

Investigating the Impact of Affiliative Touch on Visual Emotional Appraisal

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Abstract

Many traditional theories of emotional appraisal hold that emotional meaning is gained only after a stimulus is relayed through the primary sensory cortices and other association areas (centralized appraisal). However, accumulating evidence from non-visual modalities show that the valence of a stimulus can be discerned the moment contact is made with the basic sensory organs (decentralized appraisal). For instance, affiliative touch (e.g., gentle stroking), signals positive affect associated with social contact and support. Critically, however, it remained unknown whether decentralized valence signals influence centralized emotional appraisal mechanisms, such as those processing emotional content from visual stimuli. This is particularly notable given the visual dominance observed throughout much of our sensory processing. The current work addressed this gap in understanding, specifically focusing on how affiliative touch influences emotional appraisal of visual information. Participants were presented with either affiliative touch, neutral touch, or no touch while viewing static images of varied emotional content and were required to rate either the visual or tactile stimuli for its valence and arousal. Affiliative touch was found to have a general influence on the perceived valence of visual stimuli without modulating arousal. However, affectively salient visual stimuli strongly influenced both valence and arousal of tactile stimuli. These findings support the sensory dominance of vision for understanding and interpreting the world, yet also suggests a supramodal influence of affective information, independent of acquisition modality. This study improves our understanding of how affectively salient stimuli from non-visual modalities influence our emotional appraisal of visual information.

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Investigating the Impact of Affiliative Touch on Visual Emotional Appraisal

In early February 2025, my favourite basketball player was unexpectedly traded in the middle of the night. I was shocked, angry and quite discombobulated. Though this happened on a Saturday, it completely derailed the upcoming week. I overreacted to everything. Anything someone said was a slight; I convinced myself that my graduate supervisor hated me and my decision making was compromised. I did have to pull myself together by the following Friday because I had a conference poster presentation. I tend to have strong emotional reactions to sporting events and that one piece of information coloured my behaviour and responses well after its initial occurrence.

Think of something that is unusually important to you; how would a comparable piece of information – an isolated, but emotionally salient event – impact your life? Would you be affected in a similar way? Or could the next piece of information reset your mood and state of mind? In a sense, your answer can represent your relationship with your sensory experience. Although our environment is fluid and ever changing, our reaction to one experience or sensation can be limited to its source or may instead colour all subsequent incoming information. Similarly, a new sensation may overpower the previous emotional state, and we are able to independently update our behaviours and cognitive responses.

Emotion as a Behavioural Driver

There are varying conceptualizations of emotion over its decades of scientific study (Barrett, 2017; Cannon, 1927; Rolls et al., 2013; Russell, 1980; Schacter & Singer, 1962). In a broad sense, emotions can be described as consciously perceived feelings or functional states that are byproducts of the environment (Anderson & Adolphs, 2014; Malezieux et al., 2023). Russell

(1980) posit that emotions are experienced on a multidimensional plane that combines unique features or dimensions, with the most dominant of these being valence and arousal. Valence is a psychological experience that encompasses the subjective, personal feeling elicited by a stimulus (Colibazzi et al., 2010) and ranges from two affective endpoints (unpleasant to pleasant; bad to good) (Russell, 2003). Arousal, by contrast, is the level of physiological excitement or agitation elicited by a stimulus; it is understood to be the intensity that accompanies a stimulus (Russell, 2003). While arousal may be best and most accurately discerned with physiological methods like electrodermal activity or changes in heart rate (Craig, 2003) it can also be assessed through self-report of subjective experience (May et al., 2013; Mayo et al., 2018; Riberto et al., 2022). The value assigned to a stimulus – its *affective qualities* – is often based on the two aforementioned dimensions. In a complementary view, emotions are functional states elicited by the immediate surroundings with subjective feelings and behaviours a result of the functional state (Anderson & Adolphs, 2014).

Emotion as a functional state entails adaptive responses to the present environment (context-dependent) and distinct from feelings of an emotion (Adolphs, 2017; Adolphs & Andler, 2018). Further, emotion states can elicit motivated, controlled behaviours of approach or avoidance (Colibazzi et al., 2010; Rolls et al., 2013). Approach and avoidance are motivated states that instigate and direct our behaviours towards or away from stimuli (Rolls et al., 2013). The valence of a stimulus is the driving force of approach-avoidance motivation (Krieglmeyer et al., 2010). However, higher order decision-making, like self-report of valence or arousal, occurs upon further inspection and awareness of the stimulus; this inspection requires our attention.

Attention is understood as the mechanism that allows a stimulus to be further inspected leading to perceptual awareness (Anderson, 2005). This process has bearing on our experience of

emotion, and our emotional assessments can help guide this process (Todd et al., 2020).

Attention capture can either be stimulus-driven or goal-driven (or formally, bottom-up vs top-down respectively; Theeuwes, 2010). Stimulus-driven attention is involuntarily and a function of physically salient stimuli (e.g., a loud noise or sudden movement) while goal-driven attention is voluntary and often dependent on the task at hand (Awh et al., 2012). Human attentional resources are limited and directed to the most salient information in the environment (Tamietto & de Gelder, 2010), thus in an environment with multiple or rapidly occurring stimuli, attention may be impaired (Porcu et al., 2014).

Evidence for the powerful pull of attentional resources towards emotionally salient stimuli can be found in attentional blink paradigms. Attentional blink is a temporary deficit in attention where an initial target stimulus in a sequence of a rapid presentations impairs the ability to accurately perceive the following target stimulus (McHugo et al., 2013). Emotional stimuli (particularly negative stimuli), however, are highly resistant to attentional blink and this resistance is augmented by the high arousal and intensity of the stimulus (Anderson, 2005), suggesting negative stimuli may draw more attentional resources than other stimuli in a multisensory environment. For instance, negative stimuli prompt stimulus-driven attention and more readily capture attention compared to neutral stimuli (Eastwood et al., 2003; Glickman & Lamy, 2017). An additional factor to consider beyond the stimulus-driven versus goal-driven dichotomy is life experience (history). Personal history can influence attention prioritization; either the goal-directed or stimulus-driven aspect of attention can be deemed more attentionally pertinent due to life experience (Kryklywy & Todd, 2018; Todd & Manaligod, 2018), suggesting that sensory processing itself may be altered by emotional salience of the environment.

Integration of Sensory Modalities.

Most of sensory-emotion research, including many of the studies highlighted in the previous section, examine emotional reactions to sensory stimuli by deploying visual cues (e.g., facial expressions; objects; printed words; animals). The methodological-structural explanation proposed by Hutmacher (2019) posits that the dominance of visual stimuli in emotion research is a function of the technology at our disposal being best suited to studying vision. The focus on visual stimuli in emotion research resulted in theories of general emotional appraisal that are biased towards processing features observed in this modality (Vuilleumier, 2005) and often neglect other forms of sensory processing (Kryklywy et al; 2020). This bias, however, is not without merit; vision-centric research has revealed a visual dominance in stimulus perception and processing (Spence & Chen, 2012). Visual dominance indicates that the processing of visual stimuli takes pre-eminence over every other sensory modality (Hecht & Reiner, 2009; Hutmacher, 2019). For example, when presented with both visual and auditory information, people tend to respond to the visual stimuli often not even perceiving the auditory stimuli; this is called the Colavita effect (Colavita, 1974). Further, in a visuo-tactile environment, the detection of visual information dominates tactile stimuli; thus, extending the Colavita effect to touch (Hartcher-O'Brien et al., 2008; Hartcher-O'Brien et al., 2010). However, it is unclear whether this Colavita effect in vision over touch holds true when the competing tactile stimuli is emotionally salient.

Affect Appraisal

To determine how emotional information impacts our experience, we must first understand how it is we judge information to carry emotional value. The study of emotional appraisal through a visual lens has led to theories that posit environmental signals as having no inherent emotional value; to gain emotional meaning and influence behaviour, sensation must

undergo appraisal from the primary sensory cortices and deeper into the association areas of the cerebral cortex (Vuilleumier, 2005). This process – emotional meaning being gained through higher levels of neural processing – is known as *centralized appraisal*. A hierarchical processing model holds the notion that visual information is integrated in stages (DeYoe & Van Essen, 1988); the primary visual cortex (V1) first perceives low-level features (e.g., hue and location) and then the contextual meaning of the stimulus is garnered in higher order visual areas like the V2 and V4 (Grill-Spector & Malach, 2004). Pessoa and Adolphs (2010) counter with a “many roads” argument suggesting that visual stimuli, regardless of emotional content, are processed simultaneously by many pathways including the V1 and higher visual areas even projecting to brain areas such as the orbitofrontal cortex (OFC), anterior insula (aIns), anterior cingulate cortex (ACC) and amygdala (Kragel et al., 2019; Rudrauf et al., 2008). This process helps establish the brain as an interconnected structure of different regions functioning to extract and process salience from our world, leading to a subjective feeling and emotion (Pessoa, 2023). The ideas of hierarchical and many roads processing, although distinct, reveal the need for centralized appraisal of visual information. However, vision is not the only sensory modality that can convey emotionality; humans experience complex multisensory environments. Thus, we should consider the role of other sensory modalities to accurately discern sensory-emotion interactions.

