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- A TOOL FOR EVALUATING AND INTERVENING IN THE AD'AGIO PROJECT
- DIGITAL AND PHYSICAL ERGONOMICS TOWARDS A NEW-OLD GENERATION OF SELF-DRIVING CARS
- HOW TO PROMOTE WELL-BEING AND ACCESSIBILITY IN VIRTUAL REALITY
- THE IMPACT OF COVID-19 IN THE RETAIL SECTOR
- FROM PATHOGENESIS TO SALUTOGENESIS: A PERSPECTIVE SHIFT FOR HAPPY WORKPLACES

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RIVISTA ITALIANA DI ERGONOMIA

THE RIVISTA ITALIANA DI ERGONOMIA, of the S.I.E. -Italian Society of Ergonomics, is a scientific journal that operates nationally and internationally for the promotion and development of ergonomics and the study of human factors, and the dissemination and systematization of knowledge and experiences related to the ergonomic approach, in close relationship with the social, environmental and productive realities where human beings, operate and live, coherently with the goals of the SIE.

Supported by an international scientific committee and using a double-blind reviewing process, the journal publishes original contributions from research and applications on ergonomic issues, in its various aspects and related to the different contexts and human activities.

The RIVISTA ITALIANA DI ERGONOMIA is aimed at ergonomic professionals and all those interested in applying the principles and methods of ergonomics / human factors in the design, planning and management of technical and social systems, in work or in leisure.

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Health and wellbeing in the framework of sustainability

Since the 2022 numbers, the Rivista Italiana di Ergonomia started a structured discussion to reflect on the synergies and intersections between Human Factors/Ergonomics and Sustainability. The topic is not new in the international debate; since 2008 the International Ergonomics Association endorsed the "Human Factors and Sustainable Development" Technical Committee, and "Designing a Sustainable Future" was the title of the 18th Triennial Congress of the IEA held in Recife, Brazil, in 2012. Since then, the interest on this topic has progressively grown and a large number of contributions fuelled the scientific debate at international level. However, in Italy the interest on the relations between Human Factors/Ergonomics and Sustainable Development remained sporadic. For these reasons, the Rivista Italiana di Ergonomia wanted to continue the initial discussions started in 2022 by focusing the journal on emerging issues that have international resonance, with the ultimate aim to look for potential convergences with the Sustainable Development Goals.

The Number 26 of the Rivista Italiana di Ergonomia addresses the ambitious goal of exploring the contribution of Human Factors/Ergonomics in the health and wellbeing sector, between the scenario of present and future demands of sustainabile interventions. As we know, health and wellbeing are two concepts that are well-known to ergonomists, traditionally connected to Human Factors/Ergonomics' theories and practices. But in a global perspective they assume new meanings related to multiple health demands, often conflicting: increasingly dynamic needs, life courses and multigenerational issues that go beyond the personal dimensions by embracing the social, community and planet instances. What is the role of Human Factors/Ergonomics in understanding the deep connections between health and the environment? How can the Human Factors/Ergonomics approach be more inclusive so that it can support the emerging health-related needs at both human and planet dimension? What role does Human Factors/Ergonomics play in conceiving technologies and services to support "healthy links" for all humans in a sustainable way? What are the most suitable person-centred models to improve health and wellbeing and to boost people autonomy and inclusion in a long-life perspective? These are only few of the main questions that the Volume 26 of the Rivista Italiana di Ergonomia intends to address at national and international levels. A special thanks to co-editors of this number. Alessia Brischetto e Mattia Pistolesi, for the competence and careful guidance with which they coordinated this Volume.

ERMINIA ATTAIANESE

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New challenges for health and well-being: More than human health

ALESSIA BRISCHETTO, MATTIA PISTOLESI Università di Firenze

Health and well-being¹, two concepts that are very similar but have different meanings, are well-known and debated topics, addressed with more or less specificity by all sectors (governments, public and private institutions, universities, SMEs), but they turn out to be, even today, as topical as ever.

Issue 26 of the *Rivista Italiana di Ergonomia*, however, wishes to extend the concept of health not only to human beings, but to all living beings, to the planet in other words.

If it is true that the health of humans and that of the planet today are more intertwined than ever, then the climate change and environmental crisis as a component of the Anthropocene (plastic, for example, is one of the symbols of the Anthropocene and symbolises the passage of man on earth), the current conflicts, and the new ones the Covid-19 global pandemic (and the fear of the outbreak of new pandemics, let us not forget the melting of glaciers caused by

¹ Health and well-being may sound like similar terms but the meaning is quite different. In fact, human health is a fundamental concept that touches on several aspects of life, including physical well-being, mental well-being, disease prevention, quality of life and finally social well-being. It is now well known that health is defined as a state of complete physical, social and mental well-being, and not merely the absence of disease or infirmity (WHO, 1948). Whereas well-being is a concept composed of two conditions: the objective and the subjective. The WHO (2013) itself proposes the following definition "well-being exists within two dimensions, a subjective and an objective one. It includes the life experience of an individual, but also the comparison of the life circumstances with social norms and values".

climate change, may be the direct consequence of the spread of new, possibly more deadly viruses), the ageing and increasing world population (according to the latest UN projections (2022) the world population could grow to around 8.5 billion in 2030, 9.7 billion in 2050 and 10.4 billion in 2100, with a consequent increase in adults in need of assistance), deaths in the workplace and finally the phenomenon of migration, represent a threat in the near future that could affect our health and well-being, and that of the planet on which we live. The scenario we have just described highlights upcoming and fu-

ture challenges that need to be studied and addressed. The future is bound to hold many surprises in store for us, for which we must prepare ourselves from a social, cultural, and technological point of view. Thanks to technological progress to research in its most general sense, these challenges can be solved. Change is already taking place.

For example, Goal 3 Good Health and Well-Being of the 2030 Agenda promoted by the United Nations (UN, 2015), aims to ensure healthy living and promote well-being for all ages. (iv) prevent, treat and promote well-being and mental health; (v) ensure universal access to sexual and reproductive health care services; (vi) support research or development of vaccines and drugs for communicable and non-communicable diseases; and (vii) increase funding for health.

To tackle the climate crisis, the 'Green Deal' (European Commission, 2019) and the 'Fit for 55' plan, i.e. a set of green policy initiatives concerning climate, environment, energy, transport, industry, agriculture and sustainable finance, set the goal of reducing emissions to 55% by 2030, and their neutrality by 2050.

Finally, an approach that is gaining global recognition is the One Health approach (WHO, 2017), i.e. an approach that recognises the interconnectedness between people, animals and our environment as an adequate condition that can address health problems and create long-term sustainable solutions.

Here, ergonomics can contribute as a scientific discipline that studies the complex interaction between humans and the system, aiming to optimise human well-being and system performance. It can contribute to knowledge and help establish new insights into existing knowledge to improve our health, well-being and that of the planet through the design of objects, technologies and environments and the efficient use of natural resources.

Of great interest is the article by Richardson & Thatcher (2023), in

which the authors state that ergonomics has contributed the least to the human-nature relationship, but its multidisciplinary nature, focusing on relationships, interfaces and systems, puts it in an ideal position "to refitting the human to nature". There is a growing awareness of overcoming anthropocentrism, fostering the development of an ecosystem vision that helps all stakeholders to develop more responsible and sustainable products, technologies and environments.

For instance, digital products, networked and connected objects and wearable technologies are playing and may play a key role in the near future. Health devices, which are compact and miniaturised, can be effective for monitoring physiological data and maintaining health status, but also for promoting the safety of users (such as the elderly) at home and supporting the performance of daily and domestic activities.

Such devices have vast potential and can be applied in different areas, depending on the user's needs. They can be integrated into watches, shoes, socks, bracelets, necklaces, etc. Wearable devices, increasingly powerful and capable of enhancing human abilities, are becoming an integral part of everyday life, blending into more traditional interactions with objects or generating new modes of action.

The role of technological progress is also an important consideration. Many case studies have demonstrated how the use of virtual reality can positively affect people's health and well-being within both home and workplace environments. For example, 'virtual and simulated nature' can be used to improve the state of relaxation of people with Parkinson's disease or be enjoyed by people living in highly urbanised environments. Virtual reality can be applied to preventing and rehabilitating cognitive and motor disorders or managing mental and mood disorders. However, it can also be used in work contexts within, for example, immersive training programmes for staff, thus enhancing individual soft skills but also the education and involvement of workers.

Finally, the built environment can significantly impact people's psycho-physical and social health and well-being. The most relevant characteristics of the built environment can influence health behaviour and health outcomes through various pathways, including encouraging exercise (indoors and outdoors), education and recreation, determining whether people have easy access to food and health resources, and influencing stress and other psychosocial factors.

In some cases, space may have therapeutic potential and speed up the acceptance of illness by inducing production at a biological level, in others, it may slow down the course of illness, providing greater well-being. Within a built environment, perceptual-sensory factors such as atmosphere, colour, natural or artificial lighting, acoustic conditions and smells can positively or negatively affect the moods of those involved. These factors can bring health benefits, support affective processes, improve cognitive functions and generate a better perception of the social and personal environment of the users of the environment.

The articles that follow, contained in this new issue of the *Rivista Italiana di Ergonomia*, focus on these macro-themes, objects, technologies and the built environment, stimulating and fuelling debate, discussion and reflection on the role of ergonomics in promoting health, personal and social well-being, and the well-being of the entire ecosystem.

Six contributions make up this volume.

The paper proposed by Teverini et al. and entitled **"More-than-human health for the responsible innovation of wearable medical devices"** introduces the theme of "more-than-human" within the context of wearable device design to consider the connections between humans and other entities in the material world and the natural environment. The presented study focuses on three levels of analysis: the human context, the sociocultural context and the natural environment. It proposes some critical lenses to guide the future design of wearable medical devices for more-than-human health.

The work proposed by Leggiero & Porfirione and entitled **"Interaction design in support of visual impairment rehabilitators: a tool for evaluating and intervening in the Ad'agio project"** addresses the issue of enabling technologies for the visual rehabilitation of the elderly in the home. The study presents an operational tool developed within a "model flat", i.e. an interactive checklist that identifies critical issues and cues for optimising and personalising living environments.

The work proposed by Imbesi et al. entitled **"Digital and physical ergonomics towards a new-old generation of self-driving cars**", addresses the issue of everyday mobility of the elderly concerning the self-driving car sector. The paper illustrates the most important factors influencing the mobility needs of the elderly and offers interesting suggestions on how a more inclusive and ergonomic approach can improve the well-being related to the everyday mobility of the elderly. The authors illustrate through the analysis of significant case studies the potential of autonomous cars through two types of intervention: digital ergonomics offers great flexibility with the possibility of simplifying functions and graphic layouts, while physical ergonomics can explore new forms and functions to make transport technology more intuitive for the elderly.

The work proposed by Nunziante et al. and entitled **"How to promote well-being and accessibility in Virtual Reality"** explores the use of virtual reality as a means to promote well-being and accessibility with a user-centred approach and a focus on the user's vision as a pillar in the design of VR experiences. Based on several case studies, the paper aims to link applied research incorporating current and future advances in digital applications in the field of inclusion and health. The authors highlight the potential of virtual reality for digital health, in particular, how virtual reality in digital health enhances well-being through creativity, learning, access to information and health skills.

The paper proposed by Silverton & Rossi and entitled **"The Impact** of Covid-19 on the Psychological Techniques Used by Visual Merchandisers in the Retail Sector" introduces an interesting analysis of the impact of psychological techniques in the visual merchandiser sector. In particular, the study investigates the change in consumer attitudes with the introduction of Covid-19-related social distancing protocols. Factors such as health, hygiene and safety, which were less considered before the pandemic, have impacted the psychological techniques currently employed by visual merchandisers.

The authors illustrate the evolution of consumer priorities before and during the pandemic and present behavioural-based recommendations for visual merchandisers to meet changing customer preferences.

The last work proposed by Guida et al. and entitled **"From pathogenesis to salutogenesis: a perspective shift for happy workplaces"** introduces the topic of happiness and the 'salutogenic perspective' in workplaces. Starting from the definition of happiness as referring to a positive internal state linked to situational and interpersonal contexts, the authors present two models of organisational ergonomics that apply the salutogenic approach to happiness in the workplace: the first aims to create a working system that balances the work demands of employees, work control and the support of colleagues and supervisors; the second to expand the salutogenic effect of work resources on positive health outcomes.

We would like to conclude by thanking the authors who responded to this call with interesting scientific contributions, and we look forward to future opportunities for discussion and debate to broaden the complex framework of issues aimed at outlining new scenarios for intervention.

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More-than-human health for the responsible innovation of wearable medical devices



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Keywords: more-than-human, wearable medical device, compression stockings, co-design, responsible innovation, product lifetime.

Abstract

The more-than-human is an emerging perspective that enlarges the focus beyond the human subject, to consider the connections between the human beings and other entities in the material world and in the natural environment. When this perspective is adopted in the design of wearable medical devices, it increases the complexity of the elements to consider and this requires the definition of a new unit of analysis beyond the patient-device interaction. To guide the design practice in this domain, we propose to focus the analysis on three levels: the human, the socio-cultural context and the natural environment. Through the discussion of a case study for the responsible innovation of compression therapy in treating venous disease, we propose some key lenses to guide the future design of medical wearable design for a more-than-human health.

