

JENTIL® : responsive clothing that promotes an 'holistic' approach to fashion as a new vehicle to treat psychological conditions.

Sub-title of Paper: Fusing Multi-Sensory Fashion With Complementary Therapies

Keywords: Scent / Emotional Well-being / Multi-sensory

Biography

Dr Jenny Tillotson is a Senior Research Fellow in Fashion & Textiles at Central Saint Martins, a member of the Research Centre for Fashion, The Body & Material Cultures at the University of the Arts London, and a member of 'Design London'; a recently launched Royal College of Art and Imperial College incubator that aims to stir together design, science, technology and business, to create radical new approaches to design led innovation. She received her PhD in Textiles from the Royal College of Art and BA in Fashion Communication from Central Saint Martins, and prior to her academic work she was a stylist, and Sensory Designer for Charmed Technology Inc. In 2006 she was nominated for a 'FiFi' Award for breakthrough progress in the fragrance industry, and is subsequently establishing a design company called Sensory Design & Technology in Cambridge (UK) to commercialise her research.

Abstract

This paper explores an ongoing interdisciplinary research project at the cutting edge of sensory, aroma and medical work, which seeks to change the experience of fragrance to a more intimate communication of identity, by employing emerging technologies with the ancient art of perfumery. The project illustrates 'holistic' clothing called the JENTIL® Collection, following on from the author's 'SmartSecondSkin' PhD research, which describes a new movement in functional, emotional clothing that incorporates scent.

The project investigates the emergent interface between the arts and biomedical sciences, around new emerging technologies and science platforms, and their

applications in the domain of health and well-being. The JENTIL® Collection focuses on the development of 'gentle', responsive clothing that changes with emotion, since the garments are designed for psychological end benefit to reduce stress. This is achieved by studying the mind and advancing knowledge and understanding of how known 'well-being' fragrances embedded in holistic Fashion, could impact on mental health.

This paper aims to combine applied theories about human well-being, with multi-sensory design, in order to create experimental strategies to improve self and social confidence for individuals suffering from depressive illnesses. The range of methodologies employed extends beyond the realm of fashion and textile techniques, to areas such as neuroscience, psychiatry, human sensory systems and affective states, and the increase in popularity of complementary therapies.

In this paper the known affective potential of the sense of smell is discussed, by introducing 'Aroma-Chology' as a 'tool' that is worn as an emotional support system to create a personal 'scent bubble' around the body, with the capacity to regulate mood, physiological and psychological state and improve self-confidence in social situations. The clothing formulates a 'healing platform' around the wearer, by creating novel olfactory experiences in textiles that are not as passive as current microencapsulated capsule systems generally are.

Introduction

This project illustrates early stage conceptual garments that add aroma to 'emotional fashion', by combining the confidence enhancing and social acceptability of fashion design, with the positive psychological benefits of manipulating moods. It explores the expanding frontier of smell, by seeking out new sensations that can be added into the fashion palette, to create radical properties which benefit the wearer. It introduces the JENTIL® Collection: a selection of well-being, 'holistic'¹ clothes that reduces stress, inspired by complementary therapies, following on from the artists 'SmartSecondSkin' PhD textile research (Figure 1) and 'Sense6' fragrance project² (Figure 2), at the Royal College of Art, and career as a fashion stylist, and work experience in the fine fragrance and healthcare sectors (in particular caring for the elderly, mentally ill, and people living with HIV and AIDS³).

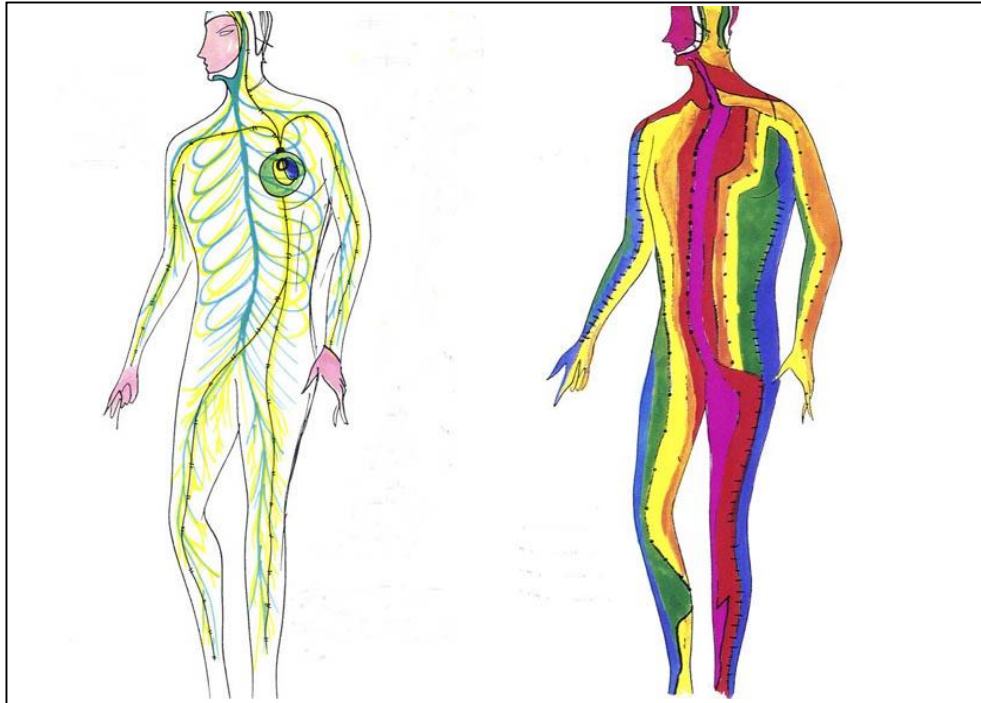


Figure 1. 'SmartSecondSkin' illustrations from the authors PhD thesis, describing a multisensorial approach to biomedical designs, recognising that all senses interact. 'SmartSecondSkin' illustrates a fabric membrane consisting of micro-tubes fused with microfluidics and drug-delivery systems. The fabric forms an invisible carrier for the delivery of liquids, inspired by the body's circulation system and references to colour-therapy. It also serves as a new scent system, that 'pulses' fluids around clothing, to illustrate the delivery of aromatherapeutic benefit chemicals for emotional well-being.