There is increasing evidence that non-visual modalities utilize an additional *decentralized* form of emotional appraisal (for review, see Kryklywy et al., 2020). These pathways are complementary, and often secondary to centralized appraisal, yet they represent a distinct manner of assessment for valence and arousal. Decentralized emotional appraisal asserts that determination of valence – the “pleasantness” or “unpleasantness” associated with an object – for

exteroceptive stimuli is not contingent on primary sensory cortices, associated processing areas or any cortical processing at all; valence can be attributed from the point of contact with the basic sensory organs (i.e., skin, nose, ears, and tongue; for review, see Kryklywy et al., 2020). Furthermore, these valenced sensations are then propagated along sensory afferent pathways that project to emotion-related brain structures, such as the insular cortex and OFC, independent of their instantiation in traditional sensory regions (McGlone et al., 2014; Todd et al., 2020). For example, Bales et al. (2015) found that lesions in the gustatory cortex (GC) of rats did not impair taste sensitivity for sucrose. One modality increasingly studied for its capacity for valence-labeled sensation is somatosensation (McGlone & Reilly, 2010; Morisson et al., 2010; Kryklywy et al., 2023).

The somatosensory system acts to signal tactile stimulation. This sensation can come from anywhere in the external, contiguous, world (Zhang et al., 2019); a tap on the shoulder, a raindrop or a stub of the toe, all constitute unique and discriminable tactile stimuli. The cutaneous system, which contains our skin, its receptors (Merkel cells, Meissner corpuscles, Ruffini endings and Pacinian corpuscles) and all the sensory channels/afferents/fibres embedded in it (e.g., A α , A β , A δ , C and C-Tactile), oversees the human perception of touch (Abraira & Ginty, 2013). It carries information that distinguish both the discriminative (recognition of what we are touching) and affective properties of touch (i.e., the emotional aspects of touch like pain and pleasure; Koch et al., 2018). Cutaneous afferents themselves do not generate touch perception, they are the conduit to the respective brain networks that produce this perception (Morrison, 2022). Touch perception is reliant on four low-threshold mechanoreceptors (LTMRs). These LTMRs are distinguished by adapting speed and receptive fields. The adapting speed of LTMRs refers to how long their signals (action potentials) fire before coming to a rest (slow or

fast) (McGlone & Reilly, 2010). The receptive fields of mechanoreceptors depend on their location on the skin; the closer the LTMRs is to the surface of the skin (between the dermis and epidermis), the smaller their receptive field (Abraira & Ginty, 2013). LTMRs have different properties and functions; they transduce mechanical force on the skin into brain messages through sensory afferent channels (Morrison, 2022).

Afferent channels – nerve fibers carrying information from receptors towards the central nervous system – are differentiated through axon diameter, degree of myelination, and conduction velocity (for in-depth review, see McGlone & Reilly, 2010; McGlone et al., 2014; for a summary, see Table 1).

Table 1

Classifying Tactile Afferents/Channels

Sensory afferents	Myelin?	Axon diameter (um)	Speed(m/s)	Associated function
A α	Yes	20	120	Proprioception
A β	Yes	10	80	Discriminative touch
A δ	Yes	2.5	12	Temperature, pain
C	No	1	<1	Pain
CT	No	1	<1	Light stroking, affiliative touch

Signals from these cutaneous afferent fibres project to the dorsal horn of the spinal cord (Todd, 2010) before propagating into the brain (Abraira & Ginty, 2013). A β fibres are heavily myelinated, fast and wide in diameter (Bear et al., 2016). A β channels help in discriminative touch (McGlone et al., 2014), the awareness of tactile stimulation across the body (Bjornsdotter et al., 2009), including the identity, location and the velocity of the tactile information (Abraira

& Ginty, 2013). A β afferents follow the dorsal column pathway from laminae III-V (L3- L5) of the dorsal horn, where integrated signals have a direct route to the primary somatosensory cortex (S1) via the thalamus (Marshall & McGlone, 2020). However, of particular interest in the current work are the affective aspects of tactile stimulation. Pain is established as a decentralized signal; although represented centrally, pain signals can also instantiate in emotion areas such as the ACC and insula (Meijer et al., 2022).

A δ fibres are lightly myelinated channels, that have intermediate conduction velocities. They are slower than A β channels, but faster than the unmyelinated channels (Bear et al., 2016). A δ elicit behaviour to reach immediate safety like removal of an aversive stimulus, hence they are involved in the perception of pain (nociception) (Qiu et al., 2006). A δ indicate the sensory-discriminative components of pain and activate the S1, secondary somatosensory cortex (S2), and insula (Meijer et al., 2022); while C-fibres with unmyelinated afferents and slow conducting velocities relay the emotional components of pain and activate the ACC and aIns (Xiao & Zhang, 2018). Differentiating the sensory-discriminative and emotional components of pain help establish this sensation as a decentralized signal. Beyond pain, CT fibres in the somatosensory system are increasingly recognized for being dissociable pleasant afferent pathways (Kryklywy et al., 2023; Morisson et al., 2010).

While “affective touch” is often used to refer to pleasant touch alone (Case et al., 2023; Olausson et al., 2010), the term “affective” has both positive (affiliative, social, pleasurable, intimate) and negative (pain, pressure, itch) connotations (for review, see Schirmer et al., 2023). Thus, for the remainder of this paper, I will refer to the portion of the somatosensory system conveying positive aspects of touch as the *affiliative touch system*. Affiliative touch via the stimulation of CT fibres elicits a tactile experience that is markedly pleasant and positive

(Ackerley et al., 2014). Signals from CT fibres across species relay pleasant touch to the posterior insular cortex, the main target of CT afferent stimulation (Ackerley et al., 2014; Pawling et al., 2017). CT fibres are optimally activated by gentle caressing of hairy skin at velocities between 1-10 cm/s at temperature of 32°Celsius (Ackerley, 2022). The interpretation of CT activation as pleasant and positive is understood to be an innate and unlearned process because it has been evolutionarily conserved from mammals and nonhuman primates (Dunbar, 2010; McGlone et al., 2012). In cats and mice, C-Low threshold mechanoreceptors (C-LTMRs) are likely homologues to the unmyelinated, slow conducting C-Tactile (CT) fibres in humans primarily found on hairy skin (McGlone et al., 2014). Social communication in primates such as grooming and cuddling is akin to slow, gentle stroking in humans that produces affiliative touch (Jablonski, 2021).

There is evidence that affiliative touch also carries a measure of importance for social interaction and thereby emotion processing, beginning as early as prenatal development (Saluja et al., 2024). In humans, touch is the first sense to develop (Cascio et al., 2019). In utero, the fluctuation of amniotic fluid stimulates fetal lanugo that has CT receptors (Peciccia, 2024). By the third trimester fetuses can respond to touch on the mother's abdomen and as early as two months old the insular is activated by slow stroking, suggesting that CTs are developed in utero (Croy et al., 2022). In infants (8-10 months old), medium-velocity brush strokes lead to heart rate deceleration lending to parasympathetic activity and decreased arousal (Pawling et al., 2017). Behaviourally, even when presented with distractor visual stimuli, infants turn their gaze toward the brush used to apply the medium-velocity touch showing some affinity for the source of the pleasant touch (Fairhurst et al., 2014). Affiliative touch is important in early infancy as the basic sensory substrate for secure attachment style (McGlone et al., 2025). CT targeted touch in early

infancy contributes to oxytocin release (indicating safety), proper stress regulation, parasympathetic control and healthy social bonding (Kidd et al., 2023; Li et al., 2022). These findings show the presence of affiliative touch in all stages of human development (from fetus to adult) biologically and socially. Hence, like vision, affiliative touch can also be a dominant force in how we perceive the world around us. Further, when processing emotional stimuli, touch may be even more informative than sight, as it is, after all, the most private and affective of all the senses humans possess (Yoo et al., 2014) and can signify ongoing, rather than imminent, harm or pleasure. Beyond behavioural influences, the representation of exteroceptive signals in the brain are also important in understanding how different modalities interact.

Neural Representation of Centralized and Decentralized Appraisal

Recall the moment my favourite player was traded; that emotional experience coloured my reactions for a week; for others, their reaction may have been limited to the moment they heard the news. With emotionally salient sensation, a similar process unfolds. Sometimes the emotion is associated only with the item or object evoking it, while other times it can colour an entire experience. Affect appraisal encompasses the ideas of modality-general and modality-specific neural processing and representations (Kim & Kim, 2025). Modality-general processing asserts that brain sensory systems do not ascribe any valence to an isolated stimulus, rather the perception of affective stimuli from all senses (supramodal) occurs at emotion-related brain structures (Kim et al., 2017). The contrasting modality-specific processes suggest that the primary sensory cortices for each modality can decode the valence of a stimuli, and that this valence remains linked to the sensory modality through which it was evoked (Miskovic & Anderson, 2018). Both frameworks often occur simultaneously and in an interactive manner to

represent emotional appraisal in the central nervous system (see Figure 1) (Gao & Shinkareva, 2021).

