Can I touch you online?

Embodied, Empathic Intimate Experience of Shared Social Touch in Hybrid Connections

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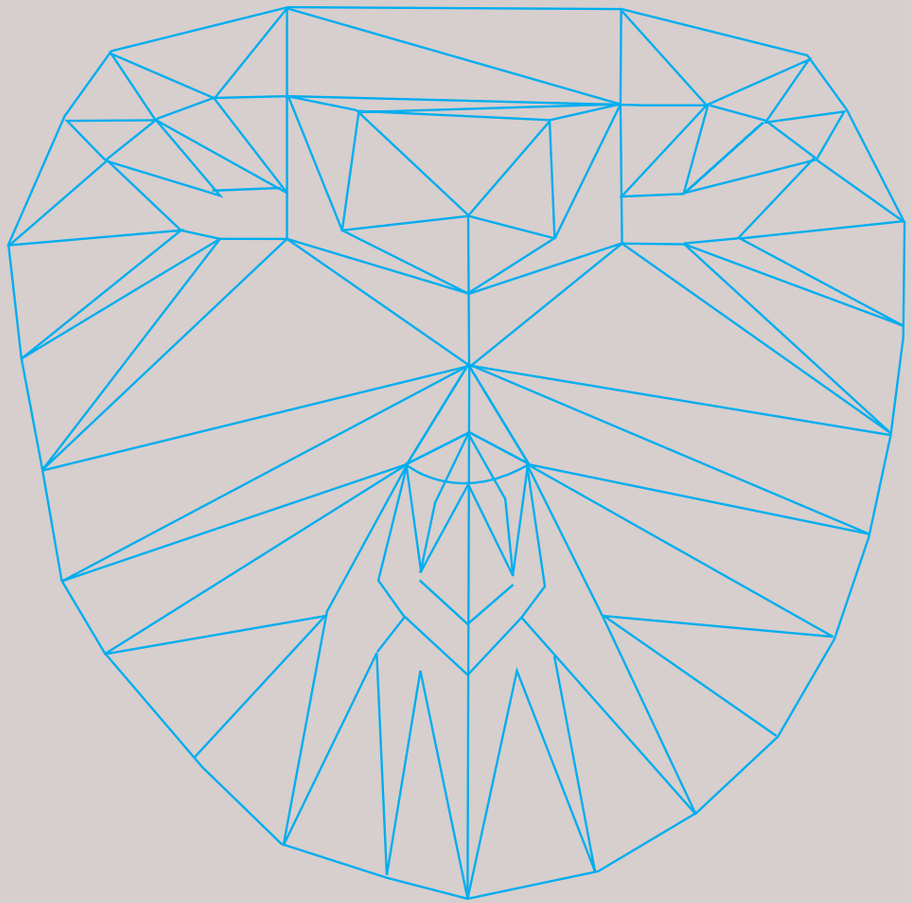

Can I Touch You Online?

KAREN LANCEL

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CAN I TOUCH YOU ONLINE?

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Dissertation

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by

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Crucial to my interdisciplinary research was participation in multiple research groups, with different focusses and vocabularies, including Art, Cultural studies, HCI, Social and Neuro-science research, and Design.

The preliminary process of the dissertation began in 2008 when the Research Group Amsterdam gave me the opportunity to publish and prepare an artistic research track. Participation in the Digital Synesthesia Research Group (University of Applied Arts Vienna) shone light on poetic design for human synaesthetic faculties to perceive the world and each other. Participation in the international consortium Dutch Touch, gave insights into technical and ethical aspects of mediated, social and affective touch research and design. With the Worlding the Brain & Neurocultures research group (University of Amsterdam (UvA)) we analyzed our work from new perspectives on human perception. The Urban Interface Group (University Utrecht) focused my attention on artistic curatorship of public space. Thank you for the rich collaborations and new insights.

My dissertation is a result of a creative journey since the late 1980s, when the ubiquity of media and computers invaded our everyday social lives. Over the years, our art practice has been subject to changing discourses, including Visual Art; Performance Art; Media Art, Art and Science; Theater; Science; Technical Innovation; Artificial intelligence; Engaged Art and Social Art; Participatory Art; Digital Art; Interactive Art; Art Science and Society; Tactical Media. These different perspectives contributed to my own analyses and design processes. Thank you to all who helped analyzing our work from these different discourse perspectives.

Vital however was also the opposite perspective. At the end of the 1990s, the four-year interdisciplinary Master of Arts DAS Academy for Theatre and Dance stimulated me to focus on creating a new interdisciplinary synthesis. Here I developed the works Agora Phobia (digitalis) (2000), StalkShow (2003), and grounded the concept of the Artistic Social Labs, presented in this thesis. The DAS Academy gave me wings.

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Thank you with all my heart,
Karen

Table of Contents

Part 1

Part 1 presents an Introduction to this thesis; followed by the Research philosophy, Research Method, Knowledge Gap, Research Questions. It concludes with an Outline of this thesis.

1 Introduction

Living together implies being together and sharing embodied experience. We touch, kiss, play, dance, make love, tune and breath together. Our bodies touch each other, and we feel touched. Being in touch with others touches us emotionally and spiritually, enables flow and transformation.

