Losing Touch with Oneself: Depersonalisation Experiences Modulate Vicarious Affective Touch and Self Touch

Anna Ciaunica (a.ciaunica@ucl.ac.uk)  
University of Porto

Jyothisa Mathew  
Bundeswehr University Munich

Ophelia Deroy  
Ludwig Maximilian University

Merle Fairhurst  
Bundeswehr University Munich

Keywords: affective touch, vicarious touch, self-touch, sense of self, depersonalization

Posted Date: March 13th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2628739/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

Depersonalisation (DP) is characterized by distressing feelings of being detached from one's self and body, often described as being “out of touch” with oneself. We conducted two online experiments looking at the relationship between non-clinical experiences of DP and vicarious affective touch and self touch. In Experiment 1 we found that people with lower occurrences of DP rate the perceived pleasantness of the imagined social touch as received by the self higher than if received by the other. By contrast, we found no difference in the perceived pleasantness of affective touch imagined as being received by the self vs the other in people with higher occurrences of DP experiences. In Experiment 2, we designed a new affective self-touch intervention in order to explore the effect of affective self-touch stroking on one's dorsal forearm on the perceived pleasantness and vividness of tactile experiences as being received by the self and others. We found that both low and high DP participants, following the affective self-touch intervention, report significantly higher ratings of vividness of tactile perception. These findings may have key implications for potential sensory tactile-based interventions for people experiencing distressing feelings of DP.

1 Introduction

The sense of self, the subjective feeling of being an 'I' or a 'self' bound to my body as distinct from the world and others, is a fundamental aspect of our everyday experiences (Gallagher 2000; see Quin et al. 2020 for a review). Depersonalisation (DP) is a common experience characterized by distressing feelings of being detached or estranged from one's self and body and from one's surroundings (Derealisation) (Sierra & Berrios 1997). As a person with DP explains: “when I’m having an episode of depersonalisation, it feels more like I'm watching myself doing things, but I'm not present for it. I'm witnessing myself... I ‘know’ I’m in control, but I’m not ‘feeling’ in control” (Perkins 2021:44). This self-detachment induces uncanny sensations of not being fully present or real, and of losing touch with one's self, body and the world (Simeon & Abugel, 2006; Sierra 2009; Ciaunica & Charlton, 2018).

DP is often triggered by traumatic life events, substance use, severe stress, prolonged depression, extreme fatigue (van Heugten et al. 2015; Titubos et al. 2018). DP has a prevalence of around 1–2% of the population, with an onset in adolescence or early adulthood (Baker et al. 2003; Hunter et al. 2003; Michal et al. 2007; see Salami et al. 2020 for a recent review). Chronic states of depersonalisation and derealisation symptoms may lead to a diagnosis of Depersonalisation-Derealisation Disorder (DDD) (American Psychiatric Association 2013). The classification of DP and DDD as dissociative condition is subject to a nuanced approach. Millman and colleagues (2021) recently used a latent profile analysis to examine symptom variability in clinical depersonalisation. They analysis identified two qualitatively different categories of dissociative symptoms: “compartmentalization” and “detachment “(Brown, 2006; Holmes et al. 2005). Detachment is defined as the subjective sense of separation typically encountered in DP, whereas compartmentalization refers to a dissociative inability to have deliberate control over actions. In this paper we are concerned with transient and mild experiences of DP as self-detachment.
The experience of a disconnect between the self and the body—strikingly described as feeling trapped in one's head (mind) and outside one's body (Ciaunica et al. 2020)—is one of the most frequently cited symptoms in DP (Sierra & David, 2011). Empirical support for this disrupted bodily sensory processing comes from studies that demonstrate disrupted physiological responses in patients with DDD, compared to healthy participants (Dewe et al., 2018; Owens et al., 2015; Sierra et al., 2002). DP has also been linked to disrupted activity in neuronal regions underlying somatic processing (Lemche, et al., 2013; Medford et al., 2016).

Importantly, people experiencing DP report a significant impact of this self-detachment on the quality of their social and emotional life, leading to social isolation: “Feeling unreal and disconnected from my body and the world around me caused me to lose interest in the people and hobbies I used to love” (Perkins 2021: 190).

Recent work has emphasised the multisensory and embodied basis of the human sense of self and self-consciousness as it unfolds dynamically throughout the lifespan (Deroy et al. 2014; Faivre et al. 2017; Tsakiris 2017; Ciaunica et al. 2021a,b). Among the senses, tactile perception and particularly self-touch has recently received close attention (Gallace & Spence 2010; Ratcliffe 2013, Ciaunica & Fotopoulou 2017; Boehme & Olausson 2021). The key idea is that tactile perception is inherently relational and reciprocal: the ‘toucher’ and the ‘touched’ need to be physically proximal, to ‘share’ the experience of touch (passive or active) (Merleau-Ponty 1962).