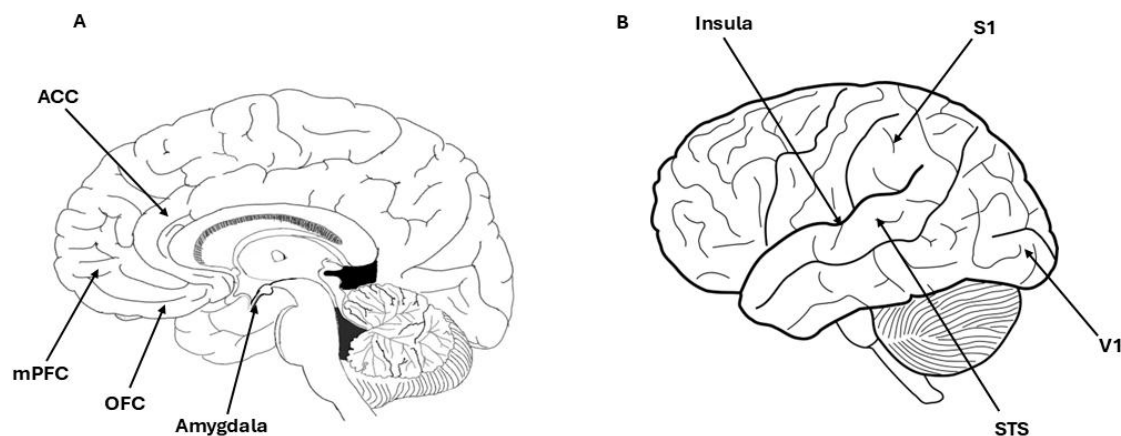
Modality-general and supramodal processing integrate all affective stimuli independent of sensory modality in emotion-related brain structures to garner meaning (Chikazoe et al., 2014), and this meaning, particularly when experienced as a supramodal emotional state, can colour our experience of all other concurrent sensation. Emotion-responsive structures implicated in this process include the OFC, which is involved in the evaluation of external sensory stimuli (tactile, auditory, visual, and olfactory; Dixon et al., 2017) and superior temporal sulcus (STS), which is thought to be a “functional chameleon” (Hein & Knight, 2008) because it is implicated in a variety of processes including theory of mind, audiovisual integration, motion perception, speech and face processing. Other modality-general regions include medial prefrontal cortex (mPFC) and ACC involved in the appraisal and regulation of negative emotional stimuli, respectively (Etkin et al., 2011). Peelen et al. (2010) found the STS and mPFC to be involved in supramodal processing when presenting participants with facial expressions, body movement and voice changes representing basic emotions (anger, disgust, fear, happiness and sadness). Kim et al. (2017) found activity in the STS, mPFC, thalamus and ACC when participants viewed silent videos and musical snippets (valenced and neutral).

In modality-specific processing, the brain areas that integrate emotional stimuli is dependent on the sensory system being activated (sight, smell, taste, touch, or hearing) (Kim et al., 2017). In this view, each sensory modality has dedicated neural regions/networks or connections that can discern emotionality (Miskovic & Anderson, 2018). The cleanest form would occur when the primary sensory cortex related to a stimulus can begin to appraise the stimulus not only for perception but also for affect. Activity in early sensory brain regions

reliably occur in modality-specific affective contexts especially for visual (V1), auditory (A1) and tactile (S1) inputs (Satpute et al., 2015). This suggests that primary sensory cortices can represent the valence of a stimuli before further cerebral cortex appraisal. The mPFC also provides modality-specific processing for visual stimuli (Gao & Shinkareva, 2021). The inferior frontal cortex (IFC) which is activated during assessment of facial emotion (Nakamura et al., 1999) has been shown to be modality-specific for visual processing. Chikazoe et al. (2014) showed gustatory valence processing in the insula and ventral temporal cortex (VTC). Although the insula also carries interoceptive information for homeostatic control (Craig, 2003; Gasquoine, 2014).

Figure 1

Supramodal Brain Regions and Primary Sensory Cortices for Vision and Touch



Note. A is a medial view of the brain labelling supramodal processing regions (OFC- orbitofrontal cortex); (mPFC- medial prefrontal cortex); (ACC- anterior cingulate cortex). B is a lateral view of the brain labelling the supramodal (STS- superior temporal sulcus) and insula as well as the (V1- primary visual cortex) and (S1- primary somatosensory cortex).

Decentralized signals of affiliative touch originate explicitly from a singular valenced sensory experience but are instantiated in brain regions implicated in general affect and multimodal processing. For example, Olausson et al. (2002) found that in individuals who lack A β fibres, activation of CT afferents still produced a pleasant sensation and activity in the posterior insula without activating S1 and S2. Since this initial finding, subsequent studies have implicated the right posterior STS, mPFC (Gordon et al., 2013), ventromedial prefrontal cortex (vmPFC) and the insular cortex (Kryklywy et al., 2023) as well as strong activation in the OFC and ACC (Rolls et al., 2003; Rolls, 2010) in the perception of affiliative touch, establishing modality-general representations. However, it seems this sensation is also processed in its early perceptual regions like S1 (Tuulari et al., 2019). Optimal CT afferent stimulation has revealed activation in the primary and secondary somatosensory cortices (S1 and S2) and posterior insula (PI) both on hairy skin (heavily CT innervated) and the palm, where CT afferents are thought to be absent (Perini et al., 2015), providing evidence for modality-specific processing of affiliative touch. In terms of cognitive perception and behavioural responses, a modality-specific response singles out a sensory experience or event from any given context (that shoulder rub feels good) while modality-general and supramodal responses generalize to the whole environment (life feels better). Notably, the perception of the sensory environment, and even the decentralized affective signals we gain from it, can also be influenced by top-down, contextual factors.

Modulation of Affect by Context

There are external and internal factors that cause different perceptions of CT-targeted touch across individuals (Croy et al., 2021). For instance, trauma exposure can truncate the pleasantness and comfort associated with affiliative touch and may result in a negative attitude towards affiliative touch (Stevens et al., 2024). People with low touch exposure to affiliative

touch do not rate CT-targeted touch as pleasant as those with regular exposure to affiliative touch but they do perceive discriminative aspects of the touch in a similar manner (Sailer & Ackerley, 2019). Further, the perception of affiliative touch can be influenced by factors such as the partner in the exchange (i.e., “who” is delivering the touch) and the intent behind the tactile stimulation (i.e., “why” it is being delivered) (Cascio et al., 2019). The emotional facial expression of the person delivering the touch (Ravaja et al., 2017) may also impact the perception of affiliative touch. The relationship between caresser and caressed impacts the pleasantness of affiliative touch to the caresser (caressing a partner vs. caressing a stranger) (Mazza et al., 2023). Being stroked by a romantic partner and stroking them are rated as significantly more pleasant than being stroked by a stranger (Tricoli et al., 2017). Affiliative touch to one’s partner causes a calming effect as indicated by lower anxiety levels and soothing autonomic responses (Mazza et al., 2023). Romantic partners spontaneously stroke their loved one at rates between 1-10 cm/s that optimize CT afferent activation (Croy et al., 2016). Further, the value assigned to affiliative touch can also depend on the touchee’s current attitude (goal) and their interpretation of the toucher’s motives (Sailer & Leknes, 2022). Similarly, in an experimental setting where the attractiveness of the imagined caresser is a variable as in Novembre et al. (2021), when participants received either a fast (27cm/s) or slow (3cm/s) caress on the palm and arm while viewing a photo of a member of the opposite sex with high or low attractiveness; it was found that slow caressing resulted in high heart rate variability (HRV) when the imagined caresser was highly attractive. Together, these studies suggest an influence of top-down/cognitive processes on the experience of decentralized signals of affect.

While affective visual and tactile stimuli can share overlapping neural representations, what remains a point of contention is which sensory modality is more effective in corralling

these neural resources (Gallace & Spence, 2010). The case for vision is its perceptual dominance over other modalities (Hecht & Reiner, 2009; Tang et al., 2025). Meanwhile, an argument for touch is its importance in early development (Sehlstedt et al., 2016) and in maintaining homeostatic control (Craig, 2003). Electrophysiological data showed that early sensory competition is modality specific, meaning if the competing stimulus is from a different modality than the initial stimulus, there is no reduced perception of initial stimulus (Porcu et al., 2014). That is, the perception of an initial tactile stimulus should not be affected by a distracting or competing visual stimulus. Another study found somatosensory-evoked potentials (SEP) – neural responses recorded through electroencephalography (EEG) that indicate activity in somatosensory cortex (Macerollo et al., 2018) – from non-noxious tactile stimuli were reduced by unpleasant images compared to positive images. Further, unpleasant images increased visual-evoked potentials (VEP) compared to pleasant images (Montoya & Sitges, 2006). What remains unclear, is the precise bidirectional nature through which affiliative touch is modulated by, and can modulate, visual experience.

The Current Study

The present work addresses this gap in emotion-sensory research by expanding the understanding of affiliative touch to include its influence on the appraisal of visual information. Using a multisensory research design (visual and tactile manipulations), we investigate the interactions between tactile stimuli and visual stimuli, focusing on the degree to which the affective quality of the sensory inputs are limited to their own modality or colours the entire environment. Different tactile stimuli (affiliative touch, neutral touch, along with a no touch condition) were applied while participants viewed a series of images with varied (yet controlled)

emotional content. Participants provided emotional responses (for valence and emotional arousal) on a visual analog scale (VAS).

The central hypothesis of this work is that the addition of affiliative touch - a signal of decentralized affect appraisal - will influence the valence and arousal rating of visual stimuli greater than the neutral or no touch conditions (somatosensory signals limited to discriminative touch). This is consistent with earlier work by Wingenbach et al. (2021) which found that when affiliative touch was delivered to participants, the evaluations (valence ratings) of positive, neutral and negative images were significantly more positive. Further, I predict affiliative touch will increase participants' valence and arousal rating of the positive and neutral images compared to no touch and neutral touch. This is based on evidence that the skin can signal emotional value to modality general regions of appraisal that would also influence visual stimuli processing (Todd et al., 2020).

By contrast, affiliative touch is not expected to significantly impact the valence rating of negative images but is expected to reduce participants' arousal rating by having a calming effect on the distressing or shocking nature of the negative scene compared to no touch and neutral touch. This prediction originates from empirical findings that the stimulation of CT fibres promotes parasympathetic autonomic responses like reduced heart rate (Pawling et al., 2017) or increased HRV (Triscoli et al., 2017). Finally, it is hypothesized that visual scenes will not impact emotional rating of tactile stimuli because the affiliative touch is inherently valence-labelled and feeds into the centralized visual affect process not vice versa, defying the sensory dominance of vision on tactile stimulation.