Increasingly, being together takes place through online interaction. This raises the questions: if distance becomes the norm for meeting each other, due to digitalisation, can touch play a role in our togetherness? And what does this mean for sharing intimacy, and trust? Can digitisation play a role in the intimate experience of touch (Van Erp & Toet 2015; Jewitt et al. 2021)? And if it can, can it give rise to new forms of touch and bodily togetherness, with multiple bodies worldwide, between lovers, friends, family, and strangers?

"Can I touch you online?", the question this thesis addresses, relates to two kinds of touch: the physical and the emotional experience, of touching and of being touched. It is about our changing experience of socially touching and of being touched in hybrid and online interaction, as a **Shared Social Touch** experience**.**

Touching each other directly, 'physically', is vital for feelings of safety, being together, and trust. And not only the experience of touching each other and being touched, but also seeing others touching each other is vital to our sense of social, interpersonal touch. Together, meaning is given to our experience, through stories and new narratives, that in turn lead to ethical agreements between people touching each other; about behaviour of touching, including aspects of control, trust and consent (Jewitt et al. 2020a), and about how this differs between individuals and cultures.

On the one hand, more and more often, interaction takes place in digital environments, whilst rooted in shielded, private physical worlds, without touching each other directly. This development is intertwined with people increasingly living alone, at a distance from loved ones. During the Corona pandemic, in public spaces, even proximity was discouraged.

On the other hand, digitally mediated shared hybrid and online (public) spaces have emerged that make intimate worlds accessible to multiple participants - for lovers, friends, family and strangers to interact with each other through forms of 'Extimacy' and 'Ambient intimacy' (Jamieson 2013).

This thesis explores the question: Can shared embodied intimate experience of mediated social touch be orchestrated for multiple participants, in empathic interplay? This question drives an interdisciplinary research journey into Art, Design and Science.

Implicit in the question is the artistic, critical exploration of physical and mediated, hybrid body-awareness. The design approach explores the necessary prerequisites for a novel shared intimate experience of hybrid social touch for multiple participants.

1.1 Intimate Experience of Social Touch

Chatzichristodoulou and Zerihan (2012) have argued that intimate experience (for example of touching) is intertwined with feelings of familiarity, closeness and trust. It can take place between sentient beings, who on a physical and/or emotional level feel safe enough with each other to reveal something about themselves, and to commit to each other in an exchange that is meaningful to them (Chatzichristodoulou and Zerihan 2012).

In line with the argument by Chatzichristodoulou and Zerihan (2012), this thesis approaches shared intimate experience through touch as a form of 'interplay'. It entails reciprocal interaction with interdependency and vulnerability, acts of self-revealing to each other and caring for each other, and shared meaning-making; that in turn can lead to new forms of being together.

1.1.1 Touching Digital Others

It was long envisioned that human bodies would no longer have to play a role in transhuman, technically mediated interaction (Ferrando 2014), and that people would be able to communicate brain-to-brain, with intimate prostheses built into their bodies. But in the meantime, it has become clear that no experience is possible without perception and consciousness of people's own bodies (Merleau-Ponty 1992), even in posthuman mixed and extended realities (Fleischmann & Strauss 2004; Massumi 2002).

Physical awareness of oneself and of the other, has thus been recognized as conditional to a sense of feeling together. However, while online technology extends our bodies in time and space, design for shared bodily intimate experience of touching each other is still underexplored.

Until recently, research into neurofeedback systems that includes haptic technology focused on *automating* touch, for example for mobile devices, social robots and humanoids, therapy and the sex and entertainment industry (Van Erp & Toet, 2015). Often, the *potential* of the technology, of interfaces and prosthetics, was the starting point of such design, instead of human, shared experience (Jewitt et al. 2021). Discriminative 'stroking and 'swiping' mobile phone screens has become an integrated part of our search for a loved one on dating sites.

What does this mean for sharing intimacy with others? Current technically mediated social practices (of for example social media) shifts our physically *visual and touchable* experience of *others*, to a *visual* experience, of *representations of others,* in (MR, XR, VR) merging realities. On electronic screens, images of friends mingle with avatars and social agents, in a social world of representations. Social intimate interaction takes place with these representations, as a kind of 'personas', that can actually be identified as 'objects'. Reciprocal interaction with 'object' others leads to a less bodily self-consciousness, effecting relations that would emerge from intimate connections between a 'self' and an 'other' (Turkle 2015).

Moreover, intelligent systems interfere with human empathic, sentient ability to decode intimate sensations of oneself and others. This decoding is not neutral, it has built-in standards of meaning managed by AI self-learning complex algorithms with implicit perspectives, bias, interpretation and moral (Roeser, Alfano & Nevejan 2018); shaping ways of intimately connecting (Lomanowska & Guitton 2016, Lombard & Jones 2013, Turkle 2010).
In contrast, Jewitt et al. (2021) emphasizes the importance of social touch, and its design, as a practice of mutual creation and meaning making, in the Manifesto of 'Social Touch in Crisis'.

In short, experience of intimacy and togetherness - but also of loneliness and isolation - is increasingly shaped by the use and design of technology (Turkle 2011). This also raises questions such as: What is the role of biometric data in design for experience of touching and being touched? Can biofeedback data replace empathic interaction? Or can other scenarios be imagined, of interweaving physicality and technology, touch and feeling touched, for empathic interplay?