The pivotal role of touch for the bodily self has received further attention especially after the discovery that gentle, caress-like stroking on the hairy skin at an optimal velocity (3-10m/s, Löken et al., 2009) and skin temperature (Ackerley et al. 2014) activates a specific subclass of receptors. The so-called C-tactile (CT) afferents in human hairy skin respond for pleasant touch, (Johansson et al. 1988; Nordin 1990; Vallbo et al 1993) and activates the neural level the posterior insula and orbitofrontal cortices (McGlone et al. 2012; Trotter et al. 2016).

Previous work outlined the beneficial effects of positive touch experiences produced by CT optimal stroking touch (Fairhurst et al. 2014; Liljencrantz et al. 2017; Pawling et al. 2017; see McGlone et al. 2007; Morrison et al. 2010 for reviews). The so-called affective or social touch is considered to subserve key mechanisms of social bonding, reducing feelings of social exclusion (von Mohr et al., 2017), soothing pain (Krahe et al., 2016; von Mohr et al., 2018) and communicating social support (Kirsch et al., 2018; Fotopoulou et al. 2021). Evidence for the rewarding nature of affective touch comes also from studies showing increased activity of mu-opioid receptors (MOR) – considered to underpin the maintenance of close social connectedness in humans (Pearce et al. 2017) – during social touch (Nummenmaa et al. 2016).

Interestingly, several studies found a strong link between the bodily self and the mechanisms underlying vicarious touch, i.e. the automatic simulation of touch observed on another person's body (Keysers et al. 2004; Adler & Gillmeister 2019). Neuroimaging work outlined that the passive observation of touch experienced by another individual elicits vicarious activity in similar brain regions as those activated...
when touch is received by the individual on her own body (Keysers et al. 2010; Lamm et al. 2011).
Significant individual variability has been reported in exploring vicarious responses to others’ sensory
experiences (Gillmeister et al. 2017).

For example, Morrison and colleagues (2011) reported that vicarious responses to dynamic stroking
touch are velocity tuned and socially specific. More recent studies found that vicarious ratings of
affective touch match the velocity tuning of CT afferents in adults (Walker et al. 2017) and in children
aged between 8 and 11 (Haggarty et al. 2021). In these studies, participants viewed and rated short
videos depicting one individual being touched by another individual at different skin sites (back, upper
arm, ventral forearm, dorsal forearm and palm) at 3 different velocities (static, 3cm/s, 30cm/s). The
authors report that the highest ratings of reported pleasantness were for observing gentle stroking touch
delivered at CT optimal stroking.

Although self-touch and affective touch are increasingly recognized as playing a key role in establishing
one's sense of self and social connectedness, little is known about the relationship between affective
touch and DP. This gap is surprising given that numerous self-reports from people experiencing
depersonalisation point to the importance of maintaining close tactile contact and social interactions
with the physical and social environment in order to enhance one's sense of self. In the words of one
interviewees: “When the depersonalisation is very deep, (...) it feels like that constant source of interaction
is the only thing that allows me to maintain a connection with the world. I'll also seek physical contact
with whoever I'm with.” (Ciaunica & Charlton 2018). Or again, coming from a person with lived
experiences of DP : “I really like when people scratch me or twist my arms or just touch me. It puts me
back in my body and makes me feel cared for” (Perkins 2021:87).

While traditionally self-awareness is considered to emerge through visuospatial and distal mirror self-
recognition (Lewis et al. 1989), recent work outlined that humans first perceptually ‘meet’ other people's
bodies (via proximal skin-to-skin interactions) (Ciaunica 2017). Indeed, touch is one of the first of our
senses to develop in the human embryo (Gottlieb 1976), and provides us thereby with our most basic and
earliest means of perceiving both the self and the social and physical environment, already in utero
(Ciaunica & Crucianelli 2019; Ciaunica et al. 2021a,d). Hence it has been hypothesised that touch
perception might represent a fundamental step in the development of both self- and other-awareness, as
well as self-other distinction (Rochat & Striano 2000; McGlone et al. 2014; Ciaunica & Fotopoulou, 2017;
Ciaunica & Crucianelli 2019). People are also more likely turn to touch for subjective reassurance, when
their sense of reality is shaken (Fairhurst et al 2018; Fairhurst & Deroy 2019).