Method

Participants

Prior to conducting the study, a G Power analysis performed on the primary analysis (3 [tactile stimulation] x 3 [image category] repeated-measures ANOVA) identified a required sample size of 69 (power = .80; effect size = .25 [Cohen's f]; alpha = .05). In anticipation of participant attrition and unusable data, 73 participants were recruited from the Lakehead University undergraduate student pool, through the SONA system. All participants were above the age of 17 and had normal or corrected-to-normal vision and no tactile insensitivity. Participants gave written consent prior to beginning the experiment. Two participants were removed from analyses due to a failure to complete the experimental tasks as instructed. Further, three participants were found to have outlying responses to the affiliative touch stimuli (z -scores more than two standard deviations below the mean) and were removed from further analyses. All subsequent analyses were conducted on the remaining 68 participants, (53 females [78%], M_{age} = 23.29, SD = 7.37). All research protocols were approved by the Lakehead University Research Ethics Board (REB-ID: 1470107).

Stimuli and Apparatus

To investigate the effects of affiliative touch on emotional appraisal, the study presented both visual stimuli and tactile stimuli. Visual stimuli consisted of images from the International Affect Picture System (IAPS; Lang et al., 1997). IAPS images have been demonstrated to effectively communicate valence and arousal dimensions of emotion (Bucks et al., 2005). The IAPS stimuli consisted of 24 photographs, with eight pictures each, designated to the three image categories (positive, negative, neutral) balanced based on content (animals, children, adults and objects; see Table 2 for extended details). These valence and arousal ratings are from the IAPS technical manual based on the Self Assessment Manikin (SAM). All images were displayed

against a grey background on a 1920x1080 pixel Acer monitor with a viewing distance of ~ 40 centimeters. Images had an approximate viewing angle of 20°.

Table 2

Chosen IAPS Images with their Standardized Valence and Arousal Ratings

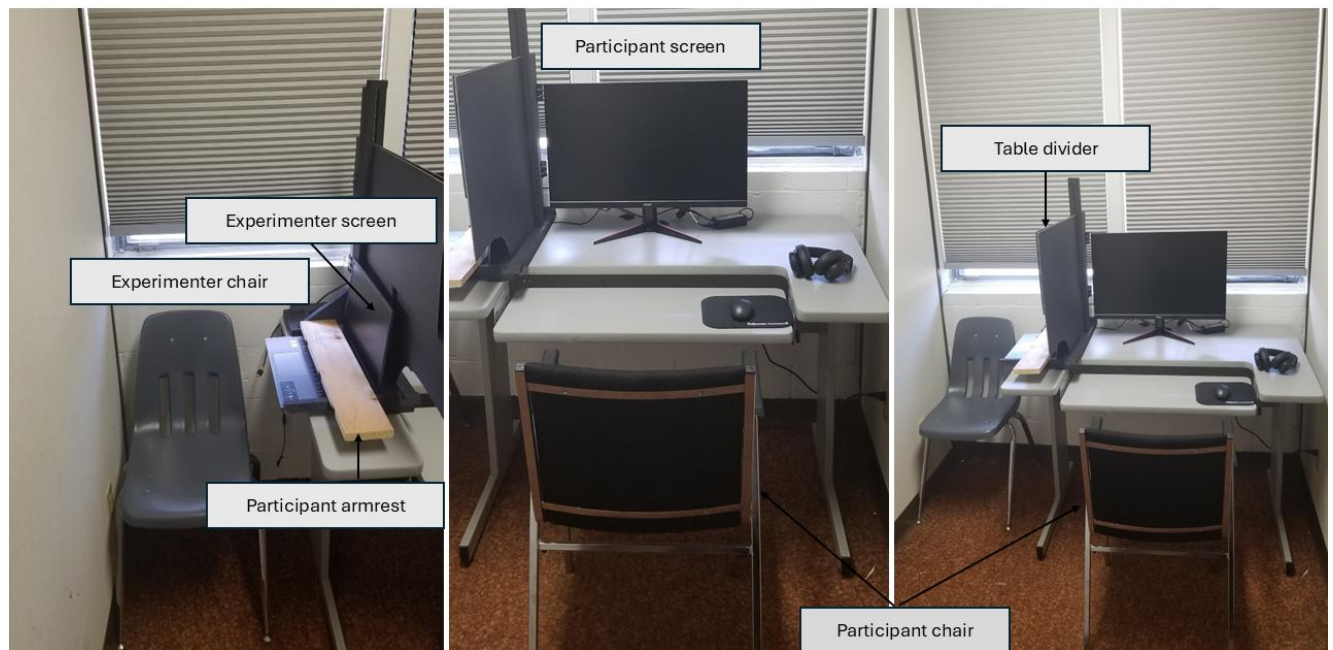
Image Category	Set	Content	IAPS Picture ID	Valence (SD)	Arousal (SD)
Positive	A	Animal	1463	7.45(1.76)	4.79(2.19)
		Adult	4626	7.60(1.66)	5.78(2.42)
		Child	2057	7.81(1.28)	4.54(2.41)
		Object	8531	7.03(1.50)	5.41(2.15)
	B	Animal	1710	8.34(1.12)	5.41(2.34)
		Adult	2030	6.71(1.73)	4.54(2.37)
		Child	2058	7.91(1.26)	5.09(2.48)
		Object	7508	7.02(1.46)	5.09(2.11)
Negative	A	Animal	1111	3.25(1.64)	5.20(2.25)
		Adult	3215	2.51(1.32)	5.44(2.16)
		Child	3301	1.80(1.28)	5.21(2.26)
		Object	2692	3.36(1.61)	5.35(2.19)
	B	Animal	9181	2.26(1.85)	5.39(2.41)
		Adult	3181	2.30(1.43)	5.06(2.11)
		Child	2095	1.79(1.18)	5.25(2.34)
		Object	2811	2.17(1.38)	6.90(2.22)
Neutral	A	Animal	1935	4.88(1.44)	4.29(1.95)
		Adult	2038	5.09(1.35)	2.94(1.93)
		Child	2870	5.31(1.41)	3.01(1.72)
		Object	5471	5.21(1.18)	3.26(2.05)
	B	Animal	1675	5.24(1.48)	4.37(2.15)
		Adult	2357	5.41(1.36)	3.33(2.07)
		Child	2385	5.20(1.32)	3.64(1.81)
		Object	7004	5.04(0.60)	2.00(1.66)

A 2 (photo set: A, B) x 2 (image category: positive, negative) ANOVA was performed for absolute valence level (i.e., deviation from “neutral” as defined by the standardized rating; Lang et al., 1997). There was no main effect for photo set, ($F [1,12] = 3.095, p = .104$) or image category ($F [1,12] = 0.099, p = .758$), and no significant image category by photo set interaction ($F [1,12] = 0.003, p = .961$). An identical 2 (photo set: A, B) x 2 (image category: positive, negative) ANOVA was performed for standardized arousal ratings. There was a main effect for photo set ($F [1,12] = 5.075, p = .044$) but not for image category ($F [1,12] = 2.78, p = .121$). Further, the image category by photo set interaction was non-significant ($F [1,12] = 0.001, p = .971$).

Tactile stimuli consisted of light brushing that targeted CT-linked receptors and light pressure that did not, both applied to the participant’s left forearm, and delivered by a trained experimenter. As part of their training, the experimenters practiced brushing on a scale to obtain an objective measure of the applied pressure. They also performed at least two full mock experiments on pilot participants. Affiliative touch was operationalized as a brush stroke velocity of 3 cm/s with a consistent pressure of ~ 0.4 N to maximally activate CT-linked mechanoreceptors on hair follicles (followed protocols established by Fu et al., 2018). Participants received a light brush on the arm 6 cm in length over a period of two seconds with a brush made of goat’s hair. Neutral touch was operationalized as a light vertical pressure applied on the forearm with no lateral movement. Pressure was applied with the back of the brush. Two experimenters (one male, one female) were trained to deliver all tactile stimuli and assisted by a visual prompt for tap and brush velocity during stimulus delivery. For an exploratory analysis on the impact of experimenter sex on tactile ratings, see Appendix. During the experiment, participants sat comfortably in front of a computer screen and placed their forearm on a

cushioned wooden plank out of direct view line for the participant. A physical barrier (table divider) was used to obscure the participant's view of both their forearm and the experimenter. On the other side of the divider, an experimenter whom the participants already met delivered the correct tactile stimulation (Figure 2).

Figure 2: *Experiment Setup*



Note. This figure displays the experiment setup. The photograph on the left is the experimenter's setup. The photograph in the middle is the participant setup. The photograph on the right shows the setup for both experimenter and participant.

