glycaemic imbalance - Anxiety/agitation (+ restlessness) - Various allergies - Neurological condition / brain tumor - Heart condition - Digestion problem - Panic attack - Claustrophobia - Personality disorders - Itching - Organic diseases - Psychosis (in a cold room)	13 6 6 5 4 4 2 2 1 1 1 1 1 1 1 1
Taking off one's clothes	21	5 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 4 Nursing Assistants 3 Psychologists		
Rolling up one's sleeves	19	5 Doctors 3 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 4 Psychologists		
Fanning oneself	18	5 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 2 Nursing Assistants 2 Psychologists		
Wiping off one's sweat	17	4 Doctors 4 Social Educators 5 Physiotherapists 1 Nurse 2 Nursing Assistants 1 Psychologist		
Opening the door/window	13	2 Doctors 2 Social Educators 2 Physiotherapists 3 Nurses 2 Nursing Assistants 2 Psychologists		
Drinking repeatedly	2	1 Doctor 1 Physiotherapist		
Sneezing	2	1 Social Educator 1 Nursing Assistant		
Rubbing one's hands/nose/body parts	2	1 Doctor 1 Social Educator		
Adjusting one's clothes	1	1 Doctor		
Asking somebody to stay next to them	1	1 Physiotherapist		

Unbuttoning one's trousers	1	1 Psychologist		
Buttoning up one's shirt	1	1 Psychologist		

"Unbuttoning one's shirt" has been reported by 38 healthcare professionals. The most associated behavior to this is "Pulling up one's sleeves" (22), while the most frequently associated symptom is excessive room and/or body heat (13).

Gender differences:

According to one female doctor, two female nurses and two psychologists, this behavior is more common among men.

According to one female social educator, women may be less prone to unbutton their blouse in public for ethical reasons. Therefore, a woman exhibiting this behavior could be more noticeable and alarming than a man doing the same action.

2.1 Analysis of the behavior "Rolling up one's sleeves"

Chart 12. "Rolling up one's sleeves": *Behavior frequency as reported by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Rolling up one's sleeves	6 Doctors	21
	3 Social Educators	
	3 Physiotherapists	
	2 Nurses	
	2 Nursing Assistants	
	5 Psychologists	

Chart 13. "Rolling up one's sleeves": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Pulling up one's sleeves	19	5 Doctors 3 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 4 Psychologists	- Excessive (room/body) heat - Fever or defervescence (increased/decreased blood pressure) - Breathing problems - Hypo- or hyperglycaemic reaction - Anxiety (+ restlessness) - Alzheimer's disease / Senile dementia - Neurological condition / brain tumor - Allergy - Itching - Organic diseases - Psychosis (if the room is cold)	11 4 3 3 2 2 2 1 1 1 1
Unbuttoning one's shirt	19	5 Doctors 3 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 4 Psychologists		
Taking off one's clothes	18	5 Doctors		

		3 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 3 Psychologists		
Fanning oneself	16	5 Doctors 2 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 2 Psychologists		
Wiping off one's sweat	12	4 Doctors 2 Social Educators 3 Physiotherapists 1 Nurse 1 Nursing Assistant 1 Psychologist		
Opening the door/window	8	1 Doctor 1 Social Educator 1 Physiotherapist 2 Nurses 1 Nursing Assistant 2 Psychologists		
Sneezing	1	1 Nursing Assistant		

"Rolling up one's sleeves" has been reported by 21 healthcare professionals. The most associated behaviors are "Pulling up one's sleeves" (19) and "Unbuttoning one's shirt" (19), while the most frequently associated symptom is excessive room and/or body heat (11).

One psychologist points out that this behavior may be seen as a social ritual.

Gender differences:

According to one female psychologist, this behavior is more typically seen in males.

2.2 Analysis of the behavior "Fanning oneself with hand / piece of paper"

Chart 14. "Fanning oneself with hand/piece of paper": *Behavior frequency as reported by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Fanning oneself with hand / piece of paper	8 Doctors	39
	6 Social Educators	
	6 Physiotherapists	
	8 Nurses	
	6 Nursing Assistants	

	5 Psychologists	

Chart 15. "Fanning oneself with hand/piece of paper": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Heat / Abundant perspiration	4	1 Doctor 1 Nurse 1 Nursing Assistant 1 Psychologist
Heart condition	1	1 Nurse
Diabetes- related problem	1	1 Nurse
State of agitation	1	1 Nurse
Breathing problems	1	1 Nursing Assistant

Chart 16. "Fanning oneself with hand/piece of paper": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Wiping off one's sweat	**27**	7 Doctors 5 Social Educators 6 Physiotherapists 3 Nurses 4 Nursing Assistants 2 Psychologists	- Excessive (room/body) heat - Fever or defervescence (increase/decrease of blood pressure) - Breathing problems - Hypo- or hyperglycaemic reaction/Glycaemic imbalance - Loss of consciousness / Fainting - Heart condition - Excessive perspiration - Chest pain (heart attack) - Neurological condition - Ischaemic event - Anxiety (restlessness) - Digestive problem - Panic attack - Allergy - Itching - Organic diseases - Psychosis (if the room is cold) - Alzheimer's disease / Senile dementia	18 10 7 6 3 3 2 1 1 1 1 1 1 1 1 1 1 1 1
Taking off one's clothes	19	5 Doctors 2 Social Educators 4 Physiotherapists 4 Nurses 2 Nursing Assistants 2 Psychologists		
Unbuttoning one's shirt	18	5 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 2 Nursing Assistants 2 Psychologists		
Pulling up one's sleeves	17	5 Doctors 2 Social Educators 4 Physiotherapists 2 Nurses 2 Nursing Assistants 2 Psychologists		
Rolling up one's sleeves	16	5 Doctors 2 Social Educators 3 Physiotherapists 2 Nurses 2 Nursing Assistants 2 Psychologists		
Opening the door/window	10	1 Doctor 3 Social		

		Educators 2 Physiotherapists 3 Nurses 1 Nursing Assistant		
Drinking repeatedly	3	2 Physiotherapists 1 Nurse		
Sneezing	1	1 Nursing Assistant		

"Fanning oneself with hand / piece of paper" has been reported by 39 respondents. The most associated behavior is "Wiping off sweat from one's face with hand / handkerchief" (27), while the most frequently associated symptom is excessive room and/or body heat (18).

One doctor points out that the first five behaviors in the list can all be linked to menopause: these are *pulling up one's sleeves, taking off one's clothes, unbuttoning one's shirt or blouse* and *rolling up one's sleeves, fanning oneself* (most frequent) and *wiping off one's sweat* (least frequent).

Gender differences:

According to one female social educator, one female physiotherapist, three female nurses and four psychologists, fanning may be linked with menopause and therefore be a typical female behavior. For many women, fanning virtually becomes a habit, so much so that they always carry fans in their handbags. Conversely, men are culturally not used to fanning and therefore they are not prone to do so.

According to one male nurse, the so-called "air hunger" in subjects with asthma, heart conditions or diabetes can prompt men and women alike to fanning. The same gesture can be a telltale sign of menopause in women when they experience hot flushes.

2.3 Analysis of the behavior "Wiping off sweat from one's face with hand / handkerchief"

Chart 17. "Wiping off sweat from one's face with hand/handkerchief": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Wiping off sweat from one's face with hand / handkerchief	9 Doctors	46
	7 Social Educators	
	7 Physiotherapists	
	7 Nurses	
	9 Nursing Assistants	
	7 Psychologists	

Chart 18. "Wiping off sweat from one's face with hand/handkerchief": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	Frequency of single associated symptoms	Healthcare Professionals
Hypo-Hyperglycemia / Diabetes	6	1 Doctor 2 Nurses 3 Nursing Assistants
Heat / Excessive perspiration	5	1 Social Educator 1 Nurse 2 Nursing Assistants 1 Psychologist
Hypotension / Fever (decreased/increased blood pressure)	5	2 Nurses 3 Nursing Assistants
Anxiety	4	2 Nurses 2 Psychologists
Various early signs of failure (autonomic nervous system, etc.)	2	1 Nurse 1 Social Educator
Chest pain	1	1 Doctor
Cold sweat	1	1 Nursing Assistant

Chart 19. "Wiping off sweat from one's face with hand/handkerchief": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	Frequency of behavior association	Healthcare Professionals	Symptoms/diseases linked to different behavior mixes	Frequency of symptoms
Fanning oneself	**27**	7 Doctors 5 Social Educators 6 Physiotherapists 3 Nurses 4 Nursing Assistants 2 Psychologists	- Excessive (room/body) heat - Fever or defervescence (increased/decreased blood pressure) - Hypo-hyperglycaemic reaction / Glycaemic imbalance - Breathing problems / Shortness of breath / Feeling of choking - Anxiety / Agitation (+ restlessness) - Loss of consciousness / Fainting - Heart condition (fatigue) - Excessive perspiration - Panic attack - Various allergies - Chest pain (heart attack) - Neurological condition - Ischaemic event - Digestion problem - Itching - Organic diseases - Alzheimer's disease / Senile dementia	18 10 8 6 5 4 4 3 2 2 1 1 1 1 1 1 1
Taking off one's clothes	18	4 Doctors 3 Social Educators 4 Physiotherapists 2 Nurses 2 Nursing Assistants 3 Psychologists		
Unbuttoning one's shirt	17	4 Doctors 4 Social Educators 5 Physiotherapists 1 Nurse 2 Nursing Assistants 1 Psychologist		
Pulling up one's sleeves	13	4 Doctors 2 Social Educators 4 Physiotherapists 1 Nurse 1 Nursing Assistant 1 Psychologist		
Rolling up one's sleeves	12	4 Doctors 2 Social Educators 3 Physiotherapists		

		1 Nurse 1 Nursing Assistant 1 Psychologist		
Opening the door/window	11	2 Doctors 3 Social Educators 2 Physiotherapists 2 Nurses 2 Nursing Assistants		
Drinks repeatedly	3	2 Physiotherapists 1 Nurse		
Sneezing	2	1 Social Educator 1 Nursing Assistant		
Rubbing one's nose/body	1	1 Social Educator		
Asking somebody to stay next to them	1	1 Physiotherapist		

"Wiping off sweat from one's face with hand / handkerchief" has been reported by 46 respondents. The most associated behavior is "Fanning oneself with hand / piece of paper" (27), while the most frequently associated symptom is excessive room and/or body heat (18).

Gender differences:

According to one female nurse and two psychologists, this behavior is more common among men (since women rather resort to using a fan), whereas one female psychologist sees this as a mainly female behavior.

2.4 Analysis of the behavior "Opening the door / window"

Chart 20. "Opening the door/window": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Opening the door / window	4 Doctors	33
	6 Social Educators	
	4 Physiotherapists	
	8 Nurses	
	7 Nursing Assistants	
	4 Psychologists	

Chart 21. "Opening the door/window": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Alzheimer's disease / Wandering	2	1 Nursing Assistant 1 Psychologist
Anxiety	1	1 Physiotherapist
(Body) heat	1	1 Nurse

Lack of air	1	1 Nursing Assistant
Mental disorder (window)	1	1 Nursing Assistant
Claustrophobia	1	1 Psychologist

Chart 22. "Opening the door/window": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Unbuttoning one's shirt	14	3 Doctors 2 Social Educators 2 Physiotherapists 3 Nurses 2 Nursing Assistants 2 Psychologists	- Excessive (room/body) heat - Breathing problems / Shortness of breath / Feeling of chocking - Alzheimer's disease (restlessness/fidgeting/lack of orientation in time and space) / Senile dementia - Fever or defervescence (inreased/decreased blood pressure) - Heart condition (strain) - Hypo-hyperglycaemic reaction - Neurological condition - Loss of consciousness - Anxiety - Excessive perspiration - Panic attack - Ischaemic event - Digestion problem - Claustrophobia - Mental disorder - Tics	11 5 3 3 3 2 2 1 1 1 1 1 1 1 1
Taking off one's clothes	12	2 Doctors 2 Social Educators 1 Physiotherapist 3 Nurses 3 Nursing Assistants 1 Psychologist		
Wiping off one's sweat	12	3 Doctors 3 Social Educators 2 Physiotherapists 2 Nurses 2 Nursing Assistants		
Fanning oneself	11	2 Doctors 3 Social Educators 2 Physiotherapists 3 Nurses 1 Nursing Assistant		
Pulling up one's sleeves	10	2 Doctors 1 Social Educator 2 Physiotherapists 2 Nurses 1 Nursing Assistant 2 Psychologists		
Rolling up one's sleeves	9	2 Doctors 1 Social Educator 1 Physiotherapist 2 Nurses 1 Nursing Assistant 2 Psychologists		
Drinks repeatedly	4	2 Doctors 1 Social Educator 1 Nurse		
Closing the door/window	3	1 Social Educator 2 Nursing Assistants		
Opening/closing the curtains	2	1 Social Educator 1 Nurse		
Putting on one's clothes	2	1 Social Educator 1 Nursing Assistant		
Opening/closing the	1	1 Social Educator		

shutters				
Adjusting one's clothes	1	1 Doctor		
Rubbing one's hands	1	1 Doctor		
Putting on/taking off one's spectacles/sunglasses	1	1 Social Educator		
Turning the lights off/on	1	1 Social Educator		
Sneezing	1	1 Nursing Assistant		
Asking somebody to stay next to them	1	1 Physiotherapist		

"Opening the door / window" has been reported by 33 respondents. The most associated behavior is "Unbuttoning one's shirt" (14), while the most frequently associated symptom is excessive room and/or body heat (11).

A number of healthcare professionals (one doctor, one physiotherapist and one nurse) believe that this behavior must be *put into context* so that it can be accurately assessed (Is the person about to leave the room? Is it summer or winter?).
According to one psychologist, this behavior may be ascribed to the form of wandering common among people with Alzheimer's disease (subjects can find it hard to stand or sit still and feel the urge to fill waiting times).

Gender differences:
According to one male psychologist, this behavior is more easily ascribed to women, as men would be more inclined to directly leave the room.

2.5 Analysis of the reaction "Sneezing"

Chart 23. "Sneezing": *Reaction frequency as detected by professionals*

Physical reaction	**Professionals who detected it**	**Total Frequency**
Sneezing	7 Doctors	35
	6 Social Educators	
	5 Physiotherapists	
	6 Nurses	
	5 Nursing Assistant	
	6 Psychologists	

Chart 24. "Sneezing": *Frequency of single symptoms/diseases associated with this reaction as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Cold related illnesses	19	4 Doctors 1 Social Educator

		3 Physiotherapists 4 Nurses 3 Nursing Assistants 4 Psychologists
Various allergies	14	3 Doctors 3 Physiotherapists 4 Nurses 1 Nursing Assistant 3 Psychologists
Sensitivity to indoor environments (dust/bacteria/reduced ventilation)	6	1 Social Educator 1 Physiotherapist 2 Nurses 2 Nursing Assistants
Fever (increased blood pressure)	3	1 Social Educator 2 Physiotherapists
(Body) cold	2	1 Nursing Assistant 1 Psychologist

Chart 25. "Sneezing": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Rubbing one's nose/body parts	4	1 Doctor 2 Social Educators 1 Physiotherapist	- Excessively low (body) temperature - Excessive (body) heat - Fever or defervescence (increased/decreased blood pressure) - Various allergies - Hypo-hyperglycaemic reaction - Breathing problems	3 2 2 2 1 1
Putting on one's clothes	3	1 Doctor 2 Social Educators		
Unbuttoning one's shirt	2	1 Social Educator 1 Nursing Assistant		
Wiping off one's sweat	2	1 Social Educator 1 Nursing Assistant		
Closing the door/window	1	1 Doctor		
Taking off one's clothes	1	1 Nursing Assistant		
Fanning oneself	1	1 Nursing Assistant		
Pulling up one's sleeves	1	1 Nursing Assistant		
Rolling up one's sleeves	1	1 Nursing Assistant		
Opening the door/window	1	1 Nursing Assistant		
Drinking repeatedly	1	1 Psychologist		

"Sneezing" has been reported by 35 respondents, with cold related illnesses (19) being the most frequently associated symptom.

According to one doctor and one psychologist, it is crucial to assess *how often this behavior occurs over a given time*: e.g. if someone sneezes 10 times over 5 minutes, this may be a symptom of allergy (whereas a single sneeze may indicate otherwise).

2.6 Analysis of the behavior "Rubbing one's own body parts (e.g. hands, arms, shoulders)"

Chart 26. "Rubbing one's own body parts": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Rubbing one's own body parts (e.g. hands, arms, shoulders)	7 Doctors	32
	5 Social Educators	
	5 Physiotherapists	
	6 Nurses	
	1 Nursing Assistant	
	8 Psychologists	

Chart 27. "Rubbing one's own body parts": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Anxiety / Agitation (+ restlessness)	5	1 Doctor 1 Nurse 3 Psychologists
Excessively low (body) temperature	4	1 Doctor 1 Physiotherapist 1 Nurse 1 Psychologist
Pain (aching body part is rubbed)	4	1 Doctor 1 Physiotherapist 1 Nurse 1 Nursing Assistant
Itch (dermatologic/senile pruritus)	4	2 Doctors 2 Physiotherapists
Peripheral paresthesia	2	2 Doctors
Alzheimer/Dementia-related psychosis	2	1 Social Educator 1 Physiotherapist
Autism	2	1 Social Educator 1 Psychologist
Tingling sensations	1	1 Doctor
Reduced body sensitivity	1	1 Doctor
TIA (transient ischemic attack)	1	1 Doctor
Stereotyped behavioral tics	1	1 Social Educator
Various infections	1	1 Social Educator
Insect bite	1	1 Physiotherapist
Skin irritation	1	1 Physiotherapist
Urticaria	1	1 Psychologist

Chart 28. "Rubbing one's own body parts": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Putting on one's clothes	6	1 Doctor 1 Social Educator 2 Nurses 2 Psychologists	- Excessively low (body) temperature - Alzheimer's disease (restlessness/fidgeting) / Senile dementia	6 2
Closing the window	4	1 Doctor 2 Nurses 1 Psychologist	- Various allergies - Anxiety	2 1
Sneezing	4	1 Doctor		

		2 Social Educators 1 Physiotherapist		
Unbuttoning one's shirt	2	1 Doctor 1 Social Educator		
Opening the door/window	1	1 Doctor		
Drinks repeatedly	1	1 Doctor		
Adjusting one's clothes	1	1 Doctor		
Wiping off one's sweat	1	1 Social Educator		
Taking off one's clothes	1	1 Psychologist		
Repeatedly drawing attention	1	1 Psychologist		

"Rubbing one's own body parts (hands, arms, shoulders)" has been reported by 32 respondents. The most associated behavior is "Putting on one's clothes" (6), while the most frequently associated symptom is excessively low body temperature (6).

According to one social educator, one nurse and one nursing assistant, rubbing one's hands may be a habit commonly witnessed among elderly people. They may also fold up handkerchiefs or tissues. According to one nurse, rubbing one's hands, as well as repeatedly touching things may be linked to the person's past professional activity (e.g. an old woman who once worked as a tailor would often touch her bed covers).

Gender differences:

According to one female nurse and one female psychologist, rubbing one's hands and body parts is typically a male behavior.

2.10 Analysis of the behavior "Putting on one's clothes (e.g. scarf, jumper, jacket, coat)"

Chart 29. "Putting on one's clothes": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Putting on one's clothes (e.g. scarf, jumper, jacket, coat)	7 Doctors	23
	5 Social Educators	
	1 Physiotherapist	
	3 Nurses	
	2 Nursing Assistants	
	5 Psychologists	

Chart 30. "Putting on one's clothes": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Excessively low (room/body)	4	3 Doctors

temperature		1 Psychologist
Febrile illness (chills)	2	2 Doctors
Hypotension	1	1 Doctor
Hypo-hyperglycemia	1	1 Doctor
(Air conditioner induced) neck pain	1	1 Doctor
Pharyngitis	1	1 Doctor
Common cold	1	1 Doctor
Serious psychological disease (*to be investigated*)	1	1 Social Educator

Chart 31. "Putting on one's clothes": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Closing the door/window	8	1 Doctor 2 Social Educators 3 Nurses 1 Nursing Assistant 1 Psychologist	- Excessively low (body) temperature - Alzheimer's disease (lack of orientation in time and space) / Senile dementia - Febrile illness - Anxiety	10 3 1 1
Rubbing one's own body parts	6	1 Doctor 1 Social Educator 2 Nurses 2 Psychologists		
Sneezing	3	1 Doctor 2 Social Educators		
Taking off one's clothes	3	1 Social Educator 1 Nursing Assistant 1 Psychologist		
Opening the door/window	2	1 Social Educator 1 Nursing Assistant		
Opening/closing the shutters	2	1 Social Educator 1 Physiotherapist		
Opening/closing the curtains	2	1 Social Educator 1 Psychologist		
Putting on/taking off one's spectacles/sunglasses	1	1 Social Educator		
Turning the lights on/off	1	1 Social Educator		

"Putting on one's clothes" has been reported by 23 respondents. The most associated behavior is "Closing the door / window" (8), while the most frequently associated symptom is excessively body temperature (10).

According to one social educator, as people age they normally feel colder.

2.11 Analysis of the behavior "Drinking repeatedly"

Chart 32. "Drinking repeatedly": Behavior frequency as detected by professionals

Behavior	**Professionals who detected it**	**Total Frequency**
Drinking repeatedly	10 Doctors	46

	5 Social Educators	
	5 Physiotherapists	
	9 Nurses	
	9 Nursing Assistants	
	8 Psychologists	

Chart 33. "Drinking repeatedly": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Diabetes (polydipsia)	30	6 Doctors 3 Social Educators 1 Physiotherapist 8 Nurses 6 Nursing Assistants 6 Psychologists
(Body) heat / Thirst	9	2 Doctors 1 Social Educator 3 Nurses 1 Nursing Assistant 2 Psychologists
Anxiety / Nervousness	4	1 Psychologist 2 Nurses 1 Nursing Assistant
Hyperglycemia	3	3 Doctors
Excessive perspiration / dehydration	3	1 Doctor 1 Physiotherapist 1 Nurse
Febrile illness	2	1 Doctor 1 Physiotherapist
Kidney condition	2	1 Social Educator 1 Psychologist
Erethism	1	1 Doctor
Sore throat	1	1 Doctor
Sjögren syndrome	1	1 Doctor
Mental disorder	1	1 Nurse
Brain tumor	1	1 Nursing Assistant

Chart 34. "Drinking repeatedly": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Opening the door/window	3	1 Doctor 1 Social Educator 1 Nurse	- Fever or defervescence (increased/decreased blood pressure)	3
Taking off one's clothes	3	1 Physiotherapist 1 Nurse 1 Nursing Assistant	- Excessive (body) heat - Glycaemic imbalance / Diabetes - Alzheimer's disease (restlessness/fidgeting)	3 3 1
Fanning oneself	3	2 Physiotherapists 1 Nurse	- Excessive perspiration - Feeling of choking	1 1
Wiping off one's sweat	3	2 Physiotherapists 1 Nurse	- Loss of consciousness - Neurological condition	1 1
Unbuttoning one's shirt	2	1 Doctor 1 Physiotherapist	- Heart attack - Ischaemic event	1 1
Adjusting one's clothes	1	1 Doctor	- Dizziness	1
Rubbing one's hands	1	1 Doctor		
Pulling up one's sleeves	1	1 Physiotherapist		

Sneezing	1	1 Psychologist		

"Drinking repeatedly" has been reported by 46 respondents. Diabetes (30) is the most frequently associated symptom.

A number of healthcare professionals (one social educator, one physiotherapist, two nurses and one nursing assistant) point out that this behavior is not typical of senior people, who generally do not drink often.

Gender differences:
One male psychologist claims that this behavior is more common among men.

2.12 Analysis of the behavior "Closing the door / window"

Chart 35. "Closing the door/window": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Closing the door / window	7 Doctors	26
	4 Social Educators	
	2 Physiotherapists	
	4 Nurses	
	5 Nursing Assistants	
	4 Psychologists	

Chart 36. "Closing the door/window": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Excessively low (room/body) temperature	6	1 Doctor 1 Physiotherapist 1 Nursing Assistant 3 Psychologists
Ambient noise	1	1 Psychologist
Paranoia	1	1 Psychologist

Chart 37. "Closing the door/window": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Putting on one's clothes	8	1 Doctor 2 Social Educators 3 Nurses 1 Nursing Assistant 1 Psychologist	- Excessively low (body) temperature - Alzheimer's disease / Lack of orientation in time and space / Senile dementia - Mental disorder (retirement from the outside world) - Febrile illness	5 4 2 1
Rubbing one's own body	4	1 Doctor	- Vision problems	1

parts		2 Nurses 1 Psychologist	- Photophobia - Various allergies - Tics	1 1 1
Opening/closing the shutters	3	1 Doctor 2 Social Educators		
Putting on/taking off one's spectacles/sunglasses	3	1 Doctor 2 Social Educators		
Turning the lights on/off	2	1 Doctor 1 Social Educator		
Opening/closing the curtains	2	1 Doctor 1 Social Educator		
Taking off one's clothes	2	1 Social Educator 1 Nursing Assistant		
Opening the door/window	2	1 Social Educator 1 Nursing Assistant		
Sneezing	1	1 Doctor		

"Closing the door / window" has been reported by 26 respondents. The most associated behavior is "Putting on one's clothes" (8), while the most frequently associated symptom is excessively low body temperature (5).

According to one social educator, patients who lie in bed often ask healthcare workers to close the window or the shutters, possibly because they were used to do so themselves as they were self-sufficient.

