

Do transdiagnostic factors influence affective touch perception in psychiatric populations?

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In this review, we suggest a new model that has its roots in studies with healthy individuals, but may be especially promising for understanding atypical CT optimal touch perception in certain clinical groups. We argue that social touch plays an important role in the development of a secure or insecure attachment style. Insecure attachment is common in psychiatric patients and potentially impacts their perception of CT optimal touch. This direct link between insecure attachment style and touch perception may be modulated by touch deprivation, to which individuals might be predisposed when they are insecurely attached. The links in this model need further exploration, especially in psychiatric patients, and concrete recommendations for future work are provided.

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Introduction

Our largest organ, the skin, provides us with the sense of touch. Touch is the earliest sensory modality to develop [1], and it is important for perceiving ourselves, developing mental representations of the body, and establishing a sense of body ownership [2]. Touch also has an emotional function, which is receiving increasing attention as evidenced from this special issue. As described extensively in this issue and various previous reviews [e.g. Refs. 3,4], a class of unmyelinated low-threshold mechanosensory fibers, called C-tactile afferents (CTs) play an important role in affective touch in humans [5]. The CT afferents are mainly present in the hairy skin [but also see Ref. 6] and respond optimally to slow, soft, gentle stroking at velocities ranging between 1 and 10 cm/s, with a peak at 3 cm/s [5]. This type of tactile stimulus is usually also perceived to be most pleasant [4]

Although CT optimal touch is generally perceived as very pleasant by the healthy population, appraisal of affective touch appears atypical in psychiatric patients. So far, a few studies have been published on this topic, showing for example that individuals with anorexia nervosa (AN) [7,8*], post-traumatic stress disorder [9,10], mood and affective disorders, personality disorders, PTSD, and anxiety disorders generally rated touch as less pleasant [9].

In this paper we would like to suggest that a promising avenue for future research would be to focus on common denominators across different psychiatric conditions that potentially play a role in atypical CT optimal touch perception. This line of work would provide more insight into why (certain) psychiatric patients perceive CT optimal touch as less pleasant than healthy individuals while at the same time offering a framework for determining transdiagnostic factors underlying affective touch perception in a variety of psychiatric disorders. We will specifically focus on insecure attachment style and touch deprivation as potential transdiagnostic factors, as these have previously been linked to psychiatric disorders [e.g. Refs. 11,12] and have been suggested to play a role in CT optimal touch perception [e.g. Refs. 13** ,14**].

Attachment style

Bowlby's Attachment theory [15–17] states that infants, to ensure their survival, are innately driven to form a close bond with their parents or primary caregivers. The way the caregiver responds to these attachment needs shapes the infants' attachment style [18, but also see Ref. 19 for a critical review]. The general assumption in Bowlby's attachment theory is that a secure attachment refers to a child's trust in their caregivers' support, where an insecure attachment refers to the opposite, a lack of trust in their caregivers' support [20]. In infancy and childhood, touch plays an important role in forming a secure attachment style [21,22]. Recently Williams and Turner [23] showed that infants who were touched more were more likely to show a secure attachment style several months later. In adults, CT optimal touch also plays a role in attachment behavior, with touch contributing to secure attachment states in adulthood [24]. In addition, it has also been reported that touch experiences in childhood and adolescence predicted attachment style in adults [25].

Social touch is thus a central factor in the development of a secure attachment style. A few studies investigated the

