



Meaning makes touch affective

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The pleasantness of gentle stroking (CT-targeted touch) varies highly between individuals and studies, indicating that relevant factors may not be accounted for. We propose that the affective value of a touch event is determined by how well its perceived purpose matches the goals of the touch receiver. The perceived purpose or meaning of touch is in turn informed by the sensory characteristics together with the setting, person factors, and the touchee's expectations. Affective touch is often a sign of affection, intended to soothe or show support. In a typical lab study however, the toucher is a stranger and its purpose is research. The purpose of laboratory touch is nevertheless compatible with the goal of participants, namely to contribute to research. To fully understand how the perception of affective touch emerges, more studies should directly manipulate participants' beliefs about the purpose of touch.

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Introduction

Touch can say many things. As an example, the slight pressure of another's hand on the arm of a grieving friend can imply 'we're in this together'. It is this meaning of the touch that has a soothing effect on the receiver. We use 'meaning' to denote the touchee's inferences about the intention of the toucher and the purpose of the touch [1]. As Morris [2] pointed out, meaning can refer to several components of communication, for example, was the touch intentional or accidental, what was the toucher's intention, and how is the touch interpreted by the touchee. In other traditions, meaning is instead defined as subjective value [3] or salience [4]. Here, we postulate

that meaning is a key determinant of subjective value, but not equal to it. Instead, we see the affective value of touch as arising from the match between the meaning of the touch and the goals of the receiver (see [Figure 1](#)). For instance, for someone trying to bend the rules unnoticed, the slight pressure of another's hand on one's arm could lead to discomfort and fear of having been caught out, far from the warm glow elicited by a friendly touch. Since the perceived meaning of touch in this context is negative, the touch experience becomes aversive.

Existing research in affective neuroscience has focused mostly on the effects of low-level mechanisms such as the activation of different receptor types. We argue that top-down processes are so important they can override any intrinsic affective value attached to bottom-up signals such as CT receptor activity. Imagine being gently stroked by someone you despise. While you might recognise that the touch itself has the potential to be pleasant, the affective value of the touch experience would hardly be positive. Hence, the field's emphasis on low-level features and the relative neglect of the meaning aspect may be one reason for the large variability typically observed in results on touch effects.

What is affective touch?

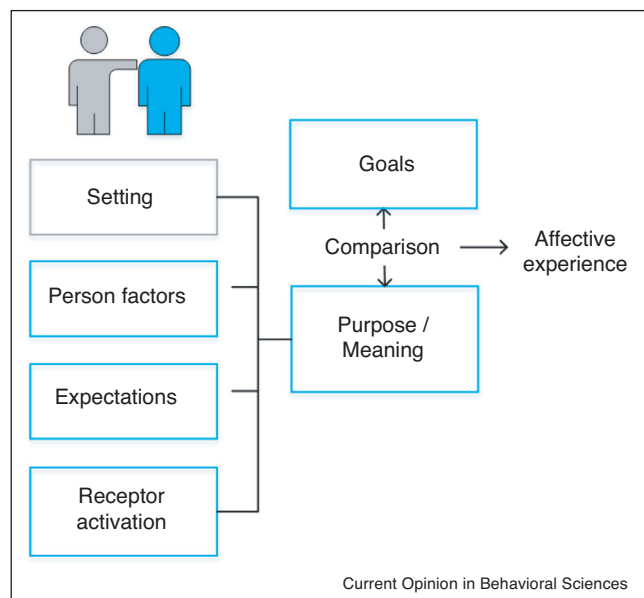
The term affective touch is typically used to describe slowly moving, low-force mechanical stimulation which is often perceived as pleasant. This type of passively received slow stroking has been found to activate a particular type of afferents, the C-tactile afferents (CTs) [5]. Because the impulse rate of CTs and pleasantness ratings follow a similar inverted u-shaped pattern [e.g. Ref. 6], it was suggested that CTs convey positive affective touch [7,8]. The term 'affective' with regard to touch was coined as an opposite to 'discriminative' [9]. 'Discriminative' refers to detecting, differentiating and identifying external stimuli via their sensory characteristics such as pressure, vibration, texture, and friction. This type of information is conveyed by fast conducting A-beta fibres. Input from A-beta and CT-activation is an important source of information that guides the touchee's inferences about the perceived purpose/ meaning of the touch.

