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ASSESSING THE EMOTIONAL DIMENSIONS OF THE CUTANEOUS-RABBIT EFFECT USING FACES

By

Bartholomew Endres

THESIS

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ABSTRACT

ASSESSING THE EMOTIONAL DIMENSIONS OF THE CUTANEOUS-RABBIT EFFECT USING FACES

By

Bartholomew Endres

This research investigated how emotional images affects tactile saltation. More specifically, we combined visual faces with three different emotions: angry, sad and happy with a tactile illusion known as the cutaneous rabbit effect (CRE) that was delivered on participants' shoulder at different durations. Because some of the faces were political figures, we assessed participant's political affiliation using Political Typology Quiz. Participants rated their emotional response using the self-assessment manikin (SAM), a three dimensional scale that measures valence, arousal and dominance. For the valence dimension, our results indicate that participants found it less pleasant to see likeable faces sad than any other figure. Data also showed that it was the least pleasant for participants to see a hateful public face when they were angry. Political affiliation and the duration of the CRE both affected the arousal dimension suggesting that liberals seems more concerned by fictional and public figures than political ones while conservatives seems to be more affected by angry faces of political figures when the tactile duration is the longest. Finally, for the dominance dimension, it was found that likeable figures made participants feel more in control of the situation and that dislikeable figures made participants feel controlled.

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1 CHAPTER ONE: The Emotional Nature of Touch

Interpersonal touch

Human beings are social creatures that use verbal and non-verbal communication to interact with each other. Non-verbal communication can consist of body movements, facial expressions, or simply touch. Touch remains a very personal sense for interpersonal communication as it can be considered pleasant or unpleasant depending on who is engaging in the act. Some studies have shown that physical contact to several body areas are perceived differently based on social bonds and interactions (Jourard, 1966; Suvilehto et al., 2015). Other studies had shown that interpersonal touch is very important in daily interaction and can have several benefits including cardiovascular health (Grewen, et. at., 2003) and infancy development (Gluck et al., 1973; Harlow et al., 1971; & Blackwell, 2000).

In her book "The Influence of Touch on Child Development," Blackwell reported anecdotes and experiments involving primates and non-primates being deprived of touch (Blackwell, 2000). The data shed the light on the necessity of touch in the development and mental health in primates. One interesting anecdote was related to King Frederick II of Germany. He is said to have removed all newborns from their parents and given them to foster parents with the instructions of not fondling or talking to them in a hope of learning if language was innate. The children all died, and it was reported that death was caused from a "lack of petting (Blackwell, 2000)." Laboratory research has also found problems in mental development of deprived primates. The most notable problems being social interaction. This was found true by Carlson and Earls (1997) study involving Romanian

orphans. Raised in an isolated environment, the children had no interaction at all, including no communication with others, no external stimuli and no caregiver. This lead to learning disabilities, autistic-like behaviors, and other social problems.

In non-human primates, baby monkeys deprived of touch and social interaction with any species from birth were found to be less intelligent in certain situations and are socially abnormal when compared to those that were not isolated (Gluck et al., 1973; Harlow & Suomi, 1971). An experiment by Gluck, Harlow, and Schiltz (1973) found that at a young age, isolated monkeys scored just as well as environmentally enriched monkeys that were not deprived of touch or social interaction. As the monkeys aged, the isolated monkeys began to score significantly lower than the enriched monkeys. Harlow and Suomi (1971) introduced isolated monkeys to a heated cloth surrogate. After two weeks with the cloth surrogate, the isolated monkeys were paired together. They displayed social play, infantile sex, locomotion, and exploratory tendencies. The display of these behaviors was clumsy and sporadic and after 6 months no improvement was noted. Monkeys that were not given a surrogate did not display the tendencies listed above. Another study by Harlow and Suomi's (1971), inseminated adult female monkeys that had been isolated all their lives. When they gave birth, they reacted abusively and aversively to their offspring. Some became adequate mothers, in terms of not acting abusively or lethally toward their second or third offspring. It is hypothesized by Harlow and Suomi (1971) that the constant contact of the offspring served as a psychotherapist meaning contact helped with some rehabilitation of the maternal instinct. The data discussed in this review shows the importance of touch in the development of primates. It is necessary for healthy cognitive growth and in building the immune system of infants (Blackwell, 2000).

The importance of touch in our lives does not change as we grow. Touch affects us in social settings and most of the time we are unaware it is occurring. Crusco and Wetzel (1984) studied tipping behavior in a restaurant when people are touched by the server compared to customers who were not touched. They found that customers who were touched tipped higher than those who were not touched by their server. However, the gender aspect was not investigated, as all the serves in this study were female. When Whitcher and Fisher (1979) investigated the effect of interpersonal touch in pre-surgery hospital patients from their caregivers they found female patients who were touched had more favorable effects after the surgery, than those who were not touched by their nurse. Favorable effects were reported as less worry and anxiety to the upcoming procedure. Male patients in this experiment experienced opposite effects, reporting more anxiety after being touched and a greater fear of complications. The authors suggested that the differences may be related to cultural patterns. American culture pushes males to not be weak and therefore a human touch during a vulnerable state such as surgery would be perceived as a person taking care of them. The nurses in the experiment were all female and this could have had some effect on the experiment.