Introduction

The more-than-human perspective applied to healthcare calls for a paradigm shift from the centrality of the human subject towards the interrelated connections between the human beings and other entities in the material and natural environment.

Today, the innovation in healthcare relies on the use of emerging technologies to personalise the treatments, improve the health outcomes and provide equitable care, from a human-centred perspective. Only recently the healthcare sector started to consider the sustainability issues related, for example, to the waste of medical devices, not just from an economic point of view but also considering the impact on the environment (Ertz & Patrick, 2020).

In light of this, the more-than-human perspective represents a way to pursue responsible research and innovation (European Commission, 2014) that promotes the development of smart, inclusive and sustainable solutions (Camocini & Vergani, 2021).

With this paper we describe a case study illustrating the more-thanhuman perspective in the design of wearable medical devices that focuses the analysis on three levels: the human, the socio-cultural context and the natural environment. A particular focus is on the level of the natural environment since it is still overlooked compared to the other two levels of analysis.

For each level, we refer to some key concepts to stimulate in thinking and designing for a more-than-human healthcare. To operationalise this framework, we discuss a case study of the compression stockings for the treatment of venous disease. The key concepts related to the human, the socio-cultural context and the natural environment emerged during the co-design with stakeholders as critical issues of the current therapy, and initiated the discussion about the role of design in dealing with responsible innovation.

Current approach of the compression therapy in treating venous disease

Venous insufficiency is a form of venous disease which slows down blood flow from legs back up to heart because of damaged vein valves. In order to prevent more invasive treatment or to follow conservative therapy after surgical intervention, people are prescribed compression therapy using the graduated elastic compression stockings (GECS).

One of the cornerstones of this therapy is patients' compliance ex-

pressed through daily wear time for extended periods of time, which often correspond to the person's lifetime. Scientific evidence reports low compliance to the therapy due to the poor acceptance of GECS by the patients (Raju et al., 2007; Rastel, 2014). The reasons for the non-compliance cover a wide range of aspects which have partly been explored within the scientific community (Chitambira, 2019; Gong et al., 2020).

First of all, the poor wearability of the device is the primary factor that prevents the compliance. The manufacturing process of GECS follows the model "one size fits all" by developing compressive garments based on standard anthropometric data, without considering the diverse body anatomy and gender. To design personalised compression clothing, one of the prominent strategies is based on 3D acquisition techniques to obtain digital scanned data useful for parametric modelling and for body-shape textile production (Kuzmichev et al., 2019; Wang, 2020).

Secondly, the patients frequently report difficulties in donning on and off the stockings as higher compression rates at feet level limit the movements, causing pain and discomfort. For this reason, a great effort has been made to design stocking aids such as foot slip and slip-on stocking aid (Wang et al., 2007).

Lastly, compression stockings are made of inactive and extensible knit fabrics which provide unvaried pneumatic compression. Recently, some studies experiment with active materials which can deliver a dynamic compression achieved by shape and stiffness changes (e.g., Pettys-Baker et al., 2022).

Considering the state of the art described above, the research on compression stocking appears as unidimensional since it focuses on the interaction between the patient and the device from a medical perspective, aiming at maximising the product performance to improve the therapy efficiency. By focusing only on functional aspects of compression stockings as a mere device for cure we miss the opportunity to reflect on the complex entanglement of human needs, social meanings, and cultural symbols related to the medical device. Indeed, stereotypes and stigmatisation generated by the poor aesthetic of the device and the lack of a gendered design, deeply affect the individual and social acceptance of the medical device (Marti, & Recupero, 2022).

Since people meet multiple barriers in using compression stocking and tend to selectively use or completely abandon them, a key factor to innovate the compression therapy is to work at different levels of the human experience of care and to frame it in a wider network of interconnections among the individual, the social context and the natural environment (Bar et al., 2021).

Case study: responsible innovation of compression therapy

The analysis of the scientific literature pointed out the limitation of the current knowledge about the multifaceted experience of people using compression stockings.

To fill this gap, we started a co-design project to envisage a transformation of the compression therapy by designing a service ecosystem around the wearable medical device. The project is currently ongoing, moving from the exploratory phase to the concept generation.

Methodology

The project adopts a co-design approach to explore the needs, desires and values of the GECS wearers who are engaged as design partners. The "Context Mapping" methodology (Visser et al., 2005) serves as a guiding methodological framework, and we use generative techniques to understand what the GECS wearers currently experience and to collaboratively envision future solutions (Van Mechelen et al., 2014).

In the exploratory phase of the project, the co-design participants were involved in a workshop to understand their daily practices and behaviours in private and social contexts. The workshop was organised by the team of the Santa Chiara Fab Lab of the University of Siena, and it took place in a public library in Cecina (Italy) in May 2023. The activity involved five people, aged 27 to 61, representing diverse user groups: two people use GECS regularly every day because they live in a chronic condition of venous insufficiency; one person has had first varicose vein evidence and wears GECS only occasionally; two people have never used GECS but they know the disease being in contacts with people wearing the stockings.

Co-design activities

One week before the workshop, the participants took part in a preliminary activity serving as a sensitising assignment by taking four photographs: a) the moment when they wear compression stockings; b) a place where they would never wear them; c) the place where they store the compression stockings after using them; d) how they dispose of them when they are worn-out. These photos were used during the workshop to stimulate the discussion among participants. The workshop included a sequence of four activities:

- 1. the participants discussed their experience using the photographs as stimuli;
- 2. the participants wrote down the keywords that emerged during the discussion on special sticky notes (Figure 1): black-side sticky notes serving as hindrances-card, green-side sticky notes serving as opportunity-card;
- 3. the participants explored a set of multi-material items (e.g., different patterns and coloured fabrics, tiny adornments, bio-inspired texture and technologies) as inspirations to envision "future compression stockings";
- 4. the participants "materialised" the ideas by sketching their future compression stockings and shared the envisioning scenarios with the others (Figure 2).



Figure 1. Writing down the keywords on the sticky notes.



Figure 2. Envisioning future compression stockings

Results

The outputs of the workshop, together with the field notes and transcripts, were elaborated to map key findings through a User Journey Map (Kalbach, 2020). The User Journey Map allowed us to highlight diverse barriers, as described below, which lead to the poor compliance and to the abandonment of GECS in diverse phases of the experience.

Then, we identified some challenges for designers to innovate the compression therapy towards smart, inclusive and sustainable solutions (Figure 3). The initial barrier is related to the difficulty in selecting the proper GECS: finding the proper stockings to fit the body and to meet the therapy requirements is complex and demanding because often the person takes some trials and errors. A factor which contributes to increasing these difficulties is the conflicting information about the GECS sizing system: some manufacturers use shoe size as baseline measurement, others use weight and height rather than legs' size circumferences.

EX	PE	RI	Eľ	VC	E

BARRIERS

BEFORE WEARTIME

difficulties in **finding the proper GECS** (model "one size fits all", materials..)

Private Weartime

Purchase

High effort in putting on GESC due to poor wearability of the device (donning on and off, discomfort and pain due to high pressure levels..)

problematic GECS daily use (burning, sweating, itching, pain, and allergies) and handling (easily damageable fabrics, correct putting..)

lack of awareness about daily compliance with therapy (impossibility to assess therapy due to loss of fabric stiffness which leads to drop in prescribed compression degree...)

WEARTIME

compromise of self-image (poor aesthetics, genderless and plain design narrow personal preferences about clothing the body according to context of use and personal sense of beauty..)

Social Weartime

compromise of self-confidence in public contexts (social stigma due to medical-looking design)

Manteinance

storing and management (washing methods, storage conditions for hygienic purpose..)

Disposal

WEARTIME

AFTER

management of the product obsolescence (right timing for replacement, correct waste disposal..) DESIGN CHALLENGES HOW CAN DESIGN

> improve device wearability?

help GESC wearers in choosing the **best fitting** stocking according to personal body needs?

extend product longevity?

provide GECS wearers with a self-monitoring solution?

reason about the **need** for beauty and fashionappeal in medical wearable device?

inform GESC wearers about proper care in daily use?

promote re-use or up-cycling culture?

create a system to ensure correct waste disposal with a low enviornmental impact?

Figure 3. Pain points and design challenges.

As for other wearable medical devices (e.g., Dunn et al., 2019; Harper & Aflatoony 2021; Marti & Recupero, 2022; Seim et al., 2022), the GECS should meet the therapy requirements as well as the need for comfort when donning on, wearing and donning off the stockings. This requires to consider not just the form of the body but also the posture and movement in everyday situations (Gemperle et al., 1998).

When the purchased stockings do not meet these requirements, they are "abandoned" in the trash bin or in a drawer, without ever being used. This cycle of purchase-trials-abandonment-trash is repeated several times during the life of the person due to the long-term therapy of the chronic disease, and this makes the therapy expensive and unsustainable.

The barriers perceived during wear time are several: the person struggles to understand when the current stockings need to be replaced with the new ones; the proper handling and care of the GECS is challenging but essential to maintain the functionality of the stockings and avoid damages.

The poor wearability of GECS (related to texture, shape, weight, freedom of movements, and perspiration) represents just one of the barriers pointed out during the co-design workshop. The aesthetics and the ungendered design of the device is an additional barrier for acceptance and long-term adoption. Both in private situations and in social situations, GECS wearers feel ashamed, they find compression stockings appearance unaesthetic as they are genderless, medical-oriented designed, and they are associated with the concepts of ageing and illness. GECS wearers also complain about the fact that, as compression stockings represent a garment to be worn daily, they often don't match with their style of clothing.

Moreover, in some cases the compression stockings are perceived as underwear clothing, so people tend to avoid exposing them in public situations. This limits them in feeling self-confident in intimacy and in interaction with other people.

The barriers listed above have a critical impact not only on the compliance but also on the amount of GECS which are disposed, since the obsolescence of the compression stockings happens in diverse cases: when the purchased device is not suitable for the person and it is discarded without being used; in case of improper care or handling that damages the device; after a certain period of use when the GECS lose their stiffness and need to be replaced.

Discussion

The outcomes of the co-design workshop enabled us to explore the interplay of factors related to the human, the socio-cultural context and the natural environment which should be considered when designing the more-than-human wearable devices (Figure 4).



Figure 4. Three levels of analysis with key concepts.

At the human level, the focus should be on the wearability to ensure that the device is comfortably wearable considering the diverse body shapes and daily situations (e.g., wearing GECS in the different seasons, under different clothes), as well as on the aesthetics to ensure that the device does not compromise the self-image of the person (Motti & Caine, 2014; Hemapriya et al., 2017; Marti & Recupero, 2022). At the level of socio-cultural context, the concept of social acceptability should be deeply investigated since the wearable medical device is related to stereotypes and stigma which reduce the self-confidence of the person in public situations (Sehrt et al., 2022).

Indeed, when the medical devices are worn on the body every day, they can act as distinctive marks that label the person with stereotypes (e.g., illness, aging) and thus they can stimulate negative attitudes by the user towards themselves and by other people towards the user (Farrington, 2016; Profita, 2016).

Finally, at the level of the natural environment, the concept of product lifetime (also called product lifespan) refers to the period during which the product is considered useful or significant by its users, before it becomes obsolescent (Den Hollander et al., 2017). In light of the responsible innovation, the design challenge is to increase the lifetime of the wearable device. Following the classification proposed by Den Hollander et al. (2017), there are diverse approaches to address this challenge which are detailed below.

Design approaches for product longevity

The strategy of "recovery" relies on the use of biodegradable material, or the use of waste bio-based material to produce the textile component of the wearable device (e.g., Vasquez & Vega, 2019).

From a systemic perspective, this strategy requires changes in the production process in terms of resources, machines and chains for collecting and transforming the raw material into the product. Moreover, the material design deals with the regulatory framework since the medical device that is worn in contact with skin should be compliant with the diverse regulatory national and international requirements (McDermott et al., 2022). The strategy of the "extended use" aims to postpone obsolescence by retaining or restoring the device in its functioning state. When the restoring of the functional capabilities of the device is not possible, as in the case of GECS, the strategy can be providing information to the person for the right management of the device (e.g., laundering technique to avoid damages) to maintain the functional capabilities as long as possible.

The strategy of the "long use" aims at extending the emotional durability of the product, in addition to its physical durability (Den Hollander et al., 2017). The emotional durability is related to what Burns (2010) defined as "aesthetic obsolescence" which occurs when fashion changes and the device becomes outmoded. In a life-long perspective, the aesthetic obsolescence is not only related to the changes in fashion trends, but it is strongly connected with the changing self-image of the person while ageing. This is relevant for the wearable medical devices for chronic diseases which are used during diverse life stages, when the body anatomy changes together with the personal sense of style.

Service design to address the product longevity

Another strategy to deal with the product lifetime is to design a service ecosystem in which the technologies are not only enabling artefacts, but they are agents co-performing with the humans and the other entities (Giaccardi & Redström, 2020).