Characteristics of the touch event

Stimulus features – pleasantness, temperature, and so on

A range of stimulus (touch) features influence the affect induced by touch, including frequency/velocity, duration, location, temperature, texture, and force [10]. CT firing and the pleasantness derived from it depend on velocity,

Figure 1



Elements contributing to the touch experience. Note that the elements on the chart typically also influence each other in complex ways. For instance, one's goals can influence expectations, which influence inferred purpose/meaning, and so on.

temperature and force [6,11]. The experienced pleasantness of CT-targeted slow stroking is further influenced by stroking duration [12–14] and texture [for a review, see Ref. 15]. Temperature, force, duration and texture affect pleasantness also for other types of touch such as hugging, patting, holding, or massage. Deep pressure can be experienced as pleasant and activates similar brain regions than CT-targeted stroking, but also other regions [16].

Purpose, intention, and meaning

All touch is experienced in a certain context or setting, which is typically associated with a purpose. A striking example of the importance of purpose in affective touch perception is the participants' reaction in a 1930s study on fabric texture [17]. When asked for the pleasantness and their preferences for one of two fabrics, participants 'refused to compare fabrics as such without knowing the purpose for which they were intended' (p. 211). In line with the view on proximate versus ultimate causes of behaviour [18,19], one could distinguish between proximate and ultimate purposes of touch. A proximal purpose would be one that applies to behaviour in the specific time, place, and manner where it occurs, whereas an ultimate purpose would refer to a higher-order purpose. Along these lines, the 1930's fabric study (initiated and advised by a fabric manufacturer) reports the proximate purpose: fabric should feel good to the skin. This helps achieve the ultimate purpose: to sell more fabric.

Most affective touch occurs between individuals. This means that beliefs about the intention of the toucher and the purpose of the touch are the same. In the lab, participants are able to tell from the touch characteristics alone whether the touch was meant to signal attention, love or intended to calm the receiver [20,21]. For interpersonal affective touch such as stroking or hand-holding, the proximate purpose may be to signal love or support, whereas the ultimate purpose may be to maintain the social bond between individuals. Supportive relationships are beneficial for health and longevity [22].

Touch with an interaction partner also takes part in a certain setting, for example at home, in public, a professional setting, or in the lab. There is to date little research on how the overall setting influences how touch is experienced. Culture can make a further context modulating how touch is interpreted and experienced [23]. Culture defines which types of touch are appropriate when and by whom, and thereby guides the attributed meaning of a touch. For example, in a Western cultural context, CT-targeted touch on the forearm performed by an unfamiliar or unappealing experimenter as part of an experiment can be assumed to cause less negative affect than when performed by the same person during the coffee break in the kitchen.

All the elements listed above — characteristics of the touch itself, the context, person variables [24], together with other sensory cues present (Spence, this volume) — set the framework from which the intentions of the touch provider are derived. In the field of nursing, the term 'affective touch' coined in 1981 describes touch that is not related to tasks [25], thus, a definition of touch based on its intention and function.

A handful of studies have addressed how the perceived intention of the toucher influences the affective experience of touch [e.g. Refs. 26–28]. Mulaik *et al.* [26] reported that the touch of nurses was often perceived as a sign of care and affection, but also as a means of control. Hospital patients who received a high amount of instrumental touch (e.g. while being helped to sit up or walk) preferred that nurses limit touch, whereas no such preference was revealed for affectionate touch (patting or holding the hand, shaking hands, backrubbing and hugging). In contrast, hospitalised elderly people in a different study found touch by a nurse more comfortable when it was instrumental than affectionate. The authors attributed this to perceived intention, which may be clearer for instrumental touch, namely to facilitate performance, and more ambiguous for affectionate touch [29]. The differences in the findings of these two patient studies may be due to the types of touch involved: It appears that the former study evaluated touch during 'heavier' tasks than the latter, such as help with walking or turning. As the authors reasoned, instrumental touch along with these

activities could have been tiring or painful. Furthermore, the latter study explicitly asked for the preference of affectionate touch in the face and on the leg, areas that may be perceived as rather intimate. A preference for instrumental touch was also observed in an experimental study with healthy participants [27] where a robotic nurse touched and wiped the forearm of the participant while it verbally gave an instrumental ('I will clean you') or an affectionate ('everything will be all right, you are doing well') explanation for the touch. Enjoyment and the willingness to let the robot touch the participants again were higher for instrumental than affectionate touch. Despite contrasting results, all three studies illustrate how the perceived intention can influence the affective value of touch.