Gender differences:

According to one female nurse and one female psychologist, this behavior is typical among women.

2.13 Analysis of the behavior "Opening the curtains to let the sunshine in"

Chart 38. "Opening the curtains": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Opening the curtains to let the sunshine in	6 Doctors	16
	1 Social Educator	
	1 Physiotherapist	
	5 Nurses	
	1 Nursing Assistant	
	2 Psychologists	

Chart 39. "Opening the curtains": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Reduced (room/physiological) vision	3	1 Doctor 1 Physiotherapist

		1 Psychologist
Feeling of fear	1	1 Doctor

Chart 40. "Opening the curtains": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Putting on/taking off one's spectacles/sunglasses	8	3 Doctors 1 Social Educator 3 Nurses 1 Nursing Assistant	- Reduced (room/physiological) vision - Vision problems - Photophobia - Alzheimer's disease (lack of orientation in time and space)	5 2 2 1
Opening the window	2	1 Social Educator 1 Nurse	- Mental disorder (retirement from the outside world)	1
Closing the window	2	1 Doctor 1 Social Educator	- Claustrophobia - Hearing problems	1 1
Opening/closing the shutters	2	1 Social Educator 1 Nurse	- Excessively low (body) temperature	1
Putting on one's clothes	2	1 Social Educator 1 Psychologist		
Taking off one's clothes	1	1 Social Educator		
Turning the lights off/on	1	1 Social Educator		

"Opening the curtains to let the sunshine in" has been reported by 16 respondents. The most associated behavior is "Putting on / taking off one's spectacles / sunglasses" (8), while the most frequently associated symptom is reduced room and/or physiological vision (5).

According to one doctor, this behavior should be seen in a positive light if it is ever displayed, as it is not common among senior people.

Gender differences:

According to one female doctor and one female nurse, this behavior is more common among women.

2.14 Analysis of the behavior "Putting on one's spectacles / sunglasses"

Chart 41. "Putting on one's spectacles/sunglasses": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Putting on one's spectacles / sunglasses	8 Doctors	28
	2 Social Educators	
	5 Physiotherapists	
	4 Nurses	
	4 Nursing Assistants	
	5 Psychologists	

Chart 42. "Putting on one's spectacles/sunglasses": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Vision problems	8	3 Physiotherapists 2 Nursing Assistants 3 Psychologists
Reduced (room/physiological) vision	6	4 Doctors 1 Nurse 1 Nursing Assistant
Photophobia	2	1 Doctor 1 Physiotherapist
Retirement from the outside world	1	1 Psychologist

Chart 43. "Putting on one's spectacles/sunglasses": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Opening/closing the curtains	9	3 Doctors 1 Social Educator 1 Physiotherapist 3 Nurses 1 Nursing Assistant	- Reduced (room/physiological) vision - Vision problems - Photophobia - Mental disorder (retirement from the outside world) - Various allergies - Alzheimer's disease (lack of orientation in time and space) - Hearing problems - Headache - Depression	5 4 4 2 1 1 1 1 1
Opening/closing the shutters	4	2 Social Educators 1 Nurse 1 Psychologist		
Turning the lights off/on	4	1 Social Educator 2 Physiotherapists 1 Psychologist		
Closing the window	3	1 Doctor 2 Social Educators		
Opening the window	1	1 Social Educator		
Putting on one's clothes	1	1 Social Educator		
Taking off one's clothes	1	1 Social Educator		

"Putting on one's spectacles / sunglasses" has been reported by 28 respondents. The most associated behavior is "Opening / closing the curtains" (9), while the most frequently associated symptom is reduced room and/or physiological vision (5).

According to one doctor, this behavior is very common among senior people. One psychologist claims that sensitivity to light becomes more common as people age.

Gender differences:

According to one male psychologist, this is a typical male behavior, whereas according to one female psychologist it is more common among women.

2.15 Analysis of the behavior "Closing the shutters"

Chart 44. "Closing the shutters": *Behavior frequency as detected by professionals*

Behavior	Professionals who detected it	Total Frequency
Closing the shutters	9 Doctors	33
	6 Social Educators	
	5 Physiotherapists	
	5 Nurses	
	2 Nursing Assistants	
	6 Psychologists	

Chart 45. "Closing the shutters": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	Frequency of single associated symptoms	Healthcare Professionals
Photophobia / Reduced Vision	5	1 Doctor 1 Physiotherapist 1 Nurse 1 Nursing Assistant 1 Psychologist
Vision problems (cataract)	1	1 Doctor
Headache	1	1 Doctor
Autism	1	1 Social Educator
Manic disorder	1	1 Nurse
Excessively low temperature	1	1 Nurse
Depression	1	1 Psychologist

Chart 46. "Closing the shutters": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	Frequency of behavior association	Healthcare Professionals	Symptoms/diseases linked to different behavior mixes	Frequency of symptoms
Turning the lights on/off	15	6 Doctors 3 Social Educators 1 Physiotherapist 1 Nurse 4 Psychologists	- Photophobia / Over illumination - Depression - Mental disorder (reduced reality awareness/retirement from the outside world)	7 4 3
Putting on/taking off one's spectacles/sunglasses	4	2 Social Educators 1 Nurse 1 Psychologist	- Vision problems - Alzheimer's disease / Lack of orientation in time and space	3 2
Holding one's hands over one's ears	4	1 Doctor 1 Social Educator 2 Physiotherapists	- Febrile illness - Migraine - Various allergies	1 1 1
Closing the window	3	1 Doctor 2 Social Educators	- Excessively low (body) temperature - Excessive ambient noise	1 1
Opening/closing the curtains	2	1 Social Educator 1 Nurse		
Putting on one's clothes	2	1 Social Educator 1 Physiotherapist		
Opening the window	1	1 Social Educator		
Taking off one's clothes	1	1 Social Educator		

"Closing the shutters" has been reported by 33 respondents. The most associated behavior is "Turning the lights on / off" (15), while the most frequently associated symptoms are photophobia and over illumination (7).

Gender differences:

According to one female nurse, this is a typical female behavior.

2.16 Analysis of the behavior "Turning the lights off"

Chart 47. "Turning the lights off": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Turning the lights off	8 Doctors	30
	4 Social Educators	
	5 Physiotherapists	
	5 Nurses	
	3 Nursing Assistants	
	5 Psychologists	

Chart 48. "Turning the lights off": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Vision problems (excessive lacrimation) / Sensitivity to neon lights	1	1 Physiotherapist
Phobia / Control issues	1	1 Nurse

Chart 49. "Turning the lights off": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Opening/closing the shutters	12	5 Doctors 3 Social Educators 1 Physiotherapist 3 Psychologists	- Photophobia / Over illumination - Depression - Mental disorder (reduced reality awareness /retirement from the outside world) - Vision problems - Alzheimer's disease / Lack of orientation in time and space - Headache / Migraine	4 4 4 2 2 2
Putting on/taking off one's spectacles/sunglasses	4	1 Social Educator 2 Physiotherapists 1 Psychologist		
Holding one's hands over one's ears	3	1 Social Educator 2 Physiotherapists		
Closing the window	2	1 Doctor 1 Social Educator		
Opening/closing the curtains	2	1 Social Educator 1 Physiotherapist		
Opening the window	1	1 Social Educator		
Putting on one's clothes	1	1 Social Educator		
Taking off one's clothes	1	1 Social Educator		

"Turning the lights off" has been reported by 30 respondents. The most associated behavior is "Opening / closing the shutters" (12), while the most frequently associated symptoms are photophobia and over illumination (4).

Some healthcare professionals (one social educator, one physiotherapist, two nurses and three psychologists) claim that turning the lights off in their own homes reflects in the case of many senior people an anthropological pattern linked with money saving.

Gender differences:

According to one female physiotherapist, this behavior, together with "Turning on the heater" and "Closing the window / shutting the blinds", reflect a number of home habits, to the brink of obsessions, which are rather associated with men.

According to another female physiotherapist, this behavior can be witnessed in men and women alike, but their motives are different: men do so to save money, whereas women do so because they do not like artificial lighting.

According to one female psychologist, this is a typical female behavior.

2.17 Analysis of the behavior "Holding one's hands over one's ears"

Chart 50. "Holding one's hands over one's ears": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Holding one's hands over one's ears	8 Doctors	40
	5 Social Educators	
	6 Physiotherapists	
	7 Nurses	
	6 Nursing Assistants	
	8 Psychologists	

Chart 51. "Holding one's hands over one's ears": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Hearing problems (hypoacusis/ear infection/tinnitus/itching) / Excessive ambient noise	15	2 Doctors 2 Social Educators 2 Physiotherapists 2 Nurses 3 Nursing Assistants 4 Psychologists
Serious pain / Psychological	11	1 Doctor

disease (*to be investigated*)		1 Social Educator 1 Physiotherapist 4 Nurses 1 Nursing Assistant 3 Psychologists
Auditory hallucinations (hearing voices)	3	2 Nursing Assistants 1 Psychologist
Serious headache	2	1 Physiotherapist 1 Psychologist
TIC	1	1 Social Educator
Isolation	1	1 Physiotherapist
Alzheimer's disease	1	1 Nursing Assistant

Chart 52. "Holding one's hands over one's ears": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Speaking up	10	5 Doctors 1 Nurse 2 Nursing Assistants 2 Psychologists	- Serious pain / Psychological disease (*to be investigated*) - Hearing problems (hypoacusis/ear infection) / Excessive ambient noise - Depression - (Serious/Sudden) headache - Photophobia - Febrile illness - Mental disorder - Vertigo - Anxiety / fear - Panic attack	6 6 3 2 1 1 1 1 1 1
Repeatedly drawing attention	4	2 Doctors 1 Nurse 1 Psychologist		
Asking somebody to stay next to them	4	2 Doctors 1 Social Educator 1 Nurse		
Closing the shutters	4	1 Doctor 1 Social Educator 2 Physiotherapists		
Turning the lights off	3	1 Social Educator 2 Physiotherapists		

"Holding one's hands over one's ears" has been reported by 40 respondents. The most frequently associated symptoms are hearing problems, including hypoacusis, earing infection, tinnitus, itching and excessive ambient noise (15).

2.18 Analysis of the behavior "Speaking up"

Chart 53. "Speaking up": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Speaking up	9 Doctors	47
	6 Social Educators	
	7 Physiotherapists	
	9 Nurses	
	9 Nursing Assistants	
	7 Psychologists	

Chart 54. "Speaking up": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated**	**Healthcare Professionals**

	symptoms	
Hearing problems (hypoacusis) / Excessive ambient noise	21	4 Doctors 3 Social Educators 5 Physiotherapists 3 Nurses 5 Nursing Assistants 1 Psychologist
Anxiety / Nervousness / Rage	6	1 Doctor 1 Physiotherapist 2 Nurses 2 Psychologists
Serious pain / Psychological disease (*to be investigated*)	5	1 Doctor 1 Social Educator 1 Physiotherapist 2 Nurses
Alzheimer's disease / Senile dementia	5	1 Doctor 1 Social Educator 1 Physiotherapist 1 Nursing Assistant 1 Psychologist
Fear (+ loneliness)	3	1 Social Educator 1 Nurse 1 Nursing Assistant
(Psychiatric) behavior disorders	2	1 Doctor 1 Nurse

Chart 55. "Speaking up": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Holding one's hands over one's ears	11	5 Doctors 2 Nurses 2 Nursing Assistants 2 Psychologists	- Hearing problems (hypoacusis/earing infection) / Excessive ambient noise	7
Repeatedly drawing attention	8	1 Doctor 1 Social Educator 2 Physiotherapists 1 Nurse 1 Nursing Assistant 2 Psychologists	- Feeling of abandonment / disorientation (Alzheimer's disease / Senile dementia / Parkinson's disease)	4
			- (Serious/Sudden) headache	2
			- Fear of loneliness / Anxiety / Insecurity	2
Asking somebody to stay next to them	6	1 Doctor 1 Social Educator 2 Physiotherapists 1 Nurse 1 Nursing Assistant	- Serious pain / Psychological disease (*to be investigated*)	2
			- Vision problems	1
			- Mental disorder	1
			- Vertigo	1
			- Rage	1
			- Panic attack	1

"Speaking up" has been reported by 47 respondents. The most frequently associated symptoms are hearing problems (hypoacusis) and excessive ambient noise (21).

According to one social educator, senior people often speak up in order to ask for somebody's attention, as they are afraid to be left alone.

According to another social educator, this behavior can be typically witnessed in people suffering from Alzheimer's disease, who may also display aggressive behaviors.

Gender differences:

According to one female physiotherapist, this behavior is generally common among women. According to one female psychologist, conversely, it is more common among men.

According to one male psychologist, this behavior can be found in men and women alike. It depends largely on a person's social background.

2.19 Analysis of the behavior "Repeatedly drawing attention"

Chart 56. "Repeatedly drawing attention": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Repeatedly drawing attention	8 Doctors	50
	8 Social Educators	
	8 Physiotherapists	
	8 Nurses	
	8 Nursing Assistants	
	10 Psychologists	

Chart 57. "Repeatedly drawing attention": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Fear / Loneliness / Insecurity / Emotional – functional vulnerability / Feeling of marginalization	6	2 Doctors 1 Nurse 2 Nursing Assistants 1 Psychologist
Alzheimer's disease / Senile dementia	6	2 Physiotherapists 1 Nurse 2 Nursing Assistants 1 Psychologist
Serious pain / Psychological disease (*to be investigated*)	4	2 Physiotherapists 1 Nursing Assistant 1 Psychologist
Psychiatric condition	2	1 Doctor 1 Nurse
Down syndrome	1	1 Doctor
Autism	1	1 Doctor
Depression	1	1 Physiotherapist
Multiple sclerosis	1	1 Nursing Assistant
Panic attack	1	1 Nursing Assistant
Narcissistic disorder	1	1 Psychologist

Chart 58. "Repeatedly drawing attention": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**

Asking somebody to stay next to them	**29**	6 Doctors 8 Social Educators 4 Physiotherapists 4 Nurses 4 Nursing Assistants 3 Psychologists	- Fear (+ loneliness + death) / Anxiety / Insecurity / Emotional – functional vulnerability - Serious pain / Psychological disease (*to be investigated*) - Feeling of abandonment / disorientation (Alzheimer's disease / Senile dementia / Parkinson's disease) - Psychiatric condition - Cognitive impairment / Neurological condition - Hearing problems - Erethism - Depression - Vision problems - Rage - Panic attack	21 8 6 2 2 2 1 1 1 1 1
Speaking up	9	2 Doctors 1 Social Educator 2 Physiotherapists 1 Nurse 1 Nursing Assistant 2 Psychologists		
Holding one's hands over one's ears	4	2 Doctors 1 Nurse 1 Psychologist		
Rubbing one's hands	1	1 Psychologist		
Taking off one's clothes	1	1 Psychologist		

"Repeatedly drawing attention" has been reported by 50 respondents. The most associated behavior is "Asking somebody to stay next to them" (29), while the most frequently associated symptoms are fear of loneliness and death, anxiety, insecurity and emotional-functional vulnerability (21).

According to one physiotherapist, this behavior should be linked to a psychological factor, as senior people normally like to be around someone to talk to.
According to one nurse, senior people – especially those with Alzheimer's disease – tend to take off their clothes or shoes when they feel distressed. When displaying these behaviors, they are trying to attract somebody's attention.
According to one nursing assistant, this behavior may reveal that senior people are feeling afraid, especially if they cannot get their message across verbally.

Gender differences:
According to one female physiotherapist and one female nursing assistant, this behavior can be more commonly ascribed to old men, especially those who are lonely.

2.20 Analysis of the behavior "Asking somebody to stay next to them"

Chart 59. "Asking somebody to stay next to them": *Behavior frequency as detected by professionals*

Behavior	**Professionals who detected it**	**Total Frequency**
Asking somebody to stay next to them	9 Doctors	**52**
	10 Social Educators	
	8 Physiotherapists	
	8 Nurses	
	10 Nursing Assistants	

	7 Psychologists	

Chart 60. "Asking somebody to stay next to them": *Frequency of single symptoms/diseases associated with this behavior as detected by professionals*

Single associated symptoms/diseases	**Frequency of single associated symptoms**	**Healthcare Professionals**
Fear / Loneliness / Insecurity / Emotional – functional vulnerability / Disorientation	11	1 Doctor 1 Physiotherapist 4 Nurses 4 Nursing Assistants 1 Psychologist
Anxiety – depression	5	2 Doctors 2 Physiotherapists 1 Psychologist
Serious pain / Psychological disease (*to be investigated*)	4	1 Doctor 1 Social Educator 2 Psychologists
Alzheimer's disease / Senile – vascular dementia (short term memory impairment /disorientation)	3	2 Nursing Assistants 1 Psychologist
Panic attack	1	1 Doctor
Phobia	1	1 Nursing Assistant
Multiple sclerosis	1	1 Nursing Assistant

Chart 61. "Asking somebody to stay next to them": *Frequency of associations with other behaviors as reported by professionals and frequency of linked symptoms/diseases*

Associated behaviors	**Frequency of behavior association**	**Healthcare Professionals**	**Symptoms/diseases linked to different behavior mixes**	**Frequency of symptoms**
Repeatedly drawing attention	**29**	6 Doctors 8 Social Educators 4 Physiotherapists 4 Nurses 4 Nursing Assistants 3 Psychologists	- Fear (+ loneliness + death) / Anxiety / Insecurity / Emotional – functional vulnerability	21
Speaking up	7	2 Doctors 1 Social Educator 2 Physiotherapists 1 Nurse 1 Nursing Assistant	- Serious pain / Psychological disease (*to be investigated*) - Feeling of abandonment / disorientation (Alzheimer's disease / Senile dementia / Parkinson's disease) - Psychiatric condition - Cognitive impairment / Neurological condition	9 5 2 2
Holding one's hands over one's ears	4	2 Doctors 1 Social Educator 1 Nurse	- Panic attack - Hearing problems - Erethism - Depression - Vision problems	2 2 1 1 1
Pulling up one's sleeves	1	1 Physiotherapist		
Unbuttoning one's shirt	1	1 Physiotherapist		
Fanning oneself	1	1 Physiotherapist		
Wiping off one's sweat	1	1 Physiotherapist		
Opening the door/window	1	1 Physiotherapist		

"Asking somebody to stay next to them" has been reported by 52 respondents. The most associated behavior is "Repeatedly drawing attention" (29), while the most frequently associated symptoms are fear of loneliness and death, anxiety, insecurity and emotional–functional vulnerability (21).

According to one social educator, senior people display this behavior very often as they feel a need

for security.

According to one nursing assistant, depression is almost physiological in senior people. Consequently, they are inclined to ask for help.

According to one physiotherapist, one nurse and one psychologist, this behavior may signal mental distress connected to abandonment, e.g. in a senior person who has recently entered a healthcare center and/or has been suffering from Alzheimer's disease, senile dementia or Parkinson's disease.

Gender differences:

One female doctor and one female physiotherapist view this as a typical female behavior. Conversely, one female physiotherapist sees this as typically male.

2.21 Discussion of the results

A qualitative analysis of the 20 behaviors listed in the interview sheet shows that the least frequently reported behavior by healthcare professional is *"Opening the curtains to let the sunshine in" (16),* whereas the most frequently reported is *"Asking somebody to stay next to them" (52).*

The most frequently associated single behaviors are "Asking somebody to stay next to them" – "Repeatedly drawing attention" (29) and "Wiping off sweat from one's face with hands / handkerchief" – "Fanning oneself with hands / piece of paper" (27).

Healthcare professionals seem to be more concerned by behaviors associated with perceptions of high temperature rather than those associated with perceptions of low temperature.

2.21.1 Behaviors not included in the list regarded by respondents as symptoms of discomfort

- *"Adjusting one's clothes".* Put forward by another doctor. Together with "Unbuttoning one's shirt", "Opening the door/window", "Drinking repeatedly" and "Rubbing one's hands", it may indicate restlessness, a common form of fidgeting among people with Alzheimer's.
- *"Perspiring".* This body reaction has been put forward by the same doctor. It may signal that the senior person needs to go to the toilet and he/she is experiencing a serious distress, yet he/she is unable to communicate it verbally.
- *"Producing inarticulate speech".* As pointed out by one nursing assistant, senior people who start to utter disconnected words could be suffering from an early phase of stroke.
- *"Unbuttoning one's trousers"* was put forward by a psychologist. Combined with "Unbuttoning one's shirt", this could be seen as a symptom of Alzheimer's disease or personality disorders.

2.21.2 Age and gender differences in senior people as reported by respondents

According to 26 healthcare professionals (4 doctors, 4 social educators, 5 physiotherapists, 5 nurses, 5 nursing assistants and 3 psychologists), no significant age or gender differences can be reported as far as the behaviors in the list are concerned.

Other respondents however did witness age and gender differences in their professional experience. Their opinions and comments on the subject are presented in this section.

According to one male doctor and one female psychologist, more women statistically enter senior age than men.

One female social educator and one female nursing assistant report that the number of female residents in their respective healthcare centers is by far higher than that of their male counterpart. One female psychologist suggests, conversely, that men are more commonly found in healthcare centers than women.

According to one female doctor, men generally suffer from heart attacks and strokes, whereas women experience depression, menopause and hypo/hyperthyroidism.

One female social educator reports that – according to statistics and based on her own experience - Alzheimer's disease affects mainly female subjects.

One female psychologist feels the need to make distinctions between the various stages of dementia. It is interesting to notice that behaviors change considerably from early to advanced stages. According to another female psychologist, women seem to face dementia better than men, as they have more strategies and resources, are better listeners and are better at implementing advice from healthcare workers.

According to one male doctor, old men who are alone are more in need of help and are more vulnerable in their psychomotor balance. Old women conversely are more likely to get by more easily. According to another male physician, it is more common to find men assisted by women than the other way around.

According to one female physiotherapist, women seem to be calmer when they are alone, and normally ask for help less than men do. Men are generally less self-sufficient and ask for attention more often. One female educator also reports that men need more support and that old men are comparable to babies, whereas old women are more autonomous. According to a female nursing assistant, in the ward where she works, men are perceived as weaker and are more likely to ask for the professionals' help than women.

According to another female nursing assistant, men tend to voice their complaints more than women. One female psychologist also claims that elderly men complain more and make more

requests compared to women, who are by contrast more used to pain and endure it autonomously based on their maternity experience. Additionally, as one female social educator points out, men tend to be more annoying and needy, generally making more requests than the women suffering from the same disease.

According to one female nurse, self-sufficient women generally tend to physiologically display more behaviors compared to men (e.g. adjusting and buttoning up their clothes, letting the sunshine in, opening and closing the shutters, fanning themselves, etc.). As one female nursing assistant points out, women ask for help only when they are barely able to carry out their everyday tasks on their own (e.g. personal care, cleaning the house, reaching for an object, etc.). Another female nurse reports that women generally seek control of their environment, are more active and vigilant towards their surroundings, whereas men prefer to delegate actions aimed at controlling their environment.

Another female nurse reports that women expressing their troubles are generally more worried and confused, whereas men are clearer and straightforward. One female nursing assistant, conversely, claims that men normally need more attention than women but they make fewer requests and are not quite clear when asking for help (e.g. they do not take their jumper off, they do not sit up etc.). They prefer to manage by themselves and avoid making requests. According to another female nurse, men tend not to put on or off their clothes and are generally speaking much more discreet than women. Again on this subject, one female educator reports that women are generally more sensitive to temperature and better at choosing the right clothes based on indoor and outdoor temperatures, aesthetics aside. Men seem to pay much less attention to this.

To conclude, on the subject of age differences one female social educator states that younger senior people need more dialogue than physical treatment as opposed to older senior people.

2.21.3 Respondents' impressions and comments

One doctor states that he views all the behaviors in the list as *warning signals about the environment* rather than body symptoms of a specific person.

Another doctor says that he pictured all behaviors – as he was going through the list – as relatable more to *men* than women.

One social educator reports that all behaviors make her think of *forms of stress pertaining temperature, lighting, sound etc.*

According to one physiotherapist, all typical behaviors tend to intensify to extremes at a pathological level.

Another physiotherapist reports that she views the behaviors in the list as connected to *more of a psychological* (*i.e. a disproportionate anxious state as compared to the context*) *than physiological distress*.

Another physiotherapist claims that *symptoms are subjective*: for instance, someone may reveal his/her anxiety developing a headache, someone else developing a stomachache.

A nurse states that she felt that *a distinction must be made between signs and symptoms,* claiming that while the former are objective and clear, the latter are subjective (symptoms are for instance those associated with heat). The temperature control in the brain structures (*hypothalamus*) of average senior people not suffering from any particular disease is generally impaired. The nurse suggests therefore reading most behaviors in the list bearing this in mind. From this perspective, such behaviors can be seen as gestures which are altered by impaired thermoregulation affecting all senior people, particularly those suffering from neurological conditions (patients with low body temperature). Based on this assumption, they cannot be considered "symptom-behaviors". To sum up, the nurse feels the need to outline four key elements to be taken into account while assessing older patients: *hearing and memory loss*, *physiological failure of thermoregulatory system* (for this reason, the temperature in an indoor environment accommodating senior people should never be under 20°C), and *life environments* (distinguishing between private homes and community environments such as nursing homes, long term care facilities etc.).

One psychologist reports that the list of behaviors made her mainly think of *people with cognitive decline*.

While going through the list of behaviors, another psychologist reportedly thought on the one hand of someone with disturbed behaviors – a common trait among people with dementia – and on the other hand of someone feeling sick or hurt, yet unable to communicate. Often, *the struggle with communicating in senior people can make their symptoms even more evident*.