The disciplines of fashion, science and technology are brought together under the concept of **Scentsory Design®**. This is a term the author has coined, which is a research project that explores the relationship between aromas and emotional well-being, and is a word that plays on the emerging field of 'Sensory Design'. Although a new field, which can sometimes be viewed as controversial, due to its' alternative 'New Age' reputation and association with 'alternative therapies', (and is generally used to treat a person instead of conventional health treatments, rather than complementary therapies which 'complement' conventional treatments), Sensory Design is an increasingly relevant inter-discipline that focuses on the mind, the body and the space in between.

Sensory Design seeks to understand the interface between the senses and the designed environment within society, whether this is through gardens, day centres, classrooms, cinemas, nightclubs or to constructions of fantasy and fashion design, the fundamental issue is that it embraces all modes of understanding, and all the senses. First and foremost, Sensory Design not only foregrounds the primary senses such as chemosensation (taste, smell), visual, auditory and somatosensation (touch), but also includes the haptic senses i.e. orientation, temperature, plasticity, kinesthesia and texture⁴.



Figure 2. A multi-sensorial fragrance called “Sense6” that supported ‘The Wellness Collection’, the author’s PhD at the RCA. Inspired by the ‘human aura’ reference in colour-therapy, the fragrance creates an ‘Aroma Rainbow’, by stimulating the senses, and boosting therapeutic and sensory dimensions in Fashion, thus allowing the wearer to enter a sixth dimension.

This research was first introduced in a paper called *Scentsory Design®: Fashion Fluidics*, at the Digital Art Weeks ETH Zurich [Kon.[Text]] Symposium in 2006⁵, a meeting point between art and technology. The research presented has since developed into a larger project that fuses fashion, nanotechnology with complementary therapies, (supported by an animation film of the same name and directed by the author, and has subsequently won two International Film Awards in 2007⁶), and will result in a multi-sensory exhibition at the Institute of Psychiatry in London, to launch ‘World Mental Health Day’.

Scentsory Design

The foundation for this research describes wearable items that invent a new method of aroma delivery, and has since led to the registration of a patent and establishing a startup Fashion Technology enterprise called 'Sensory Design & Technology', in Cambridge (UK) as a spin-out from the Innovation Centre based at Central Saint Martins. In collaboration with analytical chemist Professor Andreas Manz, a pioneer of 'lab-on-a-chip' and a novel concept called ' μ TAS' (Miniaturized Total Analysis Systems⁷) and Head of the Institute of Analytical Sciences in Dortmund; Ben Hughes, Industrial Design at Central Saint Martins, jeweller Don Baxendale, and many years experience working with experts from the fragrance industries (including Dr George Dodd, the authors PhD advisor at the Royal College of Art and one of the first perfumers to write a description of perfumery phenomena in terms of modern molecular biology and psychology⁸, and John Ayres, Chairman of the Fragrance Foundation UK), 'Scentsory' bags and jewellery, were employed that were capable of pulsing minute doses of fragrance, that were triggered by the body's behaviour to specific points of the body, to benefit personal well-being (Figure 3).

Scentsory Design® seeks to create gentle, sensitive clothing, whereby the aroma dimension is an integral part of the wearer's total sensory experience. The research employed emerging technologies, including Micro-electro-mechanical-systems⁹ (also known as MEMS or micromachines), and sensor technologies; with colour-therapy and the ancient art of perfumery, the latter which can be defined as the subtle alchemy of intelligence, sensitivity and technique, and witnessed in the French perfumer Jacques Guerlain's infamous 'Perfume Organ'¹⁰, which plays a major role in the aesthetics of this research.

This paper explores 'emotional clothing', and new connections with the body, in order to discover ways in which Fashion might experience a difference. It describes experimental strategies for a collection of clothes that adds function to fashion design, by improving the quality of life for people suffering from stress and other problems relating to mental (ill) health. The purpose is for the clothing to respond to the psychological state of an individual, whilst offering social and therapeutic value through the senses.

The main objection is to exploit olfaction in multi-sensorial fabrics, by creating 'responsive', or 'living garments', which emulate the mechanics of the human body's respiratory system, and which have the capacity to go one step beyond passive, microencapsulated scented textile techniques (i.e. scratch and sniff or 'Micro-Fragrance Coating technology', invented by 3M in the

1970's). Although such traditional textile technologies are good for moisture protection management and delivering antimicrobial properties, they are unable to act intelligently or have the ability to detect stress levels.



Figure 3. Multiple scent-output bag called Fontenay-aux-roses', designed for the author by Industrial Designer Ben Hughes, to deliver a variety of scents by pressing three switches on the front panel of the bag. Photograph by Daniel Alexander.

The author considers the sense of smells known affective potential to regulate mood, and psychological state, and suggests how scent can be worn as a tool on the body to create an '*emotional support system*', which gently calms the mind, body and soul (hence the title JENTIL®, a play on the word 'gentle'). By wearing scent in this manner, clothes create active, *scentsory* properties, by offering new efficient qualities, to benefit well-being depending on the lifestyle of the wearer. The clothes achieve this by generating novel, olfactory experiences that promote relaxation (and therefore a good nights sleep), relieve tension and boost self-esteem; but the clothes can also expand the wearer's 'sensory repertoire' by accompanying other media to augment a particular experience.

Background

The advance of technology in the 21st century has extended the sensory world of human beings. Artists and designers use provocative colours and a multitude of 'smart materials'. Sounds can be digitized and combined to give sublimely exotic new music, which in some case exceeds the

evolutionary development of our brains. Although olfaction is dominated by the audiovisual senses, this attitude is changing, especially after recent scientific breakthrough in 2004, when an American Biologist and Neurologist won the Nobel Prize for Medicine or Physiology, for the discovery of odorant receptors and the organization of the olfactory system"¹¹.