Here, we conducted an online study featuring two experiments aiming to examine the relationship
between DP experiences and vicarious affective touch and self-touch. Experiment 1 built upon previous
work by Walker and colleagues (2017) and explored to what extent DP traits modulate the perceived
pleasantness and/or vividness of tactile experiences as imagined being received by the self and other. We
hypothesised that people with higher experiences of depersonalisation (as measured by the Cambridge
Depersonalisation Scale (CDS-29), Sierra & Berrios 2000, see Methods below) will report lower perceived
pleasantness and/or vividness of the vicarious tactile experiences as imagined being received by both the self and other. This is because feelings of self-detachment and anomalous bodily experiences in DP may be linked not only to emotional numbness (Medford et al. 2012) but also to feelings of being detached from the others (Farmer et al. 2021).

In Experiment 2 we designed a new affective self-touch task (adapted from Walker et al. 2017), aiming to explore the effect of CT-optimal self-touch stroking on one’s dorsal forearm on the perceived pleasantness and vividness of tactile experiences as being received by the self and other. We hypothesised that the dynamic and affective self-touch stroking (as opposed to static self-touch) will enhance the perceived vividness and pleasantness of the social touch as imagined being received by the self and other in both people with high and low DP experiences. This is because dynamic social touch is a key feature of bodily self-awareness and may constitute the fundamental basis of being connected with oneself and others.

2 Results

2.1 Social Touch Questionnaire (STQ)

Using a student t-test, we found a significant effect of experimental GROUP on reports of touch behaviour as captured by the STQ (t (106) = -3.22, p < 0.01), with significantly higher total scores for low DP individuals (M = 46.15) than high DP individuals (M = 38.28). Additionally, we compared ‘give’ vs. ‘get’ items (that is instances in which the individual is either touching or being touched). We found that high DP (M = 19.19) individuals rate “get” (being touched) items significantly lower (t (106) = −4.23, p < 0.001) compared to low DP (M = 24.72) individuals. This is not the case for “give” (touching) items (t (106) = −1.47, p = 0.14) (Fig. 1).

2.2 Results Experiment 1

Using a 2X2X2 ANOVA with factors: (i) WHO (who was imagined as receiving the touch: self vs other), (ii) WHERE (where the touch was delivered: back vs dorsal forearm), and (iii) our experimental GROUP (low vs. high DP), we found several significant effects. Firstly, for the perceived pleasantness variable, we find a significant interaction between our GROUP x WHO factors (F = 13.38195, p < 0.001). Namely: the low DP group rated imagined tactile experiences personally experienced (SELF) as more pleasant than imagined experiences as experienced by the other (OTHER). By contrast, no difference between “self” and “other” conditions are observed for the high DP group (see Fig. 2).

Additionally, we find a significant main effect for pleasantness for (i) the experimental GROUP (F = 15.85186, p < 0.001) and (ii) WHERE (F = 5.911614, p < 0.001) touch was imagined (‘FOREARM’ vs ‘BACK’), confirming previous reports with the imagined “back” touch scenarios being rated significantly more pleasant than the dorsal forearm. No significant interaction effects were found for vividness ratings (though we see a main effect of WHO (F = 7.192446, p < 0.001)).

2.3. Results Experiment 2
Using a multiple regression, including the factors (i) INTERVENTION, (ii) GROUP and (iii) CT stroking VELOCITY in our model, we identify a significant effect of intervention ($\beta = 9.66$, SE = 3.46, $t = 2.78$, $p < 0.05$). This indicates that both low and high DP participants, following a self-touch intervention, report higher ratings of vividness of imagined tactile experiences (see Fig. 3). No significant effect on the pleasantness of the imagined tactile experiences has been found across conditions.

3 Discussion

This study explored the relationship between depersonalization (DP) experiences (feelings of being detached from one's self and body) and vicarious affective touch and self-touch. Our analyses yielded evidence for several notable findings.

First, as predicted, we found that DP significantly modulates the subjective rating of touch experiences overall as measured by the Social Touch Questionnaire. Specifically, people with lower occurrences of DP experiences reported higher perceived pleasantness and vividness rating for touch. By contrast, people with higher occurrences of DP experiences rated all touch experiences as significantly less pleasant. This suggests that people with DP experiences may benefit less from the social and affective component of tactile experiences, consistent of their common complaints of feeling affectively detached from the others and unable to 'feel love' (Simeon and Abugel 2006; Sierra 2009; Perkins 2021).