specific relationship between attachment styles and CT optimal touch perception. Firstly, Krahé and colleagues [26] investigated the role of differences in attachment styles in relation to the subjective and neural responses to CT optimal touch, in healthy females. Participants were asked to rate the pain of a laser after being stroked at a CT-optimal and CT non-optimal velocity. The neural responses were mapped using EEGs. The results showed that the effects of CT optimal touch on the subjective and neural measures of pain depended on differences in attachment styles. Specifically, higher attachment anxiety attenuated the relevant EEG amplitudes related to pain (N1 and N2) after CT optimal touch. Subjective reports on pain experiences were also slightly lower in the CT optimal stroking condition in the participants with higher attachment anxiety. Participants with higher attachment avoidance showed an opposite effect [26]. In a later study, Krahé and colleagues [18] studied the sensitivity to affective touch in relation to attachment style in healthy females. Their results showed that an insecure attachment style, compared to a secure attachment style, was linked to a reduced ability to distinguish CT optimal and CT non-optimal touch. However, this effect was found only for higher attachment anxiety, not for higher attachment avoidance. Touch discrimination was operationalized by calculating the difference between pleasantness ratings for CT optimal (3 and 9 cm/s) and CT non-optimal (0.3 and 27 cm/s) touch. Furthermore, a study by Spitoni *et al.* [13**] showed that participants with an insecure, disorganized attachment style did not perceive gentle touch as pleasant. Instead, these participants perceived both CT-optimal and CT non-optimal touch as neither pleasant nor unpleasant. Participants with a disorganized attachment style even preferred the CT non-optimal stimulation over CT optimal stimulation [13**].

Taken together, these studies show that in healthy participants the perception of CT optimal touch is linked to their attachment style, with suboptimal attachment styles being associated with a reduced appraisal of affective touch. We know that insecure attachment styles are prevalent within the psychiatric population, more so than in the healthy population [27]. Insecure attachment styles are for example observed in patients with an eating disorder, such as anorexia nervosa [11,28], but also in patients suffering from schizophrenia [29], personality disorders, such as borderline personality disorder [30] or avoidant personality disorder [31], anxiety disorders, such as social anxiety disorder [32], substance use disorders, such as alcohol addiction [33], autism spectrum disorder [34,35], and mood disorders, such as major depression [30]. As such, it would be interesting to investigate whether differences in CT optimal touch perception between psychiatric patients and healthy controls are (partially) driven by differences in attachment style between these two groups. Moreover, work focusing on differences in attachment style and CT-optimal touch

perception *across* different psychiatric groups would provide another interesting path to explore as not all psychiatric patients exhibit the same type of insecure attachment style. For example, dismissing and disorganized attachment styles are overrepresented in schizophrenia [29], while an anxious attachment style is more characteristic of individuals suffering from social anxiety disorder [26]. Although not related to CT-optimal touch perception specifically, in the healthy population it was already shown that attachment avoidance, but not attachment anxiety, was predicted by individual differences in frequency of and satisfaction with childhood touch experiences [25].

Another important question to address in future work would be whether attachment style is a causal factor in atypical CT optimal touch perception in psychiatric patients, or if behavioral consequences of insecure attachment perhaps modulate CT optimal touch perception. One of these consequences may be touch deprivation [e.g. Refs. 24,36].

Touch deprivation

Touch deprivation refers to an imbalance between the amount of touch an individual needs or prefers and actual touch frequency [37*]. Previous work has indicated that healthy individuals with an insecure attachment style are more prone to report feelings of touch deprivation. Both attachment related anxiety and attachment related avoidance were linked to a lower touch frequency [25], moreover, attachment related anxiety, but not avoidance was found to be linked to higher levels of longing for touch [25,38].

Studies in healthy participants have shown that touch deprivation influences how individuals experience affective touch. A recent study by Sailer and Ackerley [14**] explored touch perception in individuals with high and low touch exposure. They found that the participants who experienced less touch, differed from controls in regard to the pleasurable aspects of touch: They rated CT optimal touch as being less pleasant than controls, who were touched more. Sailer and Ackerley [14**] suggest a ‘use it or lose it’ — principle, where ‘the more social and interpersonal touch is experienced, the more it impacts on our perception of affective touch’. In other words, when someone feels touch deprived, they might also have more trouble perceiving CT optimal touch as pleasant.