Procedure

Baseline Tactile Ratings

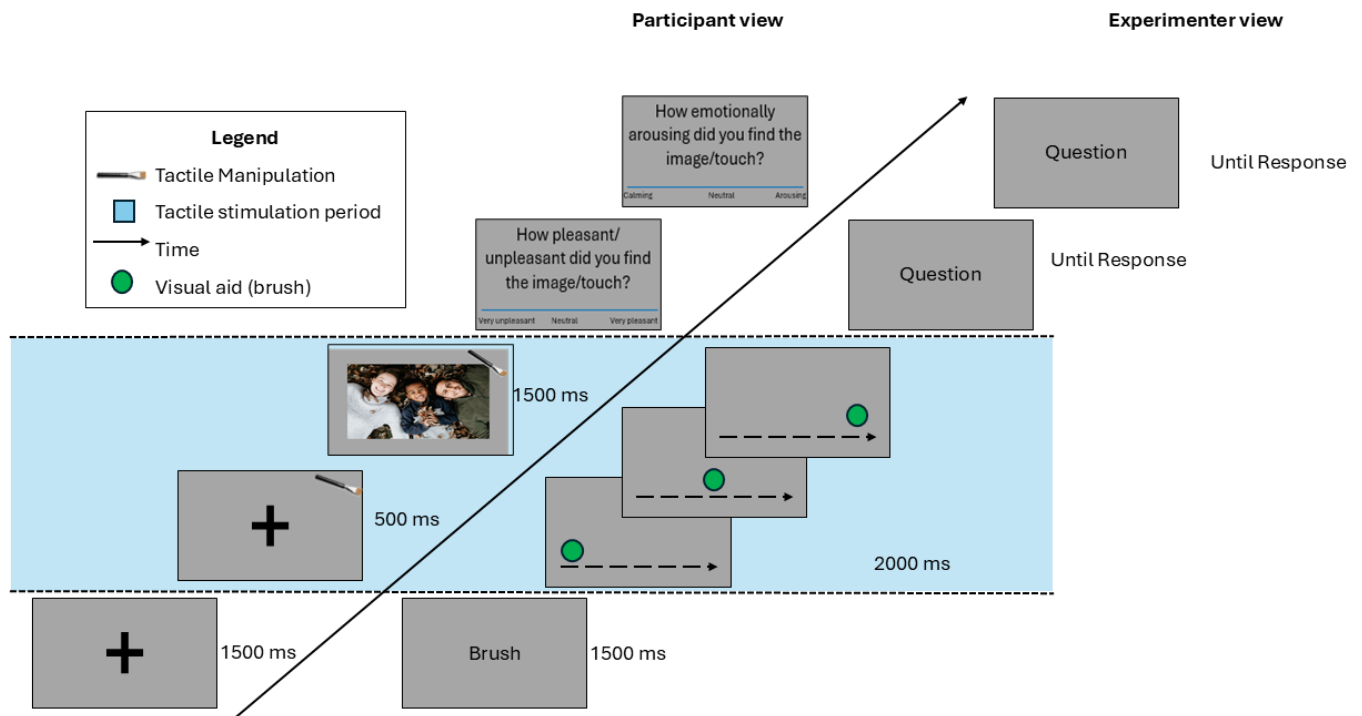
Prior to the main experiment, participants provided a baseline valence rating for both the light brushing and light pressure. These baseline ratings served as a manipulation check for our operationalized affiliative touch being more pleasant than the neutral touch condition.

Main Experiment Design

In the main experiment, participants were presented with both a visual and tactile stimulus and were required to provide an emotional evaluation of either the visual or tactile stimulus. Each trial began with participants viewing a fixation cross for 2000 ms (visual angle ~ 20°). 1500 ms into the fixation cross, a tactile stimulus was applied and continued for the remaining for 500 ms. The tactile stimulus was one of brush, light pressure, or no touch, randomized across trials. Tactile stimuli remained present as the fixation cross was replaced with a visual stimulus lasting 1500 ms, thus resulting in 2000 ms of tactile stimulation per trial. The visual stimulus was either positive, negative, or neutral, randomized across trials. Following each trial, participants were required to rate *both* the emotional arousal (Calming to Arousing) and valence (Very Unpleasant to Very Pleasant) of *either* the touch or the visual scene in random order (i.e., ratings for two emotional dimensions in one sensory modality per trial; Figure 3). Ratings were completed on a visual analog scale, and each question stayed on the screen until the participant responded. Participants completed four experimental blocks. In two of the blocks participants rated the valence and emotional arousal of the *visual* stimulus, in the other two, participants rated the valence and emotional arousal of the *tactile* stimulus on each trial (including ‘no-touch’ trials). Block order was counterbalanced based on photo set and participant number. Within each block, participants viewed each possible image/touch pairing twice for a total of 72 trials per block (3 tactile conditions x 12 visual stimuli x 2 question orders).

Figure 3

Procedure for a Single Experiment Trial



Note. This figure illustrates a single trial of the study. The views for experimenters and participants are separated by the solid diagonal line and the trial is depicted from bottom to top along the diagonal line. The experimenter receives a word cue (Brush, Tap or Nothing) followed by (dynamic green dots: brush) or (stationary yellow dot: tap) or (red dot: nothing) visual prompt, indicating the tactile stimulus to execute. Participants view a fixation cross for 2000 ms, the first 1500 ms with no tactile stimulation and the tactile stimulation begins in the final 500 ms of the fixation cross and continues into 1500 ms of image presentation. Then participants answer two questions at the end of stimulus presentation (question order is randomized). All touch/image pairings were randomized.

Data Analysis

The outcome measures in this study were the participants' emotional appraisal of both the visual and tactile stimuli along the dimensions of valence and arousal. A series of four individual 3 (tactile stimulation: affiliative touch, neutral touch, no touch) x 3 (image category: positive, negative, neutral) repeated-measures ANOVAs were conducted on the four sets of emotional appraisal ratings (visual valence, visual arousal, tactile valence, tactile arousal) to identify the influence of both visual and tactile information. For all ANOVA result reporting, when necessary, Huynh-Feldt or Greenhouse-Geisser epsilon factor were used to correct for sphericity. Significant effects were further investigated using the estimated marginal means (Bonferroni corrected when appropriate).

Results

Manipulation Check

A paired *t*-test conducted on pre-task baseline touch ratings confirmed that the affiliative touch ($M = .695$, $SD = .205$) was more pleasant than neutral touch ($M = .604$, $SD = .192$), ($MD = .091$, $t = 3.40$, $p = .001$, $d = .412$).

Visual Affect Appraisal

Valence

A 3 (tactile stimulation) x 3 (image category) repeated-measures ANOVA conducted on the visual valence ratings found a main effect for image category, $F(1.37, 92.11) = 451.80$, $p < .001$, partial $\eta^2 = .871$. This main effect was characterized by significantly higher valence rating for positive images compared to negative ($MD = .547$, $p < .001$) and neutral ($MD = .207$, $p < .001$) images, as well as significantly higher valence ratings for neutral images compared to

negative images ($MD = .34, p < .001$). These are consistent with the expected differences as outlined by the standardized picture system (Lang et al., 1997).

There was also a main effect for tactile stimulation, $F(1.78, 119.14) = 8.54, p < .001$, partial $\eta^2 = .113$. This main effect was characterized by significantly higher valence rating for affiliative touch compared to neutral touch ($MD = .019, p = .004$) and no touch ($MD = .015, p = .005$). There were no significant differences in the visual valence rating between neutral touch and no touch conditions ($MD = -.004, p = .921$). These comparison effects show that affiliative touch is the driving force for different valence ratings of images. The interaction term (tactile stimulation x image category) was non-significant $F(3.57, 239.07) = 1.40, p = .240$, partial $\eta^2 = .02$. See Figure 4A.

Arousal

A 3 (tactile stimulation) x 3 (image category) repeated-measures ANOVA conducted on the visual arousal ratings found a main effect for image category, $F(1.45, 97.37) = 122.23, p < .001$, partial $\eta^2 = .646$. This main effect was characterized by significantly higher arousal ratings for negative images compared to positive ($MD = .307, p < .001$) and neutral ($MD = .242, p < .001$) images. The visual arousal ratings for neutral images were significantly higher compared to positive images ($MD = .065, p < .001$). The ANOVA conducted on the visual arousal ratings found no significant main effect of tactile stimulation, $F(1.62, 108.65) = 2.43, p = .103$, partial $\eta^2 = .035$ or tactile stimulation x image category interaction, $F(4, 268) = 1.07, p = .372$, partial $\eta^2 = .016$. See Figure 4B.

Tactile Affect Appraisal

Valence

A 3 (tactile stimulation) x 3 (image category) repeated-measures ANOVA was conducted on the tactile valence ratings. This found a main effect for image category, $F(1.12, 75.17) = 103.33, p < .001$, partial $\eta^2 = .607$, characterized by significantly higher tactile valence rating in positive image trials compared to negative ($MD = .240, p < .001$) and neutral ($MD = .091, p < .001$) image trials. Further, neutral image trials had a significantly higher tactile valence rating compared to negative ($MD = .149, p < .001$) image trials.

Analysis also found a main effect for touch, $F(1.57, 104.97) = 7.19, p = .003$, partial $\eta^2 = .097$. This main effect was characterized singularly by significantly higher valence rating of affiliative touch compared to the no touch ($MD = .066, p = .002$). Neutral touch did not significantly differ from either affiliative touch ($MD = .052, p = .062$) or no touch ($MD = .014, p = .939$).