Science suggests that each of us lives in our own idiosyncratic 'smell sensory universe'. Scentsory Design®, which laid the foundation for the JENTIL® Collection, has resulted in patented, MEMS devices that dispenses a short burst of aroma, producing a personal 'scent bubble' from familiar but currently in-odorous objects such as clothing. Fashion therefore allows the wearer to enter a sixth dimension, by wearing multi-sensory clothing which has the capacity to deliver a symphony of aromas from an embedded 'Perfume Organ'. This makes the wearer more aware of their own smell sensory universe, by expanding their sensory repertoire towards the sixth sense, the sense of intuitive knowledge.

A prototype leading up to concepts in the JENTIL® Collection, has already been developed called the 'SmartSecondSkin' dress. This was designed to illustrate a responsive fabric inspired by neurobiological delivery mechanisms found under skin, and involved the recent development of the miniaturisation of technology in olfaction science and multi-sensory fabrics (Figure 4).

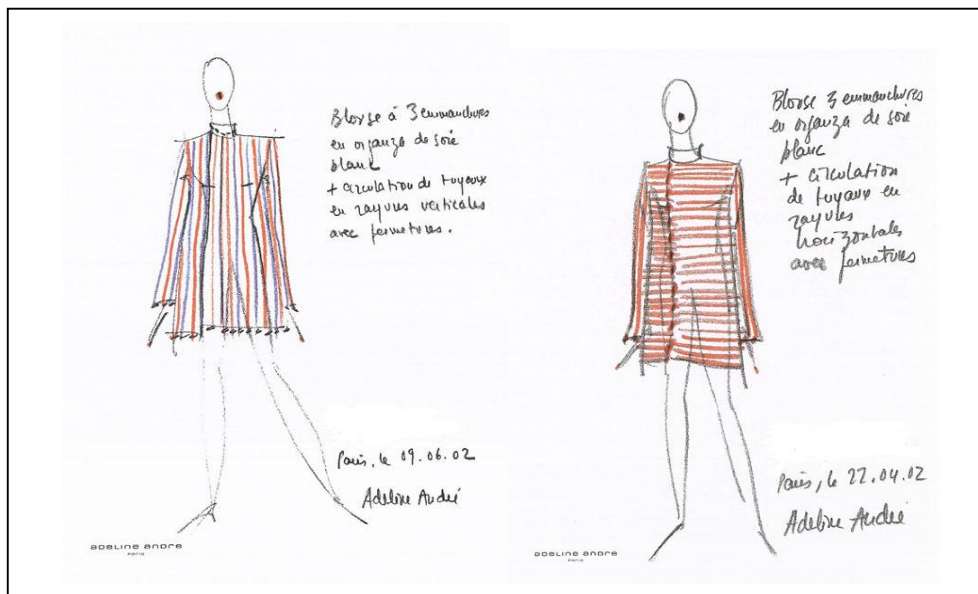


Figure 4. Original 'SmartSecondSkin' sketches by Adeline Andre (Haute Couturier, Paris) designed for the author.

The dress was developed as a creative garment prototype, to illustrate smart fabrics interacting with human emotions, whereby the aroma dimension is an integral part of the wearer's sensory experience. It was designed as an interface between the body and micro-tubing, to test and prepare the basis for a future interactive system, which fuses MEMS, micro-capsules, nozzles and biometric sensors with textile elements, in order to create a delivery system that dispenses scent worn in connection with the body, for health and wellbeing applications (Figure 5)



Figure 5. 'SmartSecondSkin' constructed from silk, with micro-tubes containing coloured liquid that demonstrates wellbeing fragrances 'pulsed' around the body to reduce stress, depending on the emotion of the wearer. Photograph by Guy Hills.

The Sense Of Smell

We discover that the most direct way our brain has of interacting, or sharing information with the external world is the sense of smell, since it is intimately plumbed into our memory and emotional centres, and it is this that makes us aware of our personal 'smell sensory universe'. While vision is considered to be our most important sense, when it comes to smell and gathering an emotional response, scent is a more powerful trigger as 75% of the emotions that we generate on a daily basis are affected by smell¹². We begin our life with smell, as we form a bond with our mothers. Since smell signals have a direct access to the emotional centres of the brain, the emotional shading of our lives is influenced by the smells around us.

When we react to an aroma; whether it is a conventional perfume or abstract aroma, there is an automatic but ineffable emotional response to the stimulus. We cannot help this; it is how Nature has arranged the physical basis of our emotional life. Thus it is that an aroma, which might even be perceived without noticing it; contributes to our sense of 'wellness', whether the aroma is generated directly from a traditional perfume that we spray on our skin, or from a new generation of dynamic electronic aroma emitters embedded in smart fashion.

PsychoNeuroImmunology

The basis for the Collection is supported by chemosensory research, which establishes how olfactory substances are capable of increasing an individual's well-being through changes in electrical brain activity in the limbic system, demonstrating how scent chemicals have the power to evoke emotion¹³. This approach is supported by a new branch of medicine called 'PsychoNeuroImmunology', founded by Dr Robert Adler, a psychiatrist from the University Of Rochester Medical Centre in 1975. This method studies the mind, brain and immunology system, and which interlaces the latter with neuroscience, physiology, pharmacology, psychiatry, behavioral medicine, infectious diseases, endocrinology and rheumatology, with 'positive psychology', and the connection between emotional stress and the health of the physical body¹⁴.

Aroma-Chology

Based on the PsychoNeuroImmunology approach, the JENTIL® Collection is engineered to boost self-confidence and the immune system, through the targeted delivery of specific odours relating to the new science of fragrance called 'Aroma-Chology'. Unlike aromatherapy (which contrary to belief has no science to back it up), Aroma-Chology is not concerned with the therapeutic effects on mental or physical conditions, but with the temporary effects of fragrance

on feelings and emotions, through stimulation of olfactory pathways in the brain. It measures the effects of blends of odorants and single natural and synthetic odour materials, through electrical brain activity, physiological parameters such as heart rate and skin conductance, cognitive functions and voluntary and involuntary behaviour¹⁵, since certain odours can relieve side effect from chemotherapy, or significantly benefit people who suffer from insomnia, muscle stiffness, bronchitis, poor concentration, indigestion and high blood pressure¹⁶.

