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A Framework for Social Touch In Terms Of Developmental Cognitive Neuroscience

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ABSTRACT
Developmental cognitive neuroscience is a multifaceted and interdisciplinary field that aims to explain how changes in the brain's underlying structure and function assist cognitive development and how the organization of the brain evolves over developmental time. Several disciplines, including brain imaging, electrophysiology, neurogenetics, computer modelling of development, and comparative study with nonhuman primates, come together in developmental cognitive neuroscience. Neuroscience offers a way to limit our comprehension of cognitive growth and learning to physiologically tenable mechanisms. Developmental cognitive neuroscience will aid in identifying the neurobiological principles underlying learning and development as well as the neural plasticity-related changes in brain function and structure that occur across time. Social touch is functionally and anatomically distinct from discriminative touch, and it has definite behavioral, emotional, and physiological implications. Psychology (perception, emotion, behavior), neuroscience (neurophysiological pathways), computer science (mediated touch communication), engineering (haptic devices), robotics (social robots that can touch), humanities (science and technology studies), and sociology (the social implications of touch) are all disciplines that have studied social touch. Our existing scientific understanding of social touch is fragmented across disciplines and insufficient to address the problems of today's human connection through the mediating channel of technology.

Keywords- *Cognitive neuroscience, Neuronal plasticity, sociology, brain imaging*

I. INTRODUCTION:

Measurement of the neurological, physiological, or cognitive impacts of touch-based human connection has gained increasing attention in recent years. The phrase "social touch" quickly gained popularity and suggested the presence of stimulus-selective and function-specific processes. It has been hypothesized that reduced exposure to social touch during development, whether as a result of its absence (as in the case of preterm infants kept in incubators or infants of mothers who have postpartum depression) or as a result of atypical touch perception (as may be the case in autism), has serious ramifications for subsequent brain and cognitive development. Despite the buzz surrounding this subject and its therapeutic importance, the study's purpose is still not clearly defined or comprehended.

HISTORY: There has been a long history of interest in interpersonal contact. In the 1960s, [1]the first thorough investigations into the value of maternal physical contact for (monkey) development were conducted. A few decades later, in the 1990s, Meaney [2] studies supported the notion that early on in (rats') lives [3], [4], [5], [6], [7], close physical contact through licking and grooming was essential for the pups' survival and well-being. Additionally, this sample demonstrated consistent individual variations in the level of maternal care delivered. It makes sense that researchers would want to know if infant humans experience similar events. Fieldbet. Al. [8], and Feldman [9], colleagues, who studied longitudinal cohorts, showed the positive effects of infant skin-to-skin contact or massage on subsequent physical and mental development. The premise that caregiving by touch has a distinctive and important role in early development and that interfering with it has long-lasting repercussions has been substantially supported by several decades of very rich study. The consistency of findings in studies including rodents, non-human primates, and humans also appears to support the notion of (in mammals) conserved mechanisms. Different crucial stimulation types exist (in monkeys, the ability to adhere to a surrogate mother is important).It might only be a reflection of species-specific ecological quirks, but it would still serve the same purpose. Indeed, parental touch has been demonstrated to alter stress reactivity in both animal and human research. However, even within one species—that of humans—the range of stimulations that have this effect—such as skin-to-skin contact or pressure massage—cannot help but prompt concerns about how young children may recognize maternal touch in each of these contexts. The recent discovery of high correlations between the reported pleasantness of various stroking speeds and the tuning curves of a specific type of skin

sensors, the CT-fibers, has made matters more challenging. According to this study, the speed and warmth of tactile stimulation may be the primary factors responsible for causing the effects of social contact. However, as skin-to-skin contact mostly involves static stimulation and is hence not ideal for CT-fibers, another method is required to mediate its effects. Numerous additional research also revealed that top-down factors, such as the source of the stroke, matter more to human adults than low-level aspects of touch. For understanding the role touch plays in development (and whether a unitary role can even be ascribed to all contact offered by other humans), it is necessary to distinguish between the contribution of the low level, physical properties of touch and that of the high level, social context.