1.1.2 Emphatic Interplay

This leads to the second meaning of touch, being emotionally 'touched', in empathic interaction. **Empathy,** or 'Einfühlung' (Gallese 2017) makes it possible to feel what others feel, in their bodies, and through their bodies in interaction with the world, to share emotions of pain, death, fear and loneliness, of illness, happiness and desire, in profound connections (Turkle 2018).

These empathic processes are based on a combination of a) immersive, physical experiences of others, and b) cognitive meaning-making of these experiences (Gallese 2007, Ward 2018). A distinct self-other awareness is necessary to identify with other persons and imagine their emotions. And disrupted, immersive self-other experience is required for physical, mirror perception (Ward 2018). Neuroscientific research into the activity of mirror neurons and synaesthesia assumes that in mirror processes, people extend, as it were, their body boundaries. People physically identify with others whereby other peoples' experiences seem to temporarily integrate in their own embodied experiences.

Experiments with visuo-haptic motor feedback data loops, of affective touch, show that individual participants can even physically connect (and identify) with virtual representations of other (body parts of) persons visible on a screen (Ijsselsteijn et al. 2006; Tajadura-Jiménez et al. 2012). Temporarily, they sense a strong sense of 'body ownership' with these peoples' bodies or body parts. In these experiments, technology is integrated in physical 'fluid' connections between the self and technically mediated others.

This thesis investigates whether empathic process of touching, and embodied connections (such as through mirroring and identification), can be orchestrated for multiple participants, in hybrid and online interaction. It explores the possibility of 'distributed body awareness', by rethinking the role of technology as part of the physical emphatic interplay for social touch.

1.1.3 Digital Others in Co-existence

From an Actor Network Theory perspective (Latour 1991), the role of technology has been described as a 'co-producer' (Federova 2020), rather than 'an instrumental prosthesis' or 'interface'. Technology as a 'co-producer' is part of the process of meaning making, in which it co-produces what it mediates. Technology, from this perspective, is part of an assemblage of which people are part: with mutual influence of sensory modalities and computational regimes (Haraway 2016, Parisi 2018).

This perspective resonates in current sustainable social eco-system research, that is shifting from a human-centred to an actor-centred approach, in which actors - human and non-human - 'co-exist'. This research opens a new awareness of potential configurations and assemblages, of organic and non-organic systems; of bionic and symbiotic neurofeedback systems; in multi-species, human and non-human connections (Haraway 2016).

From this perspective, this thesis explores artistic distributed (neurofeedback) systems, for shared interaction between humans, technology and biofeedback data, for an emphatic interplay of intimate social touch.

1.1.4 Touching Hybrid Bodies

Artistic design of distributed neurofeedback systems for social touch has been explored in interactive media performance art. In these artworks, the aesthetic principle of 'disruption' has guided the design (Kwastek 2013). In this context, the term disruption, firstly, has been used to refer to digital mediation of social touch, disrupting direct sensory connections.

But more importantly, the aesthetic principle of disruption is used to create new forms of embodied interaction, with new forms of bodily awareness, through technology. In these art works, embodied interaction is disrupted and re-orchestrated into novel connections of sensory, synaesthetic syntheses, through 'entanglement' (Salter 2010) or 'collective intercorporeity' (Hansen 2012; Kozel 2007, p.241). Ambiguous assemblages of embodied interaction and datafication form the starting points for individual experience and self-reflection. Biofeedback data are exposed to evoke imagination and reflection, both on digital

mediation itself (Morton 2018), and on the consequent ethical consequences that include agency, control, privacy, responsibility, and trust (Jewitt 202b; Nevejan 2007; Roeser, Alfano & Nevejan 2018).

In general, these media performance artworks, discussed by among others Kwastek (2013), orchestrate interaction between artists (performers) and individual members of the audience (participants). Less focus has been on social touch interaction shared by participants among each other. Subject of this thesis is *shared* embodied intimate experience of social touch for multiple participants.

The research in this thesis is grounded in observations of six interactive media art performances, created by artists Lancel and Maat (2009-2021). These 'Artistic Social Labs' (ASL) have been presented internationally, in hybrid and online (city) public spaces, in Europe, USA and Asia. Participants in these ASLs are invited as 'co-researchers', to explore and play with experience of physical and technically mediated affective touch among each other. They kiss, caress and embrace themselves and each other.

The ASL's artistic orchestrations for disrupted social touch interaction are orchestrated from an **Actor Network Theory (ANT)** perspective (Latour 2005), including multiple human and non-human (digital) actants, in interplay. Participants meet in hybrid and remote shared biofeedback data systems via technologies outside, on and inside their bodies (including smart city facial technologies; smart haptic textiles; streaming platforms; phone apps; and brain-to-brain computer interfaces). Shared, composed datafications, that are complex and unique form the starting point for joint experience and *shared* reflection; in shared 'Reflective Datascapes' (discussed in section 4.3).

Performance scripts have been developed, based on ethical considerations of agency for the joint autonomy to be responsible, and response-able (Barad 2007), in interdependent sensory connections, with reciprocal influence, in empathic, vulnerable interplay.

Based on the research, this thesis presents a prescriptive and descriptive interaction model 'Can I touch you online?' (CITYO), first created based on literature, and evaluated for the ASLs orchestrations described above. This thesis is developed to inspire Art, Design and Science, including fields of Neurology, Social Interaction and Complex Self-learning Systems.