Further research has proved that the benefits of fragrance include the balancing of the nervous system, reducing blood pressure that rises during stressful events, reducing heart rate, fear and the stress of unpleasant medical procedures e.g. MRI scans, and promoting a positive mood, e.g. happiness or relaxation¹⁷. It is anticipated that the properties of fragrance materials relevant for this research could benefit everyone who wears the clothing, but will be of special value to people susceptible to anxiety and depression.

Memories

In the next fifty years, it is expected that life spans will extend well beyond a century. New technologies will permit people to reshape their bodies to fit their personal aesthetics and lifestyle¹⁸. Smells spur memories, help define our self image and drive our emotions, evoking memories from the past. Research into the way we smell, has revealed that the olfactory system directly targets the rhinencephalon, which deals with emotion in the brain. This system also plays a significant role in selecting and transmitting information between our short and long-term memories. Smell is used in 'Reminiscence Therapy' for the elderly, to help them to interact by stimulating, encouraging and reliving happy childhood memories through olfaction. It is also effective in improving cognition and mood of demented people, and can alleviate early stage Alzheimer's symptoms with clinical applications of fragrances¹⁹.

Mental Health

There is increasing interest in the effect of the environment on symptoms of mental illness, but until now the focus of recent intervention research in this area has been in the more distant environment, for example the built environment, unlike this research which explores intervention in the immediate air-space around the individual. There are precedents for unconventional approaches to therapeutics in psychiatry, making use of the immediate physical environment, such as bright light therapy for depression, and infant massage as an intervention for (maternal) postnatal depression.

According to the World Health Organization, by the year 2020, depression will be the second greatest illness to heart disease²⁰. National statistics indicate a rise in the incidence of mental illness, with an estimated 1 in 6²¹ of the UK population likely to be suffering from, or at risk of a neurotic disorder. When a person is depressed, it affects both the body and the mind and disrupts some of the body's most basic functions, such as the stress-response system, or central nervous, hormone, gastrointestinal and immune systems, or sleep-wake cycle. Consequently the government is prompting calls from mental health experts for a radical rethink in the treatment of 3.5 million people taking anti-depressants in the UK. They have decided to promote alternative methods of dealing with the nation's dependency on drugs, and have unveiled a major new strategy which has been scientifically tested called 'talking therapies', or 'Cognitive Behavioural Therapy', which works by stopping negative thoughts that happen with depressive illnesses and helps identify ways to manage an individual's illness and stay well.

Colour Therapies

As public interest in complementary therapies continues to grow and many nurses and midwives are incorporating therapies such as aromatherapy, massage and light-therapy into their clinical practice to complement orthodox routes to treatment, the JENTIL® Collection seeks to take advantage of this current trend. This includes the concept of alleviating mental health ailments through colour-therapy and the perception of colour by the human eye and brain. Although still a controversial phenomena in medical terms, the basis for colour-therapy is the 'human aura', which consists of layers of clear luminous colour's that depend on the condition of an individual's health. The different layers of colour's, which are fine emanations of energy and extend around every human being, relate to the pre-manifestation of the whole person and correspond to different aspects of human functioning (heartbeat, blood circulation, personality, ego, sexuality, nervous system etc)²².

Future Fashion And The Holistic Dimension

As we move further towards the convergence of fashion and medical products, and into new textile hybrids, we will inevitably see more fashion designers creating clothes for 'well-being', particularly due to increased health awareness. 'Lytess', the French company who are currently marketing holistic fashion with their microencapsulated "cosmetotextiles" range which deliver anti-swelling, anti-fatigue and aloe vera properties, predict that by 2020, functional or intelligent textiles will represent 80% of the textile industry²³. As it stands the smart fabrics industry

(including wearable electronics) is currently a \$340 million dollar industry, growing 19% annually and projected to reach \$720 million by 2008²⁴.

A recent example of holistic fashion includes BuBelle²⁵, an emotional-sensing dress by Philips 'Body Architect' Lucy McRae, which lights-up by monitoring physical changes associated with different emotions and, likewise to Professor Rosalind Picard's pioneering work in the Affective Computing Research Group at the Massachusetts Institute of Technology (MIT) Media Lab in 1995, is responsive to subtle triggers like sensuality, affection and sensation. A further textile example includes Rachel Wingfield's, 'Light Sleeper' bedding (Figure 6) as part of the Textile Collection at the Victoria & Albert Museum²⁶, which is an illuminating, personalized alarm integrated into fabric, for sufferers of Bipolar Disorder and Seasonal Affective Disorder (SAD).

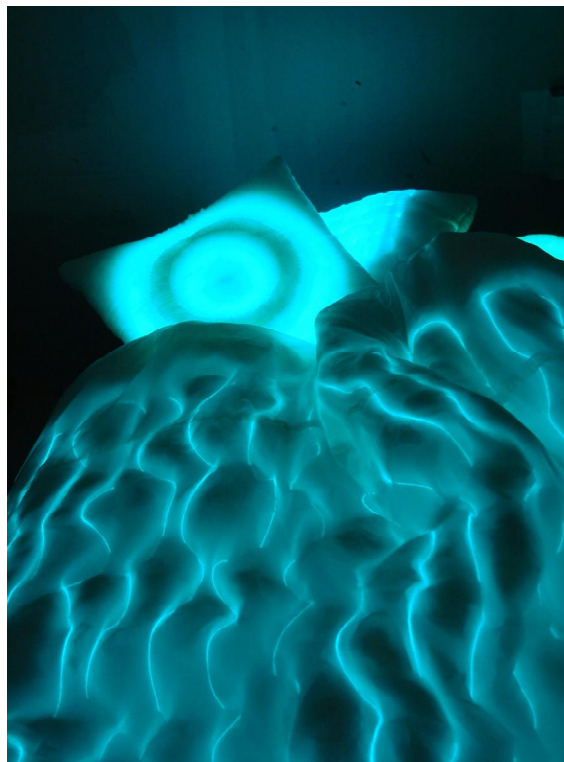


Figure 6. Responsive bedding that uses electroluminescent technology allowing traditional textile surfaces to become a reactive light source. Photo courtesy of Rachel Wingfield.