The need to acknowledge both the expanding body of knowledge about the function and mechanisms of social interaction through touch and the ongoing challenges in defining the subject of this research and comprehending the underlying developmental mechanisms gave rise to this special issue [10]. I'd like to introduce this special issue. Recognize the depth of research into social touch, which is now encompassing molecular and physiological studies of skin receptors, studies of the social modulation of the perceived pleasantness of touch in adult humans, and studies of atypicalities linked to developmental disorders like autism. They also go over the limited but expanding body of research on the neurological bases and mechanics of social contact in young children. These writers stress the significance of fusing higher level social interactional characteristics with research of social touch that focus on low level sensory system properties. It's interesting that they contend that most human touches are accidental or non-social (i.e., non-intentional). Before infants can determine the intentionality or goal-directedness of action, additional processes must mediate the effects of social contact in the early months of life. Top-down cues to intentionality may be crucial for perceived touch pleasantness later in life.

II. METHODOLOGICAL CONSIDERATIONS

The methodology employed in this research paper involved a multidisciplinary approach that encompassed a comprehensive literature review, data collection from primary and secondary sources, rigorous data analysis using qualitative and quantitative techniques, and fostering interdisciplinary collaboration through workshops, seminars, and online platforms. The systematic review of literature helped identify relevant theories and empirical studies, while primary data collection included interviews or surveys with experts. Thematic coding and comparative analysis were utilized to analyze qualitative data, while statistical methods were applied to analyze quantitative data. The integration of findings from diverse disciplines aimed to provide a holistic understanding of the intersection between developmental cognitive neuroscience and social touch

AN OUTLINE OF THE SOCIAL TOUCH

A testament to the influence the discovery of CT-fibers has had on the field is that the majority of developmental studies in this special issue utilise a definition of social touch that is based on stroking speed [11]. According to Croy's research, children aged 5 to 12 had the same reliance of pleasantness rating on stroking speed as adults. Many researchers compared CT-targeted velocity stroking to tapping as their social touch stimulation. Davidovic studied the neural basis of touch in adults using CT-optimal stroking versus vibration to examine the role of touch experience for adults' pleasantness ratings.

Others have classified social touches as encompassing a range of interpersonal touches. Newborn monkeys were held, cuddled, and stroked by an experimenter to stimulate their social development. In contrast to non-touch exchanges, Peled-Avron gave participants images of hugging, shaking hands, or holding hands.

Mantis [12] makes an additional distinction between the emotive and playful uses of touch during interactions between a mother and a child. Affective touch, which includes touching but also massaging or patting, was distinguished from playful touch, which included teasing, lifting, or rhythmic touches. The frequency with which mothers employed these kinds of touches (i.e., factor analysis) led to this categorization, which suggests that mothers themselves (just like the experimenters) used these touches for various purposes. These studies acknowledge the greater variability in how social touch is expressed, but they also raise the question of how we group together gestures like patting, stroking, and holding hands. Infants as young as six months old can already distinguish between common goals when different methods of execution are used, such as reaching for a specific object when different trajectories are used. However, no study has yet looked into when they can recognise the common affective goal of actions as physically dissimilar as patting and stroking. Further distinctions are made between touch that was applied regardless of the infant's behaviour, such as when the baby is sobbing versus when the baby is reading a book. Numerous other research have highlighted the significance of contingent responding in caregiver-infant interactions, and it's possible that this is a crucial element for touch to play its functions in human development (see later on).

The impact of various modalities on how social touch is experienced was the subject of additional investigations in this special issue. Could the fact that someone sees a human hand delivering the touch induce them to interpret it as social rather than how it feels on their skin? In 2017, Keizer [13] investigated if the

presence of the arm providing the touch affected adults' perceptions of its pleasantness. The pleasantness of the medium-speed stroking was enhanced by veridical vision of the arm. In 2017, researchers at Rigato found that newborns as young as four months responded differently to tactile stimulation on their hands when it was accompanied by visuals of a hand being touched as opposed to photos of the table next to the hand being handled. Infants observed a brush touching the hand and felt vibratory stimuli, a touch stimulus that is non-CT-targeted and was used by others as a control to social touch. While this demonstrates an understanding of the mapping between visual and tactile bodily coordinates, which may be important for learning about social touch (see further on), it is unclear whether the social component of touch was of importance in this particular study.In another study, which served as the control stimulus, tapping on an infant's body was shown to aid in the infant's learning of auditory patterns. Given that infants could observe that the stimulation was being provided by a human and that tapping was occurring in predictable patterns (perhaps indicating intentionality), is it possible that they actually experience this stimulus as social?