Standards of interpersonal touch are socially shaped and set by specific cultural patterns. Some cultures have gone so far as to create manuals for proper touch etiquette, such as the Seventeenth-century Dutch etiquette manuals (Finnegan, 2005). For instance, these manuals set guidelines for the distance that people should keep from each other while standing or interacting with one another. Most cultures do not have such specific guidelines and the social touch interaction is learned and inherited from previous generations, and through trial and error (Finnegan, 2005). The importance of touch cannot be argued. Touch

plays a vital role in our lives every step of the way. Touch triggers different emotions in the person, depending on who and where they are being touched (Jourard, 1966; Suvilehto et al., 2015). With the changes in technology and virtual reality becoming more accessible to the public, research on haptic devices and the emotional affects they can have need to be investigated. My research investigates the emotional effect of a tactile stimulus on a person's arm that is conveyed by a visual stimulus with emotional connotations.

Triggering Emotions Using Haptic Devices

With the emergence of virtual and augmented reality in recent years, there is a need to develop efficient haptic technology to enhance the user's virtual immersion. For instance, Go Touch VR (n.d.), and Tactai (n.d.) are two companies that are aiming to improve users' experience in the virtual world. Go Touch VR is collaborating with BMW to train their workers to reduce costs related to equipment damage during the training. A VR training that could damage the engine can be reset with a button push. Tactai is tempting a more immersive experience, allowing the user to feel the texture and shape of the object such as the feel of a tangible metal of a door knob when you are opening a virtual door. Most touch immersion devices are still under development and are available only for academic purposes. When building haptics for virtual or augmented reality, it is not only crucial to focus on the timing and the occurrence of the tactile stimuli in relation to its visual counterpart, but also to investigate the emotional aspects.

Bailenson et al. (2007) used an artificial handshake to express emotion. In the first experiment, participants were asked to shake a joystick based on seven emotions: anger, disgust, fear, interest, joy, sadness, and surprise. The trials of shakes were recorded and were used to classify these seven emotions based on distance, speed, acceleration, duration,

and the angle of the shake. The purpose of this first experiment was to classify all parameters of an emotional handshake. In the second experiment, the joystick copied all these parameters of the individual emotions and new participants were asked to identify the emotion conveyed by the haptic device. It was found that participants were able to identify the specific emotion produced by the joystick. The usage of a joystick was limited by the nonrealistic nature of the handshake such as the grip, temperature, dryness, and texture that are different from a human hand. That said, even though these aspects were missing, participants were able to classify correctly the emotion triggered by the haptic device.

In a recent study Sefidgar et al. (2016), a haptic artificial creature was used to help people manage anxiety. Based on previous research of human-animal therapy (Kruger & Serpell, 2006; Mallon 1992), the authors demonstrated that when stroking a haptic device that mimics an animal breathing, participants were more relaxed. The haptic device was a wire skeleton that was covered with fur and imitated a breathing movement of a rib cage. Participants were instructed to hold the robot on their laps with one hand on the rib cage and the other hand stroking the robot. It was reported that participants felt calmer and happier after one minute. Their physiological responses such as heart and respiration rates also decreased significantly. Different breathing patterns were used in this experiment and slow breathing patterns were most calming, while rapid breathing patterns had opposite effects and made participants feel more anxious. The authors suggested that participants were mirroring the robot's emotional state or what they believed to be the emotional state of the robot based on its breathing pattern.

In summary, touch is important in every aspect of life and has an effect of ones emotions. As life becomes more and more effected by machines it is important to understand that machines too can influence our emotions and display emotions. Right now, the focus is on creating haptic devices that immerse us farther into a virtual world, without considering emotional effects of this immersion. In the next chapter, we focused on our study and the usage of a specific haptic illusion, known as the cutaneous-rabbit effect (CRE) that shows promising results for emotional touch.

2 CHAPTER 2: The multimodal emotional dimensions of the Cutaneous-Rabbit Effect or Saltation

Saltation

Saltation, also known as the cutaneous rabbit effect (CRE) is a tactile illusion that was first reported by Frank Geldard in 1975. In an experiment to examine the tau effect on tactile stimuli, Geldard stumbled across something unexpected. Geldard set up three contactors evenly spaced at 4 inches apart on the left arm of a participant. The contactors vibrated on the arm in the location in which they were placed. The participant reported feeling the vibrations in locations other than where the vibration occurred and used the analogy of a small rabbit hopping up the arm as a way of explaining the feeling, hence the name. Geldard researched every aspect about the phenomenon of the "rabbit." Finding that direction did not matter and that more than one "rabbit" could be hopping on the arm or leg simultaneously. The "rabbit" was able to be produced with as few as two contactors, one contactor pulsing twice and the other pulsing once, in that order. That varying the length of the bursts of the contactors and the time between bursts the "rabbit" could make very small steps to large leaps. The next section deals with the importance of timing in increasing or decreasing the effect of the illusion.