According to another psychologist, people generally resent heat and light as they age.

Another psychologist reports that most behaviors in the list made her think of *someone suffering from Alzheimer's disease and/or senile dementia*.

Another psychologist says that all the behaviors in the list made her think of *senior people's environmental sensitivity*, in relation with environments which may be little suited to accommodate older people. Elderly people very often fail at communicating verbally, thus they resort to a number of behaviors – most notably speaking up, drinking repeatedly and putting their clothes on and off – to get the message across. For instance, senior people with senile dementia often get upset when they feel sick or hurt because they cannot explain with words what they feel. To sum up, *senior*

people tend to move less, to wear more clothes and are more sensitive in terms of perception of changes in their environment.

Lastly, some very interesting points were raised during the interviews by some professionals across the board:

- Three doctors, one social educator, two physiotherapists, one nurse, three nursing assistants and six psychologists point out that an important variable to be taken into account while assessing the behaviors in the list is "*context*". To provide an accurate and truthful account of behaviors, context should be considered in terms of place, time of the day (day-time / night-time), season, state of activity vs. state of rest, etc.. "Closing the window", "Turning the lights off", "Putting on / taking off clothes" etc. have all been cited as examples of this.

One psychologist claims that also the *time of the day* when given behaviors are displayed must be taken into account. For instance, putting on one's spectacles or sunglasses and/or closing the shutters during the day as opposed to the evening has a different meaning.

As pointed out by one nurse, a senior person residing in a nursing home *would never open the door / window, would never close the window / shutters, would never turn the lights off*. All these behaviors are deemed as unlikely, as they would be inhibited by the environment. Moreover, *drawing attention* is a very common action and is completely flawed by community health environments themselves, i.e. places where many patients are hosted simultaneously.

- According to one doctor and two psychologists, recording the moment and also the *duration* of a behavior as displayed by a person is key to assessing and to accurately differentiating between normal and abnormal behaviors.

- Two doctors, two social educators, one physiotherapist, one nurse, two nursing assistants and four psychologists stress that the *frequency* of a specific behavior or a mix of behaviors over a given period of time is important to assess whether it actually signals a senior person's poor health.

- According to one nursing assistant and one psychologist, some behaviors generally *intensify* as people age, with *certain thresholds being exceeded*, so that such behaviors become even more alarming.

2.21.4 Senior people's struggle with verbal communication

Two doctors, one social educator, one nurse, one nursing assistant and three psychologists reported that, at some point, senior people are in a state of such distress that they can hardly communicate verbally and have to resort to gestures. To them, actions come easier than words.

Some examples could include a senior person who feels very hot and at the same time tense and nervous, yet unable to communicate his/her feeling, or a person who needs to go to the toilet and starts to perspire, yet he/she cannot use words to communicate his or her need.

2.21.5 Family habits and cultural background

According to one physiotherapist, one nurse and one nursing assistant, cultural backgrounds, family habits and personal experiences all play a role in determining senior people's behaviors, especially in their calls for assistance.

According to one social educator and one physiotherapist, "Closing the window / shutters", "Turning on the heater" and "Turning the lights off" are all actions that elderly people carry out in their everyday lives at home.

According to one social educator, one nurse and one nursing assistant, "Rubbing one's hands" could be one of those repetitive, routine actions typical of elderly people. According to one psychologist, "Rolling up one's sleeves" may be seen as a social ritual.

According to another psychologist, speaking up may be due to a person's cultural background. People working in the fields or in open, loud environments, as it was the case for many senior people when they were younger, tend to talk loudly.

According to two nurses and one psychologist, turning the lights off at home is a routine behavior based on an anthropological pattern connected to making savings: senior people often want to save energy in their homes.

Moreover, two psychologists point out that "Turning the lights off" and "Closing the shutters" may indicate an obsession for saving money.

2.21.6 (Cool / conditioned) air and (sun / artificial) light

One nurse reports that in the healthcare center where he works *there is no air conditioning in the summer. Consequently, this is the most critical time of the year for senior residents*. With very high temperature and humidity levels, the heat exacerbates these people's conditions. Moreover, the residents experience significant fluid loss because of the medicines that they take, and it is difficult for them to re-integrate those fluids since they usually do not drink regularly.

One nursing assistant and one psychologist both working for the aforementioned healthcare center claim that open windows for airing are generally barely tolerated by senior people, including at times when the weather outside is very hot. *Therefore, senior people seem to not be particularly fond of cool air and sunlight, probably due to both the physiological changes their bodies go*

through and their cultural background. Additionally, one nurse points out that artificial lighting is often *a nuisance to elderly people*.

Finally, one doctor points out that many hospitals have rooms which are barely exposed to sunlight. Therefore, to keep the temperature at decent levels in those rooms, the heating system is running in the whole healthcare center, causing patients, visiting relatives, staff, etc. to perceive the overall temperature as too high.

3. Conclusions

In this section, the results of the structured ad-hoc interviews with healthcare professionals are discussed. The respondent group includes doctors, social educators, physiotherapists, nurses, nursing assistants and psychologists, who are all familiar with ageing. The aim of the interviews was collecting information and opinions based on the professionals' first-hand experience in relation to their professional environments and the senior people with whom they interact on a daily basis. The respondents were asked to go through a list of behaviors related to temperature, lighting and safety that a senior person may display in any everyday-life indoor environment, and to identify from a clinical perspective those behaviors that could be assessed as symptoms, and link them to specific situations of onset of pathological processes. Experts were also asked to express their potential reactions if faced with some of the symptoms and to report any difference based on the senior people's age and/or gender. The following step was an analysis through NVIVO software of each behavior in the list. Subsequently, potential connections were established with other behaviors from the list, and specific symptoms / diseases were listed based on data linkage. Gender differences reported by professionals have been analyzed, together with other comments and remarks that were made during interviews.

The qualitative analysis of the 20 behaviors in the interview sheet indicates that the behavior least frequently reported by respondents is *"Opening the curtains to let the sunshine in" (16)*, while the most frequently reported is *"Asking somebody to stay next to them" (52)*. The most frequent behavior associations are: "Asking somebody to stay next to them" – "Repeatedly drawing attention" (29) and "Wiping off one's sweat with hand / tissue" – "Fanning oneself with one's hand / piece of paper" (27). Respondents additionally reported a number of behaviors which are seen as symptoms of discomfort which were not in the list: these are *"Adjusting one's clothes"*, *"Perspiring"*, *"Producing inarticulate speech"* and *"Unbuttoning one's trousers"*. Interviews outline a number of key aspects of ageing, namely *hearing and memory loss*, *physiological failure of thermoregulatory system* (for this reason, the temperature in an environment accommodating

senior people should never be under 20°C), and *a need for security / protection* which is progressively perceived by elderly people. According to the professionals, senior people tend to move less and wear more clothes; additionally, they are more sensitive in relation to environmental changes, notably being less tolerant towards cool air and both sunlight and artificial lighting. For these reasons, *healthcare professionals are reportedly more alarmed by heat-related behaviors than cold-related behaviors*. Scholarly sources is in line with findings, as it outlines the following features of senior age: a) reduced mobility, which can be assessed notably based on the progressive decrease of walking pace, in standard conditions and in the presence of obstacles; percentage of senior people who are able to walk a given distance; increasing number - in relation to age - of senior people who do not leave their homes anymore; b) physical inactivity, which is in turn due to reduced body flexibility and decreased muscle mass and muscle strength among others, triggering loss of confidence in the senior people's own functional capabilities, with further impact on their mobility. Moreover, reduced thermoregulation can be observed in older people. Together with other changes in their body composition, reduced thermoregulation is linked to a decrease in the total water inside a senior person's body (Franceschi, Pauletto, A. Incalzi, & M. Fabbri, 2011). Pierpaoli (2010) also focuses on insufficient thermoregulation and rapid dehydration. Additionally, a number of authors (Bouchama & Knochel, 2002; Dinarello & Porat, 2008; Pontieri, 1998) have dealt with the subject of pathophysiology of thermoregulation, with the hypothalamus as the thermoregulatory center of the human body. If the thermoregulatory system is damaged and does not work effectively, a person's health can be seriously affected. Senior people seem to be most exposed to risk because of their age-induced thermoregulatory impairment. More specifically, a loss of lean body mass, reduced mobility, inadequate eating habits, reduced cold-induced chills and reduced vasoconstriction result in reduced heat generation capacity (Bragagni, Alberti, Castelli, & Lari, 2012). *Body temperature is consequently lower in senior people, their perception of cold being one symptom of ageing, especially in bedridden and non-self-sufficient subjects*. In impaired senior people, environmental temperatures being only a few degrees lower than their body temperature can lead to hypothermia. Additionally, a number of pathological conditions such as cerebrovascular diseases, neoplasms of the central nervous system, Parkinson's disease, uremia, sepsis, heart failure, hypothyroidism, hypopituitarism, adrenal failure, alcohol abuse, diabetes mellitus and hypoglycaemia can jeopardize thermoregulation. Various drugs (barbiturates, opiates, tricyclic antidepressants, benzodiazepines, phenothiazine, alpha blockers, clonidine, lithium) can cause central thermoregulation deficits and interfere with peripheral vasoconstriction. *Social and environmental factors* must be particularly considered, including location and type of house and

lifestyle of senior subjects. As they experience reduced mobility, senior people often cannot fulfill and are less capable of showing their needs (e.g. fluid intake) to their caregivers, which makes care even more difficult.

With regard to gender differences as reported by the 34 healthcare professionals during interviews, generally speaking, more women enter senior age than men, and the number of female residents in healthcare centers is by far higher than that of their male counterpart. While men are less autonomous, make more requests and are more needy, women seem to have more resources at their disposal and to be more autonomous. Self-sufficient women generally tend to physiologically display more behaviors compared to men (e.g. adjusting and buttoning up their clothes, letting the sunshine in, opening and closing the shutters, fanning themselves, etc.). As one female nursing assistant points out, women ask for help only when they are barely able to carry out their everyday tasks on their own (e.g. personal care, cleaning the house, reaching for an object, etc.). They are normally more sensitive to temperature and carefully choose the right clothes to wear based on both indoor and outdoor temperatures, seek control of their environment, are more active and vigilant towards their surroundings. Additionally, as the outcomes of other studies carried out in various indoor environments indicate (Choi, Aziz, & Loftness, 2010; Karjalainen, 2007, 2012; Kcomt Ché, Pardons, Vanrompay, Preuveneers, & Berbers, 2010; Kim, de Dear, Candido, Zhang, & Arens, 2013; Parsons, 2002; Zalejska-Jonsson & Wilhelmsson, 2013), *women are less satisfied with room temperatures and generally prefer higher temperatures than men*, *with discomfort in relation to both heat and cold being reported much more frequently in women than men*.

Lastly, across all professions, a number of interesting subjects were raised during the interviews: 1) the role of *context*. To provide an accurate and truthful account of behaviors, context should be considered in terms of place, time of the day (day-time / night-time), season, state of activity vs. state of rest, etc.. “Closing the window”, “Turning the lights off”, “Putting on / taking off clothes” etc. have all been cited as examples of this; 2) the role of *duration* and *frequency* of a specific behavior or a mix of behaviors over a given period of time is important to assess whether it actually signals a senior person’s poor health; 3) some behaviors generally *intensify* as people age, with *certain thresholds being exceeded*, so that such behaviors become even more alarming; 4) at some point, senior people are in a state of such distress (e.g. senile dementia) that they can hardly communicate verbally and have to resort to gestures: actions come easier than words; often, *the struggle with communicating* in senior people can make their symptoms even more evident; 5) *cultural background*, *family habits* and *previous life experiences* all have an influence on the behaviors of individuals, especially in their calls for assistance: for instance, turning off the light at

home can be ascribed to an anthropological and ritual pattern in senior people, connected to making savings in terms of money and energy.

Subsequent analysis provided for an insight into some display of thermal discomfort experienced by senior people in their everyday-life environments and seen through the eyes of the professionals who take care of them. These data can be used to plan devices that can effectively ensure comfort and improve the quality of life of individuals, including more vulnerable categories such as non-self-sufficient senior people.

CHAPTER 7
DESCRIPTIVE ANALYSIS OF QUESTIONNAIRES ADMINISTERED TO REPRESENTATIVES OF THE FIVE AGE GROUPS

For the present research project, 800 field observations have been carried out based on a checklist in order to investigate different behaviors (both directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of people's perceptions of heat and/or cold in their everyday-life environments. The main objective of the present study is understanding actions displayed by subjects in their every-day life environments in order to develop devices that can truly ensure comfort.

The behaviors that have been detected by means of the checklist can be divided into unambiguous and ambiguous; some of these behaviors are not necessarily triggered by one's perception of heat or cold, but rather other factors can come into play as is the case for "Sneezing" and/or "Coughing". Additionally, a number of behaviors may be displayed in relation to both one's perception of heat and cold, as is the case for "Drinking repeatedly" and/or "Tying up one's hair". Therefore, it was deemed sensible to administer ad-hoc questionnaires to common representatives of five age groups in order to cross survey data with those resulting from the checklist-based observations, also aiming at gaining further insight into the behaviors that had been previously observed. Survey data resulting from the questionnaires are presented and discussed hereafter.

1. The sample

A questionnaire using four occurrence rates has been devised. Common people, belonging to a randomized sample composed of five different age groups, were asked to report their own usual behaviors when faced with situations when they feel (excessively) hot or (excessively) cold in any everyday-life indoor environment. The questionnaire is made up of two parts, the first one on the sensation of heat and the second one on the sensation of cold, both including a number of possible behaviors, the same listed in the checklist to detect behaviors in generic indoor environments. The respondents were asked to tick the occurrence case according to the frequency with which they carry out each action, experience each physical reaction and/or communicate each perceived discomfort. For each behavior, only one occurrence could be ticked choosing between "Never", "Rarely", "Often" and "Always". Date and place of completing, birth year and gender of respondents were recorded. The aim of the survey was gaining insight in the occurrence of different behaviors (directed towards both oneself and one's environment), physical reactions and verbal

communication which can be all interpreted as a display of discomfort at thermal level (hot / cold) in individuals in their everyday-life environments.

From April 5th to July 17th 2018, a number of questionnaires were administered to respondents in the provinces of Macerata and Fermo (Marche region, Italy). Subsequently, a total of *100 questionnaires* on the sensation of heat and cold were collected. The respondent sample is made up of 50 males and 50 females, more specifically 10 males and 10 females for each of the 5 age groups.

The following age groups have been considered for the present project: 15-29 (young people) / 30-44 (young adults) / 45-59 (adults) / 60-74 (younger seniors) / 75-89 (older seniors).

The average ages of the respective age groups are: 22.95 / 34.35 / 50.45 / 65.75 / 79.50 years.

2. Data collection

Data resulting from the questionnaires are presented and discussed hereafter. They are sorted according to sensations of heat and cold, genders and age groups.

2.1 Analysis of data in relation to the sensation of heat

Chart 1 lists heat-related behaviors, with their respective frequencies sorted by occurrence rate.

Chart 1. Frequencies of heat-related behaviors sorted by occurrences

HEAT	**FREQUENCIES**				
BEHAVIORS	**NEVER**	**RARELY**	**OFTEN**	**ALWAYS**	**TOTAL**
ACTIONS DIRECTED TOWARDS ONESELF					
Taking off one's clothes	1	6	36	57	**100**
Unbuttoning/unzipping one's coat/jacket	3	5	48	44	**100**
Moving away from the sunlight (streaming through the window pane)	3	14	36	47	**100**
Drinking repeatedly	2	20	46	32	**100**
Pulling up one's sleeves	11	21	40	28	**100**
Rolling up one's sleeves	15	25	32	28	**100**
Wiping off one's sweat with one's hand/handkerchief	17	32	29	22	**100**
Fanning oneself with one's hand / piece of paper	25	25	28	22	**100**
Pulling one's collar	21	31	29	19	**100**
Sitting down	27	30	28	15	**100**
Unbuttoning one's shirt	27	33	28	12	**100**
Tying up one's hair	54	12	15	19	**100**
Leaving the room	22	45	24	9	**100**
Touching one's face	34	37	20	9	**100**
Laying down	53	30	13	4	**100**
ACTIONS DIRECTED TOWARDS ONE'S ENVIRONMENT					
Opening door/window	5	6	42	47	**100**
Closing curtains/shutters	20	18	26	36	**100**
Regulating the heater	30	29	25	16	**100**

Turning dehumidifier/fan/air conditioner on	26	33	30	11	**100**
PHYSICAL REACTIONS					
Flushing	31	33	24	12	**100**
VERBAL COMMUNICATION					
Verbal communication occurring	9	29	33	29	**100**
TOTAL	**436**	**514**	**632**	**518**	**2100**

A total of 21 heat-related behaviors have been divided into actions directed towards oneself, actions directed towards one's environment, physical reactions and occurrences of verbal communication. Chart 1 ranks all behaviors by frequency based on the sum of the occurrences "often" and "always". Hereafter, the same behaviors are presented as ranked according to their highest frequencies for all four occurrence rates.

Never: *"Tying up one's hair" (54)*, "Laying down" and "Regulating the heater".

Rarely: *"Leaving the room" (45)*, "Touching one's face", "Unbuttoning one's shirt", "Turning dehumidifier /fan / air conditioner on", "Flushing", "Wiping off one's sweat with hands / handkerchief", "Pulling one's jumper / coat collar" and "Sitting down".

Often: *"Unbuttoning/unzipping one's coat/jacket" (48)*, "Drinking repeatedly", "Pulling up one's sleeves", "Verbal communication occurring", "Rolling up one's sleeves" and "Fanning oneself with one's hand / piece of paper".

Always: *"Taking off one's clothes" (57)*, "Moving away from the sunlight (streaming through the window pane)", "Opening the door/window" and "Closing the curtains / shutters".

The occurrence rate "Never" has been reported for 3 behaviors, more specifically 2 actions directed towards oneself and 1 action directed towards one's environment. The occurrence rate "Rarely" has been reported for 8 behaviors, more specifically 6 actions directed towards oneself, 1 actions directed towards one's environment and 1 physical reaction. The occurrence rate "Often" has been reported for 6 behaviors, more specifically 5 actions directed towards oneself and 1 occurrence of verbal communication. The occurrence rate "Always" has been reported for 4 behaviors, more specifically 2 actions directed towards oneself and 2 actions directed towards one's environment. The behaviors displaying the highest frequencies for each occurrence rate are "Tying up one's hair" (Never), "Leaving the room" (Rarely), "Unbuttoning/unzipping one's coat/jacket" (Often) and "Taking off one's clothes" (Always), respectively. All 4 of them are actions directed towards oneself. In relation to the sensation of heat, the single behavior that has been more frequently reported is taking off one's clothes (57), and it falls into the occurrence rate "Always".

2.2 Analysis of data in relation to the sensation of cold

Chart 2 lists cold-related behaviors and their respective frequencies sorted by occurrence rate.

Chart 2. Frequencies of cold-related behaviors sorted by occurrences

COLD	FREQUENCIES				
BEHAVIORS	**NEVER**	**RARELY**	**OFTEN**	**ALWAYS**	**TOTAL**
ACTIONS DIRECTED TOWARDS ONESELF					
Putting on one's clothes	4	10	35	51	**100**
Pulling down one's sleeves	8	10	41	41	**100**
Getting closer to the heater	6	18	30	46	**100**
Buttoning up one's shirt	22	11	33	34	**100**
Rolling down one's sleeves	24	19	31	26	**100**
Pulling up one's collar	22	29	27	22	**100**
Pulling up one's coat/jumper hood	26	25	29	20	**100**
Rubbing/cleaning one's nose with handkerchief/tissue	18	33	32	17	**100**
Rubbing one's hands/arms/shoulders	24	27	39	10	**100**
Curling up	32	29	21	18	**100**
Drinking repeatedly	31	40	24	5	**100**
Tapping one's feet	63	26	8	3	**100**
Running in place	85	12	1	2	**100**
ACTIONS DIRECTED TOWARDS ONE'S ENVIRONMENT					
Closing the door/window	1	7	39	53	**100**
Getting rid of drafts	2	17	44	37	**100**
Regulating the heater	19	14	36	31	**100**
Opening the curtains/shutters (to let the heat in)	20	30	34	16	**100**
Opening the door (to contrast conditioned air)	46	28	18	8	**100**
PHYSICAL REACTIONS					
Shivering	14	33	33	20	**100**
Sneezing	14	46	29	11	**100**
Coughing	26	44	28	2	**100**
Making one's teeth chatter	52	32	8	8	**100**
VERBAL COMMUNICATION					
Verbal communication occurring	16	31	29	24	**100**
TOTAL	**575**	**571**	**649**	**505**	**2300**

A total of 23 cold-related behaviors have been divided into actions directed towards oneself, actions directed towards one's environment, physical reactions and occurrences of verbal communication. Chart 2 ranks all behaviors by frequency based on the sum of the occurrences "often" and "always". Hereafter, the same behaviors are presented as ranked according to their highest frequencies for all four occurrence rates.

Never: *"Running in place" (85)*, "Tapping one's feet", "Making one's teeth chatter", "Opening the door (to contrast conditioned air)" and "Curling up".

Rarely: *"Sneezing" (46)*, "Coughing", "Drinking repeatedly", "Rubbing/cleaning one's nose with handkerchief/tissue", "Shivering", "Verbal communication occurring" and "Pulling one's jumper / coat collar".

Often: *"Getting rid of drafts" (44)*, "Pulling down one's sleeves", "Rubbing one's hands / arms / shoulders", "Regulating the heater", "Opening the door/shutters (to let the heat in)", "Shivering", "Rolling down one's sleeves" and "Pulling up one's coat/jumper hood".

Always: *"Closing the door/window" (53)*, "Putting on one's clothes", "Getting closer to the heater", "Pulling down one's sleeves" and "Buttoning up one's shirt".

Both pulling down one's sleeves and shivering make it twice in the list above as they display equally high frequencies for two different occurrence rates, namely "often / always" and "rarely / often", respectively.

The occurrence rate "Never" has been reported for 5 behaviors, more specifically 3 actions directed towards oneself, 1 physical reaction and 1 action directed towards one's environment. The occurrence rate "Rarely" has been reported for 7 behaviors, more specifically 3 physical reactions, 3 actions directed towards oneself and 1 instance of verbal communication. The occurrence rate "Often" has been reported for 8 behaviors, more specifically 3 actions directed towards one's environment, 4 actions directed towards oneself and 1 physical reaction. The occurrence rate "Always" has been reported for 5 behaviors, more specifically 1 action directed towards one's environment and 4 actions directed towards oneself. The behaviors displaying the highest frequencies for each occurrence rate are "Running in place" (never), "Sneezing" (rarely), "Getting rid of drafts" (often) and "Closing the door/window" (always), respectively. 1 of them is an action directed towards oneself, 1 is a physical reaction and 2 are actions directed towards one's environment. In relation to the sensation of cold, the single behavior that has been by far more frequently reported is running in place (85), and it falls into the occurrence rate "Never".

Finally, in relation to both heat (632) and cold (649), *"Often"* is the single occurrence displaying the most total frequencies.

2.3 Analysis of data sorted by gender

Charts 3 and 4 list the frequencies of heat-related and cold-related behaviors, respectively, sorted according to the occurrences "often" and "always" and by gender.

Chart 3. Frequencies of heat-related behaviors sorted according to the occurrences "often"/"always" and by gender

BEHAVIORS	**FREQUENCIES**					
	OFTEN		**ALWAYS**		**TOTAL**	
Taking off one's clothes	36		57		**93**	
	12M	24F	35M	22F	47M	46F
Unbuttoning/unzipping one's coat/jacket	48		44		**92**	
	23M	25F	24M	20F	47M	45F
Opening door/window	42		47		**89**	
	23M	19F	21M	26F	44M	45F
Moving away from the sunlight (streaming through the window pane)	36		47		**83**	
	21M	15F	20M	27F	41M	42F

Drinking repeatedly	46		32		**78**	
	18M	28F	18M	14F	36M	42F
Pulling up one's sleeves	40		28		**68**	
	22M	18F	12M	16F	34M	34F
Rolling up one's sleeves	32		28		**60**	
	19M	13F	16M	12F	35M	25F
Closing curtains/shutters	26		36		**62**	
	11M	15F	17M	19F	28M	34F
Verbal communication occurring	33		29		**62**	
	15M	18F	11M	18F	26M	36F
Wiping off one's sweat with one's hand/handkerchief	29		22		**51**	
	19M	10F	11M	11F	30M	21F
Fanning oneself with one's hand / piece of paper	28		22		**50**	
	9M	19F	7M	15F	16M	34F
Pulling one's collar	29		19		**48**	
	19M	10F	7M	12F	26M	22F
Sitting down	28		15		**43**	
	17M	11F	6M	9F	23M	20F
Regulating the heater	25		16		**41**	
	12M	13F	6M	10F	18M	23F
Turning dehumidifier/fan/air conditioner on	30		11		**41**	
	19M	11F	4M	7F	23M	18F
Unbuttoning one's shirt	28		12		**40**	
	17M	11F	7M	5F	24M	16F
Flushing	24		12		**36**	
	7M	17F	7M	5F	14M	22F
Tying up one's hair	15		19		**34**	
	2M	13F	1M	18F	3M	31F
Leaving the room	24		9		**33**	
	7M	17F	4M	5F	11M	22F
Touching one's face	20		9		**29**	
	8M	12F	3M	6F	11M	18F
Laying down	13		4		**17**	
	7M	6F	4M	0F	11M	6F
TOTAL	**632**		**518**		**1150**	
	307M	325F	241M	277F	548M	602F

The most typical heat-related behaviors among male respondents as ranked by frequency are *"Taking off one's clothes" (47)*, *"Unbuttoning/unzipping one's coat/jacket" (47)*, "Rolling up one's sleeves", "Wiping off one's sweat with hands/handkerchief", "Pulling one's collar", "Unbuttoning one's shirt", "Sitting down", "Turning dehumidifier/fan/air conditioner on" and "Laying down". The following heat-related behaviors are the most typical among female respondents: *"Opening the door/window" (45)*, "Moving away from the sunlight (streaming through the window pane)", "Drinking repeatedly", "Verbal communication occurring", "Closing the curtains / shutters", "Fanning oneself with one's hand / piece of paper", "Tying up one's hair", "Regulating the heater", "Flushing", "Leaving the room" and "Touching one's face". Pulling up one's sleeves is equally split between male (34) and female respondents (34). To sum up, the most frequently reported male behaviors are taking off one's clothes (47) and unbuttoning or unzipping one's coat or jacket (47), both being actions directed towards oneself. A look at all heat-related behaviors shows that "Taking off one's clothes" also ranks highest of all in terms of frequency. Lastly, the single most frequent

behavior among female respondents is opening the door/window (45), this being an action directed towards one's environment.

