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Design for psycho-physiological balance

The great amount and quality of inputs to which the human being is constantly exposed, influence daily life and affect the conditions of psycho-physical wellness. Rethinking the relationship of people, and in particular young people, with the surrounding environment is necessary to restore a renewed priority to the creation of physical bonds and personal well-being. It is essential to put a brake to the frenetic rhythms of life and re-establish a "healthy" contact between humans and nature, the primary source of well-being. Therefore, this contribution aims to highlight the response of design to this urgency through the description of projects, developed within Hybrid Design Lab, based on re-establishing a direct experiential link with nature and in particular with its vegetal component to stimulate users to re-evaluate the relationship with the surrounding and the natural environment, according to an approach centered on empowerment and self-awareness. In this scenario, in fact, design has a fundamental role because it is able to design experiences, products and services that propose themselves as solutions capable of restoring the balance between analog and digital components in a "one health" perspective. The intrinsic educational quality of objects is therefore, understood as fundamental to promote new environmental balances for the new generations.

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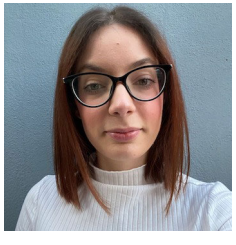

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Keywords:
Well-being; Connection; Biophilia; Hyperstimulation; Revaluation

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INTRODUCTION

The recent pandemic of Coronavirus-2 (SARS-CoV-2) has transformed people's relationship with their environment, with effects that persist even after the period of strong restrictions. It pointed out the urgency of slowing down contemporary lifestyles by highlighting the need to re-establish a deeper relationship between humans and nature. It further rooted the use of digital technologies, reducing relational distances and dissolving the boundaries between social, work and private life environments by being always connected and available. These changes have an impact on the psycho-physical well-being of people, especially for younger ones, increasing levels of stress and anxiety (Gonski Institute for Education, 2020).
At the same time, especially in urban contexts, there is a widespread phenomenon of insensitivity to green, called plant blindness (Wandersee & Schussler, 1999), that leads to ignore the important presence of vegetation in their environment. In this scenario, the principles of biophillic design are a model for products' and services' design, useful to restore the balance between men and natural environment as a function for individuals' well-being, also from an educational point of view. This paper aims to highlight this contribution by describing projects based on the re-establishment of a direct experiential link with nature and in particular, its plant component to stimulate users to reassess the relationship with the surroundings, according to an approach centred on empowerment and self-awareness (Green & Tones, 2010). The cases analysed are distinguished to educate users, make green a bodily experience and make visible the invisible of nature. Sometimes they even use digital to bring attention to the details and the charm of nature and its phenomena. In other cases, upcycling processes of plant waste are proposed to demonstrate the value of natural matter. The educational aspect, aimed at promoting a deep knowledge of nature in the new generations therefore, assumes a primary importance in the search for new balances in the environment.