Burst Duration and Inter-Burst Duration

The CRE has been used many times since its discovery (Raisamo, Raisamo, & Surakka, 2009; Raisamo, Raisamo, & Surakka, 2013; Ziat & Raisamo, 2017). To achieve the "rabbit," a vibration must occur in a region of the skin with low acuity and must last between 200 to 400 milliseconds (ms). Raisamo et al. (2009) examined two parameters of CRE, the burst duration (BD) and the inter-burst interval (IBI). The BD is how long the

burst lasts; this is usually measured in ms. IBI is the time between bursts, which is measured in the same way. Raisamo et al. (2009) found that shorter IBI created a significantly greater feeling of saltation. The BD did not have the same effect.

The most common parameters that can affect the illusion are the IBI and the BD. Based on previous research discussed above (Raisamo et al., 2009), varying the BD with three different times of 12 ms, 24 ms, and 48 ms is the most common change and makes the illusion stronger. The modification of the IBI did provide a strong effect. In the current study, we chose to modify the BD and keep IBI fixed, as the illusion is stronger. Table 1 displays the total duration of a single trial with the three BDs. As you can see, the illusion is strong for a total duration between 300 and 625 ms.

Condition	Burst Duration	Inter-Busrt Interval	Total Duration
T12	12 ms	24 ms	300 ms
T24	24 ms	24 ms	408 ms
T48	48 ms	24 ms	624 ms

Figure 1. Duration of stimulation based on BD variations.

How Visual Images Affect the CRE

Very little research has been done on emotional response to tactile sensation when combined with visual stimuli. Previous research by Ziat and Raisamo (2017, 2018) combined visual images of saltational animals with the cutaneous-rabbit illusion. It was found that participants would express an aversion to particular tactile stimulus when paired with an aversive visual stimulus, such as a spider. When the tactile stimulus was paired with a pleasant or neutral stimulus, like a rabbit, the participant did not act aversively. With the growth in visual communication, more particularly virtual and augmented reality, and the expansion of tactile devices, Ziat and Raisamo's (2017) research is a first step in the

understanding of affective haptic communication. My research follows their investigation of the emotional effects of the CRE paired with a visual stimulus, and extends the research to emotional images of human faces that have strong emotional connotations. In an effort to understand the multimodal effect on saltation, some studies had explored the multimodal aspect of the cutaneous rabbit-illusion and showed that congruent visual stimuli increase the effect of CRE; while incongruent stimuli decrease the effect (Asai and Kanayama, 2012; Samad and Shams, 2015). Few studies have actually explored the emotional aspect of saltation (Raisamo et al., 2009) and, except Ziat and Raisamo (2017), none have explored whether the valence of other modalities affect the perceptual experience of saltation. This aspect is important for effective communication of the future and our hope is to bring the tactile modality to distance communication that is missing in technology.

For this current work, our first aim was to understand how emotional human faces affect the tactile CRE. Moreover, or second aim pushes this aspect further by using images of the two political candidates of the 2016 election, i.e. Hillary Clinton and Donald Trump, that would trigger strong aversion in participants that greatly dislike one or the other. Our hypothesis is that participants will have a strong emotional aversion to tactile stimuli when paired with aversive visual stimuli and they will welcome the tactile stimulation if the visual stimulus is pleasant. Images of hateful historical and fictional figures, Adolf Hitler and Cersei Lannister from Game of Thrones (to control for the gender) were used as an unpleasant visual stimuli. For pleasant visual stimuli we added images of the most likeable public figures by the Americans, i.e. Tom Hanks and Sandra Bullock. We also used images of neutral male and female as control conditions.

Participants

Twenty-two participants were recruited from Northern Michigan University's student population (10 males, 12 females) with an age range between 18 and 32. They all received a class credit for their participation. The experiment was approved by the IRB and all participants signed a consent form.

Method

Stimuli and Apparatus

The principle setup is shown on Fig. 1 below and consists of three C-2 actuators (Engineering Acoustics, Inc.) that stimulated the upper left arm at equidistance space (5 cm between each motor) between the elbow and shoulder. The activation of the vibrations at 250 Hz was controlled through Psychtoolbox (Kleiner et al., 2007) which also be used to display visual stimuli on a computer screen.