Chart 4. Frequencies of cold-related behaviors sorted according to the occurrences "often"/"always" and by gender

BEHAVIORS	**FREQUENCIES**					
	OFTEN		**ALWAYS**		**TOTAL**	
Closing the door/window	**39**		**53**		**92**	
	18M	21F	26M	27F	44M	48F
Putting on one's clothes	**35**		**51**		**86**	
	21M	14F	21M	30F	42M	44F
Pulling down one's sleeves	**41**		**41**		**82**	
	22M	19F	16M	25F	38M	44F
Getting rid of drafts	**44**		**37**		**81**	
	19M	25F	18M	19F	37M	44F
Getting closer to the heater	**30**		**46**		**76**	
	15M	15F	19M	27F	34M	42F
Buttoning up one's shirt	**33**		**34**		**67**	
	18M	15F	18M	16F	36M	31F
Regulating the heater	**36**		**31**		**67**	
	16M	20F	15M	16F	31M	36F
Rolling down one's sleeves	**31**		**26**		**57**	
	14M	17F	14M	12F	28M	29F
Verbal communication occurring	**29**		**24**		**53**	
	11M	18F	8M	16F	19M	34F
Shivering	**33**		**20**		**53**	
	13M	20F	4M	16F	17M	36F
Opening the curtains/shutters (to let the heat in)	**34**		**16**		**50**	
	18M	16F	6M	10F	24M	26F
Pulling up one's collar	**27**		**22**		**49**	
	14M	13F	9M	13F	23M	26F
Pulling up one's coat/jumper hood	**29**		**20**		**49**	
	12M	17F	11M	9F	23M	26F
Rubbing/cleaning one's nose with handkerchief/tissue	**32**		**17**		**49**	
	18M	14F	7M	10F	25M	24F
Rubbing one's hands/arms/shoulders	**39**		**10**		**49**	
	19M	20F	5M	5F	24M	25F
Sneezing	**29**		**11**		**40**	
	13M	16F	4M	7F	17M	23F
Curling up	**21**		**18**		**39**	
	8M	13F	3M	15F	11M	28F
Coughing	**28**		**2**		**30**	
	9M	19F	0M	2F	9M	21F
Drinking repeatedly	**24**		**5**		**29**	
	6M	18F	2M	3F	8M	21F
Opening the door (to contrast conditioned air)	**18**		**8**		**26**	
	6M	12F	4M	4F	10M	16F
Making one's teeth chatter	**8**		**8**		**16**	
	3M	5F	3M	5F	6M	10F
Tapping one's feet	**8**		**3**		**11**	
	3M	5F	2M	1F	5M	6F
Running in place	**1**		**2**		**3**	
	1M	0F	1M	1F	2M	1F
TOTAL	**649**		**505**		**1154**	
	297M	352F	216M	289F	513M	641F

The most typical cold-related behaviors among male respondents as ranked by frequency are *"Buttoning up one's shirt" (36)*, "Rubbing/cleaning one's nose with handkerchief/tissue" and "Running in place". The following cold-related behaviors are the most typical among female

respondents: *"Closing the door / window" (48)*, "Putting on one's clothes", "Pulling down one's sleeves", "Getting rid of drafts", "Getting closer to the heater", "Regulating the heater", "Shivering", "Verbal communication occurring", "Rolling down one's sleeves", "Curling up", "Opening the curtains/shutters (to let the heat in)", "Pulling up one's collar", "Pulling up one's coat/jumper hood", "Rubbing one's hands / arms / shoulders", "Sneezing", "Coughing", "Drinking repeatedly", "Opening the door (to contrast conditioned air)", "Making one's teeth chatter" and "Tapping one's feet". To sum up, the most frequently reported male behavior is buttoning up one's shirt (36) – an action directed towards oneself, whereas the single most frequent behavior among female respondents is closing the door / window (45) – an action directed towards one's environment.

2.4 Analysis of data sorted by age group

Charts 5 and 6 list the frequencies of heat- and cold-related behaviors, respectively, sorted according to the occurrences "often" and "always" and by age group.

Chart 5. Frequencies of heat-related behaviors sorted according to the occurrences "often"/"always" and by age group

BEHAVIORS	**FREQUENCIES**											
	15-29		**30-44**		**45-59**		**60-74**		**75-89**		**TOTAL**	
Taking off one's clothes	**20**		**18**		**18**		**20**		**17**		**93**	
	12oft	8alw	5oft	13alw	9oft	9alw	5oft	15alw	5oft	12alw	36oft	57alw
Unbuttoning/unzipping one's coat/jacket	**20**		**18**		**19**		**19**		**16**		**92**	
	9oft	11alw	12oft	6alw	10oft	9alw	10oft	9alw	7oft	9alw	48oft	44alw
Opening door/window	**19**		**20**		**17**		**18**		**15**		**89**	
	11oft	8alw	12oft	8alw	8oft	9alw	7oft	11alw	4oft	11alw	42oft	47alw
Moving away from the sunlight	**16**		**15**		**18**		**18**		**16**		**83**	
	9oft	7alw	10oft	5alw	9oft	9alw	7oft	11alw	1oft	15alw	36oft	47alw
Drinking repeatedly	**16**		**16**		**15**		**16**		**15**		**78**	
	6oft	10alw	13oft	3alw	12oft	3alw	8oft	8alw	7oft	8alw	46oft	32alw
Pulling up one's sleeves	**17**		**14**		**12**		**13**		**12**		**68**	
	13oft	4alw	9oft	5alw	8oft	4alw	6oft	7alw	4oft	8alw	40oft	28alw
Rolling up one's sleeves	**8**		**11**		**14**		**14**		**13**		**60**	
	4oft	4alw	6oft	5alw	11oft	3alw	6oft	8alw	5oft	8alw	32oft	28alw
Closing curtains/shutters	**7**		**11**		**13**		**17**		**14**		**62**	
	6oft	1alw	8oft	3alw	6oft	7alw	6oft	11alw	0oft	14alw	26oft	36alw
Verbal communication occurring	**16**		**11**		**12**		**12**		**11**		**62**	
	8oft	8alw	6oft	5alw	5oft	7alw	10oft	2alw	4oft	7alw	33oft	29alw
Wiping off one's sweat with one's hand/handkerchief	**9**		**9**		**11**		**11**		**11**		**51**	
	6oft	3alw	4oft	5alw	9oft	2alw	7oft	4alw	3oft	8alw	29oft	22alw
Fanning oneself with hand / piece of paper	**14**		**8**		**8**		**10**		**10**		**50**	
	8oft	6alw	5oft	3alw	5oft	3alw	6oft	4alw	4oft	6alw	28oft	22alw
Pulling one's collar	**2**		**12**		**12**		**12**		**10**		**48**	
	2oft	0alw	9oft	3alw	6oft	6alw	10oft	2alw	2oft	8alw	29oft	19alw
Sitting down	**3**		**5**		**8**		**10**		**17**		**43**	
	3oft	0alw	4oft	1alw	6oft	2alw	7oft	3alw	8oft	9alw	28oft	15alw
Regulating the heater	**7**		**9**		**10**		**9**		**6**		**41**	
	6oft	1alw	5oft	4alw	6oft	4alw	5oft	4alw	3oft	3alw	25oft	16alw
Turning dehumidifier / fan / air conditioner on	**10**		**10**		**8**		**10**		**3**		**41**	
	9oft	1alw	10oft	0alw	4oft	4alw	6oft	4alw	1oft	2alw	30oft	11alw

Unbuttoning one's shirt	**4**		**8**		**10**		**10**		**8**		**40**	
	2oft	2alw	7oft	1alw	8oft	2alw	7oft	3alw	4oft	4alw	28oft	12alw
Flushing	**12**		**6**		**6**		**6**		**6**		**36**	
	9oft	3alw	5oft	1alw	3oft	3alw	5oft	1alw	2oft	4alw	24oft	12alw
Tying up one's hair	**8**		**9**		**8**		**5**		**4**		**34**	
	3oft	5alw	4oft	5alw	3oft	5alw	2oft	3alw	3oft	1alw	15oft	19alw
Leaving the room	**5**		**2**		**4**		**9**		**13**		**33**	
	5oft	0alw	2oft	0alw	3oft	1alw	9oft	0alw	5oft	8alw	24oft	9alw
Touching one's face	**0**		**5**		**7**		**7**		**10**		**29**	
	0oft	0alw	5oft	0alw	6oft	1alw	6oft	1alw	3oft	7alw	20oft	9alw
Laying down	**2**		**1**		**1**		**4**		**9**		**17**	
	2oft	0alw	1oft	0alw	1oft	0alw	4oft	0alw	5oft	4alw	13oft	4alw
TOTAL	**215**		**218**		**231**		**250**		**236**		**1150**	
	133oft	82alw	142oft	76alw	138oft	93alw	139oft	111alw	80oft	156alw	632oft	518alw

Heat-related behaviors have been sorted by age group based on the highest frequencies, as seen hereafter.

Age group 15-29: *"Taking off one's clothes" (20)*, *"Unbuttoning/unzipping one's coat/jacket" (20)*, "Pulling up one's sleeves", "Drinking repeatedly", "Verbal communication occurring", "Fanning oneself with one's hand / piece of paper", "Flushing" and "Turning dehumidifier/fan/air conditioner on".

Age group 30-44: *"Opening the door/window" (20)*, "Drinking repeatedly", "Pulling one's collar", "Turning dehumidifier/fan/air conditioner on" and "Tying up one's hair".

Age group 45-59: *"Moving away from the sunlight (streaming through the window pane)" (18)*, "Rolling up one's sleeves", "Pulling one's collar", "Wiping off one's sweat with hands/handkerchief", "Regulating the heater" and "Unbuttoning one's shirt".

Age group 60-74: *"Taking off one's clothes" (20)*, "Moving away from the sunlight (streaming through the window pane)", "Closing the curtains / shutters", "Drinking repeatedly", "Rolling up one's sleeves", "Pulling one's collar", "Wiping off one's sweat with hands/handkerchief", "Turning dehumidifier/fan/air conditioner on" and "Unbuttoning one's shirt".

Age group 75-89: *"Sitting down" (17)*, "Leaving the room", "Wiping off one's sweat with hands/handkerchief", "Touching one's face" and "Laying down".

A number of behaviors make the list more times as their highest frequency is shared by two or more age groups. More specifically, these behaviors are "Taking off one's clothes" (20), "Moving away from the sunlight (streaming through the window pane)" (18), "Drinking repeatedly" (16), "Rolling up one's sleeves" (14), "Pulling one's collar" (12), "Wiping off one's sweat with hand / handkerchief" (11), "Turning dehumidifier/fan/air conditioner on" (10) and "Unbuttoning one's shirt" (10).

Respondents of age group 15-29 reported 8 behaviors, more specifically 5 actions directed towards oneself, 1 occurrence of verbal communication, 1 physical reaction and 1 action directed towards

one's environment. Respondents of age group 30-44 reported 5 behaviors, more specifically 2 actions directed towards one's environment and 3 actions directed towards oneself. Respondents of age group 45-59 reported 6 behaviors, more specifically 5 actions directed towards oneself and 1 action directed towards one's environment. Respondents of age group 60-74 reported 9 behaviors, more specifically 7 actions directed towards oneself and 2 actions directed towards one's environment. Respondents from age group 75-89 reported 5 behaviors, all actions directed towards oneself. The single behaviors with the highest frequencies for each age group are "Taking off one's clothes" (age group 15-29), "Opening the door/window" (age group 30-44), "Moving away from the sunlight (streaming through the window pane)" (age group 45-59), "Taking off one's clothes" (age group 60-74) and "Sitting down" (age group 75-89); 4 of these are actions directed towards oneself and 1 is an action directed towards one's environment. In relation to the respondents' perception of heat, the behaviors displaying the highest frequencies are taking off one's clothes (20), unbuttoning or unzipping one's coat or jacket (20) and opening the door or the window (20).

Chart 6. Frequencies of cold-related behaviors sorted according to the occurrences "often"/"always" and by age group

BEHAVIORS	**FREQUENCIES**											
	15-29		**30-44**		**45-59**		**60-74**		**75-89**		**TOTAL**	
Closing the door/window	**18**		**20**		**16**		**19**		**19**		**92**	
	12oft	6alw	9oft	11alw	10oft	6alw	5oft	14alw	3oft	16alw	39oft	53alw
Putting on one's clothes	**18**		**17**		**16**		**16**		**19**		**86**	
	9oft	9alw	9oft	8alw	9oft	7alw	4oft	12alw	4oft	15alw	35oft	51alw
Pulling down one's sleeves	**17**		**17**		**15**		**17**		**16**		**82**	
	14oft	3alw	7oft	10alw	8oft	7alw	6oft	11alw	6oft	10alw	41oft	41alw
Getting rid of drafts	**16**		**16**		**17**		**17**		**15**		**81**	
	10oft	6alw	9oft	7alw	13oft	4alw	9oft	8alw	3oft	12alw	44oft	37alw
Getting closer to the heater	**19**		**15**		**15**		**15**		**12**		**76**	
	8oft	11alw	7oft	8alw	8oft	7alw	5oft	10alw	2oft	10alw	30oft	46alw
Buttoning up one's shirt	**12**		**13**		**12**		**18**		**12**		**67**	
	9oft	3alw	5oft	8alw	7oft	5alw	8oft	10alw	4oft	8alw	33oft	34alw
Regulating the heater	**16**		**16**		**13**		**12**		**10**		**67**	
	10oft	6alw	9oft	7alw	7oft	6alw	7oft	5alw	3oft	7alw	36oft	31alw
Rolling down one's sleeves	**11**		**11**		**11**		**14**		**10**		**57**	
	8oft	3alw	6oft	5alw	6oft	5alw	7oft	7alw	4oft	6alw	31oft	26alw
Verbal communication occurring	**11**		**12**		**12**		**10**		**8**		**53**	
	7oft	4alw	7oft	5alw	9oft	3alw	4oft	6alw	2oft	6alw	29oft	24alw
Shivering	**11**		**12**		**10**		**10**		**10**		**53**	
	8oft	3alw	7oft	5alw	8oft	2alw	6oft	4alw	4oft	6alw	33oft	20alw
Opening the curtains/shutters (to let the heat in)	**7**		**8**		**11**		**13**		**11**		**50**	
	5oft	2alw	6oft	2alw	9oft	2alw	7oft	6alw	7oft	4alw	34oft	16alw
Pulling up one's collar	**8**		**9**		**8**		**13**		**11**		**49**	
	7oft	1alw	8oft	1alw	5oft	3alw	4oft	9alw	3oft	8alw	27oft	22alw
Pulling up one's coat/jumper hood	**12**		**9**		**10**		**10**		**8**		**49**	
	6oft	6alw	5oft	4alw	7oft	3alw	7oft	3alw	4oft	4alw	29oft	20alw
Rubbing/cleaning one's nose with handkerchief/tissue	**12**		**11**		**7**		**7**		**12**		**49**	
	10oft	2alw	7oft	4alw	4oft	3alw	5oft	2alw	6oft	6alw	32oft	17alw
Rubbing one's hands/arms/shoulders	**14**		**10**		**8**		**9**		**8**		**49**	
	12oft	2alw	7oft	3alw	6oft	2alw	8oft	1alw	6oft	2alw	39oft	10alw
Sneezing	**9**		**7**		**6**		**7**		**11**		**40**	
	5oft	4alw	6oft	1alw	5oft	1alw	5oft	2alw	8oft	3alw	29oft	11alw
Curling up	**9**		**9**		**6**		**8**		**7**		**39**	

	6oft	3alw	5oft	4alw	2oft	4alw	6oft	2alw	2oft	5alw	21oft	18alw
Coughing	**6**		**6**		**4**		**5**		**9**		**30**	
	6oft	0alw	4oft	2alw	4oft	0alw	5oft	0alw	9oft	0alw	28oft	2alw
Drinking repeatedly	**8**		**4**		**6**		**5**		**6**		**29**	
	5oft	3alw	4oft	0alw	5oft	1alw	4oft	1alw	6oft	0alw	24oft	5alw
Opening the door (to contrast conditioned air)	**2**		**7**		**7**		**5**		**5**		**26**	
	2oft	0alw	5oft	2alw	7oft	0alw	3oft	2alw	1oft	4alw	18oft	8alw
Making one's teeth chatter	**8**		**2**		**1**		**3**		**2**		**16**	
	4oft	4alw	1oft	1alw	1oft	0alw	2oft	1alw	0oft	2alw	8oft	8alw
Tapping one's feet	**1**		**2**		**2**		**2**		**4**		**11**	
	1oft	0alw	2oft	0alw	2oft	0alw	2oft	0alw	1oft	3alw	8oft	3alw
Running in place	**0**		**1**		**0**		**2**		**0**		**3**	
	0oft	0alw	1oft	0alw	0oft	0alw	0oft	2alw	0oft	0alw	1oft	2alw
TOTAL	**245**		**234**		**213**		**237**		**225**		**1154**	
	164 oft	81 alw	136 oft	98 alw	142 oft	71 alw	119 oft	118 alw	88 oft	137 alw	649 oft	505 alw

Cold-related behaviors have been sorted by age group based on the highest frequencies, as seen hereafter.

Age group 15-29: *"Getting closer to the heater" (19)*, "Pulling down one's sleeves", "Regulating the heater", "Rubbing one's hands / arms / shoulders", "Pulling up one's coat/jumper hood", "Rubbing/cleaning one's nose with handkerchief/tissue", "Curling up", "Drinking repeatedly" and "Making one's teeth chatter".

Age group 30-44: *"Closing the door/window" (20)*, "Pulling down one's sleeves", "Regulating the heater", "Verbal communication occurring", "Shivering", "Curling up" and "Opening the door (to contrast conditioned air)".

Age group 45-59: *"Getting rid of drafts" (17)*, "Verbal communication occurring" and "Opening the door (to contrast conditioned air)".

Age group 60-74: *"Buttoning up one's shirt" (18)*, "Pulling down one's sleeves", "Getting rid of drafts", "Rolling down one's sleeves", "Opening the curtains/shutters (to let the heat in)", "Pulling up one's collar" and "Running in place".

Age group 75-89: *"Putting on one's clothes" (19)*, "Rubbing/cleaning one's nose with handkerchief/tissue", "Sneezing", "Coughing" and "Tapping one's feet".

A number of behaviors make the list more times as their highest frequency is shared by two or more age groups. More specifically, these behaviors are "Pulling down one's sleeves" (17), "Getting rid of drafts" (17), "Regulating the heater" (16), "Verbal communication occurring" (12), "Rubbing/cleaning one's nose with handkerchief/tissue" (12), "Curling up" (9) and "Opening the door (to contrast conditioned air)" (7). Respondents from age group 15-29 reported 9 behaviors, including 7 actions directed towards oneself, 1 action directed towards one's environment and 1 physical reaction. Respondents from age group 30-44 reported 7 behaviors, including 3 actions directed towards one's environment, 2 actions directed towards oneself, 1 occurrence of verbal

communication and 1 physical reaction. Respondents from age group 45-59 reported 3 behaviors, including 2 actions directed towards one's environment and 1 occurrence of verbal communication. Respondents from 60-74 reported 7 behaviors, more specifically 5 actions directed towards oneself and 2 actions directed towards one's environment. Respondents from age group 75-89 reported 5 behaviors, more specifically 3 actions directed towards oneself and 2 physical reactions. The single behaviors with the highest frequencies for each age group are "Getting closer to the heater" (age group 15-29), "Closing the door/window" (age group 30-44), "Getting rid of drafts" (age group 45-59), "Buttoning up one's shirt" (age group 60-74) and "Putting on one's clothes" (age group 75-89); 3 of these are actions directed towards oneself and 2 of them are actions directed towards one's environment. In relation to the respondents' perception of cold, the behavior displaying the highest frequency is closing the door/window (20).

2.5 Analysis of data linkage of age groups, occurrences rates and genders in relation to the sensation of heat

Data linkage of the five age groups, occurrence rates and genders in relation to the sensation of heat are presented hereafter. For each behavior, gender prevalence (the sum and comparison of the occurrences "often" and "always" for men and women, respectively), age group(s) and occurrence rate(s) with the highest frequencies are shown.

2.5.1 Analysis of data linkage of actions directed towards oneself

Charts from 7 to 21 show data linkage of age groups, occurrences and genders for actions directed towards oneself.

Chart 7. "Taking off one's clothes": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Taking off one's clothes	15-29	0		0		12		**8**		**20**	
		0M	0F	0M	0F	5M	7F	5M	3F	10M	10F
	30-44	1		1		5		**13**		**20**	
		1M	0F	0M	1F	0M	5F	9M	4F	10M	10F
	45-59	0		2		9		**9**		**20**	
		0M	0F	1M	1F	4M	5F	5M	4F	10M	10F
	60-74	0		0		5		**15**		**20**	
		0M	0F	0M	0F	2M	3F	8M	7F	10M	10F
	75-89	0		3		5		**12**		**20**	
		0M	0F	1M	2F	1M	4F	8M	4F	10M	10F
	TOTAL	**1**		**6**		**36**		**57**		**100**	
		1M	0F	2M	4F	12M	24F	35M	22F	50M	50F

Chart 7 indicates that taking off some clothes is a typical behavior of male subjects (47). Age group 60-74 (15) and the occurrence rate "Always" (57) are prevalent.

Chart 8. "Unbuttoning/unzipping one's coat/jacket": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Unbuttoning/unzipping one's coat/jacket	15-29	0		0		**9**		11		**20**	
		0M	0F	0M	0F	4M	5F	6M	5F	10M	10F
	30-44	0		2		**12**		6		**20**	
		0M	0F	1M	1F	6M	6F	3M	3F	10M	10F
	45-59	1		0		**10**		9		**20**	
		0M	1F	0M	0F	6M	4F	4M	5F	10M	10F
	60-74	0		1		**10**		9		**20**	
		0M	0F	0M	1F	5M	5F	5M	4F	10M	10F
	75-89	2		2		**7**		9		**20**	
		1M	1F	1M	1F	2M	5F	6M	3F	10M	10F
	TOTAL	**3**		**5**		**48**		**44**		**100**	
		1M	2F	2M	3F	23M	25F	24M	20F	50M	50F

Chart 8 indicates that unbuttoning or unzipping one's coat or jacket is more typical of male subjects (47). Age group 30-44 (12) and the occurrence rate "Often" (48) are prevalent.

Chart 9. "Moving away from the sunlight": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Moving away from the sunlight (streaming through the window pane)	15-29	1		3		9		**7**		**20**	
		0M	1F	1M	2F	5M	4F	4M	3F	10M	10F
	30-44	1		4		10		**5**		**20**	
		0M	1F	3M	1F	6M	4F	1M	4F	10M	10F
	45-59	0		2		9		**9**		**20**	
		0M	0F	1M	1F	6M	3F	3M	6F	10M	10F
	60-74	0		2		7		**11**		**20**	
		0M	0F	1M	1F	4M	3F	5M	6F	10M	10F
	75-89	1		3		1		**15**		**20**	
		1M	0F	2M	1F	0M	1F	7M	8F	10M	10F
	TOTAL	**3**		**14**		**36**		**47**		**100**	
		1M	2F	8M	6F	21M	15F	20M	27F	50M	50F

Chart 9 indicates that moving away from the sunlight is more typical of female subjects (42). Age group 75-89 (15) and the occurrence rate "Always" (47) are prevalent.

Chart 10. "Drinking repeatedly": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Drinking repeatedly	15-29	0		4		**6**		10		**20**	
		0M	0F	2M	2F	3M	3F	5M	5F	10M	10F
	30-44	0		4		**13**		3		**20**	
		0M	0F	4M	0F	5M	8F	1M	2F	10M	10F
	45-59	0		5		**12**		3		**20**	
		0M	0F	4M	1F	5M	7F	1M	2F	10M	10F
	60-74	0		4		**8**		8		**20**	
		0M	0F	3M	1F	3M	5F	4M	4F	10M	10F
	75-89	2		3		**7**		8		**20**	
		0M	2F	1M	2F	2M	5F	7M	1F	10M	10F
	TOTAL	**2**		**20**		**46**		**32**		**100**	
		0M	2F	14M	6F	18M	28F	18M	14F	50M	50F

Chart 10 indicates that drinking repeatedly is more typical of female subjects (42). Age group 30-44 (13) and the occurrence rate "Often" (46) are prevalent.