Our approach for the responsible innovation of compression therapy implies a design proposal that takes care of human needs and desires as well as of environmental issues. The project aims to increase compliance by empowering therapy self-management. At the same time, the project addresses the challenge of waste disposal by preventing still-usable compressive fabrics from ending up in landfills after short wear time or untimely product end of life and by offering disposal options. The service scenario is based on three main touchpoints (Figure 5). The smart compression stockings are capable of generating data to keep GECS wearers informed about the remaining lifespan of the device. This kind of interaction will be performed through the development of an e-textile that will collect data by measuring the stiffness degree of the fabric.

The mobile application serves as a medium for GECS wearers to monitor prospective drop of fabric compression capacity compared to the prescribed compression degree, and to make them aware of the correct moment when the GESC have to be disposed of and replaced with the new ones. The design challenge in this case is related to the data visualisation that should be comprehensive and reliable, as well as creative and engaging.

The city-distributed locker serves as a collection point for the unused or obsolete GECS. GECS wearers will be able to find the closest locker in their city through the mobile app that will also act as a smart key to open the locker and place the disposed garment.

As mentioned above, the long-term compression therapy produces a huge amount of waste disposal due to the recurring obsolescence of the device. Expanding compression stockings through wearable technology would lead to the production of another kind of disposal: e-waste. Therefore, lockers represent an essential service touchpoint to ensure a correct waste disposal system.

This service ecosystem is based on the co-performance of people and material/digital things, where the GECS are no longer a mere device to wear on the body: rather they become "some-thing more" to connect human and non-human entities, sustaining the agency of the connected entities to create new value for the interest of the people



Figure 5. Connections between the service touchpoints.

and the environment (Giaccardi & Redström, 2020). Thus, the goal of the designer is to improve the agency (in terms of power and capabilities) of the human beings who are no longer conceived as care-recipients, and to give agency to non-human entities which act and produce the expected positive impact on the human, socio-cultural and environmental levels.

The next step of the project is to engage the co-design participants in validating this design proposal and in co-creating the agency of the human and non-human entities (e.g., by designing features of smart stockings, the app, the use of lockers).

Conclusions

The case study discussed in this paper aims to highlight the limitation of the current approach of compression therapy in treating venous disease that overlooks the diversity of human beings, since it is based on the "one size fits all" solution, and the impact of the current practices on the natural environment.

To advance the knowledge on this topic, we adopt a more-than-hu-

man perspective to deeply understand the interplay between human, socio-cultural and environmental factors which affect the success and sustainability of the therapy. When designing wearable medical devices from a more-than-human perspective, the focus on the interaction between the person and the device is no longer suitable as the only unit of analysis (Giaccardi & Redström, 2020).

In light of this, we recommend enlargement of the unit of analysis articulated on three levels: the human, the socio-cultural context and the natural environment. A wider unit of analysis can help promote a more responsible design practice that:

a) identifies multiple factors determining the acceptance and long-term adoption of the medical device, considering the peculiarities of the device to wear on the body in private and public situations;b) acknowledges the complexity of the human beings which cannot be reduced to the notion of patient to cure, nor to static and unique anthropometric measures;

c) prevents unintended impacts of the device on the natural environment due to incorrect disposal, and promotes sustainable solutions;

d) allows non-human agencies and factors to become more and more part of any design practice;

e) allows humans to understand and be more aware of the interconnectedness and interdependencies of their practices and the environment;

f) provides a more complex and richer lenses to look into socio-environmental issues;

g) highlights the question of how protection, conservation, preservation of nature can be implemented and thought through together with human healthcare.

This approach aims at making the more-than-human perspective actionable for the future design of wearable medical devices.

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Interaction design in support of visual impairment rehabilitators: a tool for evaluating and intervening in the Ad'agio project

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Keywords: One health, Inclusive Design, Multidisciplinary approach, active aging, codesign process.

Abstract

The paper focuses on the "Ad'agio protocol", an EU-funded project aimed at designing a digital tool for visual rehabilitators. The goal was to develop a tool that would enable home inspection of elderly people with visual impairments and have as output solutions to secure the apartment and enable independent aging. Through the work of a multidisciplinary team, made up of designers, rehabilitators and architects, a model apartment was set up with all accessibility standards in order to identify dangerous elements of the home environment. The second part of the work was based on the design of the tool, i.e., an interactive checklist with possible critical elements and their respective solutions. Then the output of the system with suggestions is sent to the elderly or their caregivers to enable them to adjust the apartment safely and with respect to their needs.

Introduction

As the average lifespan of people becomes longer and longer, WHO international guidelines shift the focus to the concept of Active Aging, that is, maintaining a healthy, active and independent lifestyle throughout the aging years (WHO, 2002). The goal of design, therefore, is to conceive tools, products and services in a preventive and proactive logic in order to retard the onset of non-self-sufficiency. To do this, it is necessary to combine the skills of different professional fields, which synergistically put the elderly at the centre, listening to their needs and ensuring good quality of life and mental and physical well-being.

Specifically, we refer to Independent Living, Ageing in Place, and Self-Care, to indicate those interventions that aim to foster an independent lifestyle of the elderly, preferably at home, through the use of ICT, adjustments to the home space and re-enablement processes. These actions become even more necessary when the typical frailties of the elderly are compounded by the loss of visual function, a common element in aging people, which makes the possibility of independent living more complex.

This paper brings together the results of a collaboration between the Architecture and Design Department of the University of Genoa and the David Chiossone Foundation as part of the Ad'agio project, which, together with other small ICT companies in the Ligurian region, have designed an innovative service for evaluating and adapting the home environment to the needs of senior users who are visually impaired or blind. The goal of the service, designed in the form of an interactive product, is to provide home-based therapists with a tool to suggest solutions and behavioural and environmental adjustments to users for active, safe and independent living.

Goals

The Ad'agio project is a collaboration between David Chiossone Foundation, the Department of Architecture and Design of the University of Genoa, Teseo, and Humana Vox.

Funded in 2022 by the City of Genoa within the "REACT EU (Union's response to the covid-19 pandemic) – Pon "Città Metropolitane" 2014/2020" – ZIP – Zena Innovative People" call, it aims to develop 12-month projects that promote the revitalization of the Urban Economy, to counter the effects of the pandemic.

The main goal of the project is to enable elderly people with visual

impairment or fragile vision to live autonomous and independent daily lives, thanks to the use of new technologies and the adoption of homebased housing and rehabilitation protocols. Digital and home automation applications, environmental adaptations, and customizable rehabilitative strategies for all living situations are the three dimensions of the project, designed to respond concretely to the needs of a wide segment of the citizenry. In fact, when considering Italian metropolitan areas, the Genoa area has the most elderly residents (29.1 percent of the population), 55.8 percent of whom are over 75 years old. In addition, by 2021, elderly people living alone reach 37% in the Genoa area, and it is estimated that many of them have age-related difficulties, such as vision problems¹.

The specific goal of the project is to assess the homes of people with frailty to propose appropriate environmental adjustments for the safety and usability of spaces and furnishings and related rehabilitative strategies for personal adaptation. This is followed by the home assistant named "Penny": a digital platform created by Teseo and integrated with Humana Vox, capable of bringing together in a single tool, interoperable with speech synthesis, the main technological functions required by people with visual impairment: monitoring the state of health and well-being, responding to safety components, providing support in the loss of general functions related to the aging process, such as memory, and alerting caregivers in case of an emergency, such as the detection of a fall.

Methodology

The work began with a qualitative survey to gather the needs of thirty users, elderly people who are blind or visually impaired and various stakeholders. This phase highlighted the need to develop systems that would help caregivers and the elderly themselves to make their homes a safe place, allowing them to lead independent lives despite physical and cognitive decline.

Among the survey results, it was found that the typical difficulties of old age are accompanied by the onset of vision-related difficulties or already present blindness, further undermining the quality of life. By their nature, these types of conditions can present themselves in very different forms and ways, which is why it is impossible to standardize solutions that accommodate everyone's needs. For this reason, the work was carried out in perfect synergy by a team consisting of designers, visual impairment rehabilitators, architects and

¹ For a more detailed discussion, see 'Gli anziani nelle città metropolitane. Profilo sociodemografico e analisi comparativa tra i contesti urbani' available at https:// www.istat.it/it/ files//2023/08/ Focus-Citt%C3%A0-Metropolitane_ Anziani_28-07-2023.pdf and 'Invecchiamento attivo e condizioni di vita degli anziani in Italia', available at https://www.istat. it/it/files/2020/08/ Invecchiamento-attivoe-condizioni-di-vitadegli-anziani-in-Italia. pdf.
computer scientists in order to develop innovative models and supporting technologies.

The DAD research group was called in to design an intervention protocol to be implemented at the homes of visually impaired or blind senior users, aimed at supporting the operators during the home inspection and able to suggest the necessary adjustments to ensure safety and autonomy for the elderly. Given the difficulty of standardizing this procedure and the need to keep in mind all the elements to be assessed during the inspection, a pathway to follow was created, adaptable to different needs and different housing and health situations, called the Ad'agio protocol.

The development of the Ad'agio protocol included 6 meetings in January – August 2023 lasting about 2 hours. A psychologist, an architect with expertise in accessibility, the occupational therapists, and the design team took part in the iterative activity, everyone contributed their expertise, depending on the stage of the project's progress.

The protocol: evaluating and intervening

The Ad'agio protocol is a multi-professional approach to home adaptation for the visually impaired elderly. Specifically, it is a structured home analysis and adjustment intervention to be implemented during the first home inspection, to support the David Chiossone Foundation's rehabilitators in securing the elderly, ensuring an autonomous and independent lifestyle.

Divided into two parts, the protocol includes an initial assessment moment. Upon arriving at the elderly person's home, the rehabilitator reviews all potentially dangerous elements, both physical and related to home organization. For example, physical impediments, such as doorsteps, steps or encumbrances, lighting, but also the elderly person's movement habits or the way he or she organizes work surfaces and daily objects are analyzed. The goal is to identify anything that limits independence, endangers his or her health, or disrupts daily activities. The second part of the protocol includes an intervention phase, namely the adjustment of the home space through the suggestion of adaptive strategies or technological and non-technological solutions to be implemented in the home. The interdisciplinary know-how of the working group was crucial in this phase as well, in order to identify solutions that could adapt to different needs and lifestyles, as no universal solution can be envisaged, but individual and personalized adaptations.

The Ad'agio tool

The project included an initial co-creation phase of the protocol, thanks to an apartment made available to the working team, located in Piazza Del Cavalletto in Genoa. The choice fell on an apartment of about sixty square meters with a kitchen, a bathroom, a bedroom, a living room, and a utility room, to create a model that was as close to reality as possible and that met all accessibility and safety standards from the perspective of the elderly and blind people. Together with an architect and the rehabilitation therapists, critical points, such as the presence of obstacles or furniture and surfaces that were difficult to use, were identified and later adjusted as needed. In this way, it was possible to create a place of reference for adjustments to be made in all the homes of people seeking support from the Chiossone Foundation. (e.g., Figure 1)



Figure 1. Evaluation and adaptation of a model apartment.

The project envisioned that the protocol would become an interactive digital tool, in which to select as input the critical situations present in the elderly's home and receive as output a list of solutions to solve them.

The work of defining the points of interest was fundamental to developing the structure of the digital tool. Specifically, it started with a demo of a room in the house, namely the kitchen, which usually presents more problems for blind users. A tree structure was created by starting with macro-categories, such as walkable surfaces, and then going down into the details of all those that are considered impediments or dangers. (e.g., Figure 2)



Figure 2. Tree structure for the development of the Ad'agio tool.

The therapists' need to go quickly back and forth within the sections of the tool was important in choosing a tree structure, so as to explore the various categories of items only when necessary.

The need, in fact, was to be able to go through the dangerous elements without forgetting anything, but at the same time perform this function in a limited time, which is that of the first visit granted by the elders (usually lasting 30 minutes). For the same reason, the tool was developed digitally and on a medium that would allow the mobility of the operator within the home, such as a tablet or smartphone.

Once the structure was defined and a demo developed, it was necessary to repeat the survey in the model apartment to simulate an evaluation session. At this stage, it was necessary to identify common ground in language. The skills of designers and architects often include specific language, but it may not be immediately intuitive to medical staff. For this reason, a working session on terms to be used within the tool was initiated to ensure unambiguous meaning and quick usage.

The evaluation visit allowed to test the demo of the tool, which is a checklist in which to mark situations present in the home (e.g., the presence of furniture with non-visible edges, the presence of stairs, etc.) useful for keeping track of changes to be implemented, either on a physical or behavioural level. (e.g., Figure 3, 4)



Figure 3-4. First tests of the demo version of the protocol (kitchen only).