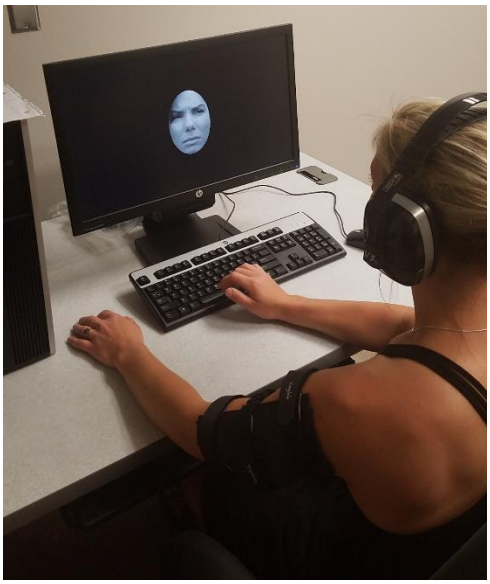

Figure 2. Participant setup.

Self-Assessment Manikin (SAM) was used to measure the emotional response to the tactile stimulus (Fig. 2). SAM is a pictorial diagram that is used to assess three emotion dimensions: valence, arousal, and dominance on a nine point scale (Bradley, M. & Lang, P., 1994).

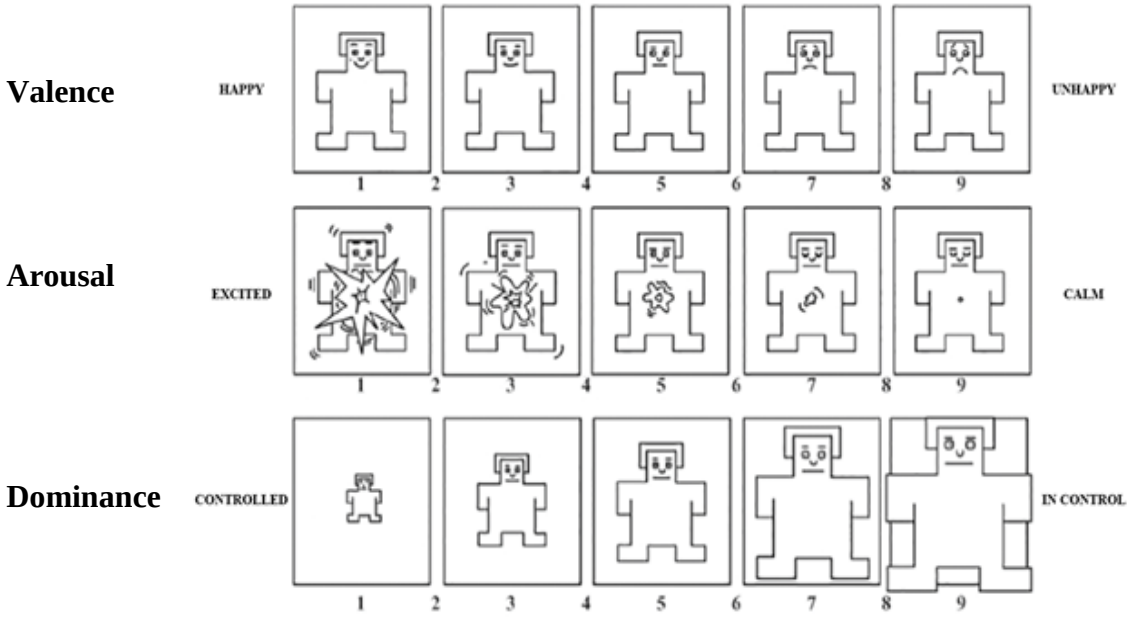

Figure 3. Self-Assessment Manikin.

[redacted]Tactile Stimuli

As stated above the tactile stimulation is created by C-2 actuators that deliver vibrations on the skin at 250 Hz. One vibration alone feels like a speaker against the skin. In this experiment, the BD had three different values: 12 ms, 24 ms, and 48 ms and the IBI was fixed at 24 ms.

[redacted]Visual Stimuli

A 24" monitor was used to display photos of faces with three possible facial expressions: angry, happy, and sad. Table 2 summarized all the faces used and they

consisted in the following figures: Adolf Hitler, Cersei Lannister (fictional character from the show Games of Thrones), Donald Trump, Hillary Clinton, neutral male face, neutral female face, Sandra Bullock, and Tom Hanks. With the three emotions and eight faces, the visual stimuli consists of 24 different conditions.

	Adolf Hitler	Cersei Lannister	Donald Trump	Neutral Female	Hillary Clinton	Neutral Male	Sandra Bullock	Tom Hanks
Angry								
Happy								
Sad								

Figure 4. Faces of used in the experiment with the three emotions: angry, happy and sad.

Procedure

The experiment lasted about an hour and had three parts. The three parts being the training phase, the test phase, and the post-test phase that consisted of a short survey.

Participants set down in a comfortable chair in a dimmed room at approximately 20” from a 24” monitor. Since the actuators were placed on the left upper arm participants were asked to keep left arm outstretched and still. All participants wore earplugs and headphones to reduce the noise by 62 dB and to avoid any perceptual cues from the vibrations.

During both phases, participants were asked to rate the tactile stimulation using the SAM for each trial by providing verbally the scale for valence, arousal, and dominance respectively. The answer was recorded by the experimenter and participants pressed the spacebar to move to the next trial.