Chart 11. "Pulling up one's sleeves": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Pulling up one's sleeves	15-29	1		2		**13**		4		**20**	
		1M	0F	2M	0F	6M	7F	1M	3F	10M	10F
	30-44	0		6		**9**		5		**20**	
		0M	0F	2M	4F	5M	4F	3M	2F	10M	10F
	45-59	2		6		**8**		4		**20**	
		1M	1F	3M	3F	4M	4F	2M	2F	10M	10F
	60-74	4		3		**6**		7		**20**	
		1M	3F	1M	2F	5M	1F	3M	4F	10M	10F
	75-89	4		4		**4**		8		**20**	
		4M	0F	1M	3F	2M	2F	3M	5F	10M	10F
	TOTAL	**11**		**21**		**40**		**28**		**100**	
		7M	4F	9M	12F	22M	18F	12M	16F	50M	50F

Chart 11 indicates that pulling up one's sleeves is equally split between male (34) and female subjects (34). Age group 15-29 (13) and the occurrence rate "Often" (40) are prevalent.

Chart 12. "Rolling up one's sleeves": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Rolling up one's sleeves	15-29	3		9		**4**		4		**20**	
		1M	2F	3M	6F	3M	1F	3M	1F	10M	10F
	30-44	4		5		**6**		5		**20**	
		1M	3F	3M	2F	1M	5F	5M	0F	10M	10F
	45-59	3		3		**11**		3		**20**	
		1M	2F	0M	3F	8M	3F	1M	2F	10M	10F
	60-74	3		3		**6**		8		**20**	
		0M	3F	2M	1F	5M	1F	3M	5F	10M	10F
	75-89	2		5		**5**		8		**20**	
		0M	2F	4M	1F	2M	3F	4M	4F	10M	10F
	TOTAL	**15**		**25**		**32**		**28**		**100**	
		3M	12F	12M	13F	19M	13F	16M	12F	50M	50F

Chart 12 indicates that rolling up one's sleeves is more typical of male subjects (35). Age group 45-59 (11) and the occurrence rate "Often" (32) are prevalent.

Chart 13. "Wiping off one's sweat with one's hand/handkerchief": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Wiping off one's sweat with hands/handkerchief	15-29	4		**7**		6		3		**20**	
		1M	3F	3M	4F	4M	2F	2M	1F	10M	10F
	30-44	4		**7**		4		5		**20**	
		1M	3F	4M	3F	3M	1F	2M	3F	10M	10F
	45-59	3		**6**		9		2		**20**	
		1M	2F	4M	2F	5M	4F	0M	2F	10M	10F
	60-74	2		**7**		7		4		**20**	
		0M	2F	2M	5F	5M	2F	3M	1F	10M	10F
	75-89	4		**5**		3		8		**20**	
		2M	2F	2M	3F	2M	1F	4M	4F	10M	10F
	TOTAL	**17**		**32**		**29**		**22**		**100**	
		5M	12F	15M	17F	19M	10F	11M	11F	50M	50F

Chart 13 indicates that wiping off one's sweat with one's hands or handkerchief/tissue is more typical of male subjects (30). The occurrence rate "Rarely" (32) and age groups 15-29 (7), 30-44 (7) and 60-74 (7) are prevalent, all three groups displaying the same frequency.

Chart 14. "Fanning oneself with one's hand / piece of paper": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Fanning oneself with one's hand / piece of paper	15-29	2		4		**8**		6		**20**	
		2M	0F	3M	1F	2M	6F	3M	3F	10M	10F
	30-44	6		6		**5**		3		**20**	
		4M	2F	3M	3F	0M	5F	3M	0F	10M	10F
	45-59	6		6		**5**		3		**20**	
		3M	3F	4M	2F	3M	2F	0M	3F	10M	10F
	60-74	4		6		**6**		4		**20**	
		3M	1F	4M	2F	3M	3F	0M	4F	10M	10F
	75-89	7		3		**4**		6		**20**	
		7M	0F	1M	2F	1M	3F	1M	5F	10M	10F
	TOTAL	**25**		**25**		**28**		**22**		**100**	
		19M	6F	15M	10F	9M	19F	7M	15F	50M	50F

Chart 14 indicates that fanning oneself with one's hand / piece of paper is more typical of female subjects (34). Age group 15-29 (8) and the occurrence rate "Often" (28) are prevalent.

Chart 15. "Pulling one's collar": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Pulling one's collar	15-29	7		**11**		2		0		**20**	
		3M	4F	6M	5F	1M	1F	0M	0F	10M	10F
	30-44	3		**5**		9		3		**20**	
		1M	2F	1M	4F	7M	2F	1M	2F	10M	10F
	45-59	3		**5**		6		6		**20**	
		2M	1F	2M	3F	4M	2F	2M	4F	10M	10F
	60-74	2		**6**		10		2		**20**	
		1M	1F	3M	3F	6M	4F	0M	2F	10M	10F
	75-89	6		**4**		2		8		**20**	
		3M	3F	2M	2F	1M	1F	4M	4F	10M	10F
	TOTAL	**21**		**31**		**29**		**19**		**100**	
		10M	11F	14M	17F	19M	10F	7M	12F	50M	50F

Chart 15 indicates that pulling one's collar is more typical among male subjects (26). Age group 15-29 (11) and the occurrence rate "Rarely" (31) are prevalent.

Chart 16. "Sitting down": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Sitting down	15-29	6		**11**		3		0		**20**	
		2M	4F	5M	6F	3M	0F	0M	0F	10M	10F
	30-44	9		**6**		4		1		**20**	
		4M	5F	4M	2F	2M	2F	0M	1F	10M	10F
	45-59	6		**6**		6		2		**20**	
		3M	3F	3M	3F	4M	2F	0M	2F	10M	10F
	60-74	4		**6**		7		3		**20**	
		1M	3F	2M	4F	5M	2F	2M	1F	10M	10F
	75-89	2		**1**		8		9		**20**	
		2M	0F	1M	0F	3M	5F	4M	5F	10M	10F
	TOTAL	**27**		**30**		**28**		**15**		**100**	

		12M	15F	15M	15F	17M	11F	6M	9F	50M	50F

Chart 16 indicates that sitting down is more typical among male subjects (23). Age group 15-29 (11) and the occurrence rate "Rarely" (30) are prevalent.

Chart 17. "Unbuttoning one's shirt": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Unbuttoning one's shirt	15-29	6		**10**		2		2		**20**	
		2M	4F	5M	5F	1M	1F	2M	0F	10M	10F
	30-44	4		**8**		7		1		**20**	
		0M	4F	5M	3F	5M	2F	0M	1F	10M	10F
	45-59	5		**5**		8		2		**20**	
		1M	4F	2M	3F	5M	3F	2M	0F	10M	10F
	60-74	5		**5**		7		3		**20**	
		4M	1F	2M	3F	3M	4F	1M	2F	10M	10F
	75-89	7		**5**		4		4		**20**	
		1M	6F	4M	1F	3M	1F	2M	2F	10M	10F
	TOTAL	**27**		**33**		**28**		**12**		**100**	
		8M	19F	18M	15F	17M	11F	7M	5F	50M	50F

Chart 17 indicates that unbuttoning one's shirt is more typical among male subjects (24). Age group 15-29 (10) and the occurrence rate "Rarely" (33) are prevalent.

Chart 18. "Tying up one's hair": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Tying up one's hair	15-29	**9**		3		3		5		**20**	
		8M	1F	2M	1F	0M	3F	0M	5F	10M	10F
	30-44	**11**		0		4		5		**20**	
		9M	2F	0M	0F	0M	4F	1M	4F	10M	10F
	45-59	**8**		4		3		5		**20**	
		7M	1F	3M	1F	0M	3F	0M	5F	10M	10F
	60-74	**13**		2		2		3		**20**	
		10M	3F	0M	2F	0M	2F	0M	3F	10M	10F
	75-89	**13**		3		3		1		**20**	
		8M	5F	0M	3F	2M	1F	0M	1F	10M	10F
	TOTAL	**54**		**12**		**15**		**19**		**100**	
		42M	12F	5M	7F	2M	13F	1M	18F	50M	50F

Chart 18 indicates that tying up one's hair is more typical among female subjects (31). Age groups 60-74 (13) and 75-89 (13) and the occurrence "Never" (54) are prevalent.

Chart 19. "Leaving the room": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Leaving the room	15-29	5		**10**		5		0		**20**	
		2M	3F	7M	3F	1M	4F	0M	0F	10M	10F
	30-44	4		**14**		2		0		**20**	
		2M	2F	8M	6F	0M	2F	0M	0F	10M	10F
	45-59	4		**12**		3		1		**20**	
		1M	3F	8M	4F	1M	2F	0M	1F	10M	10F
	60-74	4		**7**		9		0		**20**	
		3M	1F	4M	3F	3M	6F	0M	0F	10M	10F
	75-89	5		**2**		5		8		**20**	
		4M	1F	0M	2F	2M	3F	4M	4F	10M	10F

	TOTAL	**22**		**45**		**24**		**9**		**100**	
		12M	10F	27M	18F	7M	17F	4M	5F	50M	50F

Chart 19 indicates that leaving the room is more typical among female subjects (22). Age group 30-44 (14) and the occurrence rate "Rarely" (45) are prevalent.

Chart 20. "Touching one's face": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Touching one's face	15-29	5		**15**		0		0		**20**	
		2M	3F	8M	7F	0M	0F	0M	0F	10M	10F
	30-44	10		**5**		5		0		**20**	
		6M	4F	3M	2F	1M	4F	0M	0F	10M	10F
	45-59	10		**3**		6		1		**20**	
		5M	5F	2M	1F	3M	3F	0M	1F	10M	10F
	60-74	5		**8**		6		1		**20**	
		3M	2F	3M	5F	3M	3F	1M	0F	10M	10F
	75-89	4		**6**		3		7		**20**	
		3M	1F	4M	2F	1M	2F	2M	5F	10M	10F
	TOTAL	**34**		**37**		**20**		**9**		**100**	
		19M	15F	20M	17F	8M	12F	3M	6F	50M	50F

Chart 20 indicates that touching one's face is more typical among female subjects (18). The age group 15-29 (15) and the occurrence rate "rarely" (37) are prevalent.

Chart 21. "Laying down": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Laying down	15-29	**12**		6		2		0		**20**	
		6M	6F	3M	3F	1M	1F	0M	0F	10M	10F
	30-44	**14**		5		1		0		**20**	
		7M	7F	2M	3F	1M	0F	0M	0F	10M	10F
	45-59	**16**		3		1		0		**20**	
		9M	7F	0M	3F	1M	0F	0M	0F	10M	10F
	60-74	**5**		11		4		0		**20**	
		1M	4F	6M	5F	3M	1F	0M	0F	10M	10F
	75-89	**6**		5		5		4		**20**	
		3M	3F	2M	3F	1M	4F	4M	0F	10M	10F
	TOTAL	**53**		**30**		**13**		**4**		**100**	
		26M	27F	13M	17F	7M	6F	4M	0F	50M	50F

Chart 21 indicates that laying down is more typical among male subjects (11). Age group 45-59 (16) and the occurrence rate "never" (53) are prevalent.

2.5.2 Analysis of data linkage of actions directed towards one's environment

Charts 22 to 25 show data linkage of age groups, occurrences and genders in relation to actions directed towards one's environment.

Chart 22. "Opening door/window": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Opening the door/window	15-29	0		1		11		**8**		**20**	
		0M	0F	0M	1F	6M	5F	4M	4F	10M	10F

	30-44	0		0		12		**8**		**20**	
		0M	0F	0M	0F	6M	6F	4M	4F	10M	10F
	45-59	1		2		8		**9**		**20**	
		1M	0F	1M	1F	5M	3F	3M	6F	10M	10F
	60-74	0		2		7		**11**		**20**	
		0M	0F	1M	1F	4M	3F	5M	6F	10M	10F
	75-89	4		1		4		**11**		**20**	
		3M	1F	0M	1F	2M	2F	5M	6F	10M	10F
	TOTAL	**5**		**6**		**42**		**47**		**100**	
		4M	1F	2M	4F	23M	19F	21M	26F	50M	50F

Chart 22 indicates that opening the door / window is typical of female subjects (45). Age groups 60-74 (11) and 75-89 (11) and the occurrence "Always" (47) are prevalent.

Chart 23. "Closing curtains/shutters": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Closing the curtains / shutters	15-29	8		5		6		**1**		**20**	
		4M	4F	3M	2F	3M	3F	0M	1F	10M	10F
	30-44	2		7		8		**3**		**20**	
		1M	1F	5M	2F	2M	6F	2M	1F	10M	10F
	45-59	3		4		6		**7**		**20**	
		0M	3F	3M	1F	4M	2F	3M	4F	10M	10F
	60-74	3		0		6		**11**		**20**	
		3M	0F	0M	0F	2M	4F	5M	6F	10M	10F
	75-89	4		2		0		**14**		**20**	
		2M	2F	1M	1F	0M	0F	7M	7F	10M	10F
	TOTAL	**20**		**18**		**26**		**36**		**100**	
		10M	10F	12M	6F	11M	15F	17M	19F	50M	50F

Chart 23 indicates that closing the curtains / shutters is typical among female subjects (34). Age group 75-89 (14) and the occurrence rate "Always" (36) are prevalent.

Chart 24. "Regulating the heater": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Regulating the heater	15-29	**3**		10		6		1		**20**	
		1M	2F	5M	5F	3M	3F	1M	0F	10M	10F
	30-44	**7**		4		5		4		**20**	
		3M	4F	3M	1F	3M	2F	1M	3F	10M	10F
	45-59	**3**		7		6		4		**20**	
		1M	2F	6M	1F	2M	4F	1M	3F	10M	10F
	60-74	**4**		7		5		4		**20**	
		1M	3F	3M	4F	4M	1F	2M	2F	10M	10F
	75-89	**13**		1		3		3		**20**	
		8M	5F	1M	0F	0M	3F	1M	2F	10M	10F
	TOTAL	**30**		**29**		**25**		**16**		**100**	
		14M	16F	18M	11F	12M	13F	6M	10F	50M	50F

Chart 24 indicates that regulating the heater is typical of female subjects (23). Age group 75-89 (13) and the occurrence rate "Never" (30) are prevalent.

*Chart 25. "*Turning dehumidifier/fan/air conditioner on*": data linkage of age groups, occurrences and genders*

	AGE GROUPS	**NEVER**	**RARELY**	**OFTEN**	**ALWAYS**	**TOTAL**
Turning	15-29	3	**7**	9	1	**20**

dehumidifier/fan/air conditioner on		2M	1F	2M	5F	6M	3F	0M	1F	10M	10F
	30-44	5		**5**		10		0		**20**	
		2M	3F	3M	2F	5M	5F	0M	0F	10M	10F
	45-59	2		**10**		4		4		**20**	
		1M	1F	6M	4F	2M	2F	1M	3F	10M	10F
	60-74	5		**5**		6		4		**20**	
		0M	5F	3M	2F	5M	1F	2M	2F	10M	10F
	75-89	11		**6**		1		2		**20**	
		5M	6F	3M	3F	1M	0F	1M	1F	10M	10F
	TOTAL	**26**		**33**		**30**		**11**		**100**	
		10M	16F	17M	16F	19M	11F	4M	7F	50M	50F

Chart 25 indicates that turning on the dehumidifier / fan / air conditioner is typical of male subjects (23). Age group 45-59 (10) and the occurrence rate "Rarely" (33) are prevalent.

2.5.3 Analysis of data linkage of physical reactions

Chart 26 shows data linkage of age groups, occurrences and genders for physical reactions.

Chart 26. "Flushing": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Flushing	15-29	2		**6**		9		3		**20**	
		1M	1F	3M	3F	4M	5F	2M	1F	10M	10F
	30-44	5		**9**		5		1		**20**	
		3M	2F	5M	4F	1M	4F	1M	0F	10M	10F
	45-59	7		**7**		3		3		**20**	
		2M	5F	5M	2F	1M	2F	2M	1F	10M	10F
	60-74	7		**7**		5		1		**20**	
		5M	2F	4M	3F	1M	4F	0M	1F	10M	10F
	75-89	10		**4**		2		4		**20**	
		6M	4F	2M	2F	0M	2F	2M	2F	10M	10F
	TOTAL	**31**		**33**		**24**		**12**		**100**	
		17M	14F	19M	14F	7M	17F	7M	5F	50M	50F

Chart 26 indicates that flushing is typical of female subjects (22). Age group 30-44 (9) and the occurrence rate "Rarely" (33) are prevalent.

2.5.4 Analysis of data linkage of verbal communication

Chart 27 shows data linkage of age groups, occurrence rates and gender for verbal communication.

Chart 27. "Verbal communication occurring": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Verbal communication occurring	15-29	1		3		**8**		8		**20**	
		1M	0F	1M	2F	5M	3F	3M	5F	10M	10F
	30-44	0		9		**6**		5		**20**	
		0M	0F	5M	4F	2M	4F	3M	2F	10M	10F
	45-59	1		7		**5**		7		**20**	
		0M	1F	5M	2F	2M	3F	3M	4F	10M	10F
	60-74	2		6		**10**		2		**20**	
		2M	0F	3M	3F	4M	6F	1M	1F	10M	10F
	75-89	5		4		**4**		7		**20**	
		4M	1F	3M	1F	2M	2F	1M	6F	10M	10F
	TOTAL	**9**		**29**		**33**		**29**		**100**	

		7M	2F	17M	12F	15M	18F	11M	18F	50M	50F

Chart 27 indicates that voicing one's perception of heat is typical of female subjects (36). Age group 60-74 (10) and the occurrence rate "Often" (33) are prevalent.

2.5.5 Analysis of total values of heat-related behaviors

Chart 28 lists the total values of heat-related behaviors sorted by occurrence and gender.

Chart 28. Total values of heat-related behaviors sorted by occurrence rate and gender

BEHAVIORS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Taking off one's clothes	1		6		36		**57**		**100**	
	1M	0F	2M	4F	12M	24F	35M	22F	50M	50F
Unbuttoning/unzipping one's coat/jacket	3		5		**48**		44		**100**	
	1M	2F	2M	3F	23M	25F	24M	20F	50M	50F
Moving away from the sunlight (streaming through the window pane)	3		14		36		**47**		**100**	
	1M	2F	8M	6F	21M	15F	20M	27F	50M	50F
Drinking repeatedly	2		20		**46**		32		**100**	
	0M	2F	14M	6F	18M	28F	18M	14F	50M	50F
Pulling up one's sleeves	11		21		**40**		28		**100**	
	7M	4F	9M	12F	22M	18F	12M	16F	50M	50F
Rolling up one's sleeves	15		25		**32**		28		**100**	
	3M	12F	12M	13F	19M	13F	16M	12F	50M	50F
Wiping off one's sweat with one's hand/handkerchief	17		**32**		29		22		**100**	
	5M	12F	15M	17F	19M	10F	11M	11F	50M	50F
Fanning oneself with one's hand/piece of paper	25		25		**28**		22		**100**	
	19M	6F	15M	10F	9M	19F	7M	15F	50M	50F
Pulling one's collar	21		**31**		29		19		**100**	
	10M	11F	14M	17F	19M	10F	7M	12F	50M	50F
Sitting down	27		**30**		28		15		**100**	
	12M	15F	15M	15F	17M	11F	6M	9F	50M	50F
Unbuttoning one's shirt	27		**33**		28		12		**100**	
	8M	19F	18M	15F	17M	11F	7M	5F	50M	50F
Tying up one's hair	**54**		12		15		19		**100**	
	42M	12F	5M	7F	2M	13F	1M	18F	50M	50F
Leaving the room	22		**45**		24		9		**100**	
	12M	10F	27M	18F	7M	17F	4M	5F	50M	50F
Touching one's face	34		**37**		20		9		**100**	
	19M	15F	20M	17F	8M	12F	3M	6F	50M	50F
Laying down	**53**		30		13		4		**100**	
	26M	27F	13M	17F	7M	6F	4M	0F	50M	50F
Opening door/window	5		6		42		**47**		**100**	
	4M	1F	2M	4F	23M	19F	21M	26F	50M	50F
Closing curtains/shutters	20		18		26		**36**		**100**	
	10M	10F	12M	6F	11M	15F	17M	19F	50M	50F
Regulating the heater	**30**		29		25		16		**100**	
	14M	16F	18M	11F	12M	13F	6M	10F	50M	50F
Turning dehumidifier/fan/air conditioner on	26		**33**		30		11		**100**	
	10M	16F	17M	16F	19M	11F	4M	7F	50M	50F
Flushing	31		**33**		24		12		**100**	
	17M	14F	19M	14F	7M	17F	7M	5F	50M	50F
Verbal communication occurring	9		29		**33**		29		**100**	
	7M	2F	17M	12F	15M	18F	11M	18F	50M	50F
TOTAL	**436**		**514**		**632**		**518**		**2100**	
	228M	208F	274M	240F	307M	325F	241M	277F	1050M	1050F

A look at the total values of heat-related behaviors shows that "Often" (632) is the single occurrence rate with the highest frequency. Moreover, this occurrence rate is the most frequently

reported by both male (307) and female (325) respondents. Further investigating the occurrence rates "Often" and "Always", it becomes clear that women act and physically react more than men do in relation to their perception of heat (602).

2.6 Analysis of data linkage of age groups, occurrence rates and genders in relation to the sensation of cold

Data linkage of the five age groups, occurrence rates and genders in relation to the sensation of cold are presented hereafter. For each behavior, gender prevalence (the sum and comparison of the occurrences "often" and "always" for men and women, respectively), age group(s) and occurrence rate(s) with the highest frequencies are shown.

2.6.1 Analysis of data linkage of actions directed towards oneself

Charts 29 to 41 show data linkage of age groups, occurrence rates and genders for actions directed towards oneself.

Chart 29. "Putting on one's clothes": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Putting on one's clothes	15-29	2		0		9		**9**		**20**	
		2M	0F	0M	0F	5M	4F	3M	6F	10M	10F
	30-44	0		3		9		**8**		**20**	
		0M	0F	3M	0F	5M	4F	2M	6F	10M	10F
	45-59	1		3		9		**7**		**20**	
		0M	1F	1M	2F	6M	3F	3M	4F	10M	10F
	60-74	1		3		4		**12**		**20**	
		0M	1F	1M	2F	3M	1F	6M	6F	10M	10F
	75-89	0		1		4		**15**		**20**	
		0M	0F	1M	0F	2M	2F	7M	8F	10M	10F
	TOTAL	**4**		**10**		**35**		**51**		**100**	
		2M	2F	6M	4F	21M	14F	21M	30F	50M	50F

Chart 29 indicates that putting on one's clothes is typical of female subjects (44). Age group 75-89 (15) and the occurrence rate "Always" (51) are prevalent.

Chart 30. "Pulling down one's sleeves": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Pulling down one's sleeves	15-29	3		0		**14**		**3**		**20**	
		3M	0F	0M	0F	7M	7F	0M	3F	10M	10F
	30-44	2		1		**7**		**10**		**20**	
		1M	1F	1M	0F	4M	3F	4M	6F	10M	10F
	45-59	0		5		**8**		**7**		**20**	
		0M	0F	3M	2F	5M	3F	2M	5F	10M	10F
	60-74	1		2		**6**		**11**		**20**	
		0M	1F	1M	1F	4M	2F	5M	6F	10M	10F
	75-89	2		2		**6**		**10**		**20**	
		2M	0F	1M	1F	2M	4F	5M	5F	10M	10F
	TOTAL	**8**		**10**		**41**		**41**		**100**	

		6M	2F	6M	4F	22M	19F	16M	25F	50M	50F

Chart 30 indicates that pulling down one's sleeves is typical of female subjects (44). The occurrence rates "Often" (41) and "Always" (41) – both displaying the same frequency – with their respective age groups 15-29 (14) and 60-74 (11), are prevalent.

Chart 31. "Getting closer to the heater": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Getting closer to the heater	15-29	0		1		8		**11**		**20**	
		0M	0F	1M	0F	6M	2F	3M	8F	10M	10F
	30-44	0		5		7		**8**		**20**	
		0M	0F	4M	1F	2M	5F	4M	4F	10M	10F
	45-59	0		5		8		**7**		**20**	
		0M	0F	4M	1F	2M	6F	4M	3F	10M	10F
	60-74	1		4		5		**10**		**20**	
		1M	0F	2M	2F	4M	1F	3M	7F	10M	10F
	75-89	5		3		2		**10**		**20**	
		3M	2F	1M	2F	1M	1F	5M	5F	10M	10F
	TOTAL	**6**		**18**		**30**		**46**		**100**	
		4M	2F	12M	6F	15M	15F	19M	27F	50M	50F

Chart 31 indicates that getting closer to the heater is typical of female subjects (42). Age group 15-29 (11) and the occurrence rate "Always" (46) are prevalent.

Chart 32. "Buttoning up one's shirt": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Buttoning up one's shirt	15-29	5		3		9		**3**		**20**	
		3M	2F	1M	2F	4M	5F	2M	1F	10M	10F
	30-44	5		2		5		**8**		**20**	
		1M	4F	0M	2F	4M	1F	5M	3F	10M	10F
	45-59	6		2		7		**5**		**20**	
		2M	4F	1M	1F	5M	2F	2M	3F	10M	10F
	60-74	0		2		8		**10**		**20**	
		0M	0F	2M	0F	3M	5F	5M	5F	10M	10F
	75-89	6		2		4		**8**		**20**	
		3M	3F	1M	1F	2M	2F	4M	4F	10M	10F
	TOTAL	**22**		**11**		**33**		**34**		**100**	
		9M	13F	5M	6F	18M	15F	18M	16F	50M	50F

Chart 32 indicates that buttoning up one's shirt is typical of male subjects (36). Age group 60-74 (10) and the occurrence rate "Always" (34) are prevalent.