This is in line with previous self-reports from people experiencing DP noting a significant impact of their disembodiment and self-detachment on the quality of their social and emotional life. Importantly, a recent work by Millman and colleagues (2021) found that people clinically diagnosed with severe depersonalisation tend to attribute their symptoms to social factors, which can lend insights into people's subjective appraisal of their symptoms.

Indeed, a core feature of DP is impaired processing of emotions (Blevins et al., 2013; Sierra et al., 2002b; Medford et al. 2006), with a persistent decrease or loss of emotional reactivity, and emotions seem to lack 'realness' and 'colour' (Baker et al. 2003; Simeon 2004; Simeon and Abugel 2006).

A second important and interesting finding is that there were no significant interaction effects for vividness ratings of touch experiences across the groups of low vs high DP experiences. This is surprising at first glance because, in line with previous work highlighting a close link between atypical bodily self-awareness, social isolation and DP (Simeon & Abugel 2006; Sierra & David 2011), we have initially predicted that both the perceived pleasantness and vividness of the tactile experiences will be overall lower for people with higher occurrences of DP experiences. However, our results suggest that the vividness and pleasantness features of tactile experiences are underlined by two different mechanisms in relation to DP. As we will see shortly below, this hypothesis seems to receive further support from the results of our Experiment 2, where we find this time a significant effect on vividness but not pleasantness following the self-touch intervention in both low and high DP groups.
The lack of vividness effect may be explained by the fact that our study and questionnaires were conducted online. Yet, the vividness of one's perceptual tactile experiences is closely related with one's dynamic presence in the tri-dimensional embodied reality of the here and now (as opposed to the sedentary stance of the individual facing a two-dimensional, digital reality visually presented on the screen). For example, a recent study (Ciaunica et al. 2021c) found positive correlation between higher occurrences of DP experiences and increased digital media sedentary activities (e.g. playing computer game, watching TV, online e-meetings participation, etc). This may explain why people with low occurrences of DP report the same rates of vividness for touch experiences as their high DP counterparts. Further work is needed however to test this hypothesis in a systematic way.

A third notable finding is that people with lower occurrences of DP experiences rate the perceived pleasantness of the imagined social touch experiences as received by the self higher than those received by the other. Interestingly however, in people with higher occurrences of DP there is no difference in the perceived pleasantness of affective touch imagined as being received by the self and by the other. This seems to suggest that DP people may not benefit from the advantages typically provided by processing self-related information, and may treat the self in a more neutral, affectively non-colored fashion.

For example, recent trends in mind and brain research stipulating that our perceptions, cognitions and actions are intrinsically geared towards self-preservation (Northoff & Panksepp, 2008; Ciaunica & Fotopoulou 2017; Seth & Tsakiris, 2018). By maintaining and regulating the physiological needs and integrity of the organism (the human body), perceptual awareness at the most basic level is inherently “selfish”, that is self-centred, concerned with self-survival and self-care (Friston 2010; Seth & Tsakiris, 2018; Ciaunica & Crucianelli, 2019).

This idea seems to be captured nicely by the so-called ‘self-prioritization or ‘self-bias’ effect, which is an effect demonstrating that people are faster and more accurate when processing information related to the self. There is rich evidence showing that one's name, as well as images of one's face are processed faster and more accurately than other comparable stimuli (Alexopoulos et al. 2012; Alzueta, et al. 2019). This effect seems to be in place early in development, with children between 6 and 10 years of age already showing self-prioritization (Maire et al. 2020). More recently, it has been demonstrated that a similar effect can be reliably observed also for non-familiar stimuli (e.g. geometrical shapes or avatar faces) that have been arbitrarily associated with the self (Sui et al. 2009). Taken together, these studies are consistent with our findings showing that imagined social touch experiences as received by the self vs the other are rated as being more pleasant in people with low occurrences of DP experiences.

Interestingly however, while it is fairly well established that people benefit from affiliative touch directed to the self (Gallace and Spence 2010), it is less clear why do people with high DP do not show the same self-prioritization effect. Again, there are several potential interpretations of these results.

First, one alternative is to argue, in line with Ward & Banissy (2015) that DP is associated with reduced self-other distinction, which plays a key role in vicarious tactile perception.
Within this theoretical framework, atypical representations of bodily self have been linked to individuals who experience vicarious pain. For example, Bowling and colleagues (2019) found a strong positive relationship between trait DP and the tendency to experience pain on their own body when viewing others in pain (mirror-pain synaesthesia). They proposed that “impairments in the ability to distinguish and switch between self- and other-relevant representations underlie conscious vicarious experience” (Bowling et al. 2019:2). The key hypothesis here is that the self-other distinction is blurred, reduced, which may alter the ability of high DP people to optimally keep track of one's self, and benefit thereby from the self-bias effect.