For the training phase, the tactile stimulation was presented alone without any visual stimulation. It consisted of nine trails with three different durations repeated 3 times each. The purpose of this phase was a familiarization phase with the setup and the tactile stimulation.

The test phase, was a visual-tactile combination of the three tactile stimulations and the 24 faces for a total of 432 trials, with each combination repeated 6 times. This phase was broken into two blocks of 216 trials with a break of 5 minutes in between. All combinations were presented in a random order

The final phase consisted of a survey. The survey was taken on a computer to assess participants' political affiliation. The survey is a Political Party Quiz designed by Pew Research Center website (Suh, 2014).

Analysis

We used a four-way mixed ANOVA with Person (8), Emotion (3), and Tactile (3) as the main factor, and Political Affiliation (2) as the mixed factor for the three emotional dimension (valence, arousal and dominance) ratings. When interactions between factors were found, they were broken down by using simple pairwise comparisons. We only reported significant results in the following sections.

Results

Valence

A significant interaction was found between the two factors Emotion and Person [$F(14, 280) = 7.63$, $\eta^2 = .28$ $p < 0.001$]. The ANOVA also revealed a significant effect for the factors Emotion [$F(2, 40)$ $\eta^2 = 17.21$, $p<0.05$] and Person [$F(7, 140)$ $\eta^2 = 6.77$, $p<0.001$]. No significant effects of the factors political affiliation and tactile were found. To break down the interaction between the factors emotions and person, we used pairwise comparisons as detailed below. We first presented the results for different persons with same emotions, then the ratings for same person with different emotions. We did not present different emotions with different persons, because it would not be surprising that they would be different.

Same Emotion, Different Persons

Table 1 summarizes the t and p values found for the same emotion and different persons. A positive t value indicates that the mean for the first part in the pair is higher than the second part within the pair, and a negative t value indicates that the first part in the pair is lower than the second part. For “Sad”, a female and a male neutral face obtained significantly lower valence ratings compared to Donald Trump (DT), Adolf Hitler (AH), Cersei Lannister (CL), and Hillary Clinton (HC), which suggests that it is more pleasant to see a neutral face sad, no matter the gender, than a sad face of one of these four public figures. Interestingly, participants are less pleased by a sad face of the American sweetheart, Tom Hanks (TH) and Sandra Bullock (SB) than any seeing DT, AH, CL, or HC sad. It seems that SB sad is not pleasant to participants even when compared to a neutral

female or male face. The other significant result was related to DT who obtained higher valence ratings as opposed to AH.

Table 1. Sad emotion with different figures for valence.

Emotion	**Pair (Person)**	**t (df=21)**	**p value**
Sad	CL – MN	3.82	0.001
	CL – FN	3.80	0.001
	CL – TH	-5.49	0.001
	CL – SB	-5.76	0.001
	DT – FN	2.62	0.016
	DT – MN	2.34	0.029
	DT – TH	-2.93	0.008
	DT – AH	2.95	0.008
	DT – SB	-3.18	0.005
	TH – FN	-2.12	0.046
	TH – MN	-2.91	0.008
	AH – MN	4.42	0.001
	AH – FN	4.35	0.001
	AH – HC	-2.70	0.013
	AH – SB	-4.47	0.001
	HC – FN	2.36	0.028
	HC – MN	2.12	0.046
	HC – SB	2.94	0.008
	SB – MN	-3.33	0.003
	SB – FN	-3.01	0.007

For “happy” (see Table 2), with the lowest valence ratings, SB is more pleasant than the other seven faces. On the contrary, AH happy is the least pleasant comparing to TH, DT, CL, FN and MN. Finally, HC and DT happy were rated less pleasant than those of neutral faces.

Table 2. Happy emotion with different figures for valence

Happy	SB – FN	-2.6	0.017
	SB - MN	-2.57	0.018
	SB – CL	-4.02	0.001
	SB – DT	-4.01	0.001
	SB – TH	-3.19	0.004
	SB - AH	-4.72	0.001
	SB - HC	-3.57	0.002
	HC - FN	3.16	0.005
	HC - MN	3.08	0.006
	HC - TH	2.30	0.032
	AH - HC	2.50	0.021
	AH - FN	4.81	0.001
	AH - MN	4.68	0.001
	AH - CL	3.94	0.001
	AH - DT	2.14	0.044
	AH - TH	3.91	0.001
	DT - TH	2.81	0.01
	DT – FN	4.26	0.001
	DT - MN	4.26	0.001
	DT - CL	2.61	0.016

For the third emotion “Angry” (Table 3), AH angry ratings were higher than any other face indicating that it was the least pleasant emotion with the face of AH. SB and TH ratings were significantly lower than those of DT as well.