Chart 33. "Rolling down one's sleeves": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Rolling down one's sleeves	15-29	5		4		**8**		3		**20**	
		3M	2F	1M	3F	4M	4F	2M	1F	10M	10F
	30-44	4		5		**6**		5		**20**	
		1M	3F	2M	3F	4M	2F	3M	2F	10M	10F
	45-59	5		4		**6**		5		**20**	
		2M	3F	3M	1F	3M	3F	2M	3F	10M	10F
	60-74	5		1		**7**		7		**20**	
		2M	3F	1M	0F	3M	4F	4M	3F	10M	10F

	75-89	5		5		**4**		6		**20**	
		3M	2F	4M	1F	0M	4F	3M	3F	10M	10F
	TOTAL	**24**		**19**		**31**		**26**		**100**	
		11M	13F	11M	8F	14M	17F	14M	12F	50M	50F

Chart 33 indicates that rolling down one's sleeves is typical of female subjects (29). Age group 15-29 (8) and the occurrence rate "Often" (31) are prevalent.

Chart 34. "Pulling up one's collar": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Pulling up one's collar	15-29	8		**4**		7		1		**20**	
		4M	4F	3M	1F	3M	4F	0M	1F	10M	10F
	30-44	5		**6**		8		1		**20**	
		3M	2F	2M	4F	4M	4F	1M	0F	10M	10F
	45-59	4		**8**		5		3		**20**	
		2M	2F	4M	4F	3M	2F	1M	2F	10M	10F
	60-74	1		**6**		4		9		**20**	
		0M	1F	4M	2F	2M	2F	4M	5F	10M	10F
	75-89	4		**5**		3		8		**20**	
		4M	0F	1M	4F	2M	1F	3M	5F	10M	10F
	TOTAL	**22**		**29**		**27**		**22**		**100**	
		13M	9F	14M	15F	14M	13F	9M	13F	50M	50F

Chart 34 indicates that pulling up one's collar is typical of female subjects (26). Age group 45-59 (8) and the occurrence rate "Rarely" (29) are prevalent.

Chart 35. "Pulling up one's coat/jumper hood": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Pulling up one's coat/jumper hood	15-29	5		3		**6**		6		**20**	
		4M	1F	0M	3F	2M	4F	4M	2F	10M	10F
	30-44	4		7		**5**		4		**20**	
		2M	2F	5M	2F	1M	4F	2M	2F	10M	10F
	45-59	4		6		**7**		3		**20**	
		2M	2F	3M	3F	5M	2F	0M	3F	10M	10F
	60-74	7		3		**7**		3		**20**	
		3M	4F	2M	1F	3M	4F	2M	1F	10M	10F
	75-89	6		**6**		**4**		4		**20**	
		3M	3F	3M	3F	1M	3F	3M	1F	10M	10F
	TOTAL	**26**		**25**		**29**		**20**		**100**	
		14M	12F	13M	12F	12M	17F	11M	9F	50M	50F

Chart 35 indicates that pulling up one's coat / jumper hood is typical of female subjects (26). The occurrence rate "Often" (29) and age groups 45-59 (7) and 60-74 (7) – both displaying the same frequency – are prevalent.

Chart 36. "Rubbing/cleaning one's nose with handkerchief/tissue": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Rubbing/cleaning one's nose with handkerchief/tissue	15-29	3		**5**		10		2		**20**	
		3M	0F	2M	3F	5M	5F	0M	2F	10M	10F
	30-44	4		**5**		7		4		**20**	
		2M	2F	2M	3F	5M	2F	1M	3F	10M	10F

	45-59	3		**10**		4		3		**20**	
		0M	3F	5M	5F	2M	2F	3M	0F	10M	10F
	60-74	2		**11**		5		2		**20**	
		2M	0F	5M	6F	2M	3F	1M	1F	10M	10F
	75-89	6		**2**		6		6		**20**	
		3M	3F	1M	1F	4M	2F	2M	4F	10M	10F
	TOTAL	**18**		**33**		**32**		**17**		**100**	
		10M	8F	15M	18F	18M	14F	7M	10F	50M	50F

Chart 36 indicates that rubbing or cleaning one's nose with a handkerchief or tissue is typical among male subjects (25). Age group 60-74 (11) and the occurrence rate "Rarely" (33) are prevalent.

Chart 37. "Rubbing one's hands/arms/shoulders": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Rubbing one's hands / arms / shoulders	15-29	3		3		**12**		2		**20**	
		2M	1F	1M	2F	6M	6F	1M	1F	10M	10F
	30-44	5		5		**7**		3		**20**	
		3M	2F	3M	2F	3M	4F	1M	2F	10M	10F
	45-59	6		6		**6**		2		**20**	
		1M	5F	5M	1F	3M	3F	1M	1F	10M	10F
	60-74	5		6		**8**		1		**20**	
		1M	4F	4M	2F	4M	4F	1M	0F	10M	10F
	75-89	5		7		**6**		2		**20**	
		4M	1F	2M	5F	3M	3F	1M	1F	10M	10F
	TOTAL	**24**		**27**		**39**		**10**		**100**	
		11M	13F	15M	12F	19M	20F	5M	5F	50M	50F

Chart 37 indicates that rubbing one's hands / arms / shoulders is typical among female subjects (25). Age group 15-29 (12) and the occurrence rate "Often" (39) are prevalent.

Chart 38. "Curling up": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Curling up	15-29	**4**		7		6		3		**20**	
		3M	1F	5M	2F	1M	5F	1M	2F	10M	10F
	30-44	**6**		5		5		4		**20**	
		3M	3F	3M	2F	4M	1F	0M	4F	10M	10F
	45-59	**7**		7		2		4		**20**	
		5M	2F	5M	2F	0M	2F	0M	4F	10M	10F
	60-74	**6**		6		6		2		**20**	
		6M	0F	3M	3F	1M	5F	0M	2F	10M	10F
	75-89	**9**		4		2		5		**20**	
		5M	4F	1M	3F	2M	0F	2M	3F	10M	10F
	TOTAL	**32**		**29**		**21**		**18**		**100**	
		22M	10F	17M	12F	8M	13F	3M	15F	50M	50F

Chart 38 indicates that curling up is typical among female subjects (28). Age group 75-89 (9) and the occurrence rate "Never" (32) are prevalent.

Chart 39. "Drinking repeatedly": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**	**RARELY**	**OFTEN**	**ALWAYS**	**TOTAL**
Drinking repeatedly	15-29	4	**8**	5	3	**20**

		3M	1F	5M	3F	0M	5F	2M	1F	10M	10F
	30-44	5		**11**		4		0		**20**	
		3M	2F	6M	5F	1M	3F	0M	0F	10M	10F
	45-59	7		**7**		5		1		**20**	
		4M	3F	4M	3F	2M	3F	0M	1F	10M	10F
	60-74	4		**11**		4		1		**20**	
		2M	2F	7M	4F	1M	3F	0M	1F	10M	10F
	75-89	11		**3**		6		0		**20**	
		5M	6F	3M	0F	2M	4F	0M	0F	10M	10F
	TOTAL	**31**		**40**		**24**		**5**		**100**	
		17M	14F	25M	15F	6M	18F	2M	3F	50M	50F

Chart 39 indicates that drinking regularly is typical of female subjects (21). The occurrence rate "Rarely" (40) and age group 30-44 (11) and 60-74 (11) – both displaying the same frequency – are prevalent.

Chart 40. "Tapping one's feet": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Tapping one's feet	15-29	**13**		6		1		0		**20**	
		7M	6F	3M	3F	0M	1F	0M	0F	10M	10F
	30-44	**14**		4		2		0		**20**	
		8M	6F	1M	3F	1M	1F	0M	0F	10M	10F
	45-59	**13**		5		2		0		**20**	
		5M	8F	4M	1F	1M	1F	0M	0F	10M	10F
	60-74	**8**		10		2		0		**20**	
		5M	3F	4M	6F	1M	1F	0M	0F	10M	10F
	75-89	**15**		1		1		3		**20**	
		8M	7F	0M	1F	0M	1F	2M	1F	10M	10F
	TOTAL	**63**		**26**		**8**		**3**		**100**	
		33M	30F	12M	14F	3M	5F	2M	1F	50M	50F

Chart 40 indicates that tapping one's feet is typical among female subjects (6). Age group 75-89 (15) and the occurrence rate "Never" (63) are prevalent.

Chart 41. "Running in place": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Running in place	15-29	**18**		2		0		0		**20**	
		9M	9F	1M	1F	0M	0F	0M	0F	10M	10F
	30-44	**17**		2		1		0		**20**	
		9M	8F	0M	2F	1M	0F	0M	0F	10M	10F
	45-59	**17**		3		0		0		**20**	
		9M	8F	1M	2F	0M	0F	0M	0F	10M	10F
	60-74	**15**		3		0		2		**20**	
		7M	8F	2M	1F	0M	0F	1M	1F	10M	10F
	75-89	**18**		2		0		0		**20**	
		9M	9F	1M	1F	0M	0F	0M	0F	10M	10F
	TOTAL	**85**		**12**		**1**		**2**		**100**	
		43M	42F	5M	7F	1M	0F	1M	1F	50M	50F

Chart 41 indicates that running in place is typical among male subjects (2). The occurrence rate "Never" (85) and age groups 15-29 (18) and 75-89 (18) – both displaying the same frequency – are prevalent.

2.6.2 Analysis of data linkage of actions directed towards one's environment

Charts 42 to 46 show data linkage of age groups, occurrence rates and genders for actions directed towards one's environment.

Chart 42. "Closing the door/window": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Closing the door/window	15-29	0		2		12		**6**		**20**	
		0M	0F	2M	0F	5M	7F	3M	3F	10M	10F
	30-44	0		0		9		**11**		**20**	
		0M	0F	0M	0F	5M	4F	5M	6F	10M	10F
	45-59	0		4		10		**6**		**20**	
		0M	0F	3M	1F	4M	6F	3M	3F	10M	10F
	60-74	1		0		5		**14**		**20**	
		1M	0F	0M	0F	2M	3F	7M	7F	10M	10F
	75-89	0		1		3		**16**		**20**	
		0M	0F	0M	1F	2M	1F	8M	8F	10M	10F
	TOTAL	**1**		**7**		**39**		**53**		**100**	
		1M	0F	5M	2F	18M	21F	26M	27F	50M	50F

Chart 42 indicates that closing the door / window is typical of female subjects (48). Age group 75-89 (16) and the occurrence rate "Always" (53) are prevalent.

Chart 43. "Getting rid of drafts": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Getting rid of drafts	15-29	1		3		**10**		6		**20**	
		1M	0F	3M	0F	4M	6F	2M	4F	10M	10F
	30-44	1		3		**9**		7		**20**	
		1M	0F	2M	1F	4M	5F	3M	4F	10M	10F
	45-59	0		3		**13**		4		**20**	
		0M	0F	2M	1F	6M	7F	2M	2F	10M	10F
	60-74	0		3		**9**		8		**20**	
		0M	0F	2M	1F	4M	5F	4M	4F	10M	10F
	75-89	0		5		**3**		12		**20**	
		0M	0F	2M	3F	1M	2F	7M	5F	10M	10F
	TOTAL	**2**		**17**		**44**		**37**		**100**	
		2M	0F	11M	6F	19M	25F	18M	19F	50M	50F

Chart 43 indicates that getting rid of drafts is typical of female subjects (44). Age group 45-59 (13) and the occurrence rate "Often" (44) are prevalent.

Chart 44. "Regulating the heater": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Regulating the heater	15-29	3		1		**10**		6		**20**	
		3M	0F	0M	1F	3M	7F	4M	2F	10M	10F
	30-44	2		2		**9**		7		**20**	
		1M	1F	1M	1F	6M	3F	2M	5F	10M	10F
	45-59	2		5		**7**		6		**20**	
		1M	1F	3M	2F	3M	4F	3M	3F	10M	10F
	60-74	4		4		**7**		5		**20**	
		2M	2F	2M	2F	3M	4F	3M	2F	10M	10F
	75-89	8		2		**3**		7		**20**	

		5M	3F	1M	1F	1M	2F	3M	4F	10M	10F
	TOTAL	**19**		**14**		**36**		**31**		**100**	
		12M	7F	7M	7F	16M	20F	15M	16F	50M	50F

Chart 44 indicates that regulating the heater is typical of female subjects (36). Age group 15-29 (10) and the occurrence rate "Often" (36) are prevalent.

Chart 45. "Opening the curtains/shutters": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Opening the curtains/shutters (o let the heat in)	15-29	6		7		**5**		2		**20**	
		4M	2F	2M	5F	2M	3F	2M	0F	10M	10F
	30-44	4		8		**6**		2		**20**	
		1M	3F	5M	3F	4M	2F	0M	2F	10M	10F
	45-59	3		6		**9**		2		**20**	
		0M	3F	4M	2F	6M	3F	0M	2F	10M	10F
	60-74	0		7		**7**		6		**20**	
		0M	0F	4M	3F	4M	3F	2M	4F	10M	10F
	75-89	7		2		**7**		4		**20**	
		4M	3F	2M	0F	2M	5F	2M	2F	10M	10F
	TOTAL	**20**		**30**		**34**		**16**		**100**	
		9M	11F	17M	13F	18M	16F	6M	10F	50M	50F

Chart 45 indicates that opening the curtains / shutters is typical of female subjects (26). Age group 45-59 (9) and the occurrence rate "Often" (34) are prevalent.

Chart 46. "Opening the door (to contrast conditioned air)": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Opening the door (to contrast conditioned air)	15-29	**8**		10		2		0		**20**	
		6M	2F	4M	6F	0M	2F	0M	0F	10M	10F
	30-44	**10**		3		5		2		**20**	
		6M	4F	3M	0F	1M	4F	0M	2F	10M	10F
	45-59	**5**		8		7		0		**20**	
		2M	3F	5M	3F	3M	4F	0M	0F	10M	10F
	60-74	**9**		6		3		2		**20**	
		4M	5F	4M	2F	1M	2F	1M	1F	10M	10F
	75-89	**14**		1		1		4		**20**	
		5M	9F	1M	0F	1M	0F	3M	1F	10M	10F
	TOTAL	**46**		**28**		**18**		**8**		**100**	
		23M	23F	17M	11F	6M	12F	4M	4F	50M	50F

Chart 46 indicates that opening the door (to contrast conditioned air) is typical of female subjects (16). Age group 75-89 (14) and the occurrence rate "Never" (46) are prevalent.

2.6.3 Analysis of data linkage of physical reactions

Charts 47 to 50 show data linkage of age groups, occurrence rates and genders for physical reactions.

Chart 47. "Shivering": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**	**RARELY**	**OFTEN**	**ALWAYS**	**TOTAL**

Shivering	15-29	1		**8**		**8**		3		**20**	
		1M	0F	6M	2F	3M	5F	0M	3F	10M	10F
	30-44	3		**5**		**7**		5		**20**	
		2M	1F	3M	2F	4M	3F	1M	4F	10M	10F
	45-59	3		**7**		**8**		2		**20**	
		3M	0F	5M	2F	1M	7F	1M	1F	10M	10F
	60-74	2		**8**		**6**		4		**20**	
		2M	0F	5M	3F	3M	3F	0M	4F	10M	10F
	75-89	5		**5**		**4**		6		**20**	
		3M	2F	3M	2F	2M	2F	2M	4F	10M	10F
	TOTAL	**14**		**33**		**33**		**20**		**100**	
		11M	3F	22M	11F	13M	20F	4M	16F	50M	50F

Chart 47 indicates that shivering is typical of female subjects (36). The occurrence rates "Rarely" (33) and "Often" (33) – both displaying the same frequencies – are prevalent. Their respective age groups are 15-29 (8) and 60-74 (8) for the former, and 15-29 (8) and 45-59 (8) for the latter.

Chart 48. "Sneezing": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Sneezing	15-29	2		**9**		5		4		**20**	
		1M	1F	7M	2F	1M	4F	1M	3F	10M	10F
	30-44	3		**10**		6		1		**20**	
		2M	1F	3M	7F	5M	1F	0M	1F	10M	10F
	45-59	6		**8**		5		1		**20**	
		2M	4F	5M	3F	2M	3F	1M	0F	10M	10F
	60-74	1		**12**		5		2		**20**	
		1M	0F	6M	6F	2M	3F	1M	1F	10M	10F
	75-89	2		**7**		8		3		**20**	
		2M	0F	4M	3F	3M	5F	1M	2F	10M	10F
	TOTAL	**14**		**46**		**29**		**11**		**100**	
		8M	6F	25M	21F	13M	16F	4M	7F	50M	50F

Chart 48 indicates that sneezing is typical among female subjects (23). Age group 60-74 (12) and the occurrence rate "Rarely" (46) are prevalent.

Chart 49. "Coughing": data linkage of age groups, occurrences and genders

	AGE GROUPS	**NEVER**		**RARELY**		**OFTEN**		**ALWAYS**		**TOTAL**	
Coughing	15-29	6		**8**		6		0		**20**	
		4M	2F	4M	4F	2M	4F	0M	0F	10M	10F
	30-44	6		**8**		4		2		**20**	
		4M	2F	4M	4F	2M	2F	0M	2F	10M	10F
	45-59	7		**9**		4		0		**20**	
		2M	5F	7M	2F	1M	3F	0M	0F	10M	10F
	60-74	4		**11**		5		0		**20**	
		2M	2F	6M	5F	2M	3F	0M	0F	10M	10F
	75-89	3		**8**		9		0		**20**	
		2M	1F	6M	2F	2M	7F	0M	0F	10M	10F
	TOTAL	**26**		**44**		**28**		**2**		**100**	
		14M	12F	27M	17F	9M	19F	0M	2F	50M	50F

Chart 49 indicates that coughing is typical among female subjects (21). Age group 60-74 (11) and the occurrence rate "Rarely" (44) are prevalent.

Chart 50. "Making one's teeth chatter": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Making one's teeth chatter	15-29	**4**		8		4		4		**20**	
		2M	2F	4M	4F	2M	2F	2M	2F	10M	10F
	30-44	**10**		8		1		1		**20**	
		4M	6F	6M	2F	0M	1F	0M	1F	10M	10F
	45-59	**10**		9		1		0		**20**	
		6M	4F	3M	6F	1M	0F	0M	0F	10M	10F
	60-74	**13**		4		2		1		**20**	
		9M	4F	1M	3F	0M	2F	0M	1F	10M	10F
	75-89	**15**		3		0		2		**20**	
		7M	8F	2M	1F	0M	0F	1M	1F	10M	10F
	TOTAL	**52**		**32**		**8**		**8**		**100**	
		28M	24F	16M	16F	3M	5F	3M	5F	50M	50F

Chart 50 indicates that making one's teeth chatter is typical of female subjects (10). Age group 75-89 (15) and the occurrence rate "Never" (52) are prevalent.

2.6.4 Analysis of data linkage of verbal communication

Chart 51 shows data linkage of age groups, occurrence rates and genders for verbal communication.

Chart 51. "Verbal communication occurring": data linkage of age groups, occurrences and genders

	AGE GROUPS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Verbal communication occurring	15-29	0		**9**		7		4		**20**	
		0M	0F	6M	3F	4M	3F	0M	4F	10M	10F
	30-44	1		**7**		7		5		**20**	
		1M	0F	5M	2F	3M	4F	1M	4F	10M	10F
	45-59	3		**5**		9		3		**20**	
		2M	1F	2M	3F	3M	6F	3M	0F	10M	10F
	60-74	4		**6**		4		6		**20**	
		4M	0F	3M	3F	1M	3F	2M	4F	10M	10F
	75-89	8		**4**		2		6		**20**	
		4M	4F	4M	0F	0M	2F	2M	4F	10M	10F
	TOTAL	**16**		**31**		**29**		**24**		**100**	
		11M	5F	20M	11F	11M	18F	8M	16F	50M	50F

Chart 51 indicates that voicing one's perception of cold is typical of female subjects (34). Age group 15-29 (9) and the occurrence rate "Rarely" (31) are prevalent.

2.6.5 Analysis of total values of cold-related behaviors

Chart 52 shows total values of cold-related behaviors sorted by occurrence rate and gender.

Chart 52. Total values of cold-related behaviors sorted by occurrence rate and gender

BEHAVIORS	NEVER		RARELY		OFTEN		ALWAYS		TOTAL	
Putting on one's clothes	4		10		35		**51**		**100**	
	2M	2F	6M	4F	21M	14F	21M	30F	50M	50F
Pulling down one's sleeves	8		10		**41**		**41**		**100**	
	6M	2F	6M	4F	22M	19F	16M	25F	50M	50F
Getting closer to the heater	6		18		30		**46**		**100**	
	4M	2F	12M	6F	15M	15F	19M	27F	50M	50F
Buttoning up one's shirt	22		11		33		**34**		**100**	

	9M	13F	5M	6F	18M	15F	18M	16F	50M	50F
Rolling down one's sleeves	24		19		**31**		26		**100**	
	11M	13F	11M	8F	14M	17F	14M	12F	50M	50F
Pulling up one's collar	22		**29**		27		22		**100**	
	13M	9F	14M	15F	14M	13F	9M	13F	50M	50F
Pulling up one's coat/jumper hood	26		25		**29**		20		**100**	
	14M	12F	13M	12F	12M	17F	11M	9F	50M	50F
Rubbing/cleaning one's nose with handkerchief/tissue	18		**33**		32		17		**100**	
	10M	8F	15M	18F	18M	14F	7M	10F	50M	50F
Rubbing one's hands/arms/shoulders	24		27		**39**		10		**100**	
	11M	13F	15M	12F	19M	20F	5M	5F	50M	50F
Curling up	**32**		29		21		18		**100**	
	22M	10F	17M	12F	8M	13F	3M	15F	50M	50F
Drinking repeatedly	31		**40**		24		5		**100**	
	17M	14F	25M	15F	6M	18F	2M	3F	50M	50F
Tapping one's feet	**63**		26		8		3		**100**	
	33M	30F	12M	14F	3M	5F	2M	1F	50M	50F
Running in place	**85**		12		1		2		**100**	
	43M	42F	5M	7F	1M	0F	1M	1F	50M	50F
Closing the door/window	1		7		39		**53**		**100**	
	1M	0F	5M	2F	18M	21F	26M	27F	50M	50F
Getting rid of drafts	2		17		**44**		37		**100**	
	2M	0F	11M	6F	19M	25F	18M	19F	50M	50F
Regulating the heater	19		14		**36**		31		**100**	
	12M	7F	7M	7F	16M	20F	15M	16F	50M	50F
Opening the curtains/shutters (to let the heat in)	20		30		**34**		16		**100**	
	9M	11F	17M	13F	18M	16F	6M	10F	50M	50F
Opening the door (to contrast conditioned air)	**46**		28		18		8		**100**	
	23M	23F	17M	11F	6M	12F	4M	4F	50M	50F
Shivering	14		**33**		**33**		20		**100**	
	11M	3F	22M	11F	13M	20F	4M	16F	50M	50F
Sneezing	14		**46**		29		11		**100**	
	8M	6F	25M	21F	13M	16F	4M	7F	50M	50F
Coughing	26		**44**		28		2		**100**	
	14M	12F	27M	17F	9M	19F	0M	2F	50M	50F
Making one's teeth chatter	**52**		32		8		8		**100**	
	28M	24F	16M	16F	3M	5F	3M	5F	50M	50F
Verbal communication occurring	16		**31**		29		24		**100**	
	11M	5F	20M	11F	11M	18F	8M	16F	50M	50F
TOTAL	**575**		**571**		**649**		**505**		**2300**	
	314M	261F	323M	248F	297M	352F	216M	289F	1150M	1150F

A look at the total values of cold-related behaviors shows – as it was the case for heat-related behaviors – that "Often" (649) is the single occurrence rate with the highest frequency. Moreover, the highest male frequency is related to the occurrence rate "Rarely" (323), while the highest female frequency is related to the occurrence rate "Often" (352). Further investigating the occurrence rates "Often" and "Always", it becomes clear that women act and physically react more than men do in relation to their perception of cold (641).

2.7 Discussion of the results

As regards the sensation of heat, the single behavior with the highest frequency overall is *taking off one's clothes (57)* in the occurrence rate "Always". In relation to the sensation of cold, on the other hand, the most frequently reported behavior is running in place (85) in the occurrence rate "Never".

Total values of behaviors in relation to both heat (632) and cold (649) show that *"Often"* is the single most frequently reported occurrence rate. This may indicate that *the actions and physical reactions listed in the questionnaire actually reflect the behaviors of respondents in their everyday-life*. Moreover, as for the total values of heat-related behaviors for the occurrence rate "Often", frequencies are highest for both male (307) and female respondents (325). Conversely, as for the total values of cold-related behaviors, the highest male frequency has been recorded for the occurrence rate "Rarely" (323), with "Often" ranking highest among female respondents (352).

Chart 3 indicates that the heat-related behaviors that are most frequently reported by male respondents are taking off one's clothes (47) and unbuttoning or unzipping one's coat or jacket (47), both behaviors being actions directed towards oneself. Conversely, the single heat-related behavior that is most frequently reported by female respondents is opening the door / window (45), which is an action directed towards one's environment. Chart 4 indicates that the single cold-related behavior that is most frequently reported by male respondents is buttoning up one's shirt (36) – an action directed towards oneself – whereas single heat-related behavior that is most frequently reported by female respondents is closing the door/window (45) – again, an action directed towards one's environment.