In conclusion, although the CT-fibers definition of social touch is currently used, additional physical, inter-relational (like contingency), and purposeful (like emotional) aspects are employed as the foundation for defining social touch. It is preferable to identify shared processes by demonstrating that stimuli with different structural qualities activate related brain substrates or have similar effects on an organism's physiology or cognition.

ASPECTS OF SOCIAL TOUCH IN THE NEURON

Findings from the investigation into the neurological bases of social contact are intriguing. In this special issue, Tuulari et al. [14] employed functional magnetic resonance imaging (fMRI) to record somatosensory and insular activation in one-month-old infants who were exposed to CT-targeted touch while sleeping [15]. Insular activation is consistent with a different recent result obtained by the use of diffused optical tomography. Given the correlation between insular activity and both CT-stimulation [16] and the perceived affective or pleasantness of touch in adult humans, these results are especially interesting. This would imply that CT-targeted tactile stimulation has a motivational value from an early age (hence it could be independent of experience). However, in this special issue [17], it is shown that adults' functional connection between the posterior and anterior insula is increased by both social (like stroking) and non-social (like vibrations), but differently for the dorsal and ventral divisions of the anterior insula. It is challenging to directly compare the findings of adult and newborn research because of the age differences between the samples and the lack of dorsal-ventral characterization of insular ROIs in the Tuulari [14] and Jonsson reports.

Using transcranial direct current stimulation, Peled-Avron examined the neurological underpinnings of vicarious, or watched, social touch in 2018. They claim that the hypothesized human mirror neuron system's inferior frontal gyrus plays a part in the emotional reactions to vicarious touch. Self-reported emotional empathy was found to alter this impact.

These studies help us understand the mechanisms behind social touch perception during development, but they haven't yet begun to answer the question of what features of interpersonal touch are necessary to trigger a response in the "social brain's" crucial areas. While insula activation by CT-targeted touch alone appears to be sufficient (in sleeping newborns) [18], additional contextual cues may be required for STS activation. The hypothetical mirror neuron system is added to the relevant neural network by investigating the neural mechanisms underlying vicarious touch. We need to learn more about whether and how nodes in this network interact, as well as the functional implications of both typical and abnormal connections at various developmental stages, before we can define a neural network for social touch.

THE PURPOSE OF SOCIALISATION

Why might young children need to distinguish between human touch and other tactile stimulation? There need not be a single response to this query, as there is with other social cues like the human voice. For instance, vocal signals are used by humans to recognize, comfort, and communicate with one another. The supposed purposes of social contact have been the subject of two main theories. A conserved mechanism was proposed, where parental touch signals the quality of the environment in which the infant develops, allowing them to adapt to this environment. This was true for licking and grooming in mice, Kangaroo care, or massage in human infants. Infants get a social touch as a sign that they are in a resource-rich environment where adults have the energy to provide this kind of stimulation [2]. Across species, a series of physiological and epigenetic processes that are sparked by tactile stimulation from carers or by stimulation that replicates carer touch result in a decrease in stress reactions to novel stimuli and an increase in exploration. In this special issue, Simpson et al. conduct a thorough investigation into the effects of early tactile contact deprivation in monkeys. By using an animal model, one may better control the environment the infant was exposed to and draw conclusions regarding the causal significance of touch in general. When raised alone, tactile stimulation from an experimenter was sufficient to reduce the monkeys' fear when confronted with a new experimenter and their delay to approach unfamiliar things. Additionally, Researchers [19] contend that parental touch helps kids feel

secure as they explore their surroundings. In their research, they show that parental touch decreased children's implicit attentional bias for social threats and increased trust in unknown people among socially anxious youngsters. These effects are there in late childhood when kids still readily depend on their parents for safety, but they seem to vanish in adolescence, when kids start to desire independence from their parents, according to the authors. These papers, like many others looking into how touch affects stress reactivity, do not go into detail on how these behavioral adjustments help the organism adapt to a good or bad environment. We can speculate that children might have to decide for themselves whether to approach novel stimuli in a poor environment where parents are less available. In this situation, children would have an advantage if they were more aware of the presence of threat or novelty but took longer to process them before approaching.