BENEFITS OF DIRECT CONTACT WITH NATURE IN THE DIGITAL AGE

If the period of Coronavirus-2 pandemic has represented for men a moment of fragility and isolation, for nature, on the contrary, has been a breath of relief from oppression and omnipresence of human domination. A research conducted by the Institute for Bioeconomy of the National Research Council (CNR-IBE) and published later in the international journal Environmental Pollution, has analysed six of the most populated italian cities, going from north to south, during the Covid-19 lockdown period, to assess the impact of road traffic on air quality in urban areas (Gualtieri et al., 2020). The lockdown has led to significant changes in air pollution and greenhouse gas emissions. The 48% - 60% reduction of road traffic offered a unique opportunity to study how a significant and prolonged decrease in emissions positively affected urban air quality, leading to a marked decrease in nitrogen dioxide (NO2) levels.
The pandemic period has certainly highlighted the vulnerability of human beings and inevitably rewrote the balance between physiological and psychological well-being. In addition to the significant economic consequences, concerns have emerged about less obvious mental health effects related to stress, isolation and lack of social connection. As well known, to face the World Health Organization's measures, in order to slow down or prevent the spread of the virus, many cities around the world have had to implement various restrictions that affected mobility and public life, redesigning individuals' habits and social spaces, inducing them to study and/or work from home.
This change in everyone's routines has generated several negative effects on physical and mental health, mainly related to the decrease of social relations, restrictions on access to public places and restrictions on outdoor activities (Dushkova et al., 2022). Immediately after the first wave, world leaders and health professionals, recognizing the early consequences of pandemic restrictions, have been unanimous in encouraging people to engage in outdoor activities to improve their well-being, in places where it was possible, also to ensure the still necessary social distancing. For many, it was an opportunity to rediscover, or even discover for the first time, the green lung of their city. Green areas have allowed safe spaces for socialising and going out, playing sports, getting in touch with nature, finding peace, tranquillity, and spending time with ease free from stress and anxiety (Grima et al., 2020). They have therefore made it possible to safeguard mental health at a particularly necessary moment.
As known, there is a wide literature on the effects of nature in improving cognitive, physical and psychological health (Jimenez et al., 2021). Exposure to these places promotes a better brain activity, blood pressure, mental health, physical activity and sleep, even in the youngest. In particular, a few minutes per day, in total 2 hours per week (White et al., 2019), in contact with nature reduce symptoms of anxiety, physical stress and heart rate (Shuda et al., 2020), improve mood by helping with the symptoms of depression (Berman et al., 2012) and make them more relaxed, "recharging" the levels of attention and concentration. In this perspective, develops the Attention Restoration Theory (ART), a theory born to remedy the frenetic rhythms of contemporary living and the numerous technological stimuli to which the brain is constantly subjected, that put a strain on the working memory and sustained attention (Macit, Macit & Güngör, 2018). According to this theory, spending some time in contact with nature, in more peaceful environments, improves cognitive performance, reducing mental fatigue and improving concentration (Jimenez et al., 2021). The results of an experimentation at the University of Illinois indicate that children with ADHD (attention deficit hyperactivity disorder), whose main factors in symptomatology are inattention and emotional dysregulation, show an improvement in attention functioning after recreational activities in green environments, and more the play area is green, less severe the symptoms become (Taylor, Kuo, & Sullivan, 2001).
In this sense, ART provides a motivation to investigate the potential benefits of exposure to nature for issues related to anxiety, stress and inattention affecting an increasing number of subjects, mainly due to the growing use of technological devices that

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stimulate a release of dopamine using gratifications and instant rewards as likes, comments and notifications (Macit, Macit, & Güngör, 2018). Users, in this way, are increasingly motivated to spend time on social media through their smartphones. The use of these devices intensified during the lockdown, as they were seen as the most accessible means to stay in touch with loved ones or with the rest of the world, receiving news and information not always completely reliable (Alshare, Moqbel & Merhi, 2023). During the quarantine period, technology has played a crucial role in everyone's lives, especially those of children and teens, influencing various aspects of their development and daily life. From distance learning due to school closures, to the use of new digital tools to spend time or to enrolling on online platforms to socialise at distance. This, in the long term, has led to an increase in screen time with harmful impacts (Orgilés et al., 2020) on mental (anxiety and stress) and physical (sedentary and myopia) health, also compromising cognitive development (Gonski Institute for Education, 2020). Between 2021 and 2022, according to Istat and Save the Children in the XIV edition of the Atlas of at-risk childhood in Italy, on average about 65,9% of children in Italy between 6 and 17 years old used their smartphone every day. This figure seems to be dramatically increasing, since in the 2018-2019 biennium the use of smartphones in children between 6 and 10 years was 18,4% but today it is 30% higher.
The Covid-19 crisis has marked a turning point in the digital transition: on the one hand, technology has gained more and more space in the daily life of every person, especially the youngest, on the other hand, the excessive and uninformed use of these digital tools has led to face a new "crisis of the individual". Reconnecting with natural elements of the planet would restore the necessary physical and mental balance, while rediscovering the essential values of life. Nature has always provided answers to the needs and daily problems, and in this context design plays a key role.

Fig. 1. Natural-mente: kit to promote the knowledge of nature's details in children. Design by Enya De Rosa; scientific group Carla Langella, Valentina Perricone.

BIOPHILIC DESIGN APPROACH FOR HUMAN NATURE RELATIONSHIP

Humans are, therefore, constantly exposed to a multitude of external inputs that influence and shape their relationship with their environment. The quantity and quality of the input we receive from the outside world influences our daily life experience, impacting on our psycho-physical well-being. Therefore, it is necessary to rethink people's relationship with their environment in order to give renewed priority to the creation of physical relationships and personal wellbeing, putting a brake on the frenetic pace of life and re-establishing a 'healthy' contact between humans and nature, the primary source of wellbeing. In this sense, biophilic design stands as a design model based on the search for natural characteristics that have positive effects on human health. Biophilia is intended as the atavistic affiliation of human beings with other living organisms and which also innately affects the physiological and psychological well-being of human beings (Wilson, 1984). People have developed a vital bond with the natural environment - to survive, obtain food, shelter and protection - such that they are now seeking those same characteristics in the natural environment (Orians 1980). According to