There are several indications that there is a link between psychiatric conditions and touch deprivation [14**]. Previous studies showed that individuals who are touch deprived tend to be more aggressive and have more impairments in psychological wellbeing [37*,39]. The other way around, psychiatric patients are at risk of being touch deprived, since mental health service users generally have a smaller social network [40,41] while affective

touch interactions primarily take place in relationships with partners and children [42]. Indeed, previous research indicates that touch deprivation occurs in psychiatric patients, for example in anorexia nervosa [12] and personality disorders [9]. Of note, in these conditions insecure attachment styles have also been reported [11,28,30,31].

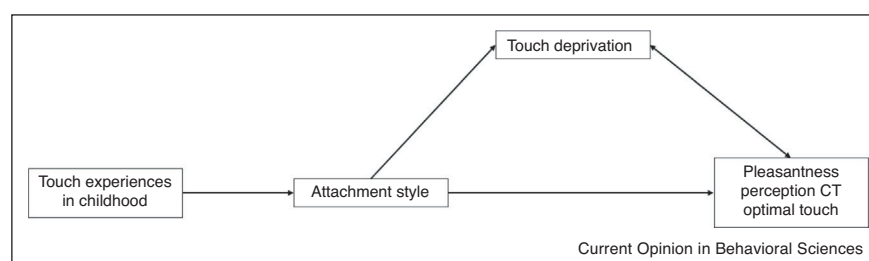
Following from this, it could be that an insecure attachment style sets the stage for lower touch exposure across the lifespan, which in anxiously attached individuals may result in feelings of touch deprivation, while this would not be expected for avoidantly attached individuals. In anxiously attached individuals, this may result in feelings of touch deprivation, as they often worry about rejection and abandonment from significant others and have a deep need for closeness and reassurance [43]. For individuals with an avoidant attachment style a low touch exposure might not necessarily result in feelings of touch deprivation, as they prefer (emotional) distance from others [44,45]. A recent study has even shown that in individuals with an avoidant attachment style coping with pain was *hindered* by the (supportive) presence of their romantic partner [46]. In other words, avoidantly attached individuals coped better with pain while undergoing a painful stimulus on their own instead of with their partner being close. Although this study conceptualized support as the partner of the participant being nearby [46], it could be that support in the form of (CT optimal) touch from the partner is also not beneficial for avoidantly attached individuals. Preliminary support for this line of reasoning is provided by a later study by Krahe and colleagues [26], showing that CT-optimal stimulation (provided by an experimenter) *increased* subjective pain ratings in avoidantly attached individuals, while it decreased pain ratings in anxiously attached individuals.

Taken together, we argue that since close and frequent physical contact between an infant and their caregiver promotes a secure attachment style [21] infrequent or

abnormal touch experiences early in life might contribute to an insecure attachment style. Low touch exposure later in life might predispose anxiously attached individuals to experiencing feelings of touch deprivation [25,38]. Since touch deprivation is associated with atypical perception of affective touch [14**] anxiously attached individuals may show a decreased ability to discriminate between CT optimal and CT non-optimal touch [18]. For individuals who develop an avoidant attachment style, low touch exposure later in life is unlikely to result in feeling touch deprived [25,38], as such, no differences in the ability to discriminate between CT optimal and CT non-optimal touch are expected for avoidantly attached individuals [18]. Although there appears at this point no reason to assume that avoidantly attached individuals appraise touch in an atypical way, previous work has indicated that in avoidantly attached individuals the beneficial effects of CT optimal touch on for example pain perception are absent, CT optimal touch has even been found to increase subjective pain experiences in this group [26].