Once the assessment phase of the environment is over, we move on to the adjustment phase. Specifically, the Ad'agio protocol includes suggesting solutions to the elderly or caregivers in order to limit the possibility of danger as much as possible. For this reason, the tool keeps track of the situations reported within the checklist, proposing for each of these a series of possible solutions. The suggestions in the tool are categorized into three levels:

- significant, which includes structural changes to the home or the purchase of invasive or expensive technological elements, such as removing steps or purchasing high-impact assistive devices;
- devices easily available on the market at low prices or low tech, such as lighting sources inside cabinets or water faucets that change color to prevent burns;
- behavioral, related to living habits within the home environment,

such as safely organizing detergents in furniture or creating pathways with landmarks to follow when moving around the home.

Suggestions for solving problems represent an open and implementable system in order to collect ideas and solutions that are always new and customized according to needs. For this reason, for each problem encountered, the therapist has the opportunity to note down new possible suggestions, even taking inspiration from adjustments implemented by other users or experts in other fields. Currently, the system contains about a hundred solutions filtered in the logic of the three levels, which are continuously implemented during the testing phases of the project.

Once the critical points and their respective solutions have been selected, the therapist sends a report to the user or their caregiver so that people can adjust their home space concerning their personal needs, both logistical and economic.

Conclusion

In an ever-changing and increasingly complex environment, the typical problems of old age are considered a limitation to a good quality of aging. This is made worse when vision-related difficulties, such as low vision or blindness, are added. However, some therapists specialize in these kinds of problems and can improve the elderly person's autonomy by suggesting solutions, either to be purchased or related to living habits within the home environment.

The project examined in this paper aimed to design a tool to support therapists at the Chiossone Foundation to enable them to conduct home inspections systematically. The result was a protocol for evaluating and intervening in the home environments of the elderly, in the form of an interactive digital tool. This makes it possible to identify problems and summarize about a hundred solutions to dangerous situations present within the home. The creation of an ever-growing tool that adapts to the needs of the individual elderly person represents great potential when considering the increase in average age in the near future.

The development of the tool is still ongoing and, when finished, it will be an application that can be used on mobile devices, mainly tablets. Work has already been done on the interaction design aspect, by designing its structure and how it can move within the digital space, filtering, adding and selecting solutions. Future developments include dedicated work on the communication aspects and interface of the digital product, which will take into account the positioning of information, fonts, colors, and everything that makes a tool more usable. Finally, home tests are planned to be conducted by Fondazione Chiossone therapists in the homes of 20 elderly people with visual impairments, four of which have already occurred. (e.g., Figure 5, 6). The project is scheduled to close at the end of September 2023, with the dissemination of the results of the experiments.



Figure 5-6. Home testing of the protocol conducted by the staff of the David Chiossone Foundation.

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Digital and physical ergonomics towards a new-old generation of self-driving cars



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Keywords: Design for the elderly, inclusive mobility, innovative vehicles, selfdriving cars.

Abstract

In the context of the aging society and digitalization, this contribution aims to illustrate how a more inclusive and ergonomic approach can enhance well-being related to the daily mobility of the elderly. In the first part of the contribution the most important factors influencing the elderly's mobility needs are highlighted, and then are analysed with two significant cases of autonomous vehicles for older users. Autonomous cars have the potential to enhance the safety and efficiency of silver mobility with two types of intervention: digital ergonomics offers great flexibility with the potential to simplify functions and graphics layout, while physical ergonomics can explore new shapes and functions to make transportation technology more intuitive for seniors.

Introduction

The overall current scenario can be considered as an antinomy: on the one hand, the current context is characterized by an increasingly rapid (but not always positive) technological and economic development; on the other hand, society – as it grows older – demands a slowdown, greater comprehensibility, acceptability and inclusiveness of technology. This is particularly true for the technology helpful in traveling and enabling the elderly population to maintain its independence, in their daily and weekly routine activities. In today's market, there are already specific solutions for the elderly, such as four-wheeled electric scooters, but very often this high specificity on the product – although it allows the elderly to move around independently – leads to stigmatizing the elder person as a weak person, not up to date, slow, unfit for social and working life.

Designing suitable mobility for the elderly is not only an ethical requirement but a concrete issue for the mobility of the future. This conviction is also supported by the Nielsen Norman Group (Experience, n.d.) which not only considers older people an important part of the next society but also emphasizes their ability to spend on products and services that can solve their real problems, especially when it comes to maintaining their daily routines and their health.

For these and other reasons, it is, therefore, necessary to begin to consider mobility, no longer exclusively linked to the traditional values of speed, power, and success but also to values more related to a cooperative space, no longer the domain of the driver alone, but an amplifier of social interactions especially for elderly people which normally are excluded to the driving tasks due to their natural muscular and cognitive decline.

Aiming to include elderly people in the travel population, it is worthed to focus on three kinds of issues when involved in the design of artifacts, services, and interfaces for older people: sensory, physical, and cognitive limitations (Young et al., 2017).

Older people naturally show a progressive decline in all 5 senses but particularly in sight, hearing, and touch. Considering vision, elderly people often have problems reading very small texts and distinguishing colors, especially in non-optimal visibility conditions. Within a vehicle, these difficulties could be overcome through adequate use of font size, the correct frequency and quantity of information presented, and by using more than one sense the communication between vehicle and user. Messages and actions could be sent with a combination of visual, auditory, and tactile stimuli always taking into account possible problems with high-frequency sounds (Corso, 1981) and the lower sensitivity to touch and vibration that the elderly usually present (Gescheider et al., 1994).

Elderly people are also likely to suffer from physical decline that can affect their mobility while using private or public transport. As a consequence, the elderly present reduced flexibility and coordination which have a negative influence on the proper use of the car equipment. Several research projects carried out with the intent to improve elderly mobility have been focused on the facilitation of the vehicle interface including slower steps and clearer pauses to compensate for muscle weaknesses, slower comprehension, and stiff joints.

Last, but not least, there are difficulties related to the elderly comprehension and their slower information processing (Eby et al., 2016; Johnson & Finn, 2017; Salthouse, 2010; Yang & Coughlin, 2014). These difficulties are particularly significant when it is necessary to stay focused on several tasks all at once like normally it occurs while driving. In fact, in the common driving experience, the attention is split between the standard car movement operations – normally, the pedals and steering wheel usage – and the information processing from the inside or the outside of the vehicle. Therefore, while designing interfaces or vehicles for frail people like the elderly, it is crucial to design proper information flows that take into account the slower cognitive process of the elderly. Hence, an interface design with an inclusive intent should consider the correct information timing aiming to reduce distraction, confusion, or mental overload (Koppel et al., 2009).

After having introduced the aging society trends and the relative influence on the design of services, products, and interfaces it is worth it to dive deep into the factors that influence the needs of the elderly about mobility.

Factors influencing the elderly's needs for mobility

Providing a transportation system able to meet the needs of older people is a complex aim, especially considering differences in people's health status, social and cultural background, and travel requirements (Luiu et al., 2018). Scientific research about gerontological mobility shows that the use of transport decreases with the deterioration of health status, causing a reduction of accessibility to transportation (Haustein et al., 2013). Understanding which specific factors impact the fulfillment of the elderly's needs can influence stakeholders as service providers and policymakers in providing those users with better ways of accessing and using transport.

The worsening of health conditions diminishes the elderly outdoor activities, especially leisure ones. In particular, health issues can affect the ability to board the vehicle and drive it, making necessary the assistance of another person, and causing the shift from driver to passenger, with a consequent limitation of independence and the feeling of being a burden for others (Musselwhite, 2017).

According to Luiu et al. (2018), the fulfillment of the elderly's needs for traveling is related not only to the transportation environment but also to other elements creating a complex framework, and providing useful information to analyse different specific situations. The analysis of those elements can provide a great amount of details and data useful to properly describe the chosen group of older users, and then design specific solutions.

Identified impacting factors are:

- Demographics: It provides some data useful to assess a background profile, some characteristics, human factors, and daily habits of the involved category of users. Examples of individual peculiarities and living habits are data are age, gender, weight, origins, education level, occupation, place of residence, cohabitants, and relationships with the community.
- Health and well-being: It concerns personal health conditions and the impairments that could affect mobility and transportation abilities. This element includes even qualitative information such as the individual perception of well-being, satisfaction with one's lifestyle, and feelings about the personal quality of life.
- Built environment: It provides information about the urban living context, the urban transportation public services, transportation infrastructure quality, and availability of facilities without using transport.
- Activities: It regards the personal attitude and abilities of the user related to transportation and the consideration given to proposed activities. It also regards the destinations and frequency of their journeys and frequently encountered difficulties in traveling.
- *Transportation*: It regards traveling options and the physical access to transport modalities, the personal attitude towards traveling, the ability to drive and plan journeys, and the options for non-driving people. Examples are car availability, presence

of driving license, frequency of use and typology of used transportation means, issues in public mobility services, and attitude in planning travels.

Among the analysed factors, several scientific research analyses demonstrated that the elements most influencing the relationship with out-of-home mobility are the person's health conditions and access to transport (Kim, 2011; Luiu et al., 2018).

In particular, health conditions greatly influence access to transport, limiting the independent use of the personal car in favour of other solutions like involving another person as the driver, using public transport (not always accessible), and moving by walk (not always physically possible). In these cases, the restricted access to transport causes a significant reduction of outdoor activities for older people, contributing to their isolation and need for personal assistance.

Influencing factors like demographics, built environment, and activities, have a lower impact on the usability of artifacts, services, and interfaces for aging people.

These elements make it evident that the design of new typologies of vehicles is a key research field to ensure aged drivers have appropriate solutions for their instances. Sensory, motor, and cognitive issues can be partially overcome by ergonomic solutions improving the physical and digital accessibility of designed solutions.

Future perspectives for self-driving cars addressed to older users

Considering the worldwide aging trend, the growing number of aged drivers will exponentially increase in the coming years. Compared to nowadays drivers, they will be healthier and hold more resources to preserve their favourite ways to live their everyday lives. These people will be highly automobile-dependent and used to moving on their own more than the previous generations of drivers, who have given up the independence of autonomous driving with less suffering (Alsnih & Hensher, 2003).

Following this perspective, one of the current potentially disruptive innovations characterizing the automotive industry is the advent of self-driving cars. This change could affect not only the shape and functions of the vehicle but even the design of cities and infrastructures, beyond the interaction between the user and the automobile. Besides, the potential removal of drivers from driving would avoid issues deriving from human factors, like age-related ones, and consequently improve key aspects such as safety, journey planning, fuel efficiency, and other issues related to mobility (Ahmed et al., 2022). Generally, there is a lack of empirical evidence of the most important requirements from the users' point of view, focusing the design process on technicians' inputs, rather than orienting it to the customer's acceptance (König & Neumayr, 2017). When new self-driving cars were initially widely presented to the public, the more sophisticated the car level of automation, the more users were skeptical about it (Bekiaris & Petica, 1997). In recent years, a more positive opinion of self-driving cars and related technologies has been detected, even if some perplexities and concerns remain (Kyriakidis et al., 2014).

Older users' resistance and caution to radical innovations are crucial for the development of new products and services. They often show a sort of irrational distrust towards everything unknown and unfamiliar. Especially with cars, the driving experience is conceived as something "adventurous, thrilling and pleasurable" (Steg, 2005), and for many expert drivers, this makes it difficult to grant the driving task to the car.

Understanding instances and requirements of future aging drivers can support the development of technological and non-technological solutions able to innovate the sector of elderly mobility by introducing new typologies of artifacts, providing safe and satisfying experiences to this category of users. In particular, individual health conditions and the vehicle's accessibility should be priority factors. Car designers are now thrilled to seize the opportunity of revolutionizing the concept of mobility with self-driving vehicles, considering consumers' preferences and behaviours. Re-thinking the car's design and interaction model, avoiding traditional constraints such as the passenger's visibility, the seating position, and the control panels, opens new possibilities for solutions improving ergonomics and accessibility by exploring new form factors accommodating an innovative user experience.

Case study

The advent of electrical and autonomous vehicles has opened a new scenario for automotive designers which has to deal with new needs especially coming from an aging society together with the removal of the traditional interface. Among the numerous projects all over the world about Autonomous vehicles for elderly people here are presented two significant case studies.

The first case study is Flourish, a three-year research project recently developed in the United Kingdom (2015-2019) by many automotive industries and the Centre for Connected and Autonomous Vehicles (CCAV). Based on autonomous driving systems technology, the project focused on developing new mobility alternatives for older adults that can enhance their accessibility and inclusivity to transport services.

The project is based on creating a mobility service for older adults that uses autonomous two-person pod vehicles that enable users to travel in urban contexts safely and inclusively.

The vehicle itself has special morphological aspects that are different from the forms of traditional vehicles. For example, the horizontal plane of the electric vehicle allows greater accessibility of the vehicle ingress and egress for people with reduced mobility. The orientation, the decentralized arrangement, and the orientation of the seats offer greater space for movement and dialogue between older people, fostering greater sociability inside the vehicle (Figure 1).



Figure 1. The Flourish autonomous pod during a demonstrative public test. More information at http://www.flourishmobility.com/about-flourish.

The peculiarity of the Flourish service lies in the design of its interface. The project has used a human-centered and participatory approach with users to foster interactions and configurations that are understandable and accessible, suitable for the elderly who may have reduced abilities or physical and cognitive impairments.