Previous work by Adler and colleagues (2016) used electroencephalography (EEG) to demonstrate that increased DP experiences among healthy adults is associated with altered tactile mirroring mechanisms with less of an activation for self-face related information compared to those with low experience of DP. They argue that mirroring, especially for events on one's own face can be strongly affected by how connected the person feels to their own bodily self.

This hypothesis received further support from a study by Farmer and colleagues (2020) using the Visual Remapping of Touch (VRT; Serino et al., 2008) paradigm to explore self-bias in visual tactile integration in non-clinical participants reporting high and low levels of DP experiences. In typical population, the VRT effect is enhanced by self-relevance with as stronger effect for one's own compared to another's face (Serino et al., 2008), suggesting that self-representation plays a key role in mediating this process. A similar effect has also been found for other body parts, namely the hands (Gillmeister, 2014), suggesting that the VRT effect generalises to tactile perception in general. Strikingly, Farmer and colleagues found that the high DP group showed a greater VRT effect when observing the face of the other as opposed to the self.

A second route to explain why DP people do not show preference for touch experiences received by the self may be related to alterations in sensory imagery. For example, Lambert and colleagues (2001) conducted a study on twenty-eight people diagnosed with depersonalisation disorder (DDD) using self-report measures of imagery ability in relation to a range of symptoms and in comparison with age- and sex-matched controls. They found that symptoms of depersonalisation correlated with impaired ability to generate visual images. This was particularly evident with images pertaining to the self and other people as opposed to objects. It is currently an open question whether these alterations may apply also to all sensory modalities (e.g. imagined touch versus imagined pictures). Our study seems to suggest that tactile imagery may be impaired as well in people with high DP. Further work is needed to answer these key questions, by contrasting imagery abilities in different sensory modalities in people with DP.

A fourth notable finding is that high DP individuals rate “get” (being touched) items significantly lower compared to low DP individuals. However, this is not the case for “give” (touching) items. This seems to suggest again a tendency to move away from the sensing self.

Additionally, our study reveals a significant main effect for pleasantness on where the touch is delivered, confirming previous reports with the imagined “back” touch scenarios being rated significantly more
pleasant than the dorsal forearm in both groups (Walker et al. 2017).

While our first experiment consisted in asking participants to passively watch short videos of CT-optimal stroking and to rate vicarious tactile experiences of affective touch in relation to the self and other, in Experiment 2 we have added a dynamic, active component. Specifically, our CT-optimal self-touch intervention on one’s body (dorsal forearm) yielded several key results. First, as anticipated we found that the dynamic CT-optimal self-touch stroking intervention (as opposed to static self-touch, i.e. right palm resting on the forearm) enhanced the vividness of touch experiences in both people with high and low occurrences of DP experiences. This is a key aspect, because it suggests that affective touch stroking modulates tactile perception not only when it is delivered by others on one’s body, but also when it is delivered by oneself on one’s own body. To our knowledge, this is the first study providing evidence that affective self-touch influences one’s subjective tactile experiences in DP.

This is an important finding also because it suggests that dynamic and affective self-touch stroking on one’s own body may enhance the vividness of one’s perceptual experiences, and potentially reduce thereby feelings of disembodiment and unreality in people with DP. These findings seem to be supported further by DP experiencers’ anecdotal self-reports highlighting the positive effect of dynamic proximal tactile interactions with close others and the environment on one’s sense of self (Ciaunica et al. 2021; Perkins 2021).

Again, there are several potential interpretations of this key finding. First, as briefly mentioned in the Introduction section, previous theoretical and empirical work outlined that among the senses, touch has a special status in relation to both the body and the world and others. As Merleau-Ponty famously pointed out, whilst vision “presents us with a spectacle spread out before us at a distance”, in perceiving the world through touch, “I cannot forget in this case that it is through my body that I go to the world” (1962:316). By directly mediating the boundary between body and world, the skin inevitably distinguishes yet relates body and world, as the two faces of the same coin. By gaining information about the world via touch, the individual inherently gains information about oneself ‘for free’.