Based on this previous work with health participants, we tentatively, suggest a model (see Figure 1) on the relation between childhood and later touch experiences, attachment style and affective touch perception. Importantly, while these participants were touch deprived [14**] or insecurely attached [18], they were not necessarily sampled from a psychiatric population. Levels of touch deprivation and/or insecure attachment are likely to be more extreme in patients with a psychiatric condition, the combined potential impact of these two factors might therefore not only affect the ability to discriminate between CT optimal and CT non-optimal touch [18], but also impact the perceived pleasantness of touch. Following previous work with healthy individuals by Sailer and Ackerley [14**] and Krahe and colleagues [18], we would expect that especially in patients with an anxious attachment style, atypical CT optimal touch perception would be most prevalent [33] compared to patients with an avoidant attachment style. It should be

Figure 1



Model depicting transdiagnostic factors that potentially impact pleasantness perception of CT optimal touch.

Note: This model proposes that childhood touch experiences impact attachment style. Attachment style is linked to pleasantness perception of CT optimal touch. Attachment style could also be related to touch deprivation, which in turn might modulate the direct relation between attachment style and pleasantness perception of CT optimal touch. Evidence for the separate pathways has been found in healthy adults, for psychiatric patients the pathways require further, systematic, investigation.

noted that within different psychiatric conditions differences in attachment style exist as well [47]. Several testable hypotheses can be derived from the proposed line of reasoning. A first step in providing direct support for this model would be by investigating the direct relationship between attachment style and atypical CT optimal touch perception in a wide variety of psychiatric patients.

Future challenges

The general direction of future research is, across the factors attachment style and touch deprivation, to expand the participant groups to a larger variety of psychiatric populations. However, some undiscussed considerations remain that could influence these types of future studies.

Firstly, the current review focused on slow CT optimal stroking, however, just being touched could elicit similar benefits. For example, when simply being touched by a parent on the shoulder, reduces social vigilance in (socially anxious) children [48*]. Another example comes from Goldstein and colleagues [49], who found that holding hands with a romantic partner could provide relief from a painful stimulus. At a neural level, Coan, Schaefer and Davidson [50] found reduced responses to threat when participants were holding hands with their spouses. These studies did not focus specifically on CT optimal stroking velocities, nevertheless, they showed that social touch impacts our behavior and experiences. This shows that affective touch involves more than just 3 cm/s stroking and indeed CT-fibers also respond to static touch [51].

In line with this, this review and the majority of the discussed studies record pleasantness ratings of CT optimal touch. However, an interesting extension would be to determine whether atypical CT optimal touch perception influences the benefits of CT optimal touch. Several studies have shown that CT optimal touch is effective in reducing feelings of social exclusion [52], increasing feelings of relaxation [53], reducing pain [26,54] and that it acts as a buffer against stress [55]. However, it is unknown whether the beneficial effects of CT optimal touch are modulated by perceived pleasantness of touch, or whether they perhaps exert their influence in a different way. It would be important to investigate this in psychiatric conditions as a reduced pleasantness perception of CT-optimal touch has been observed in this group [e.g. Ref. 8*]. The outcomes of future work addressing this question would have important consequences for potential therapeutic applications of CT-optimal touch.

Conclusion

To conclude, individuals across certain psychiatric populations do not seem to perceive CT optimal touch as pleasant as healthy controls. In the current paper we aimed to explore attachment style and touch deprivation

as possible transdiagnostic factors that could underly atypical CT optimal touch perception in psychiatric patients. Based on the currently available studies, we suggest that both factors could contribute to altered CT optimal touch perception in the psychiatric population. However, studies directly linking these factors to CT optimal touch perceptions are scarce, especially regarding psychiatric populations. Therefore, strong conclusions cannot be drawn, and it is recommended to further explore and investigate this topic by expanding research to different psychiatric populations, exploring the precise relation between attachment style, touch deprivation, and affective touch perception. Moreover, it would be important to determine what the effect of atypical CT optimal touch perception is on its benefits.

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Conflict of interest statement

Nothing declared.

CRedit authorship contribution statement

Anouk Keizer: Conceptualization, Supervision, Writing – review & editing. **Jasmijn O Heijman:** Conceptualization, Writing – original draft. **H Chris Dijkerman:** Conceptualization, Supervision, Writing – review & editing.

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