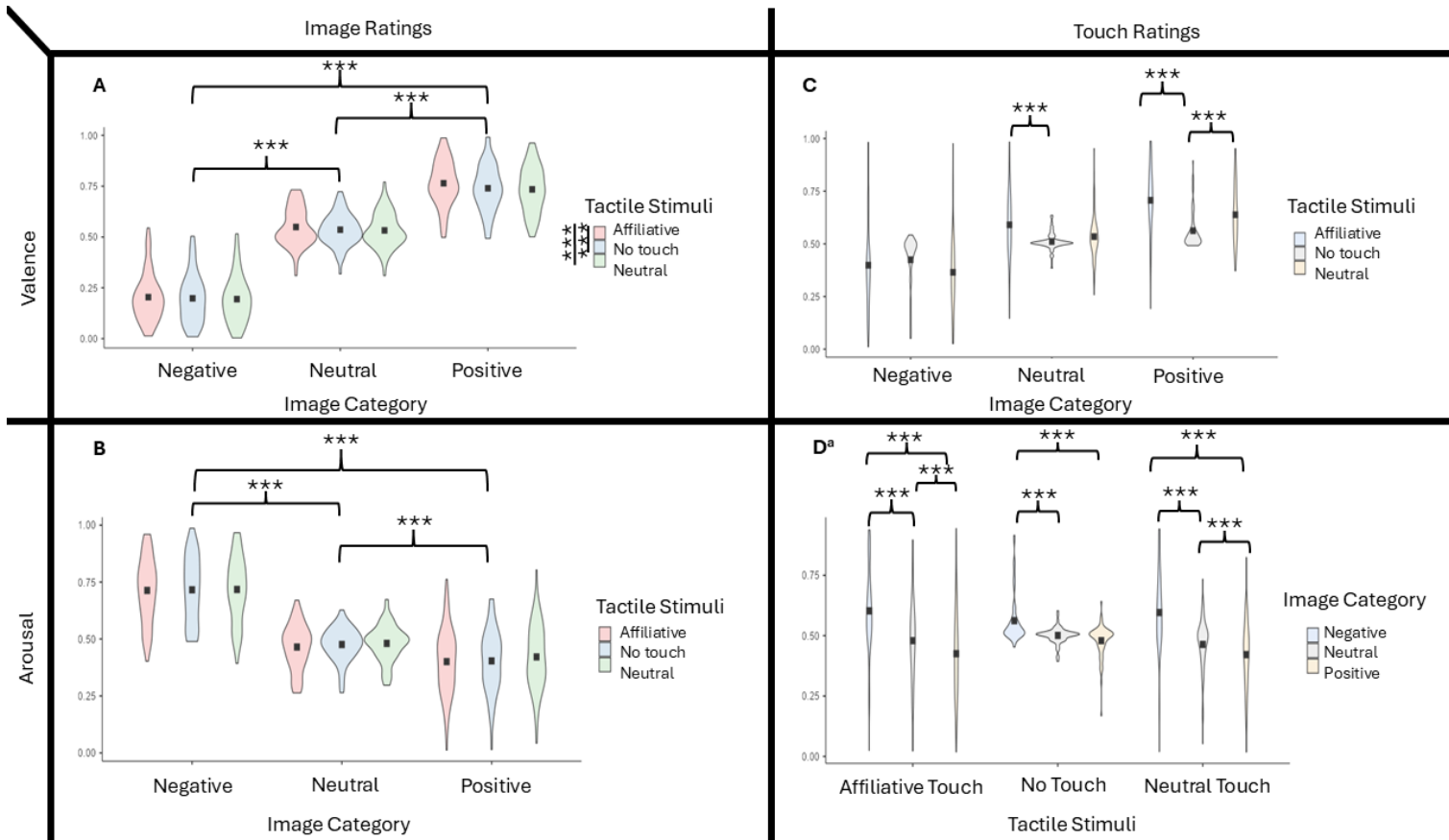
A tactile stimulation x image category interaction was significant; $F(1.81, 121.43) = 35.96, p < .001$, partial $\eta^2 = .349$. Pairwise comparisons were conducted within image categories to further investigate this effect. Firstly, our main effect for touch was replicated within positive image (affiliative touch significantly more pleasant than no touch; $MD = .144, p < .001$). Further, viewing positive images resulted in participants rating neutral touch as significantly more pleasant than no touch $MD = (.075, p < .001)$. Neutral images also significantly increased the valence rating of affiliative touch compared to no touch ($MD = .08, p = .004$) but did not affect any other tactile stimulation pairings. Finally, negative images did not have a significant impact on the valence rating of tactile stimuli. See Figure 4C.

Arousal

A 3 (tactile stimulation) x 3 (image category) repeated-measures ANOVA conducted on the tactile arousal ratings found a main effect for image category, $F(1.34, 89.75) = 64.791$, $p < .001$, partial $\eta^2 = .492$. This main effect was characterized by significantly higher tactile arousal ratings for negative compared to positive ($MD = .145$, $p < .001$) and neutral ($MD = .106$, $p < .001$) images as well as neutral compared to positive images ($MD = .039$, $p < .001$). The ANOVA conducted found no main effect of tactile stimulation, $F(1.66, 111.24) = 0.642$, $p = .5$, partial $\eta^2 = .009$.

The tactile stimulation x image category interaction was found to be significant; $F(2.70, 180.76) = 18.951$, $p < .001$, partial $\eta^2 = .220$. Consistent with pairwise comparisons for tactile valence, initial pairwise comparisons investigated differences between tactile conditions within each image category level. This identified no effects inconsistent with the main effect of touch. Thus, tactile arousal pairwise comparisons were interrogated across image categories within tactile conditions.

In both active tactile conditions (affiliative touch; neutral touch), negative images were found to elicit higher arousal ratings than both positive ($MD = .178$, $p < .001$; $MD = .174$, $p < .001$) and neutral images ($MD = .124$, $p < .001$; $MD = .132$, $p < .001$) while neutral images elicited higher arousal than positive images ($MD = .054$, $p = .006$; $MD = .042$, $p = .022$). Further, in the no touch condition, negative images were found to elicit higher arousal rating than both positive ($MD = .082$, $p < .001$) and neutral images ($MD = .061$, $p < .001$), yet no significant difference was identified between positive and neutral images ($MD = -.021$, $p = .320$). See Figure 4D.

Figure 4
Visualization of ANOVA Analyses


Note. This figure displays results for the four ANOVA analyses (including significant main effects and interactions). A represents the results for valence rating of images. B represents the results for arousal rating of images. C represents the results for valence rating of tactile stimuli. D represents the results for arousal rating of tactile stimuli.

^a In quadrant D, the presentations of the independent variables are switched (tactile stimuli are on the x-axis while image category is displayed on the legend). This change is because after initially investigating pairwise comparisons between tactile conditions within each image category the interaction effects were not apparent. Thus, it was more appropriate to visualize this interaction between image categories within tactile conditions.

Discussion

Research on emotional appraisal has historically focused on how we extract meaning from visual stimuli, and how this in turn influences our sensory perception. However, other senses also provide useful information that can help appraise the world around us. Recently, affective research has identified decentralized or peripheral, pathways to emotional appraisal. In this view, the sensory environment has inherent emotional meaning that can be identified at the level of sensory receptors, independent of processing in the primary sensory cortices (Kryklywy et al., 2020). Affiliative touch is one of these decentralized signals (Olausson et al., 2010; Loken et al., 2009). Although decentralized appraisal is gaining traction in integrated cognition and emotion research (Sadeghi et al., 2024), the way such signals interact with the traditional or centralized form of emotion appraisal mechanisms remained unclear. The current study investigated how affective appraisal from multiple sensory modalities (touch and vision) interact, and whether one is more effective in corraling neural resources and guiding behavioural responses (Gallace & Spence, 2010). Support for affiliative touch to be dominant was its evolutionary conservation (Jablonski, 2021), its early development in humans (Li et al., 2022), and its ability to signify immediate threat/harm to an organism (Yoo et al., 2014). On the other hand, vision has demonstrated a dominance over the other sensory modalities – including touch – in both research and ecological settings (Hutmacher, 2019; Vuilleumier, 2005). Sensory dominance of vision occurs in how preferentially we process visual stimuli compared to other modalities, hence often dictating behavioural responses (Tang et al., 2025).

The present study manipulated a multisensory environment of visual and tactile information to investigate whether the affective meaning acquired through tactile stimulation is experienced independent of visual input or whether there is a supramodal integration of both

stimuli. Affiliative touch, along with other tactile conditions, were applied while participants viewed images with varied emotional content. Participants provided emotional evaluations (valence and emotional arousal ratings) for both tactile and visual stimuli on a visual analog scale. The most notable cross-modal effect was a pervasive influence of visually appraised affect on the perception of visual, and more surprisingly, tactile stimuli. The valence of visual stimuli (image category) were reflected in the valence and arousal ratings of tactile stimuli consistently, often overshadowing any affective differences between tactile conditions alone. While visual affective features were the primary driver of ratings across modality, an influence of touch on visual valence (but not arousal) was also observed. Specifically, affiliative touch led to higher image valence ratings for all image categories. Thus, the presence of CT-targeted affiliative touch, regardless of visual context augmented pleasantness; the injection of inherent pleasantness coloured the entire environment.

The Global Impact of Affiliative Touch

An inherent positivity and emotional ubiquity of affiliative touch is consistent across the literature, and real-world experiences (Saluja et al., 2024). For example, a back rub can console a child while they are crying, and affiliative stroking may increase pleasant feelings toward a romantic partner. Wingenbach et al. (2021), the only other study to my knowledge that has investigated changes in subjective valence ratings of images in the presence of affiliative touch, found hand-squeezing to increase pleasantness of positive, neutral and negative images, an effect consistent with the current results. Similarly, Fu et al. (2018), found CT targeted touch to increase valence ratings of neutral human faces. Thus, the current results help support the notion that affiliative touch can have widespread (albeit often subtle) positive effects on emotional state. At a neurological level, Schirmer et al. (2011) demonstrated that gentle pressure enhanced event-

related potential (ERP) correlates of both negative and neutral images, suggesting dynamic touch may further enhance the perception of visual stimuli. The finding of a generalized impact of affiliative touch on image valence ratings contrasts with a-priori prediction of an affiliative touch impact on individual image categories as there were no interaction effects. Specifically, I predicted affiliative touch would increase pleasantness of both positive and neutral photos without causing any change in the valence of negative images. I expected negative images to be exempt from an increase in valence because negative stimuli often corral the limited attentional resources in order to prioritize our safety (Dunsmoor & Paz, 2015; Mobbs et al., 2009). This need for safety leads to negative stimuli dominating sensory perception (Tang et al., 2025). However, the current work found that negative images were also made more positive when viewed in the presence of affiliative touch compared to other touch conditions. This suggests CT activation may signal the immediate safety that we need, even when presented with negative stimuli or situations.