Building upon the idea that affective touch is believed to play an important role to the sense of body ownership (Crucianelli et al., 2013; 2018; van Stralen et al., 2014) and self-identity (Panagiotopoulou et al., 2017), one may speculate that affective self-touch may increase the vividness of perceptual experiences overall. Our findings complement previous work suggesting that voluntary active self-touch (as opposed to static self-touch) increased body ownership over a virtual hand, showing an important role for active self-touch in the formation of the bodily self (Hara et al. 2015).

Interestingly, our study found no significant effect of the CT-optimal self-stroking on the pleasantness of the experiences across conditions. As mentioned previously, this suggests that perceived vividness and pleasantness of tactile experiences are underpinned by two distinct mechanisms in relation to self-detachment in DP. One may speculate that the pleasantness aspect of affective touch experiences is intrinsically related to a social component. Seminal studies illustrated that we automatically anticipate the sensory effects of self-initiated actions which explains why people typically cannot tickle themselves
Similarly, we typically prefer to receive a massage from another close person, rather than a self-massage. By contrast, the vividness of self-touch experiences may be related to a functional, rather than social component. For example, for basic survival reasons, one must be able to keep track of one's body and provide immediate soothing in case of harmful events (e.g. humans typically self-stroke instinctively painful body parts after a harmful stimuli). This suggests that self-touch may have a potential soothing effect and decrease the impact of nociceptive stimuli as shown by work on the role of self-touch in somatosensory and body representation disorders after stroke (van Stralen et al. 2011). This may explain why self-touch enhances the vividness but not the pleasantness of tactile perception.

Limitation and outlook

Our study has several important limitations. First, the study was conducted online, hence we were unable to control how accurately our participants followed our instructions (e.g. whether they attentively watched the videos, or whether they correctly performed the CT-optimal self-stroke on their dorsal forearms as instructed). Moreover, further work needs to contrast the conditions where the CT-optimal stroking is delivered on one's body by oneself versus a close/trusted other, or the experimenter in people with high and low DP experiences. For example, it would be interesting to examine whether CT-optimal stroking delivered by others (as opposed to self-touch) will increase both the vividness and pleasantness of tactile experience in people with high and low occurrences of DP experiences. Another important limitation is that our study was conducted during the COVID-19 pandemic. The current exceptional context encourages people to avoid as much as possible proximal tactile interactions with others and the surroundings (aiming at limiting the risks of potential infection). Hence the touch-related social behaviours may be disrupted by this atypical context, and it would important to conduct a follow-up study post-pandemic to confirm the same pattern of findings.

Another important limitation is that there was only one video per condition. Further work needs to contrast several videos per condition, ideally with an in-person CT-optimal vs CT-non-optimal stroking, to explore the relationship between seeing affective touch versus actually receiving affective touch on one's body.

Our study points to several potential important implications. For example, the finding that CT-optimal self-touch delivered by both people with low and high DP experiences on their own bodies (dorsal forearms) modulates the perceived vividness of tactile experiences, suggests that our approach may be used to design affective self-touch based interventions. This is important because tactile perception is pivotal not only in establishing affective bonds with others, but also in constituting our embodied sense of self.

4 Materials And Methods

4.1 Participants: Participants were recruited from the healthy adult general population. A total of 409 participants were pre-screened via the online platform SoSci Survey (Leiner, 2016) using the Cambridge Depersonalization Scale (CDS-29) (Sierra & Berrios, 2000). From these, 108 eligible participants (Male =
38, Female = 67, non-binary = 2, prefer not to say = 1) (mean age = 26.92, SD = 5.034) completed the study in two groups: (a) 57 participants in the High DP group with their score ≥ 50 on the CDS-29; and (b) and 51 participants in the Low DP group with their scores ≤ 20 on the CDS-29. CDS-29 score calculation used a well validated procedure developed by Kanayama et al. (2009) which ensures that the DP scores of the two groups are meaningfully distinct. Previous studies have demonstrated that this procedure should yield a sensitivity threshold of 75.5% for DP patients in the High DP group (Sierra et al., 2005). Other criteria included: (a) between 18 to 40 years old, (b) fluent English speakers, (c) right-handed and (d) without a history of neurological illness. Informed consent was obtained from all participants before the start of the experiment according to procedures approved by the Ethics Committee of the Universität der Bundeswehr München. The experiment was conducted in accordance with the Declaration of Helsinki.