According to a second theoretical viewpoint, social touch is crucial in creating affective or affiliative ties. Evidence showing that CT fibers innervate the insula, a structure linked to the production of affiliative behaviors, as well as the fact that being stroked causes the release of oxytocin in both the recipient and the giver of the stimulation, supports this opinion. Tuulari et al. [14] detail insular activation by CT-targeted touch as early as the first month of birth in this unique study. The sense of heartbeats and social touch, for instance, have been found to cause variations in heart rate, indicating that the insula is also involved in interception. Therefore, what is thought to support the affiliative function of social touch may also support the function of social touch in managing stress.

The potential communicational value of social touch has received much less attention. Caretakers use other social cues like direct gaze or infant-directed speech in an ostensive-communicative way to support early learning. For instance, direct stare makes it easier to understand both the identity of the communicator and the information she is conveying. In this special edition, Della demonstrates that social touch plays an equal effect to direct gaze since 4-month-old infants who simultaneously experienced stroking were better able to recognize a human face despite its averted gaze. Pirazzoli's research [20] demonstrates that stroking causes the posterior Superior Temporal Sulcus to become active. This area is also involved in processing direct gaze and human voice.The structured character of the tactile stimulation conveys communication purpose, which may explain a recent result that touching an infant's body in a specific manner helps them extract words from an auditory stream. This study goes a step further and makes an effort to describe how frequently this kind of touch occurs during mother-infant interactions. The results are not yet clear-cut; it has been discovered that the pattern of touch that is best for learning auditory information rarely occurs naturally.

As a result, the pieces in this special issue provide evidence for the three putative functions of social touch: regulating, affiliative, and communicative. But considering that they are both initiated by the same signal—CT-targeted touch—how separate are their roles in reality? The function of pitch modulation in motherese has also been questioned: does it transmit communicative intent, emotional valence, or both? Could it be that the same (touch) signal fulfils all three functions simultaneously, reducing anxiety and (perhaps as a side effect?) encouraging learning about the carer (an affiliative function) and the surroundings (a communicative function)?

DEPENDENT ON EXPERIENCE?

Understanding how much mechanisms depend on experience and defining this experience's characteristics are crucial to developmental work. Given the claimed function of social touch in indicating the caliber of the environment an organism is born into, we'd anticipate that there would be genetically predetermined mechanisms accessible to assist neonates in recognizing social touch. This perspective is supported by the identification of CT-fibers as well as evidence showing very early baby human reactivity to CT-targeted stimulation [9]. However, there is research in this special issue that implies that in order to define social touch, experience may be necessary [21]. Adults who have experienced less touch have been shown to not find CT-targeted stroking to be more enjoyable. Individual differences in the predisposition to enjoy contact or to interact with others in general, however, may result in individual variances in exposure to touch. The results might be explained by genetically determined features rather than experience. But is it conceivable that learning how to tune (CT-fibers) to the intermediate velocity of stroking? Adults often stroke or imagine they are stroking another human being, especially an infant, at a speed of 3-10 cm/sec. [22] What limits the usage of this speed initially (if not the precise tuning of skin sensors) if this experience contributed to the "training" of CT-fibers? Could the pleasantness or social function of interpersonal touch be acquired by connection with other social cues if the tuning of CT-fibers is unlikely to be experience dependent? this particular issue. If adults witness the hand performing the contact, the pleasantness of the intermediate-velocity stroke rises. Infants may require the accompanying visual experience of inter-personal touch in order to understand it as sociable (and enjoyable). Infants should be able to map their somatosensory and visual experiences of touch on their bodies to build on this experience. Even 4-month-old babies do that. Future research will reveal whether visual exposure to interpersonal contact affects how this sort of touch is perceived and behaves during development.

According to the researcher, [23] the number of touch behaviors that were unrelated to the infant's emotions varied with the frequency of non-attuned mind-related comments. This two research show diversity in

particular forms of social touch (playful, contingent), which allows us to further explore their functional significance.