Occurrences of verbal communication are more frequent in relation to heat (62) than cold (53). In both cases, they seem to be more typical of female respondents. Women tend therefore to voice their perceptions of heat and cold much more than men do.

Chart 5 takes into account all five age groups in relation to the sensation of heat. A look at the chart indicates that the respective most frequently reported behaviors are "Taking off one's clothes" (age group 15-29), "Opening the door/window" (age group 30-44), "Moving away from the sunlight (streaming through the window pane)" (age group 45-59), "Taking off one's clothes" (age group 60-74) and "Sitting down" (age group 75-89). 4 of these are actions directed towards oneself, while 1 is an action directed towards one's environment. To sum up, the most frequently reported behaviors across all age groups are taking off one's clothes (20), unbuttoning or unzipping one's coat or jacket (20) and opening the door / window (20). In relation to the sensation of cold, on the other hand, as indicated in chart 6, the most frequently reported behaviors are "Getting closer to the heater" (age group 15-29), "Closing the door / window" (age group 30-44), "Getting rid of drafts" (age group 45-59), "Buttoning up one's shirt" (age group 60-74) and "Putting on one's clothes" (age group 75-89). 3 of these are actions directed towards oneself, while 2 are actions directed towards one's environment. To sum up, the single most frequently reported behavior across all age groups is closing the door/window (20).

Further investigation in the older seniors' group lead to interesting results. The most frequently reported heat-related behaviors for age group 75-89 are "Sitting down", "Leaving the room", "Wiping off one's sweat with hands/handkerchief", "Touching one's face" and "Laying down", whereas the most frequently reported cold-related behaviors are "Putting on one's clothes", "Rubbing/cleaning one's nose with handkerchief/tissue", "Sneezing", "Coughing" and "Tapping one's feet". This seems to be in line with a number of scholarly sources (Bouchama & Knochel, 2002; Dinarello & Porat, 2008; Pontieri, 1998) on the subject of pathophysiology of thermoregulation, with the hypothalamus as the thermoregulatory center of the human body. If the thermoregulatory system is damaged and does not work effectively, a person's health can be seriously affected. Senior people seem to be most exposed to risk because of their age-induced thermoregulatory impairment. More specifically, a loss of lean body mass, reduced mobility, inadequate eating habits, reduced cold-induced chills and reduced vasoconstriction result in reduced heat generation capacity. (Bragagni, Alberti, Castelli, & Lari, 2012). Body temperature is consequently lower in senior people, their perception of cold being one symptom of ageing, especially in bedridden and non-self-sufficient subjects

Finally, a look at the occurrences of "often" and "always" seem to indicate that *women act and physically react more than men in relation to their perceptions of both heat (602) and cold (641). Especially in relation to cold, there is a clear female predominance*.

3. Conclusions

After data have been collected from field observations in generic indoor environments, it has been deemed sensible to administer questionnaires to a randomized sample of common people from different age groups in order to cross data resulting from observations with those resulting from the survey. The aim was assessing whether the behaviors detected during observations could be deemed as ambiguous or unambiguous and additionally gaining further insight in relation to the perceptions of the people that had been previously monitored. The questionnaires use a frequency scale from "Never" to "Always". Respondents were asked to report their own usual behaviors whenever they feel (excessively) hot or (excessively) cold in an indoor everyday-life environment, in order to determine the frequency of the detected behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of thermal (hot / cold) discomfort as experienced by a number of individuals in their daily life. Of all collected data, in relation to both heat and cold, a specific

analysis by gender and age group was carried out. Subsequently, an analysis of data linkage of age groups, occurrences and gender followed.

Data resulting from both observations and the survey indicate that *taking off one's clothes* is the single behavior displaying the highest frequency overall. In both cases, voicing one's perception of heat is more frequent than voicing one's perception of cold, verbal communication seemingly being more typical of female subjects.

Linkage of data resulting from observations in generic indoor environments and from the survey shows that the most typical heat-related behaviors among male subjects are "Taking off one's clothes", "Wiping off one's sweat with hands/handkerchief", "Rolling up one's sleeves", "Unbuttoning/unzipping one's coat/jacket", "Unbuttoning one's shirt" and "Turning dehumidifier/fan/air conditioner on". The most typical heat-related behaviors among female subjects are "Fanning oneself with one's hand / piece of paper", "Verbal communication occurring", "Tying up one's hair", "Touching one's face" and "Flushing". Linkage of data resulting from observations in generic indoor environments and from the survey shows equally that the most typical cold-related behaviors among male subjects are "Rubbing/cleaning one's nose with handkerchief/tissue" and "Buttoning up one's shirt, while the most typical cold-related behaviors among female subjects are "Putting on one's clothes", "Rubbing one's hands / arms / shoulders", "Verbal communication occurring", "Shivering", "Drinking repeatedly", "Opening the curtains/shutters (to let the heat in)" and "Pulling up one's coat/jumper hood".

As the analysis of observations indicates, men act and physically react in relation to their perception of heat more than women do, whereas women seem to perceive cold much more than men do. It is interesting to notice that the most part of the most frequent heat-related behaviors detected during observations seem to be more typical of male subjects, with women normally acting and physically reacting more than men during the autumn and the winter. This may indicate both that during the colder part of the year particularly high temperatures are set in indoor environments and that women tend to move and be generally speaking more active than men. Moreover, physiologic features play an important role in this regard: according to scholarly sources, men and women tend to dress differently in relation to temperature, with women displaying significantly different hormone levels than men (Kim, de Dear, Candido, Zhang, & Arens, 2013).

Questionnaire data, on the other hand, show that women act and physically react more than men do in relation to their perceptions of both heat and cold. It is interesting to notice that women act on their environments much more than men: in relation to heat, the female behavior with the highest

frequency is “Opening the door/window” (45), whereas the cold-related most frequent female behavior is “Closing the door / window” (45).

To conclude, data resulting from both research instruments show that *in relation to the sensation of cold, there is a clear female prevalence: women tend to act, physically react and verbally communicate more than men do. They are normally more sensitive to temperature and carefully choose the right clothes to wear* based on both indoor and outdoor temperatures. These data are in line with the outcomes of other studies carried out in various indoor environments (Choi, Aziz, & Loftness, 2010; Karjalainen, 2007, 2012; Kcomt Ché, Pardons, Vanrompay, Preuveneers, & Berbers, 2010; Kim, de Dear, Candido, Zhang, & Arens, 2013; Parsons, 2002; Zalejska-Jonsson & Wilhelmsson, 2013), which indicate that *women are less satisfied with room temperatures and generally prefer higher temperatures than men, with discomfort in relation to both heat and cold being reported much more frequently in women than men*.

Data collection lasted for a bit longer than three months during the PhD program. Subsequent analysis and comparison with data from the checklist provided for an insight into the perceptions of people that had been monitored during field observations. These data can be used to plan devices that can effectively ensure comfort and enhance well-being of individuals in their everyday-life environments.

Conclusions

Starting from a review of the theoretical framework and business evaluation, the following research question was developed in the early stage of the project: "*Is it possible to create the best comfort possible (at thermal, luminous, acoustic level among others) in an indoor environment with minimized activity by final users, at any time?*". The perspective of *probabilistic models and multi-causal models* was chosen. These models introduce a systemic vision of development, which is regarded as the outcome of the individual's actions in a given context. These actions are responsible for a change in the individual as well as in the development context, the said change being mutual and continuous over time. Lifespan psychology draws from this background: it advocates *a vision of humans as ever-changing beings*, both in what is commonly referred to as the age of development and during later stages. Lifespan psychology additionally introduces *a new vision of elderly people and ageing*, moving away from the narrative of decay, decline and loss while embracing a new framework of re-structuring and advances. As argued by P.B. Baltes and M.M. Baltes (1990), ageing is a heterogeneous process (both within single people and across people of the same age) implying decay of fluid intelligent (i.e. speed of perception, memory capacity, problem-solving) in which, conversely, crystallized intelligence-based skills (including cultural intelligence, language and social skills based on experience and expertise) can be enhanced all along one's lifespan. Enhancement and upgrades can be witnessed also in senior people experiencing serious physical and mental decline. This awareness can often help to better envisage and implement recovery measures. During old age, many skills can actually be developed. An ongoing growth process can be witnessed, in which people display their own characteristics and specificities more effectively, *providing for a role continuity at micro-systemic and macro-systemic level* and consequently a strong and stable sense of inner identity.

The present research is based on a constructivist theoretical paradigm, with sees the researcher's role as that of a participant and broker of understanding and re-structuring of life constructions that are typical of the subjects of investigation. The researcher is considered with his/her peculiarities as an individual belonging to a culture, a society, a group, a specific category, with a set of beliefs, opinions, values and drives that cannot be neglected during the research, but can conversely be used as a major instrument of analysis. This paradigm underpins the methods that were used for the present research project. Its aim is investigating various aspects of human behavior in everyday-life environments in order to develop and experimentally assess cutting-edge technological products that are aimed at improving both final users' quality of life and perception of well-being.

With this goal in mind, the first step to finding an answer to this question has been assessing the state of the art. Information and data have been collected through bibliographic and online research on the following topics: Domotics and Indoor Environmental Quality (IEQ); temperature as a parameter and the notion of Thermal Comfort; gender differences in the perception of general comfort and more specifically of thermal comfort; assisted living for senior and people with disabilities and active ageing, the notions of thermoregulation and lighting in relation to the age group of older senior people (75-89 years and more).

The project unfolded in four different phases. In the first phase, field observations in multiple indoor environments, both public and private (homes, offices, universities, etc.) in Italy and abroad (Europe and US), aimed at detecting behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication which can be interpreted as display of sensations of heat and/or cold as perceived by people in their everyday-life environments. Observations indicate that men act and physically react more than women do in relation to the sensation of heat, particularly in the spring and in the summer: men seem to endure heat less than women. On the other hand, women seem to perceive cold much more than men do, and this in all seasons. As a matter of fact, female subjects tend to wear more clothes and are more prone to voice their discomfort. Verbal communication is more frequent in relation to heat than cold; in both cases, occurrences are more typical of female subjects. Women therefore tend to voice their perceptions of heat and cold much more frequently than men do. Considering total frequencies in relation to both heat and cold, men seem to act more frequently in the spring and in the summer, whereas women act primarily in the autumn and in the winter. The analysis of these data provided an insight into some displays of thermal discomfort as experienced by people in their daily life, who all too often have troubles overcoming it. At the same time, field observations were carried out inside five healthcare facilities (nursing homes and rehabilitation centers) located in the Marche region (Italy) to detect a number of behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of discomfort at thermal or luminous level perceived by senior residents. Observations indicate that, generally speaking, in these facilities the number of female residents is much larger than that of men, which is probably the reason why more female behaviors have been recorded. *Actions directed towards oneself seem to be more frequent than physical reactions and occurrences of verbal communication, with no action directed towards the environment being recorded*. Moreover, *both male and female subjects seem to act, react and voice their discomfort more in relation to cold. In addition to that, women tend to act much more often than men, and are generally more sensitive to*

temperature and carefully choose the right clothes based on both indoor and outdoor temperatures. To corroborate these data, scholarly literature indicates that senior people experience reduced thermoregulation, which is linked – together with other changes in their body composition – to a decrease in the total water inside a senior person's body (Franceschi, Pauletto, A. Incalzi, & M. Fabbri, 2011). Body temperature is consequently lower in senior people, their perception of cold being one symptom of ageing, especially in bedridden and non-self-sufficient subjects. Differences between the perceptions of senior people and those of their caregivers are remarkable. Moreover, the condition of comfort and/or discomfort of the most seriously ill patients is most times filtered by healthcare workers' questions and own perceptions. Subsequent data analysis provided for an insight into frequent displays of thermal and luminous discomfort experienced by senior people in their everyday-life environments, that they are not able to verbalize to the healthcare staff who takes care of them. In the third phase, interviews were conducted with a number of representatives of healthcare professions, namely doctors, professional social educators, physiotherapists, nurses, nursing assistants and psychologists, who are all familiar with ageing and work in Central Italy. The aim of the interviews was collecting information and opinions based on the professionals' first-hand experience in relation to their professional environments and the senior people with whom they interact on a daily basis. Interviews outline a number of key aspects of ageing, namely *hearing and memory loss, physiological failure of thermoregulatory system* (for this reason, the temperature in an environment accommodating senior people should never be under 20°C), and *a need for security / protection* which is progressively perceived by elderly people. According to the professionals, senior people tend to move less and wear more clothes; additionally, they are more sensitive in relation to environmental changes, notably being less tolerant towards cool air and both sunlight and artificial lighting. For these reasons, *healthcare professionals are reportedly more alarmed by heat-related behaviors than cold-related behaviors*. As scholarly literature indicates, a number of features can be witnessed in senior people because of their age-induced thermoregulatory impairment. More specifically, a loss of lean body mass, reduced mobility, inadequate eating habits, reduced cold-induced chills and reduced vasoconstriction result in reduced heat generation capacity. (Bragagni, Alberti, Castelli, & Lari, 2012). *Social and environmental factors* must be particularly considered, including location and type of house and lifestyle of senior subjects. As they experience reduced mobility, senior people often cannot fulfill and are less capable of showing their needs (e.g. fluid intake) to their caregivers, which makes care even more difficult. Interviews additionally indicate that self-sufficient women generally tend to physiologically display more behaviors compared to men (e.g. adjusting and buttoning up their clothes, letting the sunshine in, opening and

closing the shutters, fanning themselves, etc.) and ask for help only when they are barely able to carry out their everyday tasks on their own (e.g. personal care, cleaning the house, reaching for an object, etc.). Female subjects tend to be more sensitive to temperature, seek control of their environment, are more active and vigilant towards their surroundings. It is interesting to consider the role played by *cultural background*, *family habits* and *previous life experiences*, which have all an impact on senior people's behaviors, notably their calls for assistance. Thorough analysis of these data provided for an insight into some displays of thermal, luminous and emotional discomfort experienced by senior people in their daily lives and seen through the eyes of the professionals who take care of them. Finally, to understand whether the single behaviors detected during generic indoor environments could be deemed as unambiguous or ambiguous, a questionnaire including a frequency scale was devised during the last phase of the research. Questionnaires were administered in the provinces of Macerata and Fermo (Marche region, Italy) to a randomized sample of common people belonging to five different age groups. The questionnaires helped to determine the frequency of the detected behaviors (directed towards oneself and one's environment), physical reactions and occurrences of verbal communication that can be interpreted as a display of some sort of thermal (hot / cold) discomfort as experienced by a number of individuals in their daily life and to compare and contrast these data with data resulting from checklist-based observations in order to gain a further insight into the perceptions of the people that had been previously monitored. In relation to both heat and cold, data analysis shows that *"Often"* is the single occurrence displaying the most total frequencies. This may indicate that *the actions and physical reactions listed in the questionnaire actually reflect the behaviors of respondents in their daily lives*. An analysis of questionnaire data indicates that women act and physically react more than men do in relation to the sensation of both heat and cold. They additionally act much more than men on their environments. Comparing and contrasting checklist data and questionnaire data, it seems that *there is a clear female predominance in relation to cold*: *women tend to act, physically react and communicate much more than men.* According to scholarly sources, men and women dress differently in relation to temperature, women have a lower metabolic rate than men while carrying out a sedentary activities, and regulating hormones that influence their reactions to thermal comfort, thermoregulation and thermogenic thresholds. They display differences in their hormone levels compared to men (Kim, de Dear, Candido, Zhang, & Arens, 2013). Additionally, as the outcomes of other studies carried out in various indoor environments indicate (Choi, Aziz, & Loftness, 2010; Karjalainen, 2007, 2012; Kcomt Ché, Pardons, Vanrompay, Preuveneers, & Berbers, 2010; Kim, de Dear, Candido, Zhang, & Arens, 2013; Parsons, 2002; Zalejska-Jonsson &

Wilhelmsson, 2013), *women are less satisfied with room temperatures and generally prefer higher temperatures than men, with discomfort in relation to both heat and cold being reported much more frequently in women than men*.

To provide the most detailed account possible, four topics are examined in more depth in the following sections. These pertain to the heat-related behaviors of young male subjects (15-29 years), cold-related behaviors of young female subjects (15-29 years), heat-related behaviors of women with menopause (45-59 / 60-74 years) and the behaviors of older seniors (75-89 years and older) in relation to both heat and cold. For each of these topics, data resulting from indoor environment observations, questionnaires and interviews with healthcare professionals have been correlated. With regard to older senior people, field observations in medical centers have also been taken into account.

1. Young males (15-29 years) and the sensation of heat

Heat-related behaviors as displayed by male subjects aged 15-29 have been examined. Data resulting from data linkage of indoor environment observations, questionnaires and interviews with healthcare professionals are presented and commented in this section.

A female doctor among the respondents claims that boys often feel hot as their muscle component accounts for a large part of their body mass, precisely because of their young age. Bearing this in mind, *pulling up one's sleeves, taking off one's clothes, unbuttoning one's shirt and rolling up one's sleeves, opening the window* all rank as very frequent behaviors in this subject group. Moreover, as two psychologists point out, pulling up one's sleeves is to be regarded as a typical behavior among males.

As observations in generic indoor environments indicate, males aged 15-29 taking off some of their clothes show the highest frequency of all age groups (29 male subjects out of a total of 95), and this is especially true in the spring.

Additionally, 9 male subjects out of 26 have been observed as they open the door or the window, and 15 males out of 29 as they drink repeatedly, again particularly in the spring.

Looking at the occurrence of "often" and "always" in the questionnaires, 10 (5 often / 5 always) young males out of 10 claim that they take off some of their clothes, 10 (6 often / 4 always) out of 10 claim that they open the door or the window and 10 (4 often / 6 always) out of 10 claim that they unbutton or unzip their coats or jackets. 9 (5 often / 4 always) males out of 10 walk away from the sun filtering through the windowpane, and 8 (5 often / 3 always) males out of 10 tend to voice their

perception of heat. Interestingly, 6 young males out of 10 reportedly seldom communicate their perception of cold, and none of the 10 male subjects always communicate his perception of cold. Additionally, 6 (4 often / 2 always) males out of 10 claim that they wipe off their sweat with their hands or with a tissue or handkerchief, 6 (3 often / 3 always) out of 10 reportedly roll up their sleeves, 6 out of 10 claim that they often turn the dehumidifier / fan / air conditioner on, and 6 (4 often / 2 always) out of 10 claim that they experience heat-induced flushing. Finally, 5 (2 often / 3 always) male subjects out of 10 reportedly fan themselves with their hands or a piece of paper.

To sum up, interviews, observations in various indoor environments and questionnaires indicate that young males, in addition to communicating verbally their perception of heat, tend to act and react frequently in relation to heat.

2. Young females (15-29 years) and the sensation of cold

Cold-related behaviors as displayed by female subjects aged 15-29 have been examined. Data resulting from data linkage of indoor environment observations, questionnaires and interviews with healthcare professionals are presented and commented in this section.

One female doctor among the respondents claims that many girls of this age are skinny, eat little food and consequently feel cold more than other groups do. Among girls, *putting on one's clothes (specifically, additional clothes) and rubbing some of their body parts (specifically, hands, arms and/or shoulders)* may therefore be quite frequent behaviors.

As observations in generic indoor environments indicate, putting on some of their clothes ranks high in frequency (30 female subjects out of a total of 120) among girls aged 15-29, and this is especially true in the spring and in the winter.

Additionally, 6 female subjects out of 30 have been observed as they rub their hands, arms or shoulders, especially in the spring, while 4 female subjects out of 19 communicate their perception of cold, especially in the summer (probably due to the fact that air conditioning devices are set at very low temperatures) and in the autumn.

Looking at the occurrence of "often" and "always" in the questionnaires, 10 (4 often / 6 always) young females out of 10 claim that they put on some more clothes, 10 (2 often / 8 always) out of 10 claim that they get closer to the heater, 10 (7 often / 3 always) out of 10 claim that they pull down their sleeves, 10 (6 often / 4 always) out of 10 get rid of drafts, and 10 (7 often / 3 always) females out of 10 close the door or window. In this regard, one female nurse and one female psychologist claim that closing the door/window is a typical behavior among female subjects.

9 (7 often / 2 always) females out of 10 act on the heater and 8 (5 often / 3 always) females out of 10 shiver. Moreover, 7 (6 often / 1 always) females out of 10 reportedly rub their hands / arms / shoulder, 7 (5 often / 2 always) out of 10 rub / clean their noses with a handkerchief or tissue, 7 (5 often / 2 always) out of 10 curl up, 7 (4 often / 3 always) out of 10 sneeze and 7 (3 often / 4 always) out of 10 voice their perception of cold. Finally, 6 (5 often / 1 always) females out of 10 sip repeatedly from a hot drink, 6 (5 often / 1 always) out of 10 button up their blouse and 6 (4 often / 2 always) out of 10 put on their hoods. In addition to that, questionnaires on the sensation of heat indicate that, interestingly, 7 (3 never / 4 rarely) young females out of 10 seldom to never perspire and that they seldom to never wipe off their sweat with their hands or a handkerchief/tissue.

To sum up, interviews, observations in various indoor environments and questionnaires indicate that young females, in addition to voicing their perception of cold, tend to act and react frequently in relation to cold.

3. Women with menopause (45-59 / 60-74 years) and the sensation of heat

"Menopause is defined as the point at which women have ceased menstruating for a period of 12 months or more: it is a universal experience for all women, assuming they reach their mid-50s" (Utian, 2004).

Heat-related behaviors as displayed by female subjects in the two age groups 45-59 and 60-74 – menopause spanning over this period of life – have been examined. Data resulting from data linkage of indoor environment observations, questionnaires and interviews with healthcare professionals are presented and commented in this section.

One female doctor among the respondents claims that behaviors such as *pulling up one's sleeves, taking off one's clothes, unbuttoning one's blouse and rolling up the sleeves, fanning oneself (most frequent) and wiping off one's sweat (least frequent)* could all be ascribed to both the sensation of heat and menopause. Menopause is a physiological event occurring in women aged 50 – 65. As often as once per hour, they generally experience sudden hot flashes, normally lasting less than 5 minutes. In addition to that, one psychologist points out that opening the door / window is typically a female behavior.

As observations in generic indoor environments indicate, fanning oneself with hands / piece of paper ranks high in frequency (35 [17 + 18] female subjects out of 72) for women aged 45-59 and 60-74, and this is especially true in the summer. In this regard, the total frequencies resulting from indoor environment observations combined with questionnaires and interviews with healthcare professionals indicate that this is typically a female behavior [observations: 72 female subjects out

of 89 total frequencies; questionnaires: 34 (19 often / 15 always) female subjects out of a total of 50 frequencies; interviews: 1 social educator, 1 physiotherapist, 4 nurses and 4 psychologists].

As observation data indicate, 10 [4 + 6] females out of a total of 19 wipe off their sweat using their hands or a handkerchief or tissue, and they do so exclusively in the summer. 5 [4 + 1] females out of a total of 13 pull up their sleeves, this behavior being in general seemingly more common among female subjects.

Questionnaire data pertaining to female subjects aged 45-59 and 60-74 and to the occurrence of "often" and "always" indicate that 18 [9: 3 often / 6 always; 9: 3 often / 6 always] females out of 20 reportedly open the door / window, 14 [7: 3 often / 4 always; 7: 6 often / 1 always] females out of 20 voice their perception of hear, 12 [5: 2 often / 3 always; 7: 3 often / 4 always] females out of 20 fen themselves with their hands or a piece of paper, 11 [6: 4 often / 2 always; 5: 1 often / 4 always] females out of 20 pull up their sleeves, and 11 [5: 3 often / 2 always; 6: 1 often / 5 always] out of 20 roll up their blouse sleeves, 9 [6: 4 often / 2 always; 3: 2 often / 1 always] out of 20 wipe off their sweat with their hands or a handkerchief or tissue.

To sum up, interviews, observations in various indoor environments and questionnaires indicate that women with menopause, in addition to communicating verbally their perception of heat, tend to act and react frequently in relation to heat.

4. Older senior people (75-89 years and older) and thermoregulation

Scholarly sources outline the following features of senior age: a) reduced mobility, which can be assessed notably based on the progressive decrease of walking pace, in standard conditions and in the presence of obstacles; percentage of senior people who are able to walk a given distance; increasing number - in relation to age - of senior people who do not leave their homes anymore; b) physical inactivity, which is in turn due to reduced body flexibility and decreased muscle mass and muscle strength among others, triggering loss of confidence in the senior people's own functional capabilities, with further impact on their mobility. Moreover, reduced thermoregulation can be observed in older people. Together with other changes in their body composition, reduced thermoregulation is linked to a decrease in the total water inside a senior person's body (Franceschi, Pauletto, A. Incalzi, & M. Fabbri, 2011). In this regard, one nurse claims that four key elements need to be taken into account on the subject of ageing: *hearing and memory loss*, *life environments* (with a distinction being made between private homes and community environments, e.g. nursing homes, long-term care facilities, etc.) and *physiological failure of the thermoregulatory system*. The latter refers to the fact that in all elderly people, especially those who suffer from neurological

conditions (patients with cold body temperature), the control of temperature in their brain systems (*hypothalamus*) is impaired. For this reason, the temperature in an environment accommodating senior people should never be under 20°C.

Generic indoor environment observations, questionnaires and field observations inside healthcare centers seem to indicate that *older senior people act and react more in relation to their perception of cold*. To corroborate that, as the interviews indicate, *healthcare professionals are reportedly more alarmed by heat-related symptoms and behaviors, as they are displayed less frequently*.