4.2 Questionnaires

4.2.1 Cambridge Depersonalization Scale (CDS-29 henceforth) (Sierra & Berrios, 2000) is a 29 item standard questionnaire used to evaluate the severity of occurrence of depersonalization experiences. CDS-29 asks the participants to estimate the frequency and duration of their DP symptoms. Frequency is characterized as how often the symptoms have occurred in the last 6 months and is measured on a 5-point Likert rating scale ranging from 0 (never) to 4 (all the time) for each of the 29 items. Duration is measured on a 7-point Likert rating scale ranging from 0 (few seconds) to 6 (more than a week) for each of the 29 items. A total score is calculated by adding up the total frequency and duration scores and it can range between 0 to 290. CDS-29 has good statistical properties (Aponte-Soto, Vélez-Pastrana, Martínez-Taboas, & González, 2014; Fagioli et al., 2015; Migliorini et al., 2012; Sierra & Berrios, 2000; Sugiura et al., 2009) with internal reliability for different language versions reported between 0.89–0.94 (Cronbach alpha). Moreover, previous research has extracted four subscales from CDS-29 (Sierra, Baker, Medford, & David, 2005): Anomalous Body Experience, Emotional Numbing, Anomalous Subjective Recall, and Alienation from Surroundings.

4.2.2 Social Touch Questionnaire (STQ henceforth) (Wilhelm et al., 2001) is a 20 item assessing the participants’ attitude towards social situations involving touch. It consists of items that measure (i) giving/providing and (ii) getting/receiving touch along with touch involving strangers and acquaintances. The items are measured on a 5-point Likert rating scale ranging from 0 (not at all) to 4 (extremely). An STQ score is calculated by adding up the values for each item after carefully ensuring that half of the items are negatively scored. (Negative items: 2, 3, 5, 7, 8, 10, 13, 16, 17, 19). In this study, additionally a ‘Get’ and ‘Give’ score was calculated. The former score indicates how comfortable a participant is being touched (getting or receiving a touch), whereas the latter score indicates how comfortable the participant is and their attitudes towards giving touch to friends or acquaintances. The ‘Give’ (Give items: 4, 5, 6, 9, 10, 13, 14, 15, 20) and ‘Get’ score (Get items: 1, 2, 3, 7, 8, 11, 12, 17, 18, 19) were calculated as a sum of their scores for their respective items.

4.2.3 Longing for interpersonal touch picture questionnaire (LITPQ henceforth) is a rather novel method to measure longing for touch. It consists of two components i.e. touch frequency and touch wish. Touch frequency is calculated by asking participants how often they had performed a specific type of touch in
the past week whereas touch wish is calculated by asking participants how often they would have wanted to experience a specific type of touch in the past week. In the present study, to measure both these components, participants were required to respond on a slider under each picture ranging from 0 to 100 with 50 as the midpoint. For this study, pictures with four different types of touch such as holding, stroking, kissing and hugging were selected. Three scores were calculated as a result of this questionnaire namely: (i) touch wish, (ii) touch frequency and (iii) total LITPQ score. Touch frequency and touch wish was calculated as an average across all touch types. LITPQ score was calculated by dividing touch wish by touch frequency, thereby creating a ratio of the two scores.

4.3. General Procedure

Initial pre-screening for depersonalisation traits via the CDS-29, was followed by a short demographic questionnaire and completion of two experiments in a randomized order (see Fig. 4). All participants took part in both experiments. In Experiment 1, participants were asked to imagine a social touch event occurring either to themselves or another person (SELF/OTHER). In Experiment 2, participants were again asked to imagine being touched but this time, before and after a self-touch intervention that we have designed (SELF TOUCH INTERVENTION). These two experiments are described in detail below. The order of the two experiments was randomised across participants. After completing the two experiments, all participants filled (a) the Social Touch Questionnaire (STQ) and (b) the Longing for Touch Interpersonal Picture Questionnaire (LITPQ).

4.4 Design and Procedure Experiment 1 SELF/OTHER

In Experiment 1, participants viewed a series of short videos (6s) depicting an individual’s hand stroking another individual’s dorsal forearm at CT-optimal velocity (see Fig. 1). In the videos presented, the gender of the person being touched were matched according to the self-declared gender of the participant; in all cases the person performing the stroking was female. Previous work suggested that both sexes are likely to respond more homogenously to female stroking (Gazzola et al., 2012). We first manipulated the “WHERE” factor, by presenting videos in which participants observed a person gently stroking either another person’s (i) dorsal forearm (the FOREARM condition) or (ii) back (the BACK condition) at the CT-optimal speed. Secondly, we manipulated the “WHO” factor, namely: (i) in half of the trials, participants were asked to imagine these tactile experiences as if it were happening to themselves (the SELF condition). (ii) While in the other half, they were asked to imagine these as happening to someone else (the OTHER condition). In this experiment, the participants were presented with 1 practise block containing 1 trial followed by 2 test blocks containing 5 trials each for the ‘self’ and ‘other’ blocks. Participants then completed the two questionnaires STQ and LITPQ.