Table 3. Angry emotion with different figures for valence

Angry	AH - SB	3.78	0.001
	AH - HC	3.38	0.003
	AH - FN	3.16	0.005
	AH - MN	3.48	0.002
	AH - CL	3.28	0.004
	AH - DT	2.54	0.019
	AH -TH	3.69	0.001
	DT - SB	2.76	0.012
	DT - TH	2.54	0.019
	DT - MN	2.40	0.026

Same Person, Different Emotions

For the same person, the general trend is that an angry emotion is less pleasant than sad and an angry and a sad emotion is less pleasant than happy and this is true for SB, HC, AH, TH, MN, and FN. DT's angry emotion was less pleasant than happy and CL's sad emotion was less pleasant than her angry face.

Table 4. Same figure with different emotions for valence.

Person	Emotions	t (df=21)	P Value
SB	Angry - Sad	4.33	0.001
	Angry - Happy	4.83	0.001
	Sad - Happy	3.71	0.001
HC	Angry - Happy	3.09	0.006
	Sad -Happy	4.09	0.001
AH	Angry - Happy	2.34	0.001
	Happy - Sad	-2.71	0.013
TH	Angry- Happy	3.70	0.001
	Happy - Sad	-3.17	0.005
DT	Angry - Happy	2.61	0.016
CL	Angry - Sad	-5.30	0.001
	Angry - Happy	3.50	0.002
	Sad - Happy	5.26	0.001
MN	Angry - Happy	3.67	0.001
	Sad - Happy	4.28	0.001
FN	Angry - Sad	4.19	0.001
	Angry - Happy	5.64	0.001
	Sad - Happy	4.53	0.001

Arousal

The four-way ANOVA reveals a significant interaction effect between Emotion and Person [F (14, 280) = 2.54, η^2 = .11 p < 0.002], a significant interaction effect between Person, Tactile, and Politics [F (14,280) = 1.76, η^2 = 0.08, p< 0.044], and a significant interaction effect between Emotion, Person, and Tactile [F (28, 560) = 1.76, η^2 = 0.08, p<0.01]. We break down these interaction effects using pairwise comparisons and they are

detailed below. In the next subsections, the tables display t values for all pairs with different people and different burst durations (indicated by 1, 2, or 3). A negative t value indicates that the first part of the pair obtained lower arousal ratings, which means the level of excitement was higher on the SAM scale. A positive t value means that the first part of the pair obtained a higher arousal rating making people feel calmer.

Same Emotion, Different Person

Since an effect of the factor "Politics" was found, the arousal ratings are presented by political affiliation.

2.6.2.1.1 Conservative scoring

For participants who identified themselves as conservative (based on their scoring), a picture of Donald Trump angry made them feel more calm than a picture of Hillary Clinton angry for the longest burst duration T48. A similar trend is observed with a picture of Adolf Hitler as opposed to a neutral male face with the shortest burst duration. An image of AH angry has lower arousal scored (less calm) than a neutral male face. No other effect was found for other emotions, faces, or burst duration.

Table 5. Angry emotion with different figures for arousal with conservative views.

Emotion	Pair/Tactile	t (df=5)	P Value
Angry	HC3 - DT3	-3	0.03
	AH1 - MN1	-2.17	0.042

2.6.2.1.2 Liberal scoring

Cersei Lannister with the three bust durations 1, 2 and 3 (CL1, CL2, and CL3 respectively) obtained lower ratings than SB2 with a burst duration of 24 ms. The three burst durations with CL's face also obtained lower arousal ratings on the scale for SB3 and TH3 when associated with the longest burst duration. Adolf Hitler's sad face with the

longest burst duration (AH3) is seen as more exciting than Donald Trump's sad face with shortest and longest burst duration (DT1, DT3). SB2 and TH3 obtained similar ratings when compared to the neutral males and females. They are seen as more calming than the neutral faces, TH1 is more calming compared to MN1.

Table 6. . Sad emotion with different figures for arousal with liberal views.

Emotion	Pair/Tactile	t (df=15)	P Value
Sad	CL1-SB1	-2.68	0.017
	CL1-SB2	-3.29	0.005
	CL1-SB3	-3	0.009
	CL1-TH1	-2.32	0.035
	CL1-TH3	-2.85	0.012
	CL2-SB2	-2.9	0.011
	CL2-SB3	-2.81	0.013
	CL2-TH3	-2.2	0.044
	CL3-SB2	-3.52	0.003
	CL3-SB3	-3.59	0.003
	CL3-TH1	-2.43	0.028
	CL3-TH3	-2.73	0.016
	AH3-DT1	-2.29	0.037
	AH3-DT3	-2.76	0.015
	SB2-MN2	2.56	0.022
	SB2-MN3	2.46	0.027
	SB2-FN2	2.4	0.03
	TH1-MN3	2.47	0.026
	TH3-MN3	2.6	0.02
	TH3-FN1	2.28	0.037
	TH3-FN2	2.52	0.024

t and p values for significant pairs related to the emotion "happy" are summarized in Table 7. When CL is happy (no matter the burst duration), participants are more calm as opposed to a male neutral face with the intermediate burst duration (2: 24 ms). Also, participants were more calmed by CL2 than by MN3 and FN1. Similar ratings were obtained for TH when compared to male neutral face with the burst duration 2. TH2 and

TH3 were more calming to participants than when presented with the female neutral with a duration of 12 ms.TH2 was also more calming when compared to AH1 and AH3.