However this concept in well-being clothes was predicted decades ago. In 1982, designers including Thierry Mugler, Jean Paul Gaultier and Donna Karan,²⁷ were asked to imagine how they perceived the fashion industry might change at the beginning of the 21st century. Interestingly, Thierry Mugler predicted that the future of clothing would be less for show and more towards a healthier lifestyle:

"...Fashion will change dramatically in the coming years. One will find it less and less important to be 'fashionable'. Good clothes - garments well designed and well made for the purpose of protecting the body and enhancing the personality - will prevail. Fashion will be more human, closer to the needs of the people in terms of their being and well being, not "well showing".

Thierry Mugler 1982

Jean Paul Gaultier's fashion predictions have partly come to life thanks to Fabrican,²⁸ which stems from Dr Manel Torres PhD research at the Royal College of Art. Fabrican works as a textile-in-a-can, by spraying a fine mist of coloured cotton fibres onto the body to create a second skin. In 1982 Jean Paul Gaultier predicted that:

"...we will spray on the latest fashion and dispose of it at the end of the day. Spray on latex body suits in the same way as we spray on hair-spray. A person's weight will not be of concern. The image will change. We will accept our 'second skin'. The sewing machine will no longer exist. The most dramatic change will be the development and construction of new fabrics. Fabrics will evolve into something unique to envelop the body - a new way of covering the human form. Fabrics will be influenced by the weather. The temperature and atmosphere will be controlled on the actual fabric. The fabric itself will be the 'central focus', not the length of a garment".

Jean Paul Gaultier 1982

Donna Karan, who was designing for Anne Klein at the time, perceived that Fashion would be felt as a result of what is happening in the world. She predicted the merger of chemistry and (wearable) computers in fabrics:

“...we could be living in glass domes, and machines will be creating our atmosphere. Technology will produce new fibres that will protect us from what is happening outside. The creative minds will use the technology and make new fabrics look good on people. There will be a time when we will have to live through computers and chemistry and even though it seems strange and impersonal now, when it happens, when we are living it minute to minute - we wont resent it”

Donna Karan 1982

MEMS In Hems

This research follows on from the ‘eScent’ project, which was in collaboration with Professor Manz, and resulted in a small component embedded in a user-worn scent dispenser and biometric sensor system, where the frequency and type of scent delivery is flexible and determined by the user²⁹ (Figure 7). eScent is the chosen technology for the JENTIL® Collection, since the development of the clothes will be engineered for psychological end-benefits by the targeted delivery of therapeutically established vapour-borne fragrance molecules, which are actively ‘pulsed’, electronically through a micro-cabling system and released in response to physiologically monitored stress response.

Using microfluidics for perfume handling, and the theory that human biology can be modeled as micro-mechanisms; biological functions, including smell, can be miniaturised forming the basis of an integrated communication membrane, and disguised in the hemline of clothing or the construction of a garment. Microfluidics (also referred as ‘lab-on-a-chip’, and stems from MEMS), is a new technology that manipulates fluids-on-a-chip, consisting of micropumps, valves, mixers and reaction chambers and deals with extremely small volumes of fluids

JENTIL® For Wellness: The Multi-Sensory Fashion Collection

This project investigates the emergent interface between the biomedical sciences and fashion, the art of perfumery, communication design and the growing discipline of ‘textile futures’ (i.e. responsive fabrics that become a ‘second skin’, enhancing how we sense the world around us).

The objective of this research is to exercise the powerful impact that multi-sensory fashion could have on self and social confidence and well-being, by helping an individual manage their illness on a day-to-day basis, through the clothes that they wear.



Figure 7. ‘Scent Whisper’ (left and middle) is a jewellery set consisting of a wireless bombardier beetle scent-dispensing brooch, and spider brooch with humidity sensor, designed by the author in collaboration with the Institute of Analytical Sciences (ISAS). ‘Butterfly Perfume’ (right) is a MEMS gold and ruby encrusted scent-dispensing pendent by Don Baxendale.

The mission of this research is not only to offer an alternative method to reduce stress, but to complement ‘talking therapies’ and other means of treating depressive illness, through emerging and intelligent textile technologies, and the olfactory sense. The issues that distinguish this research from current microencapsulated textile techniques is that JENTIL® fabrics incorporate biosensors to initiate the scent delivery, they are not as passive as capsule systems generally are, and JENTIL® clothes are designing for psychological end benefits.

It is therefore within the realm of possibility to create clothing for stress reduction with this approach, as the biosensors could detect stress physiologically, and the MEMS devices embedded in clothing elements could produce an intimate spray of recognized well-being scent molecules, such as lavender³⁰, or rose³¹, to increase relaxation, whilst other scents could have a stimulating, antidepressant effect, such as jasmine³² or citrus³³. The choice of scent would depend on the frame of mind and mental stability of the wearer, for instance if they are experiencing anxiety, fear, panic or insomnia (Figure 8).

The JENTIL® Collection would be realised by designing contemporary aroma technology that electronically delivers dynamic aroma experiences, fabricated from MEMS, which is integrated into 'smart garments' and jewellery. Further technologies could be added for the multi-sensory affect, such as light therapy, to relieve stress, restore energy, reduce the side-effects of drugs, and moderate mood swings that would help people with mood disorders³⁴, so that the Collection achieves its objection of creating a personal 'wellness' experience for the wearer.



Figure 8. 'Frame Of Mind' neurobiological illustration from the Scentsory Design® film by the author.

The next stage of the development will be to combine microfluidics with clothing elements (i.e. pockets, collars, piping, appliqué patches, lapels, buttons, fasteners, zips), that 'pulse' liquids through an 'Emotional Embroidery', membrane constructed of micro-tubes, nozzles, microprocessors and reservoirs, to stimulate the adrenal cortex and boost therapeutic qualities. The fragrances, which are encased in individual scent capsules and represent Guerlain's 'Perfume Organ', and diffused depending on the different moods, emotions, feelings, and general well-being of the user, are targeted to specific parts of the body as an atomised mist that is detectable by the wearer alone.