In short, this thesis explores configurations of social, physical, and technological actors in interplay, for sensing co-creation of togetherness through social touch, in a dance of embodied experience, emotion and imagination.

Ethical approval of this research has been granted by the Delft University of Technology's Human Research Ethics Committee.

1.2 Research Philosophy

This section discusses the philosophical approach to the research presented in this thesis, based on the phenomenological perspective[1] by Merleau-Ponty (1962).

From Ponty's perspective of phenomenological perception, the body is considered to be "the embodied ground for all perceptions" (Svanæs 2000, p.89). Instead of acknowledging a body-mind separation, in his approach "The body is our general medium for having a world." (Merleau-Ponty, 2003).

In Ponty's approach, firstly, being in the world is based on pre-cognitive perception. In a flow of interaction and pre-reflective, subjective sensation of 'being-in-the world', and 'embodied experience', relations are grasped on the basis of the bodily situation, body-schema and kinaesthesia. Mind, body and environment are perceived in interplay, through synthesizing sensory perception.[2] Perception takes place in a state of flux.[3]

Secondly, from this experience in action, conscious reflection emerges. As a lived experience, consiousness is "perceptual, in a state of flux and therefore the certainty of perception is always changing within lived experience" (Stenslie 2010, p.208). *Conscious reflection* is evoked through ambiguity and incompleteness of experience. Through "breakdown" (Heidegger, 1978:98) of experience, recognition is suspended for a moment, evoking reflection (Stenslie 2010, p.182). A perceptual breakdown stimulates conscious reflection and cognitive meaning making (id: p.183). From these processes of interaction, based on of intertwined perceptual relations interpretation, imagination, intention, and memory can emerge.

Our perception is not transparent to ourselves: our grasp on ourselves and the world emerges from pre-reflective perception only becoming explicit in ambiguous and situated ways. It becomes explicit through being "'in action': we do not deduce 'I am' from 'I think', but rather the certainty of 'I think' rests on the 'I am' of existential engagement." (Toadvine 2019). From an intertwined mode of self-experience in interaction, new conceptions can emerge, of time, space, embodiment, consciousness and freedom.

The phenomenological perspective on **social perception** focusses on encountering embodied others, directly perceived as pre-personal beings, body-subjects in a shared world. Social

[1] Attributed to the German philosopher Edmund Husserl (1859–1938), the term "Phenomenology" refers to "a way to describe and analyse the structure of consciousness emerging from first-person experience." The term 'perception' has been added to this view point by Merleau-Ponty, meaning "a primitive awareness, that exists prior to consciousness." https://www.coursehero.com/lit/Phenomenology-of-Perception/, last accessed 2022/1/1.

[2] The history of perception has been fundamentally influenced by Aristotle's construction of five divided senses, less emphasizing cross modal perception. In phenomenology, however, experience and perception are the objects of study, without prioritizing or separating the senses.

[3] Stenslie argues that "the extreme plasticity of the body percept is reflected in Ponty's claim that the body is 'an historical idea' rather than 'a natural species'" (Stenslie 2010, p.103).

encounters are based on pre-reflective communication in a shared a perceptual field.[4] These encounters however, do not "present us with another person in the full sense, since our situations are never entirely congruent." (Toadvine 2019). Nevertheless, a shared social world is opened to us, established through common corporeality.

In this (shared) world of (social) interaction, bodies enter relations of felt proximity and distance, or resonance. This can be understood through the figure of a person's two hands touching each other (Merleau-Ponty 1962). This arrangement of touching is ambiguous, since both hands 'touch', and are 'touched' simultaneously. (Paterson 2007, p.31). The hands are both subject and object, in reversing, double sensations. Both the subject (touching) and object (touched) belongs to perceived experience (Paterson 2007, p.161). In this context, Merleau-Ponty describes how the interplay between what is in(visible) and in(tangible) "can traverse, can animate other bodies, as well as my own" (Merleau-Ponty 1962, p.140[5]).

Section 2.1.1.2 discusses social touch with reciprocal influence by two or more people, including interchangeable, intercorporeal sensations (Merleau-Ponty 1962), transcending the divide between the sensible and the sensate, object and subject, the touched and the toucher (Paterson 2007, p. 160).

[4] https://www.coursehero.com/lit/Phenomenology-of-Perception/. Last accessed 2022/1/1

[5] In the arts, touch sensations provoked by visual stimuli have been explored, as a form of haptic aesthetics. Through "**Haptic Visuality"** Marks (2002), when seeing "haptic images", a viewer dissolves "his or her subjectivity in the close and bodily contact with the image" (Marks 2002).

1.3 Research Method

The research method combines 'Research in the Arts' (Borgdorff 2012) and "Research through Design" (Zimmerman, Forlizzi, Evenson 2007). Characteristics of both methods are described below; followed by a description of how they are applied in this thesis.

This research method also relates to developments in Science and Technology Studies (STS) (Borgdorff et al. 2019; Lysen 2019) in which Research in both Art and Design are key.[6]

"Research in the Arts" (Frayling 1993; Borgdorff 2012) focusses on artistic works as the basis of new experience and knowledge production, performed by a researcher from a performative, subjective perspective (Borgdorff 2006). Borgdorff argues that "Characteristic of artistic research is that the art practice (the works of art, the artistic actions, the creative processes) is not just the motivating factor and the subject matter of research, but that the artistic practice – the practice of creating and performing in the atelier or studio - is central to the research process itself." (2012, p.148) Not only is the personal, embodied, non-verbal (tacit) knowledge and imagination of the artist a source for exploration; "the artistic practice itself is an essential component of both the research process and the research results." (Borgdorff 2012, p.38). The works are created to evoke critical reflection and imagination.