Table 7. Happy emotion with different figures for arousal with liberal views.

Emotion	Pair/Tactile	t (df=15)	P Value
Happy	CL1 - MN2	2.57	0.022
	CL2 - MN2	2.75	0.015
	CL2 - MN3	2.13	0.05
	CL2 - FN1	2.31	0.035
	CL3 - MN2	2.28	0.038
	SB3 - MN2	2.32	0.035
	TH1 - MN2	2.35	0.033
	TH2 - MN1	2.19	0.045
	TH2 - MN2	2.52	0.024
	TH2 - FN1	2.32	0.035
	TH2 - AH1	2.16	0.047
	TH2 - AH3	2.13	0.05
	TH3 - MN2	2.57	0.022
	TH3 - FN1	2.27	0.039

The emotion Angry (Table 8) displays Sandra Bullock with the most intense burst duration being more calming when compared to Tom Hanks and female neutral's 24 ms and 48 ms burst durations. Also, SB3 was seen as more calm when compared to MN3. MN1 is seen as more calm when compared to female neutral 1 and 3.

Table 8. Angry emotion with different figures for arousal with liberal views.

Emotion	Pair/Tactile	t (df=15)	P Value
Angry	SB3 - TH2	2.35	0.033
	SB3 - TH3	2.87	0.012
	SB3 - MN3	2.3	0.037
	SB3 – FN2	2.21	0.043
	SB3 - FN3	2.15	0.048
	MN1 - FN1	2.5	0.025
	MN1 - FN3	2.48	0.025

Same Person, Different Emotion

2.6.2.2.1 Liberal Scoring

Overall, an angry emotion obtained lower arousal ratings comparing to happy and sad for the intermediate burst duration (24 ms) only for SB, HC, and TH, suggesting that the tactile duration of 24 ms had an arousing effect when associated with angry as opposed to happy or sad. This was seen for SB1 and TH3 as well. The trend was the opposite for CL for the three burst durations, where sad emotion obtained lower arousal ratings, suggesting the when CL is sad, it makes people more excited than calm when CL is happy or angry no matter the tactile duration.

Table 9. Same figure with different emotions for arousal with liberal views.

Person/Tactile	Emotions	t (df=15)	P Value
SB1	Angry-Sad	-3.3	0.005
SB2	Angry – Sad	-2.77	0.014
HC2	Angry – Happy	-2.34	0.034
TH2	Angry – Happy	-2.71	0.016
TH3	Angry – Sad	-3.24	0.005
	Angry – Happy	-3.5	0.003
CL1	Happy – Sad	2.53	0.023
CL2	Angry – Sad	2.26	0.039
	Happy – Sad	2.47	0.026
CL3	Angry –Sad	2.52	0.024
	Happy – Sad	2.7	0.017

2.6.2.2.2 Conservative scoring

Tom Hanks with an intermediate burst duration obtained a higher rating for angry than happy. Meaning participants perceived an angry Tom Hanks as calmer than a happy Tom Hanks. The male neutral face with a 12 ms burst duration found a sad face to be more exciting than an angry face.

Table 10. Same figure with different emotions for arousal with conservative views.

Pair/Tactile	Emotions	t (df=5)	P Value
TH2	Angry – Happy	2.91	0.034
MN1	Angry - Sad	2.71	0.042

Dominance

The ANOVA revealed a significant effect for Emotion [F (2, 40) = 9.5, η^2 = 0.32, p< .001] and a significant interaction between the two factors Emotion and Person [F (14, 280) = 2.71, η^2 = 0.12, p< .001. No significant effect was found for Political Affiliation or for Tactile factors. A breakdown of the interaction between factors Emotion and Person was done using a pairwise comparison. Results for different persons with the same emotion is presented first. Then data for same person with different emotions is presented. Different emotions with different people was not presented because it is obvious they would be different.

Same Emotion, Different Person

In Table 11 a summary of the t and p values for same emotion with different persons is displayed. A positive t value indicates that the first person of the pair caused the participant to feel more in-control than the second person of the pair. A negative value reveals that the participant felt controlled by the first person in the pair compared to the second person in the pair. For "angry," SB and male neutral made participants feel more in-control when compared to female neutral.

Table 11. Angry emotion with different figures for dominance.

Emotion	Pair Person	t (df=21)	P Value
Angry	SB – FN	2.18	0.041
	MN - FN	2.32	0.030

The emotion "sad" is summarized below (Table 12). SB has higher ratings, making participants feel more in-control than AH, CL and the neutral faces. Participants felt more in-control when public figure TH was displayed compared to CL and MN. AH had the opposite effect, participants reported feeling more controlled when he was compared to TH and DT. CL had a similar effect when compared to the neutral faces.