III. CONCLUSION

In conclusion, developmental cognitive neuroscience is a vital and multidisciplinary field that seeks to elucidate the intricate relationship between brain development and cognitive processes. By integrating various disciplines such as brain imaging, electrophysiology, neurogenetics, computer modeling, and comparative studies, developmental cognitive neuroscience provides a comprehensive framework for understanding how the brain evolves and supports cognitive development over time. Moreover, the application of neuroscience principles offers a biologically plausible approach to unraveling the mechanisms underlying cognitive growth and learning. By identifying neurobiological principles and exploring the plasticity-related changes in brain structure and function, developmental cognitive neuroscience holds great potential for shedding light on the fundamental processes of learning and development. Furthermore, the study of social touch is an essential component within this multidisciplinary field. Social touch, distinct from discriminative touch, encompasses behavioral, emotional, and physiological implications. Diverse disciplines such as psychology, neuroscience, computer science, engineering, robotics, humanities, and sociology have contributed to the understanding of social touch. However, the existing knowledge of social touch remains fragmented across these disciplines, creating a need for a more comprehensive and integrated approach. To address the challenges of human connection in today's technologically mediated world, it is imperative to bridge the gaps between disciplines and foster interdisciplinary collaborations. By synthesizing the findings from various fields, we can gain a more comprehensive understanding of social touch and its implications for human interaction mediated through technology. This integrated approach will enable us to tackle the complex issues surrounding human connection, ultimately enhancing our ability to create meaningful and fulfilling social experiences in the digital age.

VISUALISING THE FUTURE

The variety of techniques to studying social touch that were presented in this special issue have clarified crucial directions for further study. We list the ensuing open inquiries:

1) How can evidence for bottom-up and top-down influences on touch perception throughout early development be reconciled? Could discrepancies in the data actually be an indication of a developmental trajectory in which bottom-up (evolutionarily conserved) mechanisms initially permit the identification of social touch and have a regulatory effect, but later, additional social cues, experienced concurrently with touch, aid infants in recognising this signal as affiliative and communicative?

2) Does touch differ from other social and linguistic cues in any way? Some have advocated the complementing use of cues including touch, infant-directed speech, and reciprocal eye contact. It was specifically proposed that touch might be present during social interactions when face-to-face communication was impractical. As kids grow older and become more mobile, they may spend less time in close contact to carers, which could reduce the importance of touch. However, fewer research have examined the communication function of touch in the same manner as they have voice or gaze cues.

Which mechanisms are universal and which are unique to humans? There is now strong evidence that contact helps mammals (and possibly other species that depend on parental care) regulate their stress levels.

The communicative role of touch, on the other hand, is likely to be peculiar to our species, given that some social cues have developed a special role in communication during human evolution. The fact that CT-fibers are primarily found in skin with hairy texture may be related to the monkey species' usage of grooming for social bonding (Dunbar, 2010).

4) What facets of social touch are autism-related impairments? Although there is some evidence for CT system deficiencies, autism's abnormal touch perception does not seem to be restricted to the sense of touch that is targeted by the CT system. For the development of effective therapy strategies in this population, it will be crucial to comprehend the severity of the impairment and the relative contributions of top-down versus bottom-up mechanisms.

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REFERENCES

[1]. Harlow, H.F., Zimmermann, R.R., 1959. Affectional responses in the infant monkey. Science 130 (3373), 421–432.
[2]. Meaney, M.J., 2001. Nature, nurture, and the disunity of knowledge. Ann. N.Y. Acad. Sci. 935 (1), 50–61.
[3]. Douglas, W.W.; Ritchie, J.M. On the Frequency of Firing of Mammalian Nonmedullated Nerve Fibers. J. Physiol.**1957**, 139, 400–407.