Flourish reduces driving-related interactions by using an essential dashboard with a single large screen that offers simplified functions and clear information on the status of the journey to maintain an intuitive use of the transport service. The interface allows either tactile interactions with the touch screen or conversational dialogue through a user voice interface for blind people or older adults with limited hand movement. The long and complex "planning a journey" function is broken down into many manageable steps and guided through simple questions such as "Where would you like to go?" or "Would you like to add a stop to your journey?", which allows users to complete the task of selecting the destination place calmly and efficiently.

Furthermore, the system keeps users informed and aware of where they are in their journey by viewing their journey information at a glance via a map or as a timeline. While notifications on screen, or voice messages communicate what is happening around the urban environment, making the vehicle behaviours visible and transparent to the passengers.

Finally, the artificial intelligence of the driving system offers a flexible system that adapts to users' preferences, learning not only from their needs related to the appearance of the interface itself, such as appearance, information, and interaction but also from their regular destinations. This allows the service to provide users with tailored experiences about their more frequent trips, suggest new recommendations of places to visit, and events to go to, or offer information about the surrounding area according to their needs (Figure 2).



Figure 2. An elderly person is interacting with the Flourish interface. The option "planning journey" is visually simplified and broken down in easy steps to make the selection of the destination place easier and accessible to older adults More information at http://www.flourishmobility.com/aboutflourish. The second case is the "Elliot" trial a three months research project conducted in South Australia in 2019 by the Global Centre for modern aging (GCMA) in collaboration with the AURRIGO autonomous vehicle company, the e Government of South Australia Department of Planning, Transport & Infrastructure (DPTI) and the Alexandrina Council and the Regional Development Australia.

The project aimed to test local elderly attitudes and perceptions towards autonomous vehicles (AV), the reason behind the use of the AV, and the user experience with a special focus on the space perception of the inner part of the vehicle.

Several key insights revealed an overall positive attitude towards AV with the majority of the elderly users considering the experience as useful and trustworthy and a convenient replacement of their vehicle (Figure 3).



Figure 3. One of the "Elliot" autonomous trials in South Australia while tested by three elderly users and 1 chaperone. More information at https://rdahc.com.au/wp-content/uploads/2019/04/Aurrigo-Elliot-Autonomous-Vehicle-Trial-Summary-Report-FINAL.pdf

Nevertheless, the research project also highlighted several points of improvement related to physical and cognitive ergonomics.

Regarding the physical ergonomics, the considerations that came out of the project were related to: the user request of having greater accessibility to the vehicle with better support of ramps, the need for different types of vehicle accordion to the size of the group, and the need for a larger space available for their animals, their walking aids or wheelchairs.

Considering the cognitive ergonomics, besides the fact the perception of the vehicle as safe, new, quiet, and useful several suggestions were made to improve the understanding of the overall functions. Suggestions were made about the possibility of having a phone application to guide the elder through the trial experience as well as the possibility of customizing the interior with some entertainment such as music or the regulation of the temperature inside the cabin.

Furthermore, the service could have been more enjoyable if it was designed door-to-door to accomplish their daily travel in the surrounding community, including shops. Margins of improvements were also related to the weather and availability of the pods which can be a valid alternative to walking especially during winter or in particularly rainy periods. Finally, the autonomous vehicle was perceived as the optimal vehicle to accomplish the last mile between the main route connections and the most remote locations (Figure 4).



Figure 4. The cabin inside the "Elliot" autonomous vehicle. More information at rdahc.com.au/wp-content/ uploads/2019/04/Aurrigo-Elliot-Autonomous-Vehicle-Trial-Summary-Report-FINAL.pd

Conclusions

Considering the progressive increase of aging people, giving a new usability perspective to the mobility sector is an incoming and inescapable necessity. Current technologies can provide innovative mobility solutions for older users, giving them a more efficient and safe transportation system increasing comfort, well-being, and social inclusion.

Exploring the elderly's needs is a fundamental activity to understand which requirements can be satisfied by Design Research in the transportation field. Designing mobility for older people is a challenge regarding how it is possible to overcome issues related to motor or cognitive impairments by creating digital and physical solutions able to enhance vehicle accessibility in all phases of the journey.

The paper presents two case studies regarding autonomous vehicles where a highly automated system allows the complete redesign of the passenger's user experience and the vehicle shape, supporting the person in maintaining autonomy and increasing the quality of the traveling experience. The case study is a significant example of autonomous driving because it allows the user to practice non-driving-related activities during the journey, with the only task of selecting the chosen destination. The different relationships between humans and machines can make the mobility experience less stressful and more comfortable due to safety and accessibility improvements. Cars presenting self-driving features seem to be an effective solution to make transport more inclusive for aged drivers; these peculiarities can be divided into two main groups: the digital and the physical ones. The first group regards mainly the service aspects related to digital technologies, characterized by a high level of automation, providing inclusive interfaces with simplified functions and graphic layouts that can easily guide the user through a facilitated and pleasurable non-driving experience. The second group is about the physical features of the vehicle that, free from traditional constraints, can explore new shapes, such as wide screens or boarding platforms, to physically facilitate the user in accessing every aspect of the vehicle. Self-driving cars represent nowadays a great chance to provide efficient solutions to older drivers, opening an innovative design field where experimenting with new useful and meaningful technologies, solutions, strategies, and interactions can produce a more age-friendly future for the elderly.

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How to promote well-being and accessibility in Virtual Reality



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Keywords: Digital Design, Virtual Reality, Accessibility, Design for Augumented and Mixed Reality.

Abstract

In today's digital age, XR (Extended Reality) can transform everything we envision into tangible experiences, and VR (Virtual Reality) is emerging as an innovative technology with the potential to revolutionize numerous fields. This paper aims to explore the use of VR as a medium to promote wellness and accessibility with a user-centered approach and a focus on user vision as a pillar in the design system of VR experiences. A good VR design system achieves several key objectives, which enable users to improve visual consistency and provide a higher experience. Designing for VR includes unique goals peculiar to a real time interactive environment than desktop or mobile platforms: user immersion in the virtual space for engaging experiences, interaction with direct and new input modes, user comfort, and intuitive navigation. The research highlights these traits, making VR effective and beneficial in wellness contexts. Drawing on a few case studies, the paper aims to connect applied research, that embodies current and upcoming digital application advancements in inclusion and health. The focus will be

on the methodological elements of design process rather than the realm's outcomes. The research will address the effective terms to define the state of affairs in the light of some as yet unfulfilled potential of these technologies.

Introduction

By the 1990s, we entered the digital era, and the presence of technological devices had become part of daily life for everyone; Mark Weiser, researcher at Xerox PARC and leader of the Ubicomp Group (Weiser et al., 1999), envisioned almost invisible computing devices that interact naturally with users. He coined the term "ubiquitous computing" to define how he thought "the computers of the 21st century" would be; the expression ubiquitous perfectly described his vision, which was premised on the progressive idea that computer technology should be integrated into the context of human environments and activities, rather than being separated from it (Weiser, 1999). Over time, information technology has seamlessly integrated into our lives: a prime illustration is smartphones, now ubiquitous tools offering diverse features and services accessible at all times.

Since the 1990s, Extended Reality (XR), especially Virtual Reality (VR), surged. VR, defined as tech creating simulated interactive environments (Schöne et al., 2023), evolved from 1950s to 1990s, moving from academia to groundbreaking developments. The Sensorama, developed in 1960 by Morton Heilig, embodied progress: it had multisensory, visual, auditory (Heilig, 1962), stereoscopic view, stereo, sound, ventilation, vibrating chair and smell, but it lacked interactivity (Mandal, 2013).

From its inception, VR has been seen as a means to enhance human interaction via shared virtual environments. This technology [...] evoking the sensation of being present. It allows users to interact with a simulated environment that can be customized to meet specific needs and goals, and provide researchers with a controlled environment to study human perception and behaviour under realistic conditions (Schöne et al., 2023). This technology continues to rapidly evolve, branching into diverse domains, becoming increasingly omnipresent with notable novel applications, progress, and innovations. Explorations into VR encompass many input tools like eye tracking, finger tracking gloves, optical finger tracking, and six degrees of freedom controllers. In development, cameras and pose estimation tackle user representation in HMDs. Other devices gaining ground in VR are: haptics, vests, treadmills, tracking, optical scanners for gestures (Anthes et al., 2016). Consumer VR adoption grows, and more viewers are available.

Given these premises, the rise of VR has expanded perspectives in personal well-being and accessibility, leading to incisive applications shaping our world. Through immersive virtual environments, VR shows its potential in enhancing well-being and enabling participation, especially for those facing physical or social barriers. Innovative uses like virtual therapy, fitness, inclusive education, accessible travel, and disability simulations break new ground, letting people transcend previous limitations. These VR solutions have the potential to significantly enhance quality of life, offering immersive, therapeutic, and educational experiences that foster autonomy, awareness, and empathy.

A study from Psychological Medicine, aimed at highlighting the potential of VR technologies in mental health, found that VR exposure-based treatments can reduce anxiety disorders, and treatments seem to perform comparably in efficacy to face-to-face equivalent interventions, with evidence that the beneficial effects transfer to the real world (Freeman et al., 2017).

This paper aims to comprehensively explore the effective promotion of individual well-being and accessibility through VR for a diverse range of users.

Focusing on VR well-being and accessibility is vital: well-being affects life quality, VR enriches emotionally, psychologically, and physically. Accessible VR benefits all, even those with barriers. Prioritizing design with well-being and accessibility in mind creates equitable and inclusive solutions, fostering user rights, while driving innovation, shaping diverse VR experiences and impacting society and professions.

To support this paper, several case studies will be presented to exemplify the practical application of this technology across diverse contexts. The selected case studies focus on specific scenarios where VR has demonstrated a significant impact on both individual well-being and accessibility. An in-depth analysis will be conducted on the applied methodologies, obtained results, and challenges encountered in implementing VR-based solutions.

Applied methods

This study has employed a methodical approach based on researching user requirements and needs on which to shape and define visual and interactive solutions and assets to investigate the design of interfaces in VR with the aim of promoting well-being and accessibility.

VR interface design crafts intuitive, immersive user experiences. Understand VR capabilities, limits, user expectation — hardware, tracking, interactions. Define key goals, from menus to object interaction. Build spatial Info Hierarchy for attention and retrieval. Place elements strategically by task relevance.

The research methodology had multiple steps, starting with conducting a comprehensive review of technical documentation to gather relevant information on VR interface design. In addition to scientific reports, the analysis of technical documentation from sources as Oculus provided detailed technical specification and guidelines. Oculus' guidelines ensure safe experiences, though evolving VR might challenge comfort. User tests are crucial. Meta Quest developers suggest, as basics: prevent discomfort, address photosensitivity, plan user breaks (Oculus Developers, 2016b). The documentation also address accessibility: key for inclusive design. Wider user needs shape accessible apps. Designing inclusively broadens audience and pleases core users naturally (Oculus Developers, 2016a).

A comprehensive analysis was conducted on the retrieved technical documentation, coupled with scientific literature, to identify common themes, problems, and successful strategies in the field of VR. The objective is to holistically assess VR interface design's current state by merging insights from research and technical sources, with a focus on well-being and accessibility enhancements. This approach combines academic and practical aspects for a comprehensive understanding.

Case studies

Interfaces have two main parts: indicators for conveying info and controllers for user actions. Indicators cover data, errors, suggestions, and cues. Controllers are switches, buttons, sliders. Real-world systems show interface principles; crafting user-centred interfaces is vital.

Virtual Reality boosts accessibility via immersive experiences for disabilities. VR interfaces must offer clear action feedback, using cues, animations, sounds, haptics.

For Education and Training, VR creates inclusive learning, catering to diverse needs. It enables immersive experiences like trips, history, experiments. Adapting VR aids motor-impaired users with gestures, voice, and input. Vision focus is eye comfort.

In Medical Education, VR offers immersive learning. Students explore 3D models, surgeries, scenarios. This tech aids understanding complex concepts.

Artista

ARTISTA (Figure 1) is a VR software developed in Unity (Unity Technologies, 2023), visually designed by Asternox¹, developed by Sautech² and CETMA³, and targeted for MEDAARCH⁴. The software is an intuitive and minimal virtual pottery modeling system in VR, catering to both novices and experienced users exploring ceramics' creativity. The original goal was to create a synergy between artisans and professionals, to make the former alleged "Artisans 4.0" with the support of the latter. This goal was later modified, and the user base was expanded to include novice users, since the software could promote well-being through craft experience and creative expression: arts and crafts can be therapeutic activities that promote relaxation, concentration, and creativity, contributing to mental well-being. It also educates, encouraging hands-on learning to empower users to acquire practical skills from the field of digital crafts and promoting the acquisition of more technical knowledge, such as craft fundamentals, various modeling techniques, or material characteristics. Immersive VR can offer great advantages for learning: it allows a direct feeling of objects and events that are physically out of our reach, supports training in a safe environment avoiding potential real dangers, and increases the learner's involvement and motivation while widening the range of learning styles supported (Freina & Ott, 2015).