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Kaplan and Kaplan (1989), the attentional system has evolved to be sensitive to biophilic features that favour survival and reproduction, so there is an implicit connection between the human mind and nature. This highlights how attraction to the natural environment is not just an aesthetic factor but an evolutionary adaptation. Restorability theories are supported by that, including ART and the Stress Recovery Theory (SRT). This theory, based on the same evolutionary principles, considers the natural environment to consist of reduced levels of arousal and stress (Ulrich, 1983). For this reason, the use of natural elements - water, light, plants, time patterns - and indirect experience - images, materials and geometries - within the built environment, following the biophilic design model, affects the attention and concentration levels of individuals (Gillis & Gatersleben, 2015). The implementation of natural elements in environments enhances well-being by reducing stress, improving immunity, muscle tension, blood pressure, heart frequency, increasing dopamine levels by reducing anxiety and improving physical and mental performance (Kaplan & Kaplan, 1998; Kellert & Calabrese, 2015; Ulrich, 2008; Wilson, 2008; Boga et al., 2022).

Consequently, considering contemporary features of environments, the biophilic approach appears to be of great relevance also for the design of experiences, products and services for industrial scale. In fact, possessing a tool to complete a task is one of the most important cognitive adaptations in human evolutionary history (Petroski, 1992). However, from an evolutive perspective, the ways of interacting in space and with objects are different. For this reason, there has been increasing research in design in recent years that discusses the importance of understanding the biophilic characteristics of products and the effects on users from the elements and attributes of biophilic design theorised by Kellert (2008). These have already been widely explored in urban, architectural and interior design but not exhaustively at the product scale as systematised by Sayuti, Montana-Hoyos & Bonollo (2015). In fact, the authors analyse the emotional responses of users in the FDLO (Furniture Designs with Living Organisms) product category, which brings together furniture designs that incorporate living organisms, such as plants and animals. Boga, Turan & Çetinkaya (2022) discuss the ways in which biophilic qualities influence users' decisions. The authors define these qualities through six dimensions - form, function, material, semantic, sensory and psychological - pointing out that the functional dimension is particularly relevant in users' choices, as familiarity with the product creates a cognitive and emotional connection that guides the final evaluation. People choose products not only for their functionality, but also for their psychological impact, linked to personal and collective identity. Object ownership goes beyond practical use, responding to the human need for meaning and memory. Together with the common approaches of sustainable design and biomimicry, biophilic design represents a significant development in designers' approach to nature based on scientific knowledge and collaboration between disciplines. By integrating natural and technological elements into everyday environments, functional collaborations between artefacts and living organisms are encouraged (Wolfs, 2015). The Terra seat designed by Nucleo's designers is an example of that. It emphasises the connection between nature and its environment by

Fig. 2. Pollini: augmented reality experience that allows us to see the invisible part of plants: pollen. Design by Umberto di Gennaro, Samuele Procope, Laura Taccone, Marialuisa Vastarelli; scientific group Carla Langella, Gabriele Pontillo, Valentina Perricone.

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transforming the furniture into a living organism. Putting the user in direct contact with the grass stimulates an emotional and sensorial connection with nature, improving the psychological and physical wellbeing of the user. Taking a different approach, the Bacteria lamp designed by Jan Kingler reveals the invisible to the user by connecting them with the microscopic world to reflect on the complexity of what surrounds us. Through these artefacts, design can propose a gentle nudge, inducing people to focus on the sensations, perception and wellbeing that a deeper and more intense relationship with nature can provide, in a so-called "one health" perspective. In other cases, sustainable interactions are stimulated by using digital technologies, as in the case of the NatureQuant company's NatureDose smartphone application, which sensitises users to spend more time outdoors with the help of trackers and challenges. Another approach is AI solutions for image recognition that allow the user to obtain more information about flora and fauna in order to learn more about biodiversity. Design, in this case, promotes healthy routines by physical activity and breaks without digital stimuli, integrating natural elements into everyday life as sensory stimuli and educating individuals about the risks of overstimulation and the balanced use of technology and a new relationship with the natural environment. Therefore, design plays a fundamental role because it is able to design experiences, products and services that propose themselves as solutions capable of re-establishing the balance between analogue and digital components necessary to restore a beneficial balance (Langella & Fiume, 2023).

Fig. 3. Greentouch: device for body massage with grass inspired by an insect's carapace. Design by Gaia Biele; scientific group: Carmelo Di Bartolo, Carla Langella, Laura Morelli.