The study thus used a 2x2x2 within-subjects design with three independent variables: (a) Experimental GROUP (Trait Depersonalisation - Low DP vs. High DP), (b) WHO was the imagined person receiving the affective touch (SELF vs. OTHER); (c) WHERE, i.e., the place on the body where the touch was delivered in the videos we have created with two levels (BACK vs. dorsal FOREARM). The dependent variables of this
experiment were perceived pleasantness and vividness as rated on visual analogue scales presented after each video.

4.5 Design and procedure Experiment 2 INTERVENTION

In Experiment 2, participants viewed short videos (6s) showing an individual’s hand stroking another individual’s dorsal forearm (see Fig. 1). Here we have manipulated how the stroking was performed (“HOW” factor) with videos showing stroking at either CT optimal velocity (3 m/s) or CT suboptimal velocity (30 m/s). Half of the participants (INTERVENTION group) were shown a video with an incorporated audiovisual metronome, giving them the CT-optimal pace of affective touch stroking. They were instructed to copy and perform on their own left dorsal forearm the self-touch stroking with the CT-optimal velocity as shown in the video. In the CONTROL group, participants were instructed to rest their right hand passively on the opposite arm for the same duration as the self-intervention touch (i.e. 6 seconds). The rationale behind this condition was to control for the effect of dynamic affective self-touch as opposed to static self-touch. The structure of this intervention experiment followed a pre- post design with participants completing an imagined touch block before a touch intervention (PRE), followed by a second imagined touch block (POST). The training session consisted of one video followed by the two rating scales. PRE and POST blocks consisted of five trials each. The intervention condition consisted of two trials.

The experiment had a between subject design including three independent variables: (i) INTERVENTION with two levels (Affective Self-Touch Intervention vs. Static Self-Touch Control), (ii) Experimental GROUP with two levels (High DP vs. Low DP) and (iii) VELOCITY of the video stimuli presented with two levels (CT-optimal vs. non-CT-optimal). The dependent variables of this experiment were perceived pleasantness and vividness which were calculated as delta scores by subtracting the pre-test scores from the post-test scores.

4.6 Data types and analysis

The three questionnaires used in the study for pre-screening and the main study were subjective self-report questionnaires. While CDS and STQ included Likert-rating scales providing ratio data, participants had to respond to LITPQ items on a slider response scale for each picture also providing ratio data. In both experiments, the variables of perceived vividness and pleasantness were calculated using self-report measures on a slider response scale and reaction time was recorded additionally, both, providing ratio data. The pre-screening survey was conducted using the SosciSurvey (Leiner, 2016) platform. The experiment created and hosted using the Gorilla Experiment builder (www.gorilla.sc; Anwyl-Irvine, Massonnié, Flitton, Kirkham & Evershed, 2018). Data was organised using Microsoft Excel (Microsoft Corporation, 2018) and analysed using RStudio (RStudio Team, 2020). Tests conducted include student t-tests, repeated measures ANOVAs and multiple regression.

Declarations
Acknowledgements

The Authors would like to thank Bigna Lenggenhager for helpful comments on earlier drafts of this manuscript.

Funding

This work was supported by a Bial grant n° 157/16, and a FCT grant PTDC/FER-FIL/4802/2020 to AC; OD is funded by a Momentum grant from the Volkswagen Foundation (CO-SENSE) and a grant from the NOMIS foundation (DISE).

Author contributions

AC and MF designed the study. JM and MF collected and analyzed the data. AC secured the funding and wrote the first draft of the manuscript. JM and MF wrote the Methods and Results sections. AC, JM, OD, MF revised the final version of the manuscript.

Data availability statement (mandatory) – Access to the data can be provided upon request to the corresponding and the senior author of this paper.

Additional Information (including a Competing Interests Statement)

Authors declare no competing interests.

References


**Figures**

---

**Figure 1**

Experiment 1 - Touch behaviours in low and high DP individuals measured using the Social Touch Questionnaire
Figure 2

Experiment 1 (A) interaction between GROUP x WHO factors; (B) main effect of WHERE and (C) main effect of GROUP on perceived pleasantness ratings.
Figure 3

Results experiment 2 - Self-touch intervention and perceived vividness of imagined touch.
Figure 4

Overview of the Experimental Design and Procedure