While the impact of affiliative touch on visual appraisal was widespread for *valence* assessment, tactile manipulation did not impact assessment of *emotional arousal*. This was also counter to initial predictions, wherein affiliative touch was expected to increase arousal ratings of neutral and positive images compared to other touch conditions. This prediction stemmed from evidence that affiliative touch, in certain contexts, can increase arousal (Saluja et al., 2024). For instance, Ellingsen et al. (2014) observed pupil dilation (a signal of arousal) when affiliative touch was paired with a happy face. Thus, the inherent positivity of affiliative touch augments intensity, (as observed in valence ratings of images). By contrast, I expected affiliative touch to decrease the arousal of negative images based on findings that affiliative touch increases parasympathetic activity, as observed through heart rate deceleration and increased HRV

(Morrison, 2023; van Puyvelde et al., 2019). The current study, however, found that tactile stimuli did not modulate the subjective intensity of images. This finding aligns with other research that suggest pupil dilation is a result of the sensory characteristics of affiliative touch (i.e., stroking velocity), rather than the hedonistic characteristics (pleasantness) attached to it (Bonino et al., 2024; van Hooijdonk et al., 2019). The findings of affiliative touch decreasing heart rate, increasing heart rate variability and inducing pupil dilation do not influence the perception of the visual modality. However, it may be the case that the physiological signs of arousal were present but not strong enough to change subjective ratings (Russell, 2003). Thus, future research could adopt a multidimensional assessment of arousal, that incorporates both physiological measures (pupillary response, heart rate) and subjective ratings to account for any incongruencies across assessment methods. Based on the current study, affiliative touch has a purely supramodal influence on the valence judgement of visual stimuli without modulating subjective intensity.

Contexts in the Perception of Affiliative Touch

This current work also assessed the influence of visual stimuli on touch perception. Contrary to initial hypotheses, image category distorted both valence and arousal ratings of touch conditions. This initial hypothesis of limited influence of visual valence on the appraisal of tactile stimuli was based on the conception of affiliative touch as an innate, evolutionary signal carrying a salience that permeates one's perception of the world (McGlone et al., 2014), and thus likely less susceptible to cross-modal emotional influence. Non-human mammals have homologous mechanisms (like C-LTMRs in cats and mice) that have resulted in our perception of affiliative touch (Dunbar, 2010), with animal behaviours such as allogrooming (the touching of others) often for hygienic purposes having evolved in humans to denote pleasure and

satisfaction (Morrison, 2023). This provides evidence for a heavily conserved role of affiliative touch in mammals, which suggests a relatively robust affective response to maintain its function. Indeed, newly born human brains are highly responsive to gentle skin stroking within the first weeks of life (Tuulari et al., 2019), and behaviourally, infants show preferential attention to affiliative touch even in the presence of visual distractors (Fairhurst et al., 2014). Together, this suggests that affiliative touch, a valence-labelled sensation, should feed into the centralized visual affect process not vice versa. Yet, visual stimuli (image category) were observed to significantly impact the emotional appraisal of tactile stimuli. Positive images made participants perceive affiliative touch as even more pleasant compared to other tactile conditions. This is similar to Ellingsen et al. (2014) report that positive images (smiling faces) increased pleasantness of CT-optimal touch. Thus, the augmenting of positivity/pleasantness that was expected for affiliative touch on positive images is instead attributed to positive images on affiliative touch. In Botvinick and Cohen (1998), when an artificial arm and real arm were stroked simultaneously at the same velocity, participants reported feeling the touch of the artificial arm instead of their own because they could only see the artificial arm. This is evidence that sight is powerful enough to distort the most private of sensations and corroborates the Gallace and Spence (2008) claim that concurrent stimuli from other modalities can influence the conscious perception of tactile stimuli. Further, this work provides evidence that the experience of decentralized affect signalling can be manipulated and altered by centralized mechanisms.

Upon investigating the subjective arousal ratings, it was found that negative images increased participants' arousal ratings of affiliative touch compared to positive and neutral image categories. The subjective responses in the current study reveal that the unpleasantness of the images had a strong effect that reduced any putative feelings of safety provided by affiliative

touch (Saluja et al., 2024). Since emotional stimuli increase perceived intensity compared to neutral stimuli (Anderson, 2005), it should follow that positive images also increase the arousal rating of affiliative touch compared to neutral images but interestingly it was the opposite. Of note, Triscoli et al. (2017) found higher intensity ratings for affiliative touch compared to another touch condition (vibration), with scale endpoints defined as “weak” and “strong”. The present finding of lower arousal for affiliative touch in the context of positive compared to neutral images is possibly a result of the emotional arousal endpoints in the study “calming” and “arousing”. This is in line with the McCabe et al., (2008) finding that interpretation of abstract words can influence affiliative touch perception. A future study may operationalize arousal in terms of the intensity of stimuli instead of its emotional arousal. Subjective arousal ratings may ask “how intense did you find the (touch/image)” with endpoints ranging from weak to strong or low to high. In the current study, participants associated the positive images with a more calmed state as opposed to excited, the aforementioned operational adjustment may help elucidate incongruencies between various findings.

The current work suggests that the Colavita effect (a perceptual dominance of visual information over other modalities) of vision over touch (established by Hartcher-O’Brien et al., 2008; Hartcher-O’Brien et al., 2010) does hold steadfast even when the competing tactile stimuli is emotionally salient. Croy et al. (2014) also found that abhorrent odours reduce the pleasantness of affiliative touch. Even with the evolutionary conservation of innate pleasant touch, the findings of the current study along with prior work suggest that in a multisensory environment the processing of other modalities can temper the decentralized pathway to affiliative touch perception.

Supramodal Integration of Centralized and Decentralized Signals

Across many analyses presented in the current work, valence of both tactile and visual stimuli was found to have effects on cross-modal emotional evaluations. The observed subjective reports on the affiliative touch- visual experience interaction supports a supramodal representation of visuo-tactile environments. Supramodal processing represents a global influence of valence on experience, including the perception of other sensory modalities (Kryklywy et al., 2020). This pattern of behaviour is likely due to the underlying mechanisms involved in affect processing. Although this study did not involve neuroimaging data, the pattern of subjective reporting, and the observed modality general influence of both tactile and visual valence do give some insight into the neural networks that may subserve cross-modal affect integration. Supramodal regions like the orbitofrontal cortex (OFC), receive input from multiple modalities for further emotion processing (Dixon et al., 2017). Further, the anterior insula (aIns), medial prefrontal cortex (mPFC), anterior cingulate cortex (ACC), amygdala and superior temporal sulcus (STS) (Peelen et al., 2010; Rolls et al., 2010; Satpute et al., 2015) are also activated in studies investigating neural correlates of affective visual and tactile stimuli. Research by Bo et al., (2021) showed that viewing emotionally charged (positive and negative) IAPS images, as utilized in the current study, reliably activates the insular cortex, OFC, mPFC and amygdala compared to neutral IAPS images. This has striking anatomical overlap to an investigation of neural response to affective tactile stimuli by Kryklywy et al., (2023), who found that affiliative touch is represented in the ventromedial prefrontal cortex (vmPFC) and the insular cortex. Thus, it is likely that these brain regions – prefrontal cortex and insula – are activated in the subjective appraisal of both tactile and visual stimuli and possibly related to supramodal processing of affective wellbeing. Notably, the vmPFC (Kuniecki et al., 2018) and amygdala (Baucom et al., 2012) are implicated in both valence and emotional arousal of visual stimuli,

suggesting these regions help consolidate an emotional experience. Apparent through all this work is that the experience of affectively salient visual and tactile stimuli occurs in similar neural regions.

Contextual Influences on Affect Appraisal

Emotions are a result of numerous factors, internal and external. In addition to the immediate environment, past experiences and encoded bodily responses can influence how we process information (Barrett, 2017). Thus, in a laboratory setting, the aim is often to create a controlled environment that eliminates or at least reduces confounds that may influence results. However, some contexts cannot be controlled for because they are fundamental characteristics of the participant. These include the history of interactions a person may have with an experimental object, as well as demographic or interpersonal considerations such as age and sex.

Tactile Biography

Similar to how life history with an object can help determine what stimuli in the environment are deemed most pertinent (Kryklywy & Todd, 2018); tactile biography - life history with touch- plays a role in the sensory perception of touch. A healthy tactile biography begins in infancy (Croy et al., 2019). New-born infants have a biological need for warmth and protection from their primary caregiver, when this need is met through physical contact, the child develops a secure attachment style (Gillath et al., 2008). Recent work has proposed affiliative touch in early infancy as the basic sensory substrate for secure attachment style (McGlone et al., 2025) because affiliative touch is linked to the release of oxytocin (a hormone involved in both social and maternal behaviour) (Li et al., 2022). This notion is supported by findings that low exposure to affiliative touch during childhood leads to lower pleasantness ratings in adulthood

(Bendas et al., 2021; Sailer & Ackerley, 2019). Further, a life history of positive tactile interactions is strongly associated with effective emotion and stress regulation (Bruti & Foggetti, 2024; Delhayé et al., 2018) as well as a healthy sense of self (Beltran et al., 2020). Lakehead University is a multicultural institution with students of different backgrounds and upbringings, thus the potentially heterogeneous tactile biography amongst participants could have weighted their perception toward or away from affiliative touch, in turn influencing emotional appraisal. Future work can attempt to account for participant tactile biography on the perception of affiliative touch by including tactile biography or touch exposure questionnaires like in Sailer and Ackerley, (2019).