DESIGN TO STIMULATE GREEN EMPATHY

Today the boundary between biological and synthetic dimension is now crossed leaving ample room for action to hybridization between nature and artificial, analog and digital. Developments in the most innovative scientific fields such as neuroscience and synthetic biology, and hybrid technological areas such as biorobotics, bioinformatics or artificial intelligence show us that what Kevin Kelly, in Out of Control: The New Biology of Machines, Social Systems, and the Economic World in the distant 1992, prefigured as Neo-Biological Civilization, is now fully realised.

The Hybrid Design Lab [1] has been working for many years on developing products, services and devices that can enable an empathic relationship between humans and plants (Hall, 2022) to promote a condition of well-being extended to both spheres, in an inter-species perspective (Roudavski, 2021). An amplified well-being that is not limited to the pleasure or the psycho-physical health of human users but also involves plants in a two-way path.

One of the aspects where design can make a more significant contribution is education, especially for the new generations, for a better knowledge of nature. Children living in an urban environment with little vegetation have low familiarity with plants and their botanical specificities. They are perceived as something alien or invisible, according to what was defined as plant blindness by Wandersee and Schussler in 1999. It is a psychological phenomenon about the tendency of people, especially in urban contexts, not to see or notice the presence of plants in their environment and not to perceive their vital essence, their importance in the biosphere and human affairs, and to appreci-

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ate their unique aesthetic and biological characteristics. Ignoring plants also means to not recognize their health status, life cycle, and ecological importance. This phenomenon is mainly the road trees, flowerbeds, which are a minority part of the environment that tends not to arouse the interest of passers-by, who do not pay attention to the plants around them. They don't notice any signs of deterioration, such as withered leaves, dry branches or infestations. On a wider scale, lack of attention to green can lead to general environmental degradation, as the care and protection of green areas is a factor that strongly affects the quality of urban living and global environmental sustainability (Thomas, Ougham & Sanders, 2022). According to these observations, the Hybrid Design Lab has designed the Natural-mente kit (Fig. 1) to increase children's awareness of plant details, raising their attention and also their amazement to the beauty and complexity of such details and the biological functional motivations underlying such structures. It is a tool designed to develop children's skills and, at the same time, rebuild their empathic bond with nature. The device is a luminous table on which natural elements such as flowers, leaves, plants, acorns, branches can be placed and examined by means of fixed and articulated magnifying glasses along the edge of the table. These lenses allow children to improve their psycho-motor skills by directly observing natural objects. Natural-mente aims to sensitise children to the care and respect of the environment by recreating a "micro natural environment", such as a small garden that highlights the details of nature. Shapes and figures inspired by the natural world, such as magnifying glasses with different diopters in the form of owls, robins and plants, are the tools that children use, stimulating a sense of belonging and familiarity with the natural elements.

A similar intention to generate empathy through knowledge of details accompanied by play and surprise is constituted by the interactive experience project, Pollini (Fig. 2), developed for the exhibition Essere 4.0 at Città della Scienza museum, in 2019, that allowed visitors to discover through augmented reality the most invisible part of plant life, namely their pollen. The exhibition consisted of a kind of greenhouse containing typical trees from the Mediterranean landscape. Each tree had a tag with the scientific name, a brief description and a visual marker that, framed with the smartphone, allowed us to visualise the 3D model of the pollen corresponding to the plant superimposed on reality, therefore the real tree and the surrounding people. Using the camera interface, Pollini could be magnified, resized, moved, viewed from different points of view and photographed together with its surroundings. This experience was transformed, during the days of the exhibition, into an "instagrammable" experience in which young people enjoyed being portrayed with pollen as if they were balls to play with. The playful aspect made the educational aspect more accessible. Thanks to their accurate 3D model, the visitors were able to appreciate in detail the morphological complexity of these biological structures, which correspond to specific functional strategies linked to the need to be transported in the air or by appropriate pollinators, as well as adhesion and recognition on the fertile surfaces of flowers. Thanks to design, digital can be used rather than to move young people away from the analog natural reality to make it more appreciated, bringing the human to the biological dimension of its own

Fig. 4. Biophilia: wellness centre based on plants; concept design by Idan Peiris; scientific tutor Carla Langella.