In this context, the membrane is analogous to the body and skin, thus facilitating interaction between the two membranes, using the blood signals and bodily fluids of the human system. The fabric mimics the human body's circulation system, the senses and in particular the scent glands, and acts as a new vehicle for inter-action design in fashion and textiles, offering direct life enhancing and analgesic assistance through different mechanisms' whilst gently soothing, relaxing, stimulating or invigorating the wearer. Clothing becomes an almost *living* organism; the microfluidics act as an internal pump, representing the fabrics heart, and the tubing represents the nervous and respiratory system, all integrated into an 'Emotional Embroidery' (Figure 8).

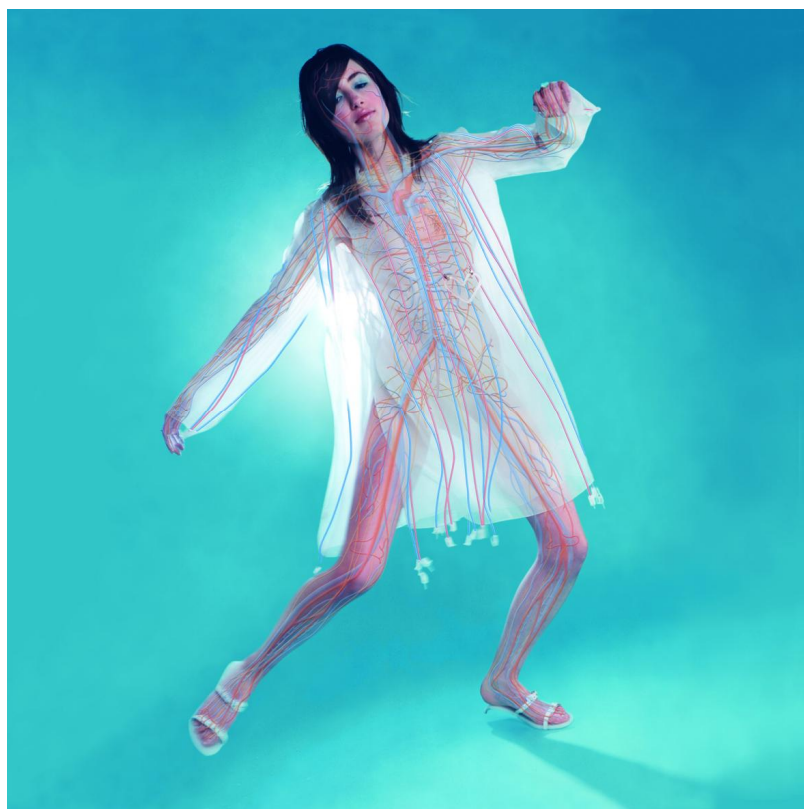


Figure 8. A responsive fabric illustrating 'Emotional Embroidery', mimicking the neurobiological delivery mechanisms of the human body (nature's microfluidic processing system), to form an additional layer of skin (SmartSecondSkin) that interacts with the wearer's emotions, to control the different emotional states of the wearer. Illustration by Wendy Latham, photographed by Guy Hills.

The fundamental advantage of the clothes is that they have the ability to shield the wearer from negative mood states such as fear or sadness, that they otherwise should be protected from (i.e. the fear of flying, or sorrow that leads to depression, or stress from life events that can trigger a manic or depressive episode in Bipolar Disorder³⁵, or stress that subsequently develops into cancer). This would be due to the functionality of the sensors embedded in the clothing, which has the capacity to measure stress levels of four signals, including blood volume pulse, galvanic skin response, electromyogram and respiration, as scientifically tested by Picard's 'ProComp' sensing system at the MIT Media Lab³⁶.

The clothing would subsequently determine the release of therapeutic scent molecules, when a person is in a bad mood or feeling low. The garments not only enhance mental and physical well-being, but also act as a medium for communicating thoughts, memories or emotions through smell, our most ancient and primitive sense.

Since JENTIL® clothing strives to be a multi-sensory collection, it seeks to achieve 'wellness' through merging aroma with colour. This is achieved through the delivery of '*colour odorant*,' benefit chemicals in controlled ways responding to personal needs. The clothing 'speaks' for the wearer through the sense of smell and vision, by reading and interpreting emotions, enabling the wearer to express their feelings through the delivery of *colodours*[™] (the combination of the olfactory and visual senses and a term the author has invented), emitted from clothing, without the use of words.

The clothing subsequently formulates a healing platform by creating novel olfactory experiences from a digitally controlled 'scent palette', based on the components of Guerlain's 'Perfume Organ', and works in tangent to colour and light recipes. The wearer's confidence in their visual identity is thus enhanced by sensory, psychological and medical well-being. An 'aroma rainbow' is formed, giving the impression of fragrant-fluidic colours that are pulsed from the heart of the fabric (the centre of intuition), offering an holistic, anti-depressive form of embodiment which targets the delivery of social, erotic, analgesic or emotional scent 'ripples', allowing the wearer to create a personal symphony by mixing aroma notes harmoniously together (Figure 9).



Figure 9. JENTIL® 'Scent Palette' (inspired by Guerlain's 'Perfume Organ' where fragrances are mixed), delivering a spectrum of scent. Photo by Guy Hills, illustration by Wendy Latham.

Conclusion And Future Development Work

In March 2006, when psychiatrists at the Institute of Psychiatry in London were consulted about the JENTIL® Collection, they suggested that although the research will be a challenge to many psychiatrists, the creative thinking that the work brings to the demands of developing new interventions in mental health should be encouraged, and that many patients would welcome stress-reducing clothes, and the prospect of attempting to offer them some further control of their emotional state, whether by conscious control or biofeedback. They also felt with further development work, (supported by research on Aroma-Chology), and the testing of the unorthodox concepts in more formal scientific trials, several psychiatric disorders and symptoms might potentially be explored for an application of the JENTIL® Collection, for example panic disorder, obsessive-compulsive disorder, residual hallucinations in psychotic illnesses and mood symptoms in postnatal depression.

Findings in Aroma-Chology show that optical stimuli (especially colour) influence the perception of smell or temperature. Clothes that give the impression of emitting 'blue' in steady pulses along the weave of a fabric (via electroluminescence materials fibreoptics or thermochromic inks), in combination with the delivery of peppermint odours, would potentially lead to a perception of calmness and lower temperature. The JENTIL® Collection has the potential to offer an entirely new concept in the art of perfumery - a scent such as neroli to lower stress-related blood pressure, which also radiates the colour orange to combine physical and emotional stimulation, or alternatively, a sedative pulse of indigo could transmit tranquil lavender molecules to relax and promote the sleep-wake cycle, or a jasmine antidepressant scent that glows a yellow colour - not just top notes fading away, but allowing the clothing to have the ability to pick from the entire palette of *colodours*™ changing over time (Figure 10).



Figure 10. 'Colodours: Aroma Rainbow' effect achieved by exploring the relationship between colour and scent for the benefit of improving emotional wellbeing, depending on the degree, type and frequency of olfactory and visual intensity by the wearer. Illustration by Wendy Latham.

As for sensory disabilities, emerging technologies are already making the deaf 'hear' and the blind 'see'. To help maintain social engagement, JENTIL® clothes could be worn as a precautionary measure to deliver an early warning aromatic signal for an anticipated accident,

for instance the spread of fire; or clothes could be worn as a navigation system on the battlefield, or to give new independence skills to the deaf and blind (Figure 11). 'Scent tones' could be employed as an alternative to audio tones in mobile phones, or olfactory display devices could be worn to improve data visualisation to convey aromatic message in smart apparel for computer games, or clothes could communicate abstract information, by releasing scents if changes occur in a persons medical status, or as a medication reminder.

According to the Fragrance Foundation (a non-profit making educational trust founded in New York in 1949 by Chanel, Coty, Elizabeth Arden, Guerlain, Helena Rubinstein and Parfums Weil, and is well known internationally as the forum for the fragrance industry), our cognition and senses could be greatly enhanced by the JENTIL® Collection. If this is true, the clothes could significantly benefit the older generation, since our sense of smell declines after the age of 65³⁷.



Figure 11. 'Scentsory Communication' aroma rainbow 'coded messages', to convey information and alert the eyes (sight) and ears (sounds) via olfaction. Illustration by Wendy Latham, photo by Guy Hills.

Contrary to popular belief, the olfactory system keeps regenerating itself until we die, however it needs to be stimulated. The Fragrance Foundation (who nominated the author for a 'FiFi' Innovation Award in 2006), suggested that wearing JENTIL® clothing could regenerate smelling and help with smell perception. It could not only prolong olfaction by initiating daily smelling practices & exercises, to help maintain sensitive olfactory accuracy, via olfactory training mechanism 'pulses' from the fabric, but also as a novel tool to support Reminiscence Therapy.

It is not only within the realm of technology that fashion will find its innovative future, but also the expanding frontier of the 'digital senses', especially olfaction, now it is widely accepted that our sense of smell is recognised as a major part of our daily life than had previously been thought. Consequently, with the growth of 'consumer well-being', the rise in popularity of aromatherapy products, and demand for complementary therapies and SPA treatments, over time olfaction science will merge with MEMS and other technologies, so that they become available for designers to exploit in the expanding domain of health and well-being in Fashion.

It should be clear from the evidence presented that this research may not only lead to further development and design implications in fashion, textiles and jewellery, but also interior design, responsive environments, architecture, vehicle and furniture design, and other systems that use smell to convey information such as Artificial Intelligence and Human-Computer Interaction. The JENTIL® Collection described herein, is given as an example of clothing that endeavors to pave the way to an expanded life, via Fashion and connections with the body, perhaps as the three leading fashion designers; Gaultier, Karan and Mugler, had perceived the industry might be in the 21st century.

It is Fashion that can help us achieve the most of what our senses has to offer the human body. This is because multi-sensory enhancement makes the senses more effective to enjoy the experience of sensing reality by allowing us to have greater control over our emotions, memories, and the connections with our bodies, by increasing creativity, expressions and visions, sparking little (aromatic) reminders, expanding colours, textures, sounds, tastes and smells, and pushing the boundaries of the senses that we didn't know we had. It strives to give us a deeper sense of life, a sense of exhilaration, a greater sensitivity, a sharper mind, and a world of beauty seen in a different light.

As individuals, we may smell different, or be more aware of what is around us, by changing our feelings, our body chemistry and body odour. The JENTIL® Collection attempts to protect and transport us to a different place we want to be, by unfolding the brainwaves. We will respond better to our chosen scent, the smell that works with us in our sensory universe, by providing aroma molecules for the right moment, for the right effect, or trigger new (previously unfelt) emotions, and enhance the intimate contact we have with other living things. We therefore develop a new hypersensitivity, learn new and stimulating pleasures and recreate lost memories. But above all, it transforms negative mood states that otherwise turns into stress, into good 'scentsations', releasing scents to regulate the sleep-wake pattern, boost self-confidence, help relax, energise, arouse, expand the imagination - and open our sense of wonder.

Endnotes

¹ Cloninger, C. Robert MD , 2006, 'Feeling Good: The Science of Well-being', *Australian & New Zealand Journal of Psychiatry*. 40 Suppl. 1:A2

² Smart Second Skin, 2007, Launch of Wellness fine fragrance Sense6 (sponsored by International Flavours & Fragrances) viewed 20 January 2008
<http://www.smartsecondskin.com/main/previouswork.htm>

³ Terrence Higgins Trust, 2007, Volunteering at Terrence Higgins Trust, viewed 19 January 2008,
<http://www.tht.org.uk/howyoucanhelpus/volunteering/whyvolunteer>

⁴ Monice Malnar, J., Vodvarka, F., 2004, 'Sensory Design', University of Minnesota Press, Minneapolis

⁵ Tillotson, J., *Scentsory Design®: Fashion Fluidics*, "The Sixth Senses of Technology", The Meeting Point Between Art & Technology at ETH Zurich, Digital Arts Week Symposium, viewed 22 December 2007,
http://www.digitalartweeks.ethz.ch/docs/daw06proc/papers/tillotson-scentsory_design.pdf

⁶ Tillotson, J., *Scentsory Design®: Award for 'Best Visual Innovation in Experimental Film'*, Int'l Fest of Cinema & Technology 2007, viewed 2 January 2008, <http://www.ifctawards2007experimental.html>
Tillotson, J., *Scentsory Design®: Award for Best Animation in a film*, The Baltimore Women's Film Festival, USA, 2007, viewed 2 January 2008, <http://www.bwfilmfestival.com/7.html>

⁷ Manz, A., Graber, N., Widmer, H.M., 1990, Miniaturized total. chemical analysis systems: a novel concept for. chemical sensing, *Sens. Actuators*, B1,244-248.

⁸ Dodd, G., Van Toller, S., 1983, The Biology and Psychology of Perfumery, *Perfumer & Flavorist* 8, 1-14

⁹ Nguyen, N.-T.; Huang, X.; Chuan, T. K., 2002, 'MEMS-micropumps: a review'. *Journal of Fluids Engineering* (Transactions of the ASME) 124:22, 384-392

¹⁰ Barille, E, Laroze, C, 1995, *The Book Of Perfume*, Flammarion Press, Paris, New York, pp 38-39

¹¹ L. Buck, Axel. R, 1991, A Novel Multigene family may encode odourant receptors: a molecular basis for odour recognition. *Cell* 65: 175 . 87

¹² Lindstrom, M, 2005 *'Brand Sense: How To Build Powerful Brands Through Touch, Taste, Smell, Sight & Sounds'*, Kogan Page Limited, UK

¹³ Vernet-Murray E, Alaoui-Ismaïli, O, Dittmar, A, Delhomme, G and Chanel, J, 1999. 'Basic emotions induced by odourants: a new approach based on autonomic pattern results'. *Journal of the Autonomic Nervous System*. Vol 75 page 176 – 183.

¹⁴ Ader, R, 2008, *'Psychoneuroimmunology, Two-Volume Set'* Elsevier Academic Press, Oxford

¹⁵ Jellinek, S. 1999 'Understanding the Psychodynamic Effects of Odors', *Aroma-Chology Review*, vol IV(2) pp 4

-
- ¹⁶ Christensen, C, John, T and Boyd, J, 2003. 'The Benefits of Fragrances'. *Perfumer & Flavorist*. Nov/Dec 2003; Vol.28; page 30 - 4
- ¹⁷ Warrenburg, S, Schwartz, Christensen, C and Wilson, W, 2003. *Fragrance Research : Measuring the Emotional Power of Fragrances presented to the Esomar meeting*, 16-18 March.
- ¹⁸ Hughes, J, 2004, *Citizen Cyborg*, Westview, Press, United States of America, pp 19
- ¹⁹ Woods, B, Spector A, Jones C, et al. 2006, *Reminiscence therapy for dementia*. In: The Cochrane Library: Issue 2, John Wiley & Sons, Chichester.
- ²⁰ World Health Organization. 2005, Burden of mental and behavioural disorders: depression disorders, *World Health Report*, ch.2, viewed 11 January 2008, <http://www.who.int/whr/2001/chapter2/en/print.html>
- ²¹ The Office for National Statistics 2006, Mental Health, viewed 12 December 2007, <http://www.statistics.gov.uk/CCI/nugget.asp?ID=1333&Pos=&ColRank=2&Rank=224>
- ²² Gimbel, T, 2001, *Healing Colour*, GAIA Books Limited, London, pp. 62
- ²³ Financial Times, 2006, 'The Age Of Cosmetics' viewed 5 January 2008 <http://www.ft.com/cms/s/0/80c9d73c-ec97-11da-a307-0000779e2340.html>
- ²⁴ Intertech Pira, 2006, Smart Fabrics Conference, Washington, USA, viewed 24 January 2007, http://www.intertechusa.com/pdf/SmartFabrics_2007.pdf
- ²⁵ Philips Design, 2007, Clothing prototypes light up to reflect the 'emotions' of the wearer, viewed 12 January 2008, <http://www.design.philips.com/about/design/designnewscenter/news/article-14931.page>
- ²⁶ Loop.ph, 2008, Specialising in the design and research of environmentally responsive textiles and structures for the built environment, viewed 3 January 2008, <http://www.loop.ph/bin/view/Loop/DigitalDawn>
- ²⁷ Khornak, L, 1982, "FASHION 2001", Kolumbus Books, London
- ²⁸ Fabrican Ltd, 2007 spray-on clothes, viewed 13 November 2007, <http://www.fabricanltd.com>
- ²⁹ Manz, A., Jenkins, G., Tillotson, J., 2005, 'Scent Whisper'. *Proceedings of the IET Seminar on MEMS Sensors & Actuators* IET, London
- ³⁰ Yagyu, T. 1994, Neurophysiological findings on the effects of fragrance: Lavender and Jasmine. *Integrative Psychiatry*, 10, 62-67.
- ³¹ Joichi, A., Yomogida, K., Nakamura, S., 1998, The scent of roses: tea-scented modern roses and ancient Chinese roses. *Proceedings of the 20th International Federation of the Society of Cosmetic Chemists*, Cannes
- ³² Yagyu, T. 1994, Neurophysiological findings on the effects of fragrance: Lavender and Jasmine. *Integrative Psychiatry*, 10, 62-67
- ³³ Komori, T., Fujiwara, R. Tanida, M., Nomura, J., & Yokoyama, M. M. 1995, Effects of citrus fragrance on immune function and depressive states, *Neuroimmunomodulation*, 2, 174-180.
- ³⁴ The MDF Bipolar Organisation 'Complementary Therapies', viewed 12 January 2007, <http://www.mdf.org.uk/?o=56907>
- ³⁵ Johnson, S., Roberts J.E., 1995, Life events and bipolar disorder: implications from biological theories, *Psychological Bulletin*, 117, 434 - 449
- ³⁶ Picard, R., 1997, *Affective Wear*, MIT Press Cambridge USA, pp 236-237
- ³⁷ Green, A., 2000, *Ageing Well With Your Sense Of Smell: A Handbook For Babyboomers*, The Olfactory Research Fund Ltd, viewed 10 December 2007 <http://www.senseofsmell.org/pdf/AgingWell.pdf>