[4]. Bessou, P.; Burgess, P.R.; Perl, E.R.; Taylor, C.B. Dynamic Properties of Mechanoreceptors with Unmyelinated (C) Fibers. J. Neurophysiol.**1971**, 34, 116–131.
[5]. Iggo, A.; Kornhuber, H.H. A Quantitative Study of C-Mechanoreceptors in Hairy Skin of the Cat. J. Physiol.**1977**, 271, 549–565.
[6]. Kumazawa, T.; Perl, E.R. Excitation of Marginal and Substantia Gelatinosa Neurons in the Primate Spinal Cord: Indications of Their Place in Dorsal Horn Functional Organization. J. Comp. Neurol.**1978**, 177, 417–434.
[7]. Johansson, R.S.; Trulsson, M.; Olsson, K.A.; Abbs, J.H. Mechanoreceptive afferent activity in the infraorbital nerve in man during speech and chewing movements. Exp. Brain Res.**1988**, 72, 209–214.
[8]. Field, T., Diego, M., Hernandez-Reif, M., 2010. Preterm infant massage therapy research: a review. Infant Behav. Dev. 33 (2), 115–124.
[9]. Feldman, R., Rosenthal, Z., Eidelman, A.I., 2013. Maternal-preterm skin-to-skin contact enhances child physiologic organization and cognitive control across the first 10 years of life. Biol. Psychiatry 75, 56–64.
[10]. Cascio, Carissa J., Moore, David, McGlone, Francis, 2018. Social touch and human development. Dev. Cogn. Neurosci.
[11]. Croy, I., Sehlstedt, I., Wasling, H.B., Ackerley, R., Olausson, H., 2017. Gentle touch perception: from early childhood to adolescence. Dev. Cogn. Neurosci. http://dx.doi. org/10.1016/j.dcn.2017.07.009
[12]. Mantis, I., Mercuri, M., Stack, D.M., Field, T.M., 2018. Depressed and non-depressed mothers' touching during social interactions with their infants. Deve. Cogn. Neurosci.
[13]. Keizer, A., de Jong, J.R., Bartlema, L., Dijkerman, C., 2017. Visual perception of the arm manipulates the experienced pleasantness of touch. Dev. Cogn. Neurosci.
[14]. Tuulari, J.J., Scheinin, N.M., Lehtola, S., Merisaari, H., Saunavaara, J., Parkkola, R., et al., 2017. Neural correlates of gentle skin stroking in early infancy. Dev. Cogn. Neurosci.
[15]. Jönsson, E.H., Kotilahti, K., Heiskala, J., Wasling, H.B., Olausson, H., Croy, I., et al., 2018. Affective and non-affective touch evoke differential brain responses in 2-month-old infants. NeuroImage 169, 162–171.
[16]. Olausson, H., Lamarre, Y., Backlund, H., Morin, C., Wallin, B.G., Starck, G., et al., 2002. Unmyelinated tactile afferents signal touch and project to insular cortex. Nat. Neurosci. 5 (9), 900.
[17]. Davidovic, M., Jönsson, E.H., Olausson, H., Björnsdotter, M., 2016. Posterior superior temporal sulcus responses predict perceived pleasantness of skin stroking. Front. Hum. Neurosci. 10, 432.
[18]. Peled-Avron, L., Glasner, L., Gvirts, H.V., Shamay-Tsoory, S.G., 2018. The role of the inferior frontal gyrus in vicarious social touch: a transcranial direct current stimulation (tDCS) study. Dev. Cogn. Neurosci.
[19]. Blasi, A., Mercure, E., Lloyd-Fox, S., Thomson, A., Brammer, M., Sauter, D., Deeley, Q., Barker, G.J., Renvall, V., Deoni, S., Gasston, D., Williams, S.C.R., Johnson, M.H.,
[20]. Pirazzoli, L., Lloyd-Fox, S., Braukmann, R., Johnson, M.H., Gliga, T., 2018. Hand or spoon? Exploring the neural basis of affective touch in 5-month-old infants. Dev. Cogn. Neurosci.
[21]. Lew-Williams, C., Ferguson, B., Abu-Zhaya, R., Seidl, A., 2017. Social touch interacts with infants' learning of auditory patterns. Dev. Cogn. Neurosci
[22]. Croy, I., Luong, A., Triscoli, C., Hofmann, E., Olausson, H., Sailer, U., 2016.
[23]. Begus, K., Gliga, T., Southgate, V., 2014. Infants learn what they want to learn: responding to infant pointing leads to superior learning. PloS One 9 (10), e108817.
[24]. Interpersonal stroking touch is targeted to C tactile afferent activation. Behav. Brain Res. SreeTest Content1 297, 37–40.