Age

Although touch is the first sense to develop in humans and affiliative touch is perceived as early as in utero, age may modulate how it is perceived. This may be due to the learned experiences from the multisensory environment throughout life or new contexts we associate with affiliative touch. With age, affiliative touch is not just about warmth and protection from the caregiver (McGlone et al., 2025), new connotations and contexts like intimacy and romantic relationships change and develop perceptions (Gazzola et al., (2012; Jonsson et al., 2015). Although neuroimaging data from May et al. (2014) suggest adolescents perceive affiliative touch as more pleasant than young and mature adults; Sehlstedt et al. (2016) found that while the perception of discriminative touch decreases with age, the pleasantness of CT-targeted, affiliative touch increases. Considering the dynamic relationship of touch and affective meaning over the lifespan and conflicting findings in the literature, caution should be taken when interpreting current result beyond the age range (17-41) in which they were obtained. Future work should explore the role of age or development on the perception of affiliative touch.

Interpersonal Contexts

The interpersonal contexts in this experiment that may modulate affiliative touch ratings are sex (of the experimenter or participant) and the relationship between experimenter and participant. Although CT-targeted touch from a stranger can be perceived as unpleasant (Mazza et al., 2023; Tricoli et al., 2017; Wingenbach et al., 2021), in this study, the non-familiarity between experimenter and participant did not reduce participants' perceived pleasantness of affiliative touch as indicated by baseline valence ratings. This may be a result of the environment created in this study. Our experiment set-up limited *direct* contact between experimenter and participant because affiliative touch was administered through brush strokes and not skin to skin contact. Further, throughout the experiment, the experimenter was not visible to the participant because of a physical barrier that occluded a direct line of vision. Beyond the physical set-up, a degree of emotional distance is maintained in an experimental context as there is an understanding that the touch is for research, rather than social communication (like intimacy or nurturing) (Sailer & Leknes, 2022). For example, if this same forearm stroking by the experimenter occurs in a Starbucks waiting line the response may be demonstrably more negative. Related to considerations of real-world situations, the sex/gender of the participants may influence touch perception as prior work found that women had higher pleasantness ratings of affiliative touch compared to men (Russo et al., 2020). Schirmer et al., (2022) also showed that at a pure sensory level males and females perceive CT activation in a similar pattern but when inquiring about other social factors like motivation for touch and comfort with being touched, males and females differed. In the current study, an exploratory analysis investigated any differences in baseline affiliative and neutral touch ratings depending on the sex of experimenter. This analysis found that baseline valence ratings of affiliative touch were higher

when the experimenter was a male compared to a female (see Appendix), indicating an influence of the sex of the experimenter in the perception of affiliative touch. However, Suvilehto et al. (2015) found both sexes more likely to accept touch from a woman than a man. This inconsistency highlights a need for continued investigation in how the sex of the giver or receiver can influence touch perception.

Limitations and Future Directions

One consideration when viewing the current work could be in the method used of tactile stimulation. Many studies simulating affiliative touch have used a Rotary Tactile Stimulator (RTS) (Blakemore et al., 1999; Olausson et al., 2002; Loken et al., 2009; Loken et al., 2011; Morrison et al., 2011; McGlone et al., 2012). However, I believe that while this device reliably executes low velocity stroking, it does have some drawbacks. Notably, the RTS only follows a fixed trajectory (Schirmer et al., 2022) which does not accurately represent natural human touch (Lo et al. 2021), nor the natural contours of the human forearm (the target of our tactile manipulation). One of the operational goals of the current study was to mimic the element of human touch that fosters warmth and interpersonal connection, so we chose to trained experimenters – rather than an automated device – to execute the touch manipulation. This choice is supported by Tricoli et al. (2013), who found the pleasantness ratings of human delivered CT-targeted touch as equivalent to that elicited by the RTS. Another drawback to the RTS is its inability to control stimulus duration. Stimulus duration for the RTS is dictated by the chosen stroking velocity (short for fast velocities and longer for slower velocities). For instance, it may take the RTS 20 seconds to execute 3 cm/s stroking velocity (Schirmer et al., 2022). In the current study there was a fixed period of time for tactile stimulation hence, we were best served

training experimenters. This operational choice is also supported by other work in this field of research (for review, see Cruciani et al., 2021).

A related consideration is the human error that may have occurred when executing brush strokes at a rate of 3 cm/s. This risk was limited by rigorous experimenter training and in-task prompts. Both experimenters were trained to deliver 3 cm/s brush strokes at consistent pressure ~ 0.4 N, using prompts to train velocity while delivering the brush stroke to a scale to assess appropriate pressure. The experimenters went through two training phases. First, experimenters practiced brushing on a scale to obtain an objective measure of the applied pressure. Second, qualitative reports on the affective quality of the touch were obtained as experimenters performed at least two full mock experiments on pilot participants to collect feedback on consistency of pressure and any potential brush desensitization. This provided instrumental feedback, as we were informed that being brushed in same area became “irritating” and may cause some sensory adaptation. To address this, we updated the experiment protocols prior to data collection to randomize between two tactile stimulation sites (the upper or lower arm). Only two experimenters (one male, one female) were trained to deliver tactile stimulation to ensure quality control and reduce variance in execution. The baseline valence ratings of light brushing and light pressure served as a manipulation check for our operationalized affiliative and neutral touch. The results of these baseline ratings confirmed that our affiliative brush strokes were more pleasant than the neutral light pressure. During the main study, the experimenter was aided by a visual prompt moving across a computer screen adjacent to the participant’s arm that indicated the desired velocity and timing of the brush strokes and arm taps.

Finally, the basis of our study is about the integration of emotional signals in the brain, yet we only collected self-report evaluations of stimuli perception. This work can be improved

and reach its full potential by expanding the current study into functional magnetic resonance imaging (fMRI) work investigating activation levels in different sensory (primary visual cortex and primary somatosensory cortex) as well as the supramodal emotion structures like the OFC, ACC, insular cortex, etc. While we believe that the results of the current work are consistent with the putative role of these regions in multimodal affect integration, further fMRI investigation could allow for more concrete conclusions. Specifically, it could help to clarify whether the integration of centralized and decentralized signals is truly modality-general or if the different contexts result in some modality specific representations as well.

Conclusions

The current study used behavioural reports to investigate the integration of affectively salient visual and tactile stimuli. Specifically, it assessed the interaction of decentralized affiliative touch and visual stimuli. The findings show that affiliative touch has the ability to influence the evaluation of the pleasantness of images. However, valence acquired through visual stimuli often overwhelm the perception of tactile stimuli, even when explicitly appraising the touch. Affiliative touch only had a general influence on the perceived valence of visual stimuli without modulating subjective emotional arousal and did not interact in a manner mediated by the visual valence. The more robust findings were that the standardized valence of images tempered any feelings of comfort and warmth provided by affiliative touch. These findings further imply the sensory dominance of vision in how the world is perceived. Finally, this work suggests the activation of supramodal emotion-processing networks in the brain when integrating tactile and visual stimuli.

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Appendix

Influence of Experimenter Sex on Baseline Affiliative and Neutral Touch Ratings

(Analyses performed by Katherine Deschenes as part of PSYCH 2917 course requirements)

The purpose of this analysis was to explore the potential influence of the experimenter's sex on baseline valence ratings of neutral and affiliative touch. The overall number of participants analyzed was 68 (53 females). There were two experimenters in this study: one male, and one female. The male experimenter tested a total of 38 participants (27 female) while the female experimenter tested 30 participants (26 female). Prior to the main experiment, participants provided a baseline valence rating for both the affiliative touch and neutral touch. These baseline ratings served as a manipulation check for our operationalized affiliative touch being more pleasant than the neutral touch condition.

Participants rated affiliative touch from the male experimenter ($M = .76$, $SD = .193$) as more pleasant than affiliative touch from the female experimenter ($M = .612$, $SD = .192$). Upon performing an independent sample t-test for baseline affiliative touch ratings based on the experimenter's sex, there was a significant difference in the affiliative touch ratings, ($MD = .148$, $t = 3.16$, $p = .002$, $d = .771$). Participants also rated neutral touch from the male experimenter ($M = .635$, $SD = .202$) as more pleasant than neutral touch from the female experimenter ($M = .564$, $SD = .174$). However, there was no significant difference between baseline neutral touch ratings based on sex of the experimenter, ($MD = .071$, $t = 1.51$, $p = .135$, $d = .370$). These results show that the baseline valence ratings of affiliative touch were significantly higher when the experimenter was male compared to female indicating an influence

of the sex of the experimenter in the perception of affiliative touch. However, there was no significant difference between baseline neutral touch ratings based on sex of the experimenter.

There are some considerations to keep in mind when interpreting these exploratory findings. Primarily, the experiment suffered from participant attrition, resulting in a decreased number of participants paired with the female experimenter. Secondly, it is difficult to standardize the procedure of the experiment in terms of the rate of the brushing or pressure, though we rely on experimenter training to standardize to 3 cm/s stroking velocity at ~ 0.4 N of pressure.