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and the world around it.
The beneficial effect of plants on the psycho-physical balance of people is not limited to the visual, olfactory or nutritional relationship but also manifests itself when the relationship is tactile. The intention to enhance this type of interaction in order to induce people to benefit from the therapeutic effect of touching plants led to the design of Greentouch (Fig. 3). Greentouch is a brush for massaging the body, in which instead of the bristles are inserted, through a special interlocking system, grass strands or aromatic plants, soft or with very thin ends. The brush was born as a tool for dry brushing inspired by the traditional ayurvedic ritual of the Gharshana (Douillard, 2012). The massage with grass, through friction, stimulates the subcutaneous microcirculation, providing relaxation effects of muscle tensions, better oxygenation and nutrition to connective tissue and lymphatic purification. It also peels the skin naturally, removing dead cells and exfoliating the upper layers of the epidermis to reveal those that are softer and younger looking, smooth and bright. The basic idea of the project is that the user is encouraged to dive into nature and to try the massaging effect of different plants, then choose those to be grafted into the brush. It contains a blade and a system of joints that allow to cut and lock the grass in its structure to conform the brush and take it home while maintaining the freshness. This serves to extend the moment of the visit in a natural place, the pleasure of the experience of direct relationship with nature, that everyone enjoyed walking for example with bare feet on the grass. The device allows you to take home a fragment of plant nature, with which you can massage, smell the scents that emanate, observe the details and enjoy until the plant dries. When the plant loses its aroma and softness, the user is encouraged to go back to a natural place in order to "reactivate" the brush. The structure of the asymmetric shell is designed to ensure an ergonomic grip for the hand and has a raised texture to increase grip and make a secondary massage also to the hand.
The massage of the body with plants could lead to conceive a new type of wellness centre based on plants (Fig. 4): a path where you walk by touching and massaging your body with the bushes of soft and fragrant plants of different types to make people appreciate the many beneficial qualities of plants (Peiris, 2024).
Attention to plants also means encouraging people to cultivate them and appreciate their practical and functional usefulness in everyday life. Some plants can be grown and used daily, such as loofah which produces a vegetable sponge that can be used to clean surfaces and objects or for the body, replacing artificial tools.
In the Loofah Light project (Fig. 5) the plant sponge is used as a light diffuser. The project proposes a scenario where the user buys a kit to regenerate old disused lamps or to personalise ordinary lamps, made of a diffuser, a vegetable sponge, from a connector and a seed bag with instructions for planting and growing other diffusers. In this way, the design acts to encourage reuse, thus avoiding the costs of disposal and replacement of unused items, but also allowing the user to personalise artificial objects by grafting a biological component obtained through an interaction between man and nature in which the plant requires care and constancy, but, at the same time, it offers the possibility of choosing the degree of growth and therefore, the size and morphology of the cultivated part. The resulting object is a hybrid object, the outcome of a symbiotic relationship between user and plant.
In the Flora project (Fig. 6) the botanical component is integrated as a waste of plant life activities into a bioplastic made from dairy waste that is used to make pots for sale with plants. An example of upcycling aimed at highlighting the importance of enhancing the beauty of flowers and plants even in their second life, further strengthening the bond between people and plants.
CONCLUSIONS

Fig. 5. Loofah Lamp: upcycling through the graft of natural material formed by Loofah. Design by Piera Di Marino; scientific tutor Carla Langella.

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The analysed projects can be defined as application cases of the biophilic model to small-scale design to contrast plant blindness and excessive exposure to technological media. From this point of view, in fact, they allow the user to establish an emotional connection by educating about the plant world, in order to develop a greater awareness and appreciation of it. In conclusion, designing to stimulate green empathy means building a deeper dialogue between humans and plants, overcoming plant blindness and bringing nature back to the centre of everyday experience. In an age dominated by technology and digital technology, design has the capacity to reconnect with the biological dimension, enhancing the beauty and importance of plants. Using educational tools, interactive experiences and devices, design not only promotes knowledge and sensitivity to nature, but also induces people to recognise the intrinsic value of plants in everyday life, from physical and mental wellbeing to their ecological function.
These projects demonstrate how it is possible to integrate technology and artifice with nature, creating experiences that stimulate a synergistic and intimate relationship with the natural world. The biophilic approach to design can build a more sustainable and respectful awareness of the plant world, contributing to the creation of an inter-species balance for shared well-being.

Fig. 6 Flora: biodegradable pot made of biobased material that integrates waste from dairy production and waste from plant-based production. Design by Maria Petrillo, Lorenzo Villani; scientific tutor Carla Langella.

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NOTE

[1] Hybrid Design Lab is a project and research laboratory dedicated to mutual relations between design and biosciences with a particular interest in biomimetics, design-driven materials, design for health, and design of cultural experiences mediated by digital technologies. https://www.hybrid-designlab.org/.

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