According to two nurses, older women tend to act on themselves and on the environment much more than men do. As one female social educator points out, women are generally more sensitive to the temperature and choose more carefully the right clothes to wear based on both outdoor and indoor temperatures. These data are confirmed by both the questionnaires and the observations inside healthcare centers.

Against this background, both heat-related and cold-related behaviors as displayed by male and female subjects in the age group 75-89 and older have been specifically investigated. Data resulting from data linkage of indoor environment observations, questionnaires and interviews with healthcare professionals are presented and commented in the next section.

4.1 The sensation of heat

As observations in generic indoor environments indicate, in relation to both male and female subjects aged 75-89, only 2 heat-related frequencies have been recorded, namely 1 woman wiping off her sweat with her hands, a tissue or a handkerchief, and 1 man unbuttoning or unzipping his coat or jacket.

In questionnaire data pertaining the sensation of heat, a look at the occurrence of “often” and “always” indicate that 17 (5 often / 12 always) older seniors out of 20 reportedly take off some of their clothes. 9 of them are male and 8 are female. Moreover, during observations inside healthcare centers, 9 female frequencies of this behavior have been recorded. Then again, a number of respondents (1 social educator, 1 nurse, 2 nursing assistants and 3 psychologists) point out in the interviews that taking off one’s clothes is typical of elderly people, especially those residing in healthcare facilities. Senior people reportedly have a habit of wearing many clothes. However, in assisted living facilities, the temperature is set rather high. As people age, they normally tolerate less heat, sunlight and artificial lighting.

Questionnaires also indicate that 17 (8 often / 9 always) senior people out of 20 reportedly sit down, possibly because the heat exhausts them. 7 of them are male while 10 are female. 16 (1 often / 15 always) senior people out of 20 walk away from the sunlight streaming through the window pane.

15 (7 often / 8 always) senior people out of 20 report to drink repeatedly, 9 of them being male. The total frequencies of generic indoor environment observations in relation to heat-induced drinking indicate that this behavior is more typical among men, and this is true also for the age group of older seniors. In addition to this, one male psychologist sees this as more of a male than a female behavior. A number of additional respondents (one social educator, one physiotherapist, two nurses and one nursing assistant) claim that this action is not typical of senior people, who normally drink little. However, it is fair to stress that most senior people that these healthcare professionals interact with are physically and cognitively impaired.

15 (4 often / 11 always) seniors out of 20 open the door / window. 7 of them are male while 8 are female. Out of a total of 20, 14 reportedly always close the curtains / shutters, and 4 reportedly never close them. Both frequencies are perfectly split for male and female respondents. In data resulting from questionnaires, out of total frequencies, opening the door/window is more typically female [34 (15 often / 19 always) female subjects out of 62 total frequencies], these data being corroborated by the information provided by one nurse among the respondents.

13 (5 often / 8 always) seniors out of 20 roll up their shirt sleeves, 7 of them being female. Out of a total of 20 senior people, 11 of them voice their perception of heat often (4) and always (7). 8 of them are female. 5 subjects never communicate verbally their perception, 4 of them being male. This may probably be due to the fact that the subjects normally stay still and tend to move less. It is interesting to notice that during observations inside healthcare centers 6 heat-related verbal communication occurrences by females have been detected. These data further confirm the assumption that verbal communication in relation to both heat and cold is generally more typical of female subjects.

Out of 20 senior people, 11 wipe off their sweat using their hand or a handkerchief / tissue often (3) and always (8). 6 of them are male. Conversely, 4 people reportedly never wipe off their sweat. During observations in healthcare centers, one occurrence of this behavior by a female subject has been recorded.

10 (3 often / 7 always) seniors out of 20 touch their own faces due to the heat. 7 of them are female. Conversely, during observations in healthcare centers, one occurrence of this behavior by a male subject has been recorded.

9 (5 often / 4 always) seniors out of 20 reportedly lay down, possibly because they are exhausted by the heat. 5 of them are male. On one hand, this piece of data, indicate that the senior people among the respondents of the questionnaires feel the need to lay down when faced with hot weather conditions, despite the fact that they are generally self-sufficient. On the other hand, this seems to

correspond with information resulting from the interviews with healthcare professionals: a number of them (1 male doctor, 1 female physiotherapist, 2 nursing assistants, 1 female psychologist and 1 female educator) claim that, based on their own experiences, older men are generally weaker - both physically and emotively, than their female counterparts.

8 seniors out of 20, 4 males and 4 females, always pull their collar. One occurrence of this behavior by one female subject has been recorded also during observations inside healthcare centers.

Questionnaires data additionally indicates that 17 (11 never / 6 rarely) older seniors out of 20 seldom to never turn on the dehumidifier / fan / air conditioner, while 14 (13 never / 1 rarely) out of 20 seldom to never act on the heater, and 10 out of 20 never experience heat-induced flushing.

Finally, as genders are concerned, a sum of data resulting from questionnaires and from observations inside healthcare centers indicates that 8 (2 often / 6 always) senior males out of 10 plus 1 male subject unbutton or unzip their coat / jacket, 8 (3 often / 5 always) senior females out of 10 plus 2 female subject fan themselves with their hands or a piece of paper, and 7 (2 often / 5 always) senior females out of 10 plus 4 female subjects pull up their sleeves. Additionally, comparing and contrasting data resulting from both observations in generic indoor environments and the questionnaires and the total frequencies pertaining to the aforementioned behaviors, the former behavior seems to be more typically male, whereas the other two are rather female behaviors. The same results are confirmed in age group 75-89. In this group, unbuttoning or unzipping one's coat or jacket is more common among senior males, fanning oneself and pulling up one's sleeves are more frequent among senior females.

4.2 The sensation of cold

Generic indoor environment observations on both male and female subjects aged 75-89, only 7 cold-related frequencies have been detected, with one 1 male and 1 female subject putting some more clothes on. 2 male subjects sneeze; 1 female closes the door / window; 1 male and 1 female rub or clean their noses with a handkerchief/tissue.

In questionnaire data pertaining the sensation of cold, a look at the occurrences of "often" and "always" indicates that 19 (4 often / 15 always) older seniors out of 20 reportedly put some more clothes on. 9 of them are male, while 10 are female. Additionally, during observations in the healthcare centers, 1 occurrence by a male and 5 occurrences by females have been detected in relation to this behavior. Total frequencies from generic indoor environment observations compared and contrasted with questionnaire data and data resulting from observations inside healthcare centers indicates that putting some more clothes on is more typically a female behavior, this being true also for the older seniors age group. According to a number of healthcare professionals (1

social educator, 1 nursing assistant and 1 psychologist), people are less fond of cool air and are less tolerant towards cold as they age. As pointed out by 1 psychologist, older people tend to move less, wear more clothes and be more sensitive to weather changes.

19 (3 often / 16 always) seniors out of 20 close the door / window. 10 of them are male, while 9 are female. 1 social educator among the respondents points out that bedridden patients often ask healthcare workers to close the window and the shutters for them. Perhaps they were used to do so themselves when they were self-sufficient.

16 (6 often / 10 always) seniors out of 20 pull down their sleeves. 9 of them are female. In addition to that, during observations inside healthcare centers, 2 female frequencies of this behavior have been detected. 15 (3 often / 12 always) seniors out of 20 get rid of drafts. 8 are male and 7 are female. Out of a total of 20 senior people, 12 (4 often / 8 always) of them reportedly button up their shirt or blouse, whereas 6 of them never button it up. Out of 20, 12 (6 often / 6 always) senior people rub or clean their noses with ha handkerchief or tissue, whereas 6 of them never do so. In addition to that, 9 female frequencies of this behaviors have been detected during observations inside the healthcare centers. Out of 20 senior people, 12 (2 often / 10 always) of them get closer to the heater, while 5 of them never do so. During observations inside the healthcare centers, 1 male occurrence and 1 female occurrence of this behavior have been detected. 11 (3 often / 8 always) senior people out of 20 pull up their collar, 5 being male and 6 female.

Questionnaire data also show that 14 (11 never / 3 rarely) older seniors out of 20 do not drink repeatedly any hot drink; 8 of them are male and 6 are female. During observations inside healthcare centers, however, one male frequency of this behavior has been recorded. At any rate, data resulting from the questionnaires seem to match those resulting from the interviews, as some healthcare professionals (one social educator, one physiotherapist, two nurses and one nursing assistant) claim that drinking is not necessarily a typical behavior among elderly people: conversely, they generally restrain from drinking. Allegedly, this is even more true when they feel cold. However, it is fair to stress that most senior people that these healthcare professionals interact with are physically and cognitively impaired.

Lastly, an investigation on genders show that 7 (5 often / 2 always) senior female subjects out of 10 open the curtains / shutters to let the heat in. This behavior can be described as generally typical of females, based on both generic indoor environment observations and questionnaires. One female doctor and one female nurse among the respondents would rather ascribe this behavior to women than men.

7 (5 often / 2 always) female subjects out of 10 plus 2 female subjects inside healthcare centers reportedly sneeze. 7 females out of 10 cough (often) plus 1 male and 11 females inside healthcare center. Moreover, 6 (2 often / 4 always) females out of 10 experience shivering. This behavior is generally speaking typical of female subjects, based on both generic indoor environment observations and questionnaires; 6 (2 often / 4 always) females out of 10 act on the heater, and 6 (2 often / 4 always) females out of 10 voice their perception of cold. It is interesting to notice that during observations in healthcare centers, 1 cold-related occurrence of verbal communication by a male and 9 by female subjects have been detected. These data further demonstrate that both heat- and cold-related occurrences of verbal communication are generally speaking more typical of female subjects.

In addition to that, during the interviews with healthcare professionals, one educator, one nurse and one nursing assistant reported rubbing one's body parts (especially one's hands) as a typical behavior among elderly people.

4.3 Additional behaviors typical of older senior people

To conclude, a number of behaviors allegedly typical of older seniors have been detected, though no link to their sensations of either heat or cold can be established.

In more details, "Putting on one's spectacles" has been reported by one doctor as a frequent action. During field observations inside healthcare centers, 2 female frequencies of this behavior have been recorded. Moreover, one psychologist claims that people become more sensitive to light as they age. Inside the healthcare centers joining the present project, 1 instance of a female subject voicing her discomfort caused by the sunlight has been recorded, along with 1 male and 1 female frequency of yet another behavior, namely wiping/rubbing one's eyes with a tissue/handkerchief/hands.

In addition to that, a number of respondents (1 educator, 1 physiotherapist, 2 nurses and 3 psychologists) claim that turning off the light at home can be ascribed to an anthropological and ritual pattern in senior people, connected to making savings in terms of money and energy.

Also "Speaking up" has been reported in the interviews by 47 healthcare professionals. Senior people often display this behavior, probably due to a number of different hearing problems.

To conclude, senior people's biological mechanisms to cope with shifts in temperatures are less effective compared to those of adult people. Senior people tend to move less and wear more clothes. Interviews, indoor environment observations, questionnaires and field observations in healthcare centers all seem to indicate that *older senior people act and physically react more in relation to their perception of cold, and are less tolerant towards cool air and both sunlight and artificial lighting. Older women, in addition to being more sensitive to temperature and carefully choosing*

the right clothes based on indoor and outdoor temperatures, apparently act towards themselves and their environment much more than their male counterpart do. Finally, *verbal communication in relation to both heat and cold is more typically observed in female subjects, also in the older seniors group*.

5. Additional remarks on correlated behaviors

As observations in generic indoor environments indicate, in the young adult group (30-44) the most behaviors were detected compared to all other age groups. Heat-related behaviors ranking highest in frequency for this age group that can be regarded as typically male are: "Opening the door / window", "Wiping off one's sweat with hands / handkerchief", "Rolling up one's sleeves", "Unbuttoning/unzipping one's cloak/jacket" and "Unbuttoning one's shirt".

Data pertaining the sensation of heat with its respective frequencies, resulting from observations in generic indoor environments combined with questionnaires and interviews with healthcare professionals, indicate the following behaviors as rather typical of male subjects: "Taking off one's clothes" [observations: 95 males out of 148 total frequencies; questionnaires: 47 (12 often / 35 always) males out of 93 total frequencies; interviews: 1 social educator and 1 psychologist], "Rolling up one's sleeves" [observations: 26 males out of 31 total frequencies; questionnaires: 35 (19 often / 16 always) males out of 60 total frequencies; interviews: 1 psychologist], "Wiping off one's sweat with hand/handkerchief" [observations: 25 males out of 44 total frequencies; questionnaires: 30 (19 often / 11 always) males out of 51 total frequencies; interviews: 1 nurse and 2 psychologist], "Unbuttoning one's shirt" [observations: 15 males out of 15 total frequencies; questionnaires: 24 (17 often / 7 always) males out of 40 total frequencies; interviews: 1 doctor, 1 social educator, 2 nurses and 2 psychologist], "Unbuttoning / unzipping coat / jacket" [observations: 14 males out of 17 total frequencies; questionnaires: 47 (23 often / 24 always) males out of 92 total frequencies] and "Turning dehumidifier / fan / air conditioner on" [observations: 3 males out of 4 total frequencies; questionnaires: 23 (19 often / 4 always) males out of 41 total frequencies].

Among heat-related behaviors, "Verbal communication occurring" shows equally split frequencies for male and female subjects for age groups 45-59 and 60-74: 3 males and 3 females, and 2 males and 2 females, respectively. Moreover, frequencies have been reported mainly in the spring (9), with a prevalence of verbal communication by men, and in the winter (9), with a prevalence of verbal communication by men.

However, based on data from both generic indoor environment observations and questionnaires, verbal communication in relation to both heat and cold seem to be more typical among females.

More specifically, observations show that out of a total of 28 heat-related verbal communication occurrences, 10 are male and 18 are female. A look at the occurrence of "often" and "always" in the questionnaires shows that out of a total of 62 frequencies, 26 (15 often / 11 always) are male and 36 (18 often / 18 always) are female. Observations additionally show that out of a total of 21 cold-related verbal communication occurrences, 2 are male and 19 are female. A look at the occurrence of "often" and "always" in the questionnaires shows that out of 53 total frequencies, 19 (11 often / 8 always) are male, whereas 34 (18 often / 16 always) are female.

The frequencies of data pertaining the sensation of cold resulting from observations in generic indoor environment indicate that "Coughing" is more common among male adults (45-59), 13 out of a total of 37, and is equally split between the spring (18) and the summer (18), with no frequency during the winter. These may reflect the fact that air conditioning devices are commonplace in indoor environments during the warmer seasons. The conditioner filters are not always adequately cleaned, thus becoming a breeding ground for pollen, mites and various micro-organisms (bacteria, fungi, mold, etc.). Additionally, irritation determined by temperature changes and low humidity can lead to a bronchial spasm and increased mucus production by the bronchi. Lastly, a decrease in the air humidity rate, vaporization of water accumulated in the environment combined with deficient water absorption in the surface layers of the skin lead to an alteration in the hydrolipidic film, whose function is to cover and protect the skin from penetration of dust and bacteria. Through conditioned air, the latter can move more actively in the environment, with low humidity rate favoring their hang time. Excessive exposure to conditioned air may cause skin dryness and lack of hydration. "Closing the door / window" is more typical of adult female subjects (45-59 years), 8 out of a total of 12, with most frequencies recorded in the spring (8 out of a total of 24). "Shivering" has been more typically recorded in female young adults (30-44 years). Interestingly, most frequencies occurred in the summer (9 out of a total of 16), probably because in the monitored locations, air conditioners were set at very low temperatures. "Rubbing / cleaning one's nose with a handkerchief/tissue" is more typical of young adults (age group 30-44), with most frequencies recorded in the summer (8 out of a total of 12) and no frequency in the winter. In addition to the above information on the potential impact of conditioned air on the respiratory tract, this behavior may indicate that excessive perspiration due to the high temperature in the summer often leads to dehydration, which in turn can be a cause of itching.

To sum up, the goal of the present research project is providing an accurate picture that shows – in the most naturalistic way possible – what happens in the daily lives of people from different age groups in relation to indoor comfort. The totality of collected data can be used to plan devices that

can enhance well-being and improve the quality of life of all individuals, including weaker groups, notably non-self-sufficient senior people. In this regard, while planning these devices, it will be crucial to consider what a number of scholarly sources (Baldewijns, Debard, Mertens, Devriendt, Milisen, Tournoy, Croonenborghs, & Vanrumste, 2013; Coughlin, D'Ambrosio, Reimer, & Pratt, 2007; Demiris, Rantz, A. Aud, D. Marek, W. Tyrer, Skubic, & A. Hussam, 2004; Dohr, Modre-Osprian, Drobics, Hayn, & Schreier, 2010; Kleinberger, Becker, Ras, Holzinger, & Müller, 2007; Krafft & Coskun, 2009; Losardo, 2014; Mishra, 2015; Mohammadi, 2010; Motta, 2015; Portet, Vacher, Golanski, Roux, & Meillon, 2012; Sun, De Florio, Gui, & Blondia, 2009) cite as the most important characteristics of smart devices for senior people: these are reliability, user-friendliness, emergency detection, reduced user's input, low maintenance costs, low invasiveness (privacy) and voice interface technology (audio input). Again, this feeds into the notion of *Ageing in Place*, by which senior people can exert control over their own environment and daily activities to improve their perceived autonomy, health, well-being and dignity.

The strengths of the present research lie in the fact that it is centered on the human being in its entirety and complexity, and that an analysis in the field of human behavior has been carried out in everyday-life environments, in a constant effort to make humanities and technologies interact and communicate. Starting from thermal comfort, it is crucial to consider further developments and a wider scope of application of the methods tested in this project, also crossing over to other domains.

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APPENDIX 1

Checklist on Temperature

DATE, LOCATION AND TIME OF THE DAY:
SUBJECT'S AGE AND GENDER:
INDOOR TEMPERATURE:
OUTDOOR TEMPERATURE:

HOW DOES THE PERSON BEHAVE WHEN HE/SHE FEELS HOT?	✓
ACTIONS DIRECTED TOWARDS ONESELF	
Unbuttoning/unzipping one's coat/jacket	
Taking off one's scarf / jumper / jacket / coat	
Pulling up one's sleeves (jumper / jacket / coat)	
Unbuttoning one's shirt/blouse	
Rolling up one's sleeves	
Fanning oneself with one's hand / piece of paper / fan / napkin	
Pulling one's collar	
Wiping off one's sweat with one's hand/handkerchief/tissue	
Touching one's face	
Tying up one's hair	
Moving away from the sunlight filtering through the window pane	
Drinking repeatedly (water / fresh drink)	
Sitting down	
Laying down	
Leaving the room	
Other (specify)	
ACTIONS DIRECTED TOWARDS ONE'S ENVIRONMENT	
Opening the door / window	
Closing the curtains / shutters to keep off the heat	
Regulating the heater	
Turning dehumidifier / fan / air conditioner on	
Other (specify)	
PHYSICAL REACTIONS	
Flushing	
Other (specify)	
VERBAL COMMUNICATION	
Verbal communication occurring – The person says "…. "	

HOW DOES THE PERSON BEHAVE WHEN HE/SHE FEELS COLD?	✓
ACTIONS DIRECTED TOWARDS ONESELF	
Curling up	
Stamping one's foot	
Running in place	
Getting closer to the heater	
Rubbing one's hands / arms / shoulders	
Putting on one's scarf / sweater / jacket / coat	
Pulling down one's sleeves (jumper / jacket / coat)	
Pulling up one's collar	
Pulling up one's coat/jumper hood	
Buttoning up one's shirt/blouse	
Rolling down sleeves	
Rubbing / cleaning one's nose with a handkerchief/tissue	
Drinking repeatedly (hot drink)	
Other (specify)	
ACTIONS DIRECTED TOWARDS ONE'S ENVIRONMENT	
Closing the door/window	
Opening the curtains / shutters to let the heat in	
Opening the door (to contrast conditioned air)	
Regulating the heater	
Getting rid of drafts	
Other (specify)	
PHYSICAL REACTIONS	
Sneezing	
Shivering	
Coughing	
Making one's teeth chatter	
Other (specify)	
VERBAL COMMUNICATION	
Verbal communication occurring – The person says: "…. "	

Remarks:

APPENDIX 2

Checklist on Lighting

DATE, LOCATION AND TIME OF THE DAY: **SUBJECT'S AGE AND GENDER:**

HOW DOES THE PERSON BEHAVE IN THE EVENT OF POOR ILLUMINATION?	✓
ACTIONS DIRECTED TOWARDS ONESELF	
Standing up to turn the light on	
Reaching out to turn the light on	
Putting one's spectacles on	
Moving across the room to get closer to the sunlight filtering from the window pane	
Other (specify)	
ACTIONS DIRECTED TOWARDS ONE'S ENVIRONMENT	
Opening the door / shutters to let the sunshine in	
Turning the main light on	
Turning floor / table / bedside lamps on	
Directing the light according to one's needs	
Other (specify)	
VERBAL COMMUNICATION	
Verbal communication occurring – The person says: "…. "	

HOW DOES THE PERSON BEHAVE IN THE EVENT OF EXCESSIVE ILLUMINATION?	✓
ACTIONS DIRECTED TOWARDS ONESELF	
Standing up to turn the light off	
Reaching out to turn the light off	
Putting one's sunglasses on	
Other (specify)	
ACTIONS DIRECTED TOWARDS ONE'S ENVIRONMENT	
Closing the curtains / shutters to not let the light in	
Turning the main light off	
Turning floor / table / bedside lamps off	
Directing the light according to one's needs	
Other (specify)	
PHYSICAL REACTIONS	
Excessive lacrimation	
Other (specify)	
VERBAL COMMUNICATION	
Verbal communication occurring – The person says: "…. "	

Remarks:

APPENDIX 3

Interview with Healthcare Professionals

PHASE 1: *Overview of the research project*
We are carrying out a research project to understand to which extent new technologies can be used to enhance people's well-being and quality of life, with a focus on people with special needs. In this regard, I would like to have a few minutes of your time to ask you some questions to advance this study. Data will be collected and used to plan new technological devices.

PHASE 2: *Biographical data*

1. Name and Surname (acronyms):
2. Birth year:
3. Nationality:
4. E-mail address / Telephone number:
5. Profession and Affiliation:

PHASE 3: *Suppose you are in an indoor environment (not necessarily inside a healthcare facility) where you see an old person displaying one or more behaviors from this list:*

- Pulling up one's sleeves
- Taking off one's scarf, sweater, jacket or coat
- Unbuttoning one's shirt
- Rolling up one's sleeves
- Fanning oneself with one's hand / piece of paper
- Wiping off one's sweat with hand / tissue
- Opening the door / window
- Sneezing
- Rubbing one's hands / arms / shoulders
- Putting on one's scarf, sweater, jacket or coat
- Drinking repeatedly
- Closing the window
- Opening the curtains to let the sunshine in
- Putting on one's spectacles or sunglasses
- Closing the shutters
- Turning lights off
- Holding one's hands over one's ears
- Speaking up
- Repeatedly drawing (your) attention
- Asking somebody (you) to stay next to them

QUESTIONS

1. Which behaviors or behavioral mix would you regard as symptoms?
2. If any of these are symptoms, which kind of distress can they be ascribed to?
3. How would you react in relation to these symptoms?
4. In your opinion and based on your previous answers, can any differences be witnessed based on senior people's age and gender?

APPENDIX 4

Questionnaire on Temperature

We are carrying out a data survey on the most frequently adopted human behaviors in relation to hot and cold temperatures. We kindly ask you to contribute to the present research project. Please report your own experience on the subject by ticking for each of the behaviors in the following lists the frequency that best describes your reactions inside everyday-life indoor environments. Please do so in order and tick one box for each behavior.

DATE AND PLACE OF COMPLETING:
BIRTH YEAR:
GENDER:

HOW DO YOU BEHAVE WHEN YOU FEEL HOT?				
	NEVER	**RARELY**	**OFTEN**	**ALWAYS**
Turning dehumidifier / fan / air conditioner on				
Pulling up one's sleeves (jumper / jacket / coat)				
Unbuttoning/unzipping one's coat/jacket				
Unbuttoning one's shirt/blouse				
Leaving the room				
Opening the door / window				
Wiping off one's sweat with one's hand/handkerchief				
Laying down				
Touching one's face				
Drinking repeatedly (water / fresh drink)				
Closing curtains/shutters to not let the heat in				
Taking off one's scarf / sweater / jacket / coat				
Moving away from the sunlight filtering through the window pane				
Tying up one's hair				
Pulling one's collar				
Sitting down				
Regulating the heater				
Fanning oneself with one's hand / piece of paper / fan				
Flushing				
Rolling up one's sleeves				
Verbal communication occurring				
Other (please specify)				

Remarks:

HOW DO YOU BEHAVE WHEN YOU FEEL COLD?				
	NEVER	**RARELY**	**OFTEN**	**ALWAYS**
Rubbing one's hands / arms / shoulders				
Drinking repeatedly (hot drink)				
Getting rid of drafts				
Sneezing				
Putting on one's scarf / sweater / jacket / coat				
Opening the door (with air conditioner running)				
Tapping one's feet				
Opening the curtains / shutters to let the heat in				
Buttoning up one's shirt/blouse				
Rubbing / cleaning one's nose with a handkerchief/tissue				
Regulating the heater				
Verbal communication occurring				
Shivering				
Rolling down one's sleeves				
Pulling up one's coat/jumper hood				
Making one's teeth chatter				
Pulling up one's collar				
Closing the door / window				
Running in place				
Getting closer to the heater				
Curling up				
Pulling down one's sleeves (jumper / jacket / coat)				
Coughing				
Other (please specify)				

Remarks:

We thank you for helping with this project!

The project personnel