Research in the Interactive Media Arts, in general, contributes to the understanding of being-in-the-world through staging perceptual breakdowns (section 1.2) as forms of disrupted interaction. Disruption facilitates an interplay between immersion and aesthetic distance, for reflection *through* interaction. Interaction and reaction become available as objects of reflections (Kwastek 2013). On the basis of disruption as an aesthetic design principle, new forms of multi-sensory, multi-modal interaction (Gsoelpointner et al. 2016) and performance (Benford & Giannachi 2011, Kozel 2007) have been explored.

Note, that the artistic approach to reflection through interaction (Kwastek 2013) is different from Schön's 'reflection-in-action' (Schön 1983) that primarily focusses on design decisions; rather than on the perceptual breakdown itself that leads to heightened awareness.

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[6] This thesis enlarges the methodological repertoire for social touch research, through "Science and Technology Studies" (STS) and "artistic research" (Borgdorff et al. 2019).

Despite social touch being vital to meaningful communication, research of technically mediated social touch is underexposed (Willemse 2018); not only in the field of science but also in the Arts. Stensley (2010) argues that this is partly due to prioritizing audio-visual senses; and, in the art's context, to problematic lifetime expectations of social touch based art works. Combined art and science research, in this thesis, explores a new perspective on shared intimate experience of technically mediated "social touch" (Haans & Ijsselstijn 2006). Notably, on the one hand, a small number of cases explored from an artistic approach "may not offer grounds for establishing reliability or generality" (Stahl Stenslie 2010) and is likely to cause biases. On the other hand, artistic in-depth case studies that have been developed and presented as a series, can reveal new perspectives (Roeser et al. 2018), without necessarily being indicative of something 'objective' (Stahl Stenslie 2010).

The objective of artistic experiments is not so much to qualify or validate something (as in an engineering or science laboratory) but to convey content, to tell something, and to provoke (critical) awareness and imagination (Lysen 2019).

1.3.1 Characteristics of Research through Design

"Research through Design" follows Frayling's design research concepts (Frayling 1993). However, instead of focusing on designing the *right* thing, it focusses on articulation of design intention and on presenting multiple (conflicting) perspectives, to inspire design questions (Zimmerman, Forlizzi & Evenson 2007).

The systemic approach to develop the design guide lignes in this thesis derives from a RtD perspective. From an this approach, shared reflection with ASL participants supports the iterative design process. To evoke reflection, participatory reflection *on* the experience of interaction (as 'an experience' that is memorized), and on the 'co-experience' (with fellow participants) (Forlizzi & Battarbee 2004) are explored.

1.3.2 Application of the Research Methods

This section describes the way the Research Methods has been applied in this thesis.

Firstly, an interaction model has been developed, on the basis of characteristics discussed in the literature (chapter 2). Secondly, this interaction model has been evaluated, through practice of interaction. Six artistic orchestrations, Artistic Social Labs (ASL), have been analyzed to evaluate the interaction model, leading to findings, insights, and guidelines.

The choice of six ASLs was based on distinctive use of technologies (Facial technologies (ASL1); Online streaming platform (ASL2); Smart Textiles and Phone App (ASL3); and (*Multi-*)Brain Computer Interface (ASL4-6)). Although each ASL was presented in multiple performances, only those performances that have provided large data sets of participants reactions have been analysed. These analyses have been based on:

A) Different 'perceptual breakdown' (section 1.2) **scenarios of ASLs.**
B) Observations by a 'Host' of participant actions and reactions, and behaviour of:

- watching;
- decision to participate;
- participation in performance scripts (of social touch and shared reflection);
- attending and supporting others in the orchestration.

C) Qualitative research methodology, of thick descriptions of participants' shared reflection, through dialogues by artists with participants. These dialogues focus *on* the shared embodied experience as an experience (Forlizzi & Battarbee 2004) with fellow participants Participants' expressions of reflection are noted by the host. *Note,* that the ASL design addresses all participants as:

1) 'co-researchers' to reflect on their own experience;
2) co-creators of experience
3) 'co-authors' of future haptic sense of knowing.

D) Photo and video documentation of these observations (when available).

1.4 Knowledge Gap

The literature in chapter 2 leads to a knowledge gap on how to design disrupted interaction of shared embodied intimate experience of technically mediated social touch, for multiple participants; defined in this thesis as Shared Social Touch.

1.5 Research Question and Sub-questions

This section presents the main research question and sub-questions.
The main Research Question is: **Can shared embodied intimate experience of technically mediated social touch be orchestrated for multiple participants?**

The Sub-questions are:

QR1 Which characteristics are essential to shared embodied intimate experience of technically mediated social touch, for multiple participants?

QR2 Can an interaction model for shared embodied intimate experience of technically mediated social touch be designed for multiple participants, and how?

QR3 Can this interaction model be used, a) to describe and analyse, and b) to artistically orchestrate, shared embodied intimate experience of technically mediated social touch, for multiple participants, and how? To answer QR3, different orchestrations of Artistic Social Labs (ASLs) are analysed. *Note*, that these ASLs were each designed by artists to address relevant questions to this thesis:

ASL1: *Saving Face*
"Can shared experience and dialogue on social touch be orchestrated,
in playful smart public spaces?"
"Is human hosting essential to social touch in the public space of merging realities?"

ASL2: *Touch My Touch*
"Can shared intimate experience of social touch be orchestrated for online connections?"

ASL3: *Tele-Trust*
"Can haptic connections through social touch be orchestrated in merging realities?"

ASL4: *EEG KISS* and *Digital Synaesthetic EEG KISS*:
"Can shared intimate experience of social touch be mediated through Multi-Brain Computer Interface (Multi-BCI) interaction in public space?"

ASL5: *Kissing Data Symphony* and ASL6: *Intimacy Agent*
"Can empathy be shared through online Multi-Brain Computer Interfaces (Multi-BCI)?"

QR4 Can design findings and insights be formulated on the basis of these studies, for the use of the interaction model for shared embodied intimate experience of technically mediated social touch, for multiple participants?

1.6 Outline thesis

Part 1

Chapter 1. Introduction

This section presents introductions to the research provided in this thesis.

Part 2

Chapter 2. Literature

This chapter addresses QR1: "Which characteristics are essential to shared embodied intimate experience of technically mediated social touch, for multiple participants?". It presents a theoretical understanding of a) meaningful interaction through technically mediated social touch, and b) a State of the Art of digital performance art presenting social touch interaction.

Chapter 3. Interaction Model 'Can I touch You Online?' (CITYO) .

This chapter addresses QR2: "Can an interaction model for shared embodied intimate experience of technically mediated social touch be designed, for multiple participants?" Based on the literature in chapter 2, a novel interaction-model 'Can I Touch You Online?' is presented, to support shared embodied intimate experience of mediated social touch for multiple participants.

Part 3

This part includes two chapters describing the design of the artistic orchestrations (Artistic Social Labs (ASL)), based on the interaction model, for which a) sensory disruption and b) shared reflection are crucial. The ASLs are used as case-studies, to explore the **QR3**: "Can this interaction model be used, a) to describe and analyse, and b) to artistically orchestrate, shared embodied intimate experience of technically mediated social touch, for multiple participants, and how?", through the research method described in section 1.3.

Chapter 4 introduces the general design approach to the ASLs and their performance scripts, in line with the interaction model.

Chapters 5-9 describe six specific ASL orchestrations, as case-studies in relation to the interaction model. These chapters present insights into the types of social touch interfaces and touch interaction that were triggered in different sensory orchestrations; the technical perspective and set up of each orchestration (publicly available open source to the community); discursive artistic approach to each orchestration; and how certain forms of interaction were meaningful to participants.

Chapter 4. Artistic Social Labs (ASL).

This chapter describes the general design approach to the Artistic Social Labs (ASL) and their performance scripts, in line with the interaction model, from the perspective of the artists Lancel and Maat. The artists create the ASLs in (semi-)public spaces internationally, for participants to explore in the roles of Actors (this notion is used to describe a more active than passive role of participation), and of Co-Actors (Spectators, potential Actors) (Lancel/Maat 2009-2021).

These ASLs present new design approaches to interfacing mirroring affective touch for multiple participants. In this novel approach, sensory connections between touching, seeing and hearing are disrupted and re-orchestrated. The ASLs are designed for participants to experience a unique sense of communal haptic connections within public, digitally distributed environments and networks.

Chapter 5. ASL1: *Saving Face* (2012-2015)

This chapter studies the question: ”Can shared experience and dialogue on social touch be orchestrated in playful smart public spaces?” Three hybrid ASLs have been created and performed, in different geographical smart city cultures of Utrecht, Dessau and Beijing.

In all three ASLs, design of **Sensory Disruption** facilitates social touch experience, through a facial and Virtual Persona interface, connected to city urban screens; and visual-haptic connections. **Shared Reflection** takes place through hosted, Staged Dialogues.

In addition, this chapter includes a separate section that explores different forms of (non-)human and participatory hosted orchestration of shared reflection. Discussed are two ASLs1 ‘Saving Face’ (at Dessau and in Beijing); and the ASL ‘Master Touch’, commissioned by the Rijksmuseum Amsterdam.

Chapter 6. ASL2: *Touch My Touch* (2021)

This chapter studies the question: “Can shared intimate experience of social touch be orchestrated for online connections?” between two people. ASL2 builds on ASL1 but explores an online streaming platform for social touch interaction, for two persons. Design of **Sensory Disruption** facilitates social touch experience, through a facial and Virtual Persona interface; and visual-haptic connections, embedded in the streaming audio-visual platform.
Shared Reflection takes place through participant hosted, Shared Dialogues.

Chapter 7. ASL3: *Tele_Trust* (2009)

This chapter studies the question: “Can haptic connections through social touch be orchestrated in merging realities?” In the context of the smart city, a hybrid ASL has been created and performed, for multiple participants simultaneously. Design of **Sensory Disruption** facilitates social touch experience, through a wearable smart textile interface (DataVeil), and visual, sonic and haptic connections. **Shared Reflection** takes place through hosted, Staged Dialogues.

Chapter 8. ASL4: *EEG KISS* (2014) and *Digital Synaesthetic EEG KISS* (2016)

This chapter studies the question: "Can shared intimate experience of social touch be mediated through Multi-Brain Computer Interface (Multi-BCI) interaction in public space?" In the context of emergent research into brain-to-brain communication, a brain computer interface (BCI) enables social touch experience through two kissing persons wearing an EEG headset. Design of **Sensory Disruption** facilitates social touch experience through a Kissing Data interface; with visual, sonic, and haptic connections. **Shared Reflection** takes place through hosted, Staged Dialogues.

Chapter 9. ASL5: *Kissing Data Symphony* (2018), ASL6: *Intimacy Agents* (2020)

This chapter studies the question: "Can empathy be shared through online Multi-Brain Computer Interfaces (Multi-BCI)?". ASL5 and ASL6 build on ASL4.

In ASL5, a Multi-Brain computer interface facilitates social touch experience through EEG headsets, for sharing brain activities of kissing Actors and of Co-Actors watching the kiss. Design of **Sensory Disruption** enables social touch experience, through a Kissing Data interface, with *shared* visual, sonic, and haptic connections, and shared recordings of brain activities.

ASL6 has been created for online communication, facilitated by a brain computer interface for two kissing Actors, and heartbeat sensors for Co-Actors. Design of **Sensory Disruption** enables social touch experience, through a Kissing Data interface, with shared visual, sonic, and haptic connections, in an online multi-player environment. In both orchestrations **Shared Reflection** takes place through hosted Shared Dialogues.

Chapter 10. Discussion on Findings and Insights from the ASLs in Relation to the CITYO Interaction Model

This chapter discusses the conclusion and findings in relation to the QR4: "Can design findings and insights be formulated on the basis of this interaction model; for the use of this model for shared embodied intimate experience of technically mediated social touch, for multiple participants?" Findings and insights are formulated on the basis of the ASL orchestrations (chapters 4-9) in line with the interaction model.

Part 4

Chapter 11. General Discussion and Conclusion

This chapter concludes this thesis by discussing the results in relation to all initial research questions posed. It discusses implications of findings for the use of the interaction model, and directions for future work.

APPENDIX (1): Artificial Intelligent (AI) Aspects of the ASLs

Appendix 1 presents an introduction to the Artificial Intelligent (A.I.) design context, and an overview of the technical A.I. aspects of each ASL.

APPENDIX (2): Correlations between Characteristics

Appendix 2 presents correlations between characteristics of the ASLs presented chapters 5-9.

APPENDIX (3): Credits.

Appendix 3 includes credits for collaboration in research, development and international presentations of the ASLs.

REFERENCES

SUMMARY

SAMENVATTING

ABOUT THE AUTHOR

LIST OF PUBLICATIONS

1.7 Publications

Parts of this thesis are based on peer reviewed publications or submitted articles. Four Journal articles, two Book articles and two Conference Articles are published. An overview is presented in the list below. The papers on which the chapters are based are explicitly named at the beginning of each chapter.

(1) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2020). 'Saving face: shared experience and dialogue on social touch, in playful smart public space.' In: Nijholt, Anton (ed.) *Making Smart Cities More Playable: Exploring Playable Cities*, 179-203.
DOI https://doi.org/10.1007/978-981-13-9765-3_9
Published, peer reviewed
Chapter 5 (sections 5.1 – 5.8)

(2) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2019). 'Saving face: playful design for social engagement, in public smart city spaces'. In Brooks, Anthony L., and Eva I. Brooks (eds.) *Interactivity, Game Creation, Design, Learning, and Innovation: 7th EAI International Conference, ArtsIT 2018, and 3rd EAI International Conference, DLI 2018, ICTCC 2018, Braga, Portugal, October 24–26, 2018, Proceedings 7* (pp. 296-305). Springer International Publishing.
https://doi.org/10.1007/978-3-030-06134-0_34
Published, peer reviewed.

(3) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2020). 'Hosting social touch in public space of merging realities'. In Brooks, Anthony L., and Eva I. Brooks (eds.) *Interactivity, Game Creation, Design, Learning, and Innovation: 8th EAI International Conference, ArtsIT 2019, and 4th EAI International Conference, DLI 2019, Aalborg, Denmark, November 6–8, 2019, Proceedings 8* (pp. 202-216). Springer International Publishing.
Published, peer reviewed
Chapter 5 (section 5.9)

(4) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2020). 'Designing disruption for social touch, in public spaces of merging realities: a multi-sensory model.' In Brooks, Anthony L. (ed.) *International Journal of Arts and Technology. Special Issue: ArtsIT 2018 Arts and Technology.* Inderscience Publishers, 12(1), 18-38.
https://www.inderscienceonline.com/doi/abs/10.1504/IJART.2020.107691
Published, peer reviewed
Chapter 5 (section 5.3.2.8); and **Chapter 7** (sections 7.1.3; 7.1.4)

(5) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2018) 'Can I touch you online?' In: Price, Sara, Kerstin Leder Mackley, Carey Jewitt, et al. (eds.) *Reshaping Touch Communication: An Interdisciplinary Research Agenda*. CHI 2018 Montreal.
https://dl.acm.org/doi/10.1145/3170427.3170603; https://intouchchi.wordpress.com
Conference Article

(6) Lancel, Karen, Hermen Maat and Frances M. Brazier *(Submitted)* 'Touch My Touch: Sharing Intimate Experience of Social Touch in Remote Interaction, through artistic design'.
Chapter 6

(7) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2019) 'Kissing Data'. In Smites, Rasa and Raitis Smits (RIXC gallerija Riga) (eds.) *Acoustic Space Volume: Virtualities and realities 1 17. New experiences, art and ecologies in immersive environments.* University of Liepaja Latvia.
http://rixc.org/en/acousticspace/issue/666/
Published, peer reviewed
Chapter 7

(8) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2019). 'EEG KISS: shared multi-modal, multi brain computer interface experience, in public space'. In: Anton Nijholt (ed.) *Brain Art: Brain-Computer Interfaces for Artistic Expression*. Springer Verlag, Human-Computer Interaction series. 207-228. https://doi.org/10.1007/978-3-030-14323-7
Published, peer reviewed
Chapter 8

(9) Lancel, Karen, Hermen Maat and Frances M. Brazier *(Submitted)* 'How Close Can We Get? Artistic Design for Shared Empathy in Intimate Connections, through Online Multi-Brain Computer Interfaces'.
Chapter 9

(10) Lancel, Karen, Hermen Maat and Frances M. Brazier (2022) 'Empathy Ecologies': New Connections between humans and plants in Techno-Ecological Sensoriums'**.** *RIXC Art Science Renewable Futures Conference 2022 'Splintered Realities'*. RIXC New Media Culture Riga. https://www.youtube.com/watch?v=Q0N4PBzBb-w (20:00/1.02.04 - 44:08/1.02.04). Online Conference Lecture.

Part 2

Literature, Interaction-model

Part 2 focusses on the design of an Interaction Model, for shared, embodied intimate experience, of technically mediated social touch for multiple participants, based on the literature.

Chapter 2 reviews both the State of the Art in scientific literature on social touch and interactive media performance art, to identify essential characteristics and the knowledge gap on which this thesis focusses.

Chapter 3 proposes an interaction model to fulfil this gap.

2 Literature

This chapter focusses on QR1: 'Which characteristics are essential to shared embodied intimate experience of technically mediated social touch for multiple participants?'. The State of the Art in the scientific literature is presented in sections 2.1, 2.2; and that of interactive media performance art in section 2.3, concluding with the knowledge gap this thesis addresses in section 2.4.

(2.1) Shared Intimate Experience of Technically Mediated Social Touch for multiple participants. This section discusses research into neurofeedback systems that includes mediated haptic interaction as form of information processing, and current research that focusses on aspects of empathy and ethical considerations. This section discusses the characteristics of shared embodied intimate experience of mediated social touch for multiple participants, as: 'Touching and being touched, with reciprocal influence on each other's actions, in vulnerable interplay, and shared reflection'. On the one hand, design of disrupted, digitally mediated social touch limits shared sensory intimate experience, with less potential for reciprocal influence, vulnerable interplay, and shared reflection. On the other hand, digital mediation has shown to enable new social, spatial, and technological configurations for intimate interplay, for multiple participants.

(2.2) Empathy, in Technically Mediated Social Touch Interaction. This section discusses literature on empathy, vital to shared intimate experience. Empathy is shown to require components of 1) identification, 2) (neural) mirror-perception; 3) emotional expression; and to emerge from both cognitive processes (requiring a *distinct* self-other awareness); and physical processes (relying on *disrupted, immersive* self-other awareness). Recent research into *individual* physical affective touch in a) synaesthetic, vicarious, mirror-touch interaction; and b) flexible body-ownership-identification (in visuo-haptic motor feedback data loops of affective touch) is reviewed. This literature provides new perspectives on the orchestration of empathetic processes through mediated social touch among multiple participants.

(2.3) Interactive Media Performance Art, of Social Touch in Shared Experience. This section discusses literature on orchestration of disruption and reflection, vital to shared, embodied intimate experience in Interactive Media Performance Art. This literature shows that disrupted, shared, ambiguous multi-sensory, multi-modal synaesthetic orchestrations of affective touch gestures can evoke participant reflection-through-interaction. Connections between artists/performers, participants and spectators have been shown to rely on interdependent performance of self-revealing touch gestures and social support in empathic, vulnerable interplay. The role of hosting in performance scripts is shown to be of importance in a number of publications.

(2.4) Knowledge Gap. There is a gap in current understanding of how to design shared, embodied intimate experience of technically mediated social touch, for multiple participants, defined as **Shared Social Touch** in this thesis.

The literature shows that two elements are required: 1) Sensory Disruption Design (through ambiguous interaction) with shared reciprocal influence in shared empathic, vulnerable interplay; and 2) Shared Reflection Design (through hosting). The combination of these two elements has to the author's knowledge not been explored.

This thesis defines shared, embodied intimate experience of technically mediated social touch, for multiple participants, as **Shared Social Touch.**

2.1 Shared Embodied Intimate Experience of Technically Mediated Social Touch, for Multiple Participants

This section discusses characteristics of shared embodied intimate experience of technically mediated social touch for multiple participants. Below, first, an introduction is presented on Human Computer Interaction research into social touch, and on ethical aspects of technically mediated social touch research. The next sections focus on social, physiological, intimate, technically mediated, and spatial aspects, including:

- **Physical social touch (2.1.1)**
- **Technically mediated social touch interaction (2.1.2)**
- