

# Living with touch

Alberto Gallace seeks to understand tactile interactions

**Despite being a relatively little investigated sensory modality, touch is involved in the large majority of our daily activities, from eating and walking to kissing and cuddling. The 'hidden' power of touch in terms of its ability to drive our behaviour and emotions has now been proven in a number of scientific studies. Touch also contributes to differentiate ourselves from the external world, and it is likely the sense that has the biggest impact on our pleasure and well-being.**

No other sense can arouse you like touch. (Field, 2001, p.57)

Just before the eighth week of gestation, an embryo may develop sensitivity to tactile stimulation (e.g. Bernhardt, 1987; Gottlieb, 1971) – it begins to touch. Whereas the visual system requires prolonged development in order to become fully effective, the sense of touch is perhaps the primordial matrix upon which the awareness of ourselves as individuals, separated from the external world, starts to form.

The skin, and the receptors therein, also constitutes the largest of our sense organs. By the time he reaches adulthood, the average male will have around 18,000 square centimeters of skin, constituting about 16–18 per cent of his total body weight (see Montagu, 1971). Our skin differentiates ourselves from the external environment physically, maintaining the integrity of our organs and protecting them from external menaces (both biological and physical). At the same time the tactile receptors embedded in our body surface help to differentiate ourselves from the outside world from a psychological point of view too. In fact, whenever we touch an object we can feel both the incoming perception from the object itself and the presence of our body differentiated from it. One might say that where our touch begins, we are!

The sense of touch protects our body by signalling potential danger and requiring us to make a prompt response. Richard Gregory, one of the most influential researchers in the world of

visual perception, once wrote that 'one cannot be attacked and eaten by an image [...], and neither can one feed on images' (Gregory, 1967, p.370). That is, while vision (and audition) inform us about 'distal' stimuli, our sense of touch informs us about those things that are occurring at the very last frontier between ourselves and the outside world. However, touch is not only our last system of defence, it also provides our main connection with the external world, both socially and physically.

The sense of touch cannot be considered to be a unitary modality. In fact, what we commonly define as 'touch' is the product of the integration among different neural signals occurring at different stages of information processing in the brain. More specifically, our sensory experience of touch results from the activity of systems responsible for the processing of pressure, temperature, joint position, muscle sense, and movement (see Berkley & Hubscher, 1995; Iggo, 1977; McGlone & Spence, 2010). Pain also offers an important contribution to this complex network of sensory signals, even if there is still little agreement among researchers and philosophers as to whether it should be considered as a separate sensory modality or rather as a submodality of touch (e.g. Auvray et al., 2010).

Very often we are not aware of the importance of touch in our everyday life. Yet even the simplest of activities, such as walking or feeding, require a great deal of tactile processing. The importance of touch for survival is amply documented by the fact that the complete lack of tactile sensations in humans is a very rarely reported phenomenon. That is, evolution seems to have protected this sense from serious damage or alteration. People who lack tactile sensations (but critically not motor control), due to a damage to their peripheral or central nervous system, experience incredible difficulties in controlling their movement; even holding a fork and self-feeding may become quite a challenge for them (e.g. Cole, 1991; Cole & Paillard, 1995). However, even in these

## questions

Why touch is so important in our social life?

Are we always aware of what occurs on our skin?

## resources

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cases, certain signals coming from the skin surface (by means of undamaged unmyelinated neural conductive fibres), such as pain and thermal sensations, are still preserved.

Touch affects all domains of our life, from feeding to walking, from sexual behaviour to social relationships. Surprisingly, however, this sensory modality has received far less research interest from scientists, as compared with other senses such as vision and audition. In the last few decades the trend seems somehow to have changed and more researchers than ever before are now starting to engage with the study of touch.

This new wave of interest would seem to reflect new discoveries about our awareness of touch (e.g. Gallace & Spence, 2008, 2010a), and its role in making our experiences real (comprehending the feeling of owning our body: see Moseley et al., 2012), and more emotionally engaging (see Gallace & Spence, 2010b).

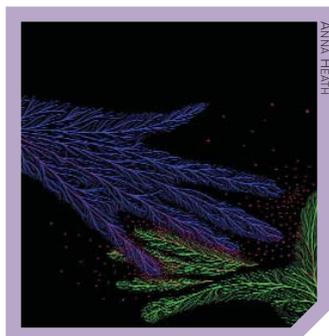
Considering that technological advances now allow us to virtually reproduce even complex environments, the possibility of increasing the realism of these simulations (and/or the sense of owning the avatar within them) by means of the tactile sense is something that certainly contributes to driving research interest in the study of this sensory modality nowadays (see Gallace et al., 2011; Gallace et al., 2007b). Compared with other senses, touch certainly has a number of limitations, as well as some important peculiarities, that contribute to make it a particularly interesting sense to study.

### Pickpocketing explained

A crowded underground on Monday morning, someone bumps into your side. You barely notice it. A few steps afterward

you suddenly realise that your wallet is gone. You have been pickpocketed! How could that have happened? How could something as significant as your wallet slipping out from your pocket ever have gone undetected?

We often think about our perception in terms of a tape recorder or a video-camera, something that passively registers all the facts occurring in the external world, and



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then we become very surprised when our awareness of such facts fails. However, most of the external stimuli falling onto our receptor surfaces (be they visual, tactile, auditory, gustatory, or olfactory) do not have access to our awareness. It would be useless to process all that information when it is not strictly

relevant to our current, or even future, behaviour. Our perceptual and cognitive systems are structured with the express purpose of consciously selecting and processing only relatively little information from the large amount of stimulation typically available at any one time.

From an ecological point of view, one of the most relevant sorts of information is a change in the status of our environment, likely to signal the presence of something that is potentially relevant (or perhaps dangerous), and that might need an adaptation or modulation of our current and future behaviour. Our wallet lying in our pocket is, from the point of view of the sense of touch, a constant signal, and as such it need not be constantly monitored. Like the chair under our bottom, in fact, our tactile sensory system has progressively reduced its neural response

to constant stimuli, so that they tend to fade from our awareness.

But what of the wallet slipping from our pocket? That is a change, and should therefore be given priority in our neural processing. However, information from different sensorial sources compete in the brain for access to awareness (Desimone & Duncan, 1995). The neural signal generated by a bump on your shoulder competes with the signal generated by your wallet being gently slipped from your pocket. In this case the bump, being more salient and/or strong, might win the competition. You then experience a failure of your tactile awareness, or more what is known as 'tactile change blindness' or 'change numbness' (e.g. Gallace et al., 2006, 2007a).

Interestingly, awareness of touch also deteriorates when we are distracted visually. I know of a Swedish psychologist who was surprised to see a woman exposing herself at him on the street in Stockholm, only to realise a moment or two later that he had been pickpocketed! Subsequent research has now confirmed that visual, but critically not auditory, stimuli are effective in reducing our ability to report the presence of tactile changes on the body surface (e.g. Auvray et al., 2008). This result is often taken to support the idea that vision is 'the dominant' sense, the one that often wins the competition for access to processing and attentional resources in our brain. Note, however, that more recent research suggests that there may not be 'a' dominant sense, as such, but that the sensory modality that dominates over the others in a given situation is the one that carries the more accurate information (e.g. Ernst & Banks, 2002). One might then wonder where and under which conditions touch becomes the most relevant sense and the information that it provides the most salient or accurate signal available. Perhaps the presence of tactile stimuli results in a failure of visual awareness when the more social and interpersonal aspects of touch are considered. Consider possibly the cheesiest line in movie history, as Carrie and Charles

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kiss in *Four Weddings and a Funeral*: 'Is it still raining? I hadn't noticed.'

### The 'golden touch'

The sense of touch is not only relevant to our interactions with external objects but also, and even more importantly, to our interactions with other human beings (see Gallace & Spence, 2010b; Hertenstein et al., 2006). A strong handshake, an encouraging pat on the back, a sensual caress, a nudge for attention, a tender kiss, or a gentle brush of the shoulder are all very familiar and important tactile social interactions. We can only try to imagine the sadness of a life without them. Such a life is effectively described in the science fiction movie *Demolition Man*, where the director, Marco Brambilla, envisioned a futuristic society where every tactile contact is prevented and heavily sanctioned. Some might argue that our society is already moving in that direction, resulting in what Tiffany Field, director of the Touch Research Institute in Florida, has memorably described as 'touch hunger' (see Field, 2001), the unsatisfied desire of people for more social touch. So why are tactile social interactions important to our well-being, and what can psychology and cognitive neurosciences tell us about them?

Animal studies have shown that touch is an important form of communication in many different species (see Hertenstein et al., 2006). Mother tigers and rats lick and nuzzle their babies, chimpanzees groom each other, and bear cubs wrestle with each other. Even amongst insects, touch plays an highly important role. Desert locusts have been shown to transform their behaviour from a little-seen solitaneous phase to a swarming gregarious phase as a function of reciprocal tactile contact of the hind legs (Anstey et al., 2009). In the animal kingdom, touch is used to comfort, to determine dominance, and to establish bonds. Not surprisingly therefore, touch seems to be even more important in those species that can be defined as 'social animals'. For example, for many primate

species living in large groups, inter-individual touch has been shown to contribute to form bonds and to keep the relationships within the group peaceful (e.g. Weber, 2005).

As far as humans are concerned, a number of studies have investigated the role of tactile social contact in neurocognitive development. In particular, Weiss et al. (2004) have demonstrated that those infants whose mothers used more stimulating touch during caregiving had better visual-motor skills at one-year of age. In addition, the infants of mothers who touched them frequently had more advanced gross motor development. Similarly, evidence has been reported suggesting that the distress caused by certain medical procedures can be substantially reduced by providing the baby with sucrose, followed by a cuddle plus either breastfeeding or a pacifier given during the procedure (Bellieni et al., 2007).

In adults, many studies have shown that social touch exerts a powerful effect on people's behaviour, and even on their opinions. In a now-famous experiment, Crusco and Wetzel (1984) studied the effects of accidental social touch in a restaurant setting. The waitresses in their study were instructed to briefly touch customers either on the hand, on the shoulder, or not to touch them when returning the change at the end of the meal. Crusco and Wetzel found that the 'tipping rate' of the customers was significantly higher in the touching conditions than in the no-touch condition. A number of similar experiments have now demonstrated that social touch is also effective in positively influencing people's opinions about a given service or person (Gallace & Spence, 2010b). It has also

been demonstrated that people who are incidentally touched are more likely to increase their compliance or civic behaviour, such as returning a coin left in a phone booth by the preceding caller. This effect, now known as the 'Midas touch effect', occurs whether the person touched remembers it or not.

What are the neurocognitive mechanisms underlying the surprisingly powerful effects of social touch? Research

has only recently started to investigate this important question. In particular, a number of studies have addressed the role of touch in mediating the release of certain hormones, such as oxytocin, implicated in a variety of mammalian bonding behaviours (e.g. Carter, 1998; Insel, 2000). In fact, research on humans would seem to suggest

that the release of oxytocin helps couples to form lasting relationship bonds. Note also that the level of oxytocin increases greatly during parturition, perhaps also helping to create an early bond between mothers and their babies.

A number of studies have shown that sexual contact, as well as non-sexual physical affection, involving tactile contact (such as back-rubbing and hugs) is effective in inducing the release of oxytocin (e.g. Uvanas-Moberg et al., 2005; see also Shermer, 2004). These studies have also shown that women who report having received more hugs from their partners in the past have higher levels of oxytocin and significantly lower blood pressure than those who do not have much of a history of being hugged by their partners (Light et al., 2005). That is, the mediating role of touch in the release of oxytocin might play an important role in affecting our social interactions.



Familiar and important tactile social interactions

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Interestingly, recent research has convincingly demonstrated that certain neural fibres and receptors in the human skin appear to specifically code for pleasant touch (see McGlone et al., 2007, 2012 for reviews). It is important to note here that these fibres respond more vigorously to the slow stroking of the skin, a stimulation that resembles a caress. Moreover, pleasant touch mediated by the activation of these fibres would seem to require the involvement of relatively older (from an evolutionary point of view) brain areas, such as the orbitofrontal cortex. That is, the more social aspect of touch might be very effective in terms of eliciting certain behaviours and certain emotions by the mediation of the most primordial parts of our brain.

### When touch drives behaviour

Nearly every day we buy something, be it our lunch, a new watch, a hat, a newspaper or a train ticket. In the large majority of cases we do not buy images or sounds, but physical objects that can be touched and explored with our hands. Even when a product can be purchased in a 'virtual' or not tangible form, such as music downloaded from the internet, we still miss the pleasure of holding the physical CD in our hands.

A number of studies have clearly shown that touch plays a very important role when it comes to buying something. For example, McCabe and Nowlis (2003) reported that consumers preferred to select those products from retailers who allowed their products to be touched, especially products for which tactile input is important for evaluation (e.g. clothing, or portable electronics). In fact, when the UK supermarket group Asda removed the wrapping from several brands of toilet tissue in its stores so that shoppers could feel and compare the textures, the sale of the in-store brand increased significantly. A trip to the supermarket nowadays will easily confirm that many products have openings on their packages, or pieces of its content stuck on the packaging itself

in order for the potential customer to touch them.

A recent study confirmed the value of the available tactile information to our buying behaviour, even when this information is not strictly relevant to the object to be purchased. The participants in a study by Ackerman and colleagues (2010) were asked to sit on either a hard wooden chair or a soft-cushioned chair, and were required to imagine shopping for a new car priced \$16,500 and to negotiate a lower price. In this bargaining task, they were allowed to make two offers for the car (the second offer had to be made on the assumption that the dealer had rejected the participant's first offer). The participants who sat in the hard chair were those who deviated least from their first rejected offer. The tactile context of a given situation affects our behaviour even when it is not directly relevant to the action to be performed. So, the next time that someone ask you to sit on a comfortable sofa perhaps you should think twice before making your decisions from there, rather than from a sturdy office chair!

The same research also demonstrated that touch is even of importance in domains where we wouldn't expect it to be relevant, such as hiring a new collaborator on the basis of his CV. The authors asked a number of passers-by to evaluate a job candidate on the basis of a CV attached to either a light (0.34 kg) or a heavy (2 kg) clipboard. Surprisingly, even if the CVs used were exactly the same, the participants that were given the CV on the heavier clipboard on average rated the candidate as being better and having a more serious interest in the position than those given the lighter clipboard. That is the concepts of seriousness and capability were transmitted by means of the tactile qualities of the material where the CV was presented rather than by the content of the CV itself. There is even research (Piqueras-Fiszman et al., 2011; Piqueras-Fiszman & Spence, 2012) showing that the perception of food can be affected by the weight of the plate or container where it is presented).

In summary, the results of the studies presented here clearly suggest that certain tactile qualities of objects, such as their weight, texture and hardness have a strong effect on the neural processes that immediately follow the contact. In particular, the neural activity generated by these tactile attributes might trigger in the participant's brain the associated concepts (e.g. strength or weight) and therefore affect their behaviour and choices.

### Conclusions

A growing body of recent research in the fields of psychology and cognitive neuroscience have highlighted that touch is a very powerful sensory modality, involved in every aspects of our life, one that certainly deserves more attention from the scientific community in the years to come. Despite its limitations, touch can affect our decisions, opinions and behaviour, even when we are not fully aware of it. It contributes to our well-being and to the maintenance of our social relationships. It also protects our body at both the physical and psychological level. The sense of touch truly contributes to making the external world 'real' to us. In the last few years, manufacturers and advertisers are increasingly coming to consider the importance of tactile interactions, and the knowledge arising from scientific research into our sense of touch is progressively becoming an important basis for the design of products that are more appealing to the user or consumer. Understanding the mechanisms of tactile processing will certainly help us to appreciate the complexity of this sense and its incredible value in our life.



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