Similarly, the reported effects of the perceived facial expression of virtual [30] and human [31] agents on touch perception may also have been (partly) driven by the assumed intention of the agent. Future lab studies should systematically investigate how attributed intention influences the perception of touch.

Person variables and expectations

The affective value of a given touch also depends on person variables. Previous experiences influence touch perception, for example childhood adversity [32] and low exposure to touch [33]. Attachment style [e.g. Refs. 34,35], behavioural inhibition [30], autistic traits [36,37], openness for new experiences [38,39], attribution style [40] and extraversion [39] were reported to play a role in touch experience. Furthermore, current physiological and emotional state can influence touch preferences and effects. For example, individuals with higher psychological distress reported a larger wish for affectionate touch [41]. There are several studies which show that touch can reduce stress and have calming effect [42,43], which suggests that being in a stressed state may change the affective value of touch.

Previous experiences and memory also contribute — implicitly or explicitly — to meaning-making. Participants who felt touch-deprived, experienced CT-optimal slow stroking as less pleasant despite reporting similar attitudes to touch than non-deprived individuals [33]. At the same time, their pleasantness ratings were unrelated to their attitudes towards touch with close others, whereas they were related in non-deprived individuals. This relationship may suggest that the pleasantness of CT-optimal touch in the lab is influenced by a previously acquired conditioned response, that is, because it evokes conscious or unconscious memories of stroking in situations when it usually is pleasant (e.g. caress by a partner), and the associated meaning, but not primarily because it activates CT afferents. This way, touch deprivation could lead to less and not more enjoyment of stroking touch in the lab. In sum, we propose that a particular type of touch

activates a certain stored meaning, which then leads to the experienced affect. Such implicit associations tied to CT-optimal and other types of touch in particular situations need to be investigated in order to determine how the percept of affective touch arises.

Touch does not only convey a particular meaning in the very situation it occurs in, but also meaning in a larger context, for example about the relationship between the touch provider and the receiver. As outlined in the review of Jakubiak and Feeney [44], touch can be a signal of the other person's affection. Such affectionate touch can further imply closeness and therefore inclusion in a social group. It may also mean that one is secure [45], and protected, and that support is available if needed. Thus, a brief touch can say something about one's social embeddedness in a much larger context and on a much longer time frame. However, this larger meaning of touch is to date largely neglected in experimental research on touch.

How all these factors make up affective experience

We propose that the affective value of a touch event is determined by how well its meaning matches the goals of the touch receiver (Figure 1). For instance, in a typical lab experiment touch is assumed to occur for research purposes. Since participants sign up to contribute to science, the meaning of touch in the lab is mainly congruent with the person's goals, and stroking touch can be rated as pleasant even when repeated, unaltered, over 50 min [12]. Similarly, when people receive touch in the context of a treatment, for example, a massage, there is full congruency between the purpose of the touch and the goals of the receiver. Outside of research and treatment contexts, the assumed intention of gentle touch will often be to signal affection, with the ultimate goal of building or maintaining a closer relationship. Whether the receipt of such touch is judged as pleasant likely depends on how the receiver feels about establishing a closer relationship with the toucher. Findings that the affective value of touch is increased in male heterosexual participants when the toucher is female [46,47] and perceived as attractive [48], fit with this notion. Moreover, the pleasantness of received stroking increases with the quality of the relationship between touchee and toucher [49]. We speculate that the proximate and ultimate purposes of affective touch (e.g. signalling love, maintaining bonds) are maximally congruent with the goals of the touchee in the case of high-quality romantic relationships.