¹ Asternox is a digital agency that specializes in digital humanities and technical IT fields. ² Sautech is a system integrator that offers technologically advanced services and applications, mostly in the fields of industrial automation, process control, and information technology. ³ CETMA is a RTO that undertakes applied research, experimental development, and technology transfer in advanced materials, ICT, and product development. ⁴ MEDAARCH is a product design and architecture startup that specializes in innovative and sustainable methods and technology.



Figure 1. The graphic interface of main menu of the software ARTISTA, immersed in a simulated VR environment.

In the interface design process for ARTISTA, a user-centred approach was adopted, including studies on the unique UX for the VR environment incorporated with in-depth research and preliminary testing using proto-personas. The primary goal was to enhance interface usability and accessibility, considering VR device limits. Furthermore, to understand how users interact with the VR interface and give them an immersive experience, an iterative design technique was adopted. User-centred approach keys into user needs, expectations and capabilities. This combination allowed to adhere to two fundamentals specific to VR design: immersion and interaction. These fundamental aspects enable both the creation of an immersive experience in which the user perceives a coherent environment, as well as intuitive and efficient interaction with the environment and virtual objects, both of which are critical to ensuring a satisfactory user experience.

The research phase centred around human vision to ensure an immersive experience and excellent visual comfort: it is critical to appropriately depict the depth of objects for both user comfort and accessibility. Stereopsis (depth perception based on eye distance) is the most significant depth "sensor," and Oculus guidelines explains how to calibrate interpupillary distance (IPD) effectively to ensure correct depth perception (Oculus Developers, 2016c); figure 2 illustrates how the optimal eye comfort zone system is applied to ARTI-STA'S interface.



Figure 2. The eye comfort zone system applied to ARTISTA's main menu.

Finally, in order to improve the software's accessibility, additional research has been conducted on interface customization features, which allow users to adapt the arrangement of elements, icon sizes, or interaction modes to further enhance the user experience by providing a sense of control and adaptability; multiple control methods allow users to select the mode that best meets their needs, as well as support for assisted movements to aid users with motor limitations.

BeezMath

BeezMath⁵ (figure 3) is an app developed by Team MAMART⁶, which includes some Students from the Apple Developer Academy of Naples, year 2022/2023. The prerequisite of the app is to be an acces-

 ⁵ https://apps.apple.
com/it/app/beezmath/ id6449602780
⁶ Team members are Maura De Chiara,
Antonio Esposito,
Matteo Altobello,
Antonio De Luca, Ravi
Heyne and Tommaso
Golino. sible calculator for enabling people who are blind and visually impaired with easy and inclusive access to mathematical computation. The app also provides a user-friendly interface and includes creative features to meet to the needs of these communities, ensuring that everyone can engage in mathematical calculations effortlessly. The application uses haptic technology (which refers to the ability to provide tactile or sensory feedback to users through the sense of touch) and audible feedback to convey information that is also visual, and is developed through innovative joysticks. The employment of haptic technology with joysticks as a simple and immediate mode of interaction between the virtual world and the user, allows the latter to experience information extracted from mathematical functions and their graphs via vibrations and tactile patterns.



Figure 3. The user interface of BeezMath, with joysticks, main component of the app.

Active exploration in tangible interfaces extends sensitivity in haptic feedback, providing a hands-on way to extend our perception. Haptic interfaces are powerful tools for interaction, using visual, auditory and haptic feedback (Farr et al., 2012). Haptic technology, however, is relatively new, but has the potential to create physical sensations like pressing buttons, holding balls or new touch sensations. This makes it understandable as to why the iPhone and touch screen technology has become more advanced than interactive gaming equipment, which, whilst popular, has not had as much immediate impact on the technological market (Farr et al., 2012).

Underlying digital accessibility is the human being's right to equality and full participation not only in the digital transition but in all aspects of life connected to ubiquitous computing. Disabled people represent a population where immersive VR can really make the difference, especially since 2015, when the first affordable HMDs appeared on the market (Freina & Ott, 2015). On the basis of the research conducted by Team MAMART and their collaboration with members of the UICI (Italian Union of the Blind and Visually Impaired), many people with partial or total visual impairments are unable to be fully included in the educational landscape because the accessible digital environments available to them are few, poorly developed or the devices are particularly expensive. Calculus, in the main, is the most neglected aspect of accessible education: according to further research by Team MAMART, the main and the most cost-effective mathematical medium that students who are blind or visually impaired have at their disposal is their own speech. These digital technologies and new methods of interaction have established new controllers and new potential forms of interaction (Farr et al., 2012), which have the opportunity to create new forms of accessibility for people with disabilities. It goes without saying that the joystick haptic feedback implemented in the app can be beneficial for other types of disabilities, such as motor disabilities (some people may benefit from not having to type on the keyboard), cognitive disabilities (auditory and haptic feedback can facilitate concentration or comprehension, improving self-efficacy), or multiple sensory disabilities (haptic feedback can replace other sensory modalities).

Virtual Reality for Medical Education

Virtual Reality gains traction for mental health and medical use, as it offers potential for enhancing medical education and patient care. VR enhances traditional medical education methods by providing an immersive simulated environment that allows learners to engage with the environment and virtual characters in a way that feels real (Pottle, 2019). Among the medical domains in which VR environments are most successful there is surgery: based on the 2020 UCLA David Geffen School of Medicine clinical validation study, VR training with VR improved participants' overall surgical performance by 230% compared to traditional methods, and the VR-trained participants finished surgical procedures 20% faster (on average) and completed 38% more steps correctly in the procedure-specific checklist than the traditionally trained group (Blumstein et al., 2020). Immersive simulation empowers surgeons to practice safely, refining skills without patient risk; VR lets surgeons simulate brain surgery, experience stages, gain comfort, and enhance performance.

Investment in surgeons' training is important for high-quality health care: worldwide, more than 80% of people diagnosed with cancer will require surgery during their disease course, but only 5% to 20% of low and middle-income countries have access to safe, affordable, and timely surgery (Bing et al., 2019). The use of virtual reality would contribute significantly both in the time required to master surgical procedures, both in terms of cost-cutting and ensuring that doctors have the skills and abilities required to undertake difficult and delicate surgical procedures, as well as staying current on the latest surgical techniques and technologies.

In surgical training, the use of VR technology has been shown to improve surgical skills, reduce errors, and increase trainee confidence. VR simulators can provide a safe and controlled environment for trainees to practice procedures and develop their skills before working on real patients (Li et al., 2017). In particular, laparoscopic simulators are commonly used to train surgeons in minimally invasive procedures; These simulators (figure 4) typically consist of a computer screen or headset that displays a virtual environment, along with specialized controllers or haptic devices that simulate the feel of surgical instruments (Li et al., 2017).



Figure 4. Medical training uses VR: Nursing student in headset, cardiac exam on virtual patient, group learning with VR, pupil responses in virtual patient. (SOURCE: Virtual Reality in medical education, Jack Pottle). There are many more benefits related to the use of VR in surgery: it enhances traditional medical education methods by providing an immersive simulated environment that allows learners to engage with the environment and virtual characters in a way that feels real, and this allows them to learn from experience as they would do in real life, then providing feedback and debrief on performance. VR scenarios are repeatable, allowing learners to make mistakes safely and then learn through deliberate practice to improve performance (Pottle, 2019).

The advantages of using VR in surgery would also bring benefits to the healthcare system: surgeons who are well-trained can perform surgical procedures safely and effectively, leading to fewer complications and hospitalizations, which could reduce the overall cost of medical care for patients. In addition, by performing surgical procedures more quickly and efficiently, the workload on the health care system is reduced as the resources are freed up to treat other patients, contributing to the improvement of the overall quality of medical care.

Conclusion

This paper investigated the use of VR as a tool to promote well-being and accessibility in the context of digital health; the potential of VR in improving people's health and well-being was emphasized (primarily in terms of immersive experiences and user involvement in the contents of the virtual environment) through the analysis of case studies, with different contexts but similar and complementary in some aspects.

The first case study highlighted how VR can foster creativity, artistic expression, and hands-on learning while significantly improving mental health and psychological well-being through a properly designed user experience. The second illustrated the importance of VR in accessibility (especially in user vision). Virtual reality has brought new ways of interaction that are helpful in providing all users with alternative methods of interacting with virtual environments and information, thus improving access to information and increasing participation. The third case study is more general but equally important, and presents the use of virtual reality as a lowcost but high-impact resource in the medical field, particularly in surgery; throughout, the benefits of VR in this field are visible in the healthcare system, substantially reducing the workload of the medical care system.

The Case studies highlight VR's digital health potential. Immersion engages users in virtual reality, yielding presence. VR in digital health boosts well-being through creativity, learning, info access, healthcare skills. It shifts medical education, pain management, mental health.

However, despite the promising potential, there are several persistent challenges in integrating virtual reality into the digital health domain. Prioritizing inclusive design principles is crucial to ensuring equal access to VR technologies for all users. Additionally, there is an ongoing need to enhance the user experience within VR environments.

Observing narrative experimentation and imaginative exploration in technology deeply affects the design and development of the digital reality. Indeed, usage, production, and design are intertwined in industrial solutions. Any interface is reducible to key elements, information architecture and usability testing, offering measurable criteria to which any interaction artifact must answer; what will be the criteria for the ergonomics of a hybrid environment in which human and machine merge in terms not only of instruments but also of language, information flow, to the point of configuring a new artificial, synthetic and humanized essence?

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The Impact of Covid-19 on the Psychological Techniques Used by Visual Merchandisers in the Retail Sector



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Keywords: Covid-19; Visual merchandising; Retail environments; Psychological techniques; Design impacts.

Abstract

Visual merchandisers use psychological techniques to target consumers' unconscious mind and influence buying patterns. Successful implementation of these techniques results in increased sales and market share. However, the Covid-19 has changed the user's behavior in stores and visual merchandisers have conceived new design strategies to ensure safety and hygiene; this trend was evident during the first years of pandemic. The impact of Covid-19 on VM is therefore crucial to understand the evolution of design aspects related to health and wellbeing. Specifically, this study investigates how the consumer attitude has changed with the introduction of Covid-19-related social distancing protocols. It draws upon comparisons in consumers priorities demonstrated during a shopping experience and how mindsets have changed. The evolution of consumers' priorities before and during the pandemic is portrayed. Finally, in the perspective of new restrictions or similar conditions, behavioral-based recommendations for visual merchandisers useful to meet the customers' changing preferences are presented to ensure that stores are attractive, healthy, well laid out, and entice consumers in.

Introduction

The Covid-19 pandemic has produced dramatic changes in the way people use public spaces. These effects were particularly evident in the retail sector (Hall et al., 2020): in many countries, all non-essential stores have been closed for a substantial amount of time. Eurostat (2021) stated that the trade volume of non-essential shops drastically decreased; store sales fell dramatically, with consumers having to move to online shopping (Donthu & Gustafsson, 2020). When stores were able to reopen, safety measures were introduced.

Safety measures related to health impacted both the human side and the design of stores. At the human level, people started to visit stores in a new way and purchasing habits have remarkably changed. At the design level, store managers and brands created new guidelines to arrange store layouts and visitor experience (Lopes & Reis, 2021). The visual merchandisers' role became central to conceive new design strategies to overcome the fear of the virus and to interpret the changes in consumer behavioral preference.

Visual merchandisers have long used psychological techniques when designing a store to increase product sales, as the unconscious mind is the main driver behind consumer decisions (Martin & Morich, 2011). All be it a consumer may enter a store with clear intentions of buying a specific product, it is the VM techniques that grabs the attention of the unconscious mind of the consumer and encourages them to make a purchase that they had not previously considered. However, during the Covid-19 restrictions, some of these techniques were ineffective and the attitude of the consumer changed, as feeling safe in a retail environment was one of the main priorities.

This study analyses what effects the pandemic has had on techniques used in the VM sector. It provides evidence about new factors to consider when designing adapted shopping experiences that are healthy, as well as techniques to be employed to face similar threats that will limit the customers' interaction with physical environments and products. This work also provides indication on the evolutions occurred in the VM sector and on the role of new psychological techniques that can be used in the design practice.

Methodology

Mixed methods of investigation (Yin, 2015) were used to gain an indepth insight into human behaviours in specific settings, as well as to retrospectively document the evolution of the scenario in the sector and to identify design recommendations. Three main methods were used in this work:

- Literature review: several sources were chosen to investigate the VM practice and to provide a critical insight into the unconscious mind of consumers.
- Interview: based upon a semi-structured approach and followed a set of structured questions allowed to gain an understanding of the profession.
- Questionnaires: an online survey was completed by a wide demographic of consumers in UK to understand their experiences in a retail environment, both pre- and post-pandemic.

Resulting qualitative data were compared to understand how the Covid-19 has affected the attitude of consumers, their priority when engaging in a store, and to establish design recommendations.

Data obtained from literature review

This section presents the main VM techniques employed, extracted from the analysis of key sources. The analysis of design techniques affected and non-affected by the Covid-19 documents significant evolutions in the sector.

Main VM techniques employed

VM techniques are a means in which a consumer can be encouraged into store for a positive retail experience. Effective techniques can stop consumers from walking by and encourage them into stores when they were previously not planning on entering. Successful psychological VM encourages consumers to behave in a certain way without them being aware that their behaviour, or buying pattern, is being influenced as the unconscious mind is the real driver of consumer behaviour (Graves, 2013).

Main employed VM techniques concern: 1) floor layout (Morgan, 2016), 2) grouping (Ali Soomro et al., 2017), 3) colour (Bell & Ternus, 2012) and 4) sensory stimulation (Graves, 2013).

Analysis of design techniques affected and non-affected by Covid-19

As a result of the Covid-19 pandemic, all retail environments have had to adapt due to national guidelines and changes in consumer attitude. This had a large impact on what techniques were no longer feasible to implement in store. Table 1 shows the design techniques affected and non-affected by Covid-19.

VM TECHNIQUES	DESCRIPTION	
Techniques affected by Covid-19	 Aromas made ineffective by compulsory use of masks. Restricted use of products to exploit the sense of touch. Zoning techniques adapted to incorporate one-way systems and social distancing measures. Additional space around displays. Reduced merchandise on displays to give an uncluttered and hygienic view. 	
Techniques non-affected by Covid-19	 High-quality first focal point within the store. Enticing window displays to attract consumers. Creating a positive ambience in store to tune into the consumers' unconscious mind. Grouping and focal point techniques to arrange products. Use of color schemes to create eye-pleasing arrangements. 	
Design-related considerations arose during Covid-19	 Less shopping assistants to aid consumers. Closure of changing rooms. Quarantine of items if returned. Reduced number of consumers allowed in stores at any one time. Reduced browsing times - time-effective shopping experience. Increased queuing times. 	

Design considerations

Data discussed in the previous sections allow defining the following design considerations that help to understand the impact produced by the pandemic in the retail sector. Therefore:

- Focal points had to be more appealing as other sensory techniques were limited.
- Visual merchandisers produced more engaging visual elements to attract the attention of the wider audience.
- Ambience had to be used in more powerful ways to create positive shopping experiences.
- Grouping techniques helped to make products look more appealing as sight was not affected by guidelines.
- Exploited colour schemes, as the sense of sight was not limited whereas the sense of smell and touch were.
- Zoning techniques had a negative impact.
- Reduced space in store resulted in a limited amount of stock being placed on display.

Data obtained from interviews and questionnaires

This section shows qualitative and quantitative data inferred from anonymous questionnaires and an interview with a professional. Findings are later analysed and discussed with the information gathered in the literature review to form a conclusion to the study.

Post Covid-19 effects identified

Primary research allowed to identify important patterns related to the effects produced by the Covid-19 pandemic on the consumer habits. Relevant data discussed in this section portray a picture of main effects identified.

In terms of change in time spent in store pre- and post-pandemic, 7% of respondents has increased the time spent in store, 49% decreased, whilst 44% has not changed (Fig. 1).

On the question 'how much has Covid-19 affected the shopping experience?', 25% of people stated that the effect was a great deal, 30% affirmed that the shopping experience changed a lot, 32% thought that the shopping experience changed moderately, whilst 12% believed it changed a little and only the 1% said that this has not changed at all (Fig. 2).



Figure 1. Change in time spent in store post Covid-19.



Figure 2. Post Covid-19 effects on shopping experience.



About the post-pandemic's in-store comfort levels, the survey revealed that males were generally more trustful than females, though this tendency was horizontal in terms of demographics (Fig. 3).

Finally, participants were asked their opinions on how well retail stores implemented health and safety measures. No participants selected the 'none at all' option, the 8% said that the safety measures were extremely well implemented, the 50% said that the measures were very well implemented, 40% of respondents said that the these were moderately well implemented, and finally the 2% said that the measures were slightly well implemented (Fig. 4).

Figure 3. Did consumers feel comfortable going into a retail store?



Figure 4. How well retail stores implemented the safety measures?

Consumer priorities

The pre- and post-pandemic sections of the questionnaire asked participants to rank five factors concerned with shop design and the consumer experience. This highlighted changes in both the attitudes and priorities of consumers, as well as experiences and feelings. 75% of respondents changed their rankings in some way. Of the 75% who changed their rankings, analysis took place to ascertain what their most important factor was pre-Covid-19 compared to post-Covid-19 (Fig. 5). As the 'lighting and ambience' factor was not ranked as being most important in the post Covid-19 responses this category has been removed from Fig. 5 (right).



Figure 5. Changes in consumer priorities pre Covid-19 (left) and post Covid-19 (right).

Interview response

An interview took place with a professional visual merchandiser working for John Lewis Visual Merchandiser. Responses noted throughout the interview have been reviewed and summarised in key points (Table 2) and further explored to extract design recommendations.

PRE COVID-19	POST COVID-19	FUTURE
 Inspirational design theme of stores. Emphasis on creating a retail experience. Customer journey. Encourage consumers to remain in store for long time. 	 Informational design theme of stores. Interactive features, hot spots and seating areas removed to prevent congregation. Clear signage and instructions throughout the store. 	 Consumers will return to stores after full confidence is achieved. Consumers will adopt 'spontaneous' safety measures, due to changed habits. Important safety measures will remain in place after the pandemic. Store will revert to creating a retail experience when it is safe to do so.

Table 2. Notes from professional interview.

Analysis and discussion

This part provides discussion of findings shown in the previous two parts.

Analysis of pre Covid-19 trends: Browsing

Participants were asked to comment on their browsing habits and attraction to window displays. Of the 42 participants who stated that they liked to browse, 30 of them (71%) were also attracted to window displays.

Trends related to Covid-19

Time spent in stores

49% of participants decreased the time spent in a retail store, whilst 7% affirmed that time has increased. This is in contrast with Graves (2013), who said that the time spent in store is the most important factor of VM and store design. In support of this, the professional interview found that visual merchandisers designed stores in such a way that consumers were encouraged to shop as efficiently as possible. This correlates with the data proving that the number of consumers now spending less time in store could be a result of both the changes in the attitude of the consumer and the purposeful store design changes implemented.

One key factor that was highlighted by participants who have spent less time in stores was the increase in perceived pressure to shop quickly due to the long queues of people outside waiting to enter the store due to capacity restrictions.

Covid-19 effect on shopping experiences

99% of participants stated that the Covid-19 affected their shopping experience to some degree. However, the professional interview found that prior to the pandemic, stores were moving towards providing a healthy retail experience for the consumer, such as safe product demonstrations. Unfortunately, these experiences were no longer provided in store during the pandemic, as all congregational points were removed.

The interviewee also mentioned changes that occurred to window displays, which moved from an 'inspirational' approach to an 'informational' one with clear graphics.

Comfort in store post Covid-19

Approximately 57% of participants still felt comfortable going into a retail store. However, 48% said yes on the provision of good safety measures and distancing rules being implemented and followed by other customers. This is the first time that aspects related to altered conditions of human interaction influence the design of retail stores. This evidences that visual merchandisers were forced to consider new behavioural elements in readapting stores.

When discussing consumer comfort during the professional interview, it was clear that signage plays an essential part in the return of consumers. Clear signage needs to be displayed informing the consumers of how to follow the safety protocols in place. However, the visual merchandiser explained the importance of welcome back signage with the acknowledgement that things have changed, but that the store is still there caring for the consumer. This is supported by the data from the questionnaires whereby approximately 50% of respondents stated they felt comfortable returning into a store if good safety measures are implemented.

Another factor highlighted from the questionnaire responses was the closing of changing facilities, which generally resulted in a negative shopping experience for some groups of consumers and increased the percentage of online purchasing.

Health and safety measures implementation

58% of respondents felt that retail stores have implemented Covid-19 health and safety measures either 'very well' or 'extremely well' with no participants selecting the 'none at all' option. This indicates that retail stores have taken on the responsibility of consumer health and safety well during the pandemic.

Sensory design elements

Positive store designs based on sensory elements Participants stated a preference for well-organised stores and mentioned clear wide aisles, which would also aid in case of new social distancing rules. This aspect is supported by Challis (2020) who predicted that "spacious and uncluttered stores will become essential across the retail sector to prioritise consumer well-being while delivering a positive experience". Furthermore, data extracted from the interview confirmed that the consumer journey is important to the brand as successful design approaches give a positive reputation.

Negative store designs based on sensory elements

A variety of shops were highlighted as having a negative design (Silverton, 2021). This resulted in consumers feeling panicked and stressed when entering these retail stores. For example, high numbers of people or high levels of sensory stimulations. This is supported by the findings of Doucé and Adams (2020), who state "a high level of stimulation in the store environment may consequently require too much processing capacity". Therefore, retail stores that have an extreme level of stimulation of any of the senses may result in consumers leaving the store and a negative effect on the store's reputation.

Temperature and touch

An optimum temperature enhances consumer comfort encouraging them to stay in store for a longer period to browse the merchandise. Research into the sense of touch (Graves, 2013) has found that holding a product for a longer period is a positive indicator of interest. It was highlighted that due to Covid-19, consumers were more aware of what they touch in store.

Changes in consumer priorities

As shown in Fig. 6, post Covid-19 'health, hygiene, and comfort' was the main priority to the detriment of 'product choice' and 'lighting and ambience'. This contradicts traditional studies on VM (i.e.: Morgan, 2016) as only 6% of respondents selected 'lighting and ambience' as main priority when going into a retail store. It may be that 'lighting and ambience', as psychological techniques, target the unconscious mind and consumers are not aware that this is so important to them during a shopping experience. The Covid-19 pandemic had very little effect on 'price' and 'space and layout' whereas 'hygiene and comfort' has more than doubled its relevance.



Figure 6. Consumer priorities pre Covid-19 (left) and post Covid-19 (right).

Covid-19 implications on retail merchandise

During the interview, some factors relating to VM throughout the pandemic became apparent. With vast numbers of people either working from home or being furloughed and spending more time at home, sales of home office equipment and technology products increased dramatically. Similarly, sales of cookware and kitchen appliances together with outdoor seating also increased due to the closure of restaurants. These increases in sales could have been previously predicted when considering the enforced national lockdowns. Alternatively, sales of items such as occasion wear fell due to the cancellation of social events. As a result of the fact that non-essential retail stores were closed for several months during the national lockdowns, stocks that ware in the stores inevitably became obsolete. In addition to this, delays in manufacture and transport resulted in retail stores being uncertain of what merchandise would be available again, and in what quantity.

Conclusion

This work has shown that the consumers' attitude has changed due to the Covid-19, making other effects even on their unconscious mind. Factors like health, hygiene, safety, etc. that were less considered before the pandemic, produced an impact on the psychological techniques currently employed by visual merchandisers in the design of retail environments because such trends have become consolidated behavioural preferences by customers.

Data suggest that younger groups tend to adapt to the changes more easily compared to older generations. Thus, for future scenarios like the ones caused by the Covid-19, visual merchandisers must consider who their target demographic is and focus the stores design to suit them. Consequently, visual merchandisers must be aware of the changes in consumers' attitude, as it is important to adapt to these behavioural changes in the competitive environment, which will undoubtedly follow the emergency scenarios.

This study clearly proved that 'health, hygiene, and comfort' are now three of the main concerns for consumers, as these have become behavioural and psychological priorities. It is expected that this trend will still be visible for years.

Although people will continue to use retail environments, it is likely that some of the adaptions implemented over the last years will remain in place to ensure consumer confidence, so that they can continue to have a positive healthy and safe retail experience (i.e.: signage).

This study also shows that consumers prefer many department stores. Contrary to this fact, it is department stores that have suffered economically in recent years, and especially during the pandemic with the announcement of many store closures. This aspect seems to be very important for visual merchandisers that must consider the experience got throughout the pandemic to design safe experiences for all customers.

In conclusion, the following design recommendations have been identified to aid visual merchandisers when implementing psychological techniques into the design of stores. These elements are recommended to improve the customers' new expectations and to support the ones already employed by visual merchandisers in the design of the effective shopping experiences. Therefore:

- Visual merchandisers should focus on consumer's health and safety and consider how their priorities have changed because of the psychological alterations produced by pandemic.
 - Store designs must reflect the changes in consumer priorities and buyers should perceive stores as safe and inclusive.
 - Stores must be designed to meet customers' new priorities since the beginning of the shopping experience.
- Visual merchandisers must create an overall experience for consumers in a healthy, safe, and comfortable environment.
- Visual merchandisers should ensure that safety protocols are clearly communicated and well managed to alleviate the concerns of the target consumer.

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From pathogenesis to salutogenesis: a perspective shift for happy workplaces



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Keywords: happiness; workplace; organizational ergonomics; well-being; salutogenesis.