Table 12. Sad emotion with different figures for dominance

Emotion	Pair Person	t(df=21)	P Value
Sad	SB – AH	2.33	0.030
	SB – CL	4.31	0.001
	SB - MN	2.32	0.029
	SB - FN	2.32	0.030
	TH - CL	3.92	0.001
	TH - MN	2.28	0.033
	AH - TH	-2.30	0.032
	AH - DT	-2.10	0.048
	CL - FN	-2.30	0.032
	CL - MN	-2.28	0.033

Below is a summary of the ratings for "happy" (Table 13). AH had a significant effect of making the participants feel more controlled when compared to SB, DT, CL, TH and the neutral faces.

Table 13. Happy emotion with different figures for dominance

Emotion	Pair Person	t(df=21)	P Value
Happy	AH - SB	-2.43	0.024
	AH - DT	-2.30	0.032
	AH - CL	-2.43	0.024
	AH - TH	-2.59	0.017
	AH - MN	-2.61	0.017
	AH - FN	-2.72	0.013

[redacted]Same Person, Different Emotion

In all figures listed below (SB, HC, TH, DT, CL, MN, and FN) the expression of happy was preferred over angry and for figures HC, CL, MN, and FN happy acquired a higher dominance rating than sad, meaning that the happy expression made participants feel more in control than the sad and angry emotions did. The display of the sad emotion was preferred over the angry emotion for figures SB, CL and FN.

Table 14. Same figure with different emotions for dominance

Person	Emotions	t(df=21)	P Value
SB	Angry - Happy	-3.53	0.002
	Angry - Sad	-3.30	0.003
HC	Angry - Happy	-2.95	0.008
	Happy - Sad	2.64	0,015
TH	Angry - Happy	-4.05	0.001
	Happy - Sad	2.11	0.048
DT	Angry - Happy	-2.40	0.026
CL	Angry - Sad	3.44	0.002
	Angry - Happy	-3.74	0.001
	Happy - Sad	4.72	0.001
MN	Angry - Happy	-2.57	0.018
	Happy - Sad	2.46	0.023
FN	Angry - Sad	-2.59	0.017
	Angry - Happy	-2.96	0.007
	Happy - Sad	2.25	0.035

3 CONCLUSION

For all three emotional dimensions of SAM a significant difference was found. Only Arousal had an effect of political affiliation and visual faces on the different tactile conditions. Something common for all participants, Sandra Bullock and Tom Hanks were rated more pleasant (valence), more calm (arousal), and more in control (dominance), while Adolf Hitler and Cersei Lannister got opposite rating for the three dimensions: unpleasant, excited, and controlled.

One common trend across all three dimensions, people preferred happy faces among the three facial expressions. This is not surprising when a person smiles, one is more likely to perceive them as pleasant, be calm, and feel in control of the situation. Sad was preferred over angry for almost all the faces. Again, sad triggers other emotional reactions in humans such as empathy and sympathy. While, most of the time people want to avoid angry people, because when someone is angry, it usually leads to confrontation or the idea that something bad is about to occur.

For valence, when comparing the different faces between one another, it was less pleasant for participants to see American sweethearts Sandra Bullock and Tom Hanks sad than any other face. For the emotion "happy," seeing Sandra Bullock was more pleasant than any other figure. The same trend was observed for Tom Hanks and neutral figures. For the emotion "angry", Adolf Hitler was the least pleasant face for the participants.

For the arousal dimension, liberal participants were more concerned with fictional characters (Cersei Lannister) and public figures (Sandra Bullock and Tom Hanks), than political figures (Hillary Clinton and Donald Trump); while conservative participants were

more affected by a picture of a liberal representative, Hillary Clinton when associated to an angry face as opposed to an angry face of Donald Trump. This difference was only observed for the longest burst duration (48 ms).

Dominance ratings follow a similar trend of Valence, where Sandra Bullock and Tom Hanks made people feel more in control of the situation for all emotions. While Adolf Hitler and Cersei Lannister had the opposite effect, i.e. made participants feel they were being controlled.

Overall, those results are preliminary and more experiments are required to shed the light on the emotional aspect of tactile communication. It seems that valence and dominance are not affected by the duration of the tactile stimulation. That said, it is possible that the visual stimulus overshadow any effect that could have been caused by touch. A better design would have been to include visual only and haptic only conditions. We first planned to include these two conditions in our original design, but the experiment time doubled and it led to participant's fatigue. We also included at first a neutral and surprise emotional faces. Because, this type of design has never been used in the past, our results can be used to improve the design and assessment tools for multimodal conditions. Finally, the duration and the frequency of the CRE can be modify so it can produce a funneling effect (start strong and get weaker) or the opposite to mimic more realistically a tap on a shoulder or a caress on the arm. Other complex stimulation can be created by changing the activation sequence of the actuators on the skin. Finally, other areas of the body should be tested such as the back of the neck or the forehead.

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