Intrinsic pleasantness of CT firing?

Does CT-targeted touch have an intrinsic positive value, as is believed to be the case for primary rewards such as sweet taste? In rats, chemogenetic activation of C-low threshold mechanoreceptors (C-LTMR), the non-human homologue of CT-fibres, was rewarding on its own as it

increased conditioned place preference and touch-seeking behaviours [50]. In humans, previously neutral stimuli that were paired with CT-targeted touch were rated to be more approachable than stimuli paired with control touch [51]. This suggests that CT-targeted touch possesses some positive valence. However, CT activation alone does not seem to be sufficient to elicit conscious positive feelings. For example, bursts of CT activity in the form of afterdischarges and longer-lasting firing seen in cooling [52,53] do not produce any corresponding percept. Also, CT-targeted touch in patients lacking A-beta fibres elicited only vague and inconsistent sensations [54,55]. Furthermore, some individuals even rate CT-targeted touch as unpleasant [56]. In sum, CT activation can reinforce gentle touch, but may be insufficient for conscious pleasure. Altogether, more evidence is needed to answer the question of whether the sensory input of CT-targeted touch is intrinsically positive and sufficient for positive affect.

In other modalities, factors related to the setting, state of the individual and expectations are often seen to influence affective experience more than the sensory input itself. For example, the affective value of tastes is heavily influenced by previous experiences [57] and contextual factors, such as hunger or satiety [e.g. Refs. 58,59]. Even highly aversive tastes such as intense saltiness can become affectively positive with severe salt deprivation [60]. Labelling the same odour once as ‘parmesan cheese’ and once as ‘vomit’ changed the ratings from pleasant to unpleasant [61]. Noxious stimulation can gain positive valence when it is believed to be useful, for example, for building muscle mass [62], or when pain is seen as better than the alternative outcome [63,64]. Many visual illusions depend on expectations based on experiences, for example the Hollow Face illusion [65].

The predictive brain creates touch affect

The multitude of studies demonstrating the importance of the factors cited above, are consistent with predictive processing accounts [66,67–69]. According to predictive models, prediction signals in the brain continuously anticipate events in the environment. These predictions, as an internal model, are revised when incoming sensory input deviates from them. In this approach, prior knowledge plays the dominant role, and sensory input can even be ignored if it is not consistent with the overall picture (e.g. Refs. [68,70]). Predictive processing models highlight the importance of precision: with low sensory precision (as in the case of pure CT signals) and reliable expectations, prediction errors are downweighted and reliance on priors becomes stronger [71]. Extreme examples of this to happen are inattentive blindness and change blindness [72,73]. In the famous gorilla example [74], participants had observed a number of passes before the gorilla appeared, so that high precision expectations for the ball passes had been built up. Based on the initial model of

basketball playing, high precision input was expected, and unexpected input such as the gorilla received low weighting [75].

Assuming such a predictive account of processing, cues in the environment and personality variables would shape the perception of touch even before the touch occurs [76]. It is hard to imagine any touch instances in conscious adults that occur without meaning-making, since touch is always embedded in a particular background setting that will be processed implicitly or explicitly. Thus, even if CT-targeted touch may be intrinsically pleasant, we argue that its affective value will also be derived from meaning. In sum, both bottom-up and top-down processes inform meaning and the affective value of touch, however their relative importance likely varies from largely bottom-up to largely top-down.

Conclusion

We suggest that affective touch researchers should look to the pain field, where it is well established that the perceived meaning is a powerful determinant of the experience of pain [77]. Manipulations that enhance the threat value of a noxious event, such as uncontrollability and unpredictability, increase both the perceived intensity and unpleasantness of pain [78]. Conversely, beliefs that pain is beneficial, for example, during exercise, decrease pain perception [62,79]. Hence, the firing patterns of peripheral nociceptors are poor predictors of pain perception; indeed the International Association for the Study of Pain highlight that pain can arise in the absence of nociceptor activation [80]. We argue that it is time for the field of affective touch to fully consider the perceived meaning of touch as a major determinant of the touch experience.

Conflict of interest statement

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