Abstract

Happiness as an internal-subjective state based on the situated perception of contextual/relational factors is a topic of recent interest, whose applications to the work context are still scarcely investigated. Even less common is adopting a salutogenic perspective that does not equate happiness with the absence of distress, but promotes employee happiness and identifies the factors that may increase it in the workplace, rather than the ones that may hinder it. The aim of the present paper is to show that a salutogenic mindset applied to a "situated" definition of happiness may benefit current ergonomics models. We first provide a definition of happiness that systematizes the existing contributions and emphasizes the role of contextual and relational factors. We then review how this construct can be applied to the work context following an ergonomic perspective. Finally, we provide an example of how two organizational ergonomics models can be framed within the salutogenic approach to happiness in the workplace: the first to create a work system that balances employee's job demands, job control, and the support from colleagues and supervisors; the second to expand the salutogenic effect of job resources on positive health outcomes. The implications and the advantages of this approach in order to rethink the paradigms underpinning the work context are discussed.

Introduction

Human factors and ergonomics (HF/E) is an interdisciplinary, user-oriented, integrated science. During the last century it has evolved into several branches, encompassing physical, cognitive, and organizational ergonomics. A specific feature of all the HF/E branches is emphasis on human interactions, tools and objects, technology, and environment, in order to develop designs aimed at reducing human error, improving health and safety, and increasing productivity (Bridger, 2018). To this end, HF/E focuses, on one side, on specific aspects of design like tools, procedures, and equipment (micro-ergonomic items) and, on the other side, on structural dimensions such as work organization, communication processes, and technology (macro-ergonomic items). An ergonomic approach has already proven to be effective in promoting well-being in the workplace (Christy and Duraisamy, 2020), but the concept of well-being is somehow limited, and a more holistic approach stressing the value also of situated contextual and relational factors may be more fruitful. Our proposal is that focusing on happiness within the work environment may prove more efficient than concentrating solely on wellbeing. The reason is that the notion of happiness - if considered from a situated cognition perspective encompasses the actual interactions and processes that characterize the here-and-now of the work environment. Consistent with this, the Happiness Agenda (Helliwell et al, 2023), based on millions of survey responses from all over the world, identified the workplace as the third factor in order of importance that affects individual happiness as well as a priority to address for national institutions. But is it really possible to be happy in the workplace? And what exactly is happiness? In the present paper, we will first provide a definition of happiness that systematizes the existing contributions and emphasizes the role of contextual and relational factors, as well as a brief review of how this construct applies to the work environment. Then, we will provide an example of how two organizational ergonomics models based on a (still implicit) notion of situated happiness may increase health and well-being in the workplace. Our general aim is to demonstrate that a salutogenic mindset applied to a "situated" definition of happiness may benefit current ergonomics models and help in rethinking the paradigms underpinning the work context.

Definition of happiness

First, a distinction must be made between the concepts of health, well-being, and happiness. Health refers to a state of complete physical, mental, and social well-being and not merely to the absence of disease or infirmity (WHO, 1992). Well-being, in turn, can be defined as a positive state originating from the quality of the individual's experience as determined by economic, environmental, and social conditions (WHO, 2021). Happiness, sometimes improperly equated with subjective well-being (Kun and Gadanecz, 2022), refers to an internal-subjective state linked to situated and embodied interactions with one's physical and interpersonal contexts (Panelli and Tipa 2009).

Due to its internal-subjective nature, happiness has been investigated mostly with a focus on the individual perception of the happiness experience (thus, basically, equating it with well-being). An interesting contribution that widens the perspective on the happiness construct was provided by a research work by Delle Fave and colleagues, who explored lay definitions of happiness across nations. Results showed that people tend to identify happiness not only in terms of internal positive psychological factors such as inner peace, balance, and contentment (42,33%), but also referring to external relational/contextual factors like family, relationships, daily life, and work (44,24%). Interestingly, work, for example, is more often mentioned than fun as a contextual factor that contributes to the state of individual happiness (Delle Fave et al, 2016).

Happiness as an emotional state is characterized by a twofold structure. On one side, it is related to the emotions and mood that people experience in a certain moment; on the other side, it refers to an individual disposition to experience moods, which vary with the circumstances and it is called mood propensity (Haybron, 2013; Seligman, 2002; Veenhoven, 2015). At the same time, each of these layers is made up of three dimensions: attunement, engagement, and endorsement (Haybron, 2008; Murgaš et al, 2022). Attunement with life consists in emotional states or moods like inner peace, confidence, and harmony; from a neuropsychological point of view it is a transient dimension linked to low-arousal activity. Engagement is linked with vitality, exuberance and flow when facing life situations; it requires high-arousal activity that motivates the energetic pursuit of goals. Finally, endorsement is linked to feelings such as joy and cheerfulness, which motivate one to expand and value the things that life contains.

Much less common are studies that highlight the contextual and relational nature of happiness, although it has recently been recognized that happiness is generated not only by individual behavioral aspects but also by here-and-now embodied interactions with one's physical and interpersonal contexts (Greve, 2023). The importance of contextual and relational factors – including work – in the experience of happiness is underlined in The Big Seven Factors for Explaining Happiness (Layard, 2005). This model posits that the most relevant factors, in order of importance, affecting happiness are: family relationships, financial situation, work, community relations, health, personal freedom, personal values or perspective on life (Layard, 2005; Somarriba Arechavala et al, 2022). Our proposal is that a "situated" definition of happiness may prove particularly useful when discussing wellbeing models applied to the workplace.

Happiness in the workplace

Happiness in the workplace can be defined as "the experience of energized employees, enthusiastic about their work, finding meaning and purpose in their work, having good relationships at their workplace, and feeling committed to their work" (Kun and Gadanecz, 2022). In a situated cognition perspective, work also bears the features of a situated activity (Ehrensberger-Dow et al, 2016), wherein employees work "in a context of personal interactions, in a given place and time [...], in connection with other processes and with an organizational structure" (Kuznik and Miquel Verd, 2010).

As in the case of happiness as general construct, also employee happiness must be differentiated from other conceptually close factors, such as job satisfaction, work engagement, and affective organizational commitment (Loureiro et al, 2023) which refer, respectively, to a positive feeling towards one's job and to the meaning attributed to it (Jegadeesan, 2007), to a work-related inner state characterized by passion and dedication (Schaufeli et al, 2022), and to an emotional attachment to the organization (Mercurio, 2015).

Due to the different nature of these constructs, factors like job control and organizational-based self-esteem (Saks, 2006; Mauno et al, 2007) can increase overall job satisfaction, work engagement, and affective organizational commitment, but have no impact on employee happiness (Fisher, 2010). Only recently, the value of generating happiness in the workplace has started to be recognized (Chen et al 2018), as happier individuals tend to show better physical and psychological health (Park et al, 2014), to handle stressful events more positively (Wood and Joseph, 2010), to perform better (Kun and Gadanecz, 2022), and to be more satisfied with their jobs (Mérida-López et al 2019). In addition, employees with higher levels of happiness are more prosocial and cooperative with their colleagues, show greater self-control and self-regulation, and display more functional coping abilities, and this results in more satisfying relationships in the workplace and in lower levels of burnout (Chen et al, 2018; Layous, 2019).

An important limitation of current research on the mechanisms that generate happiness in the workplace is that it mostly follows a pathogenic perspective, equating the development of employee happiness with a decrease in the perception of distress. Following Lazarus and Folkman (1984)'s theory, the imbalance between the number/ magnitude of workplace demands and the (technical, personal and social) resources the worker has available to adequately respond to them generates a condition of distress (Karasek and Theorell, 1990; Loureiro et al, 2023). Thus, instead of studying the mechanisms generating happiness, research has focused on the mechanisms leading to a decrease of the potential stressors and on the modalities to create a balance between demands and personal resources. In this perspective, happiness equates to the absence of stress, just as health was once identified with the absence of disease. However, it is well acknowledged by now that being happy is quite different from "not being unhappy" (Riolli and Savicki, 2010). In addition, following this pathogenic approach, it follows that the tools and strategies proposed to enhance happiness in the workplace tend to apply an assistive approach aimed at providing the employee with the missing resources which can avoid or prevent the insurgence of distress (Li et al, 2019; Kong et al, 2021).

A paradigm shift appears necessary, which approaches the promotion of employee happiness from a salutogenic approach (Antonovsky, 1979) and focuses on identifying factors that contribute to increasing happiness in the workplace rather than on reducing the factors that hinder it. In the words of Antonovsky (1987): "A distinction must be made between the elimination of stressors and the development of health enhancing job characteristics". It has been shown that the salutogenic and the pathogenic approaches are linked to opposing self-regulatory attitudes: in a promotion orientation, individuals show an "eager" processing style, motivated to achieve opportunities and associated to positive moods (hope, contentedness); instead, a preventive orientation fosters a "vigilant" processing style, motivated to avoid risks and associated to negative moods (sadness, fear) (Schwarz, 2006).

On happiness promoting factors, Antonovsky offered a dense description of a workplace where individuals may experience meaningfulness, manageability, and comprehensibility, which are the dimensions of what he called "sense of coherence". This idea has subsequently been picked up by many other authors (Jenny et al, 2022). More recent contributions have identified also positive stress (eustress) and employee engagement as constructs that mediate and support the development of happiness (Loureiro et al, 2023).

Based on Antonovsky's writing on health promoting factors at work (1987), his original model of salutogenesis was specified and simplified for the work context: job resources are part of the "generalized resistance resources" that allow for coherent (in terms of meaningfulness, manageability, comprehensibility) work experiences. This perception of coherence influences the ways in which an individual perceives, appraises, and copes with stressors in working life (the so-called job demands), and the tension they induce (Jenny et al, 2022). An employee with a high sense of coherence might, for instance, perceive and appraise the demands of her work environment as challenging (promoting attitude) rather than threatening (preventive attitude). Furthermore, that employee will feel confident that resources are available to cope with the demands, and she/he will also be more likely to select an appropriate coping strategy.

Organizational ergonomics for happy workplaces

May shifting from a pathogenic to a salutogenic perspective while discussing organizational ergonomics models contribute to increasing health and well-being in the workplace? We present, as an example of this kind of perspective change, two organizational ergonomics models which – while not explicitly referring to situated happiness – do highlight the importance of promoting the employee's personal resources and the need to focus on the reciprocal impact that individual and environment play on each other (Xanthopoulou et al, 2009). The first is the job demand-control-support (DCS) model by Karasek and Theorell (1990). This model aims to create a work system that balances employee's job demands, job control, and the support from colleagues and supervisors. The already cited study by Jenny et al (2022) proposed a salutogenic application of the DCS, where work engagement mediates the impact of job control and support on depression symptoms. This research work also demonstrated a strong relationship between job control and support with employee engagement as a positive outcome.

The second example is the Job Demands-Resources (JD-R) model, which explains how job characteristics affect employee well-being and health and widens the scope of the DCS model by taking into account also the salutogenic effect of job resources on positive health outcomes. The JD-R model categorizes job characteristics into job resources – positive aspects that promote growth and development – and job demands – negative aspects that require effort and can lead to health problems. The model describes two processes: a positive process where job resources motivate individuals and contribute to positive health outcomes, and a negative process where job demands can impair health (Bakker and Demerouti, 2017). The model also distinguishes between a pathogenic path – job demands leading to health decline – and a salutogenic path – job resources leading to personal growth and positive health. Positive health includes physical, mental, and social fulfillment, while negative health refers



Figure 1. 2x2 matrix of Rosso et al (2010) key processes.

to impaired functioning. The model emphasizes the importance of job resources in promoting positive health and mitigating the negative effects of job demands. Organizations can create healthier work environments by addressing these factors to support employee well-being and satisfaction (Jenny et al, 2022).

Rosso et al (2010) edited one of the most extensive reviews of meaningfulness within the work context. The team described six psychological processes that drive perception of work meaning: self-efficacy, self-esteem, authenticity, purpose, transcendence, belongingness, and interpersonal and cultural sense-making. Then, these key processes were mapped into a 2x2 matrix with "self-other" and "agency-communion" as the two axes. The results have been summarized in four categories (Figure 1) (Rosso et al, 2010).

Conclusions

In this paper, we fist reviewed current definitions of happiness, emphasizing the advantages of applying a situated cognition perspective that appraises happiness as an internal positive state linked to situational and interpersonal contexts. Applied to the workplace, this perspective considers happiness in terms of the actual interactions and processes that characterize the here-and-now of the work environment. Then, we presented a re-reading of two models (DCS and JD-R), based on the notion of situated happiness, showing how a shift from a pathogenic to a salutogenic approach to organizational ergonomics models may benefit workers and work organizations.

We suggest that organizational ergonomics can play a significant role in creating happy workplaces. This involves considering both micro-ergonomic aspects such as tools, procedures, and equipment, as well as macro-ergonomic dimensions such as work organization, communication processes, and technology. Organizational ergonomics models based on the salutogenic approach, such as the Job Demands-Control-Support model and the Job Demands-Resources model, can help organizations in designing work systems that balance job demands, control, and support, thereby fostering employee happiness. Further research is needed on the mechanisms that generate happiness in the workplace. Future studies should explore the role of various factors, such as job control, support, engagement, and eustress, in promoting employee happiness. Additionally, research should focus on developing practical tools and strategies based on the salutogenic approach to help organizations create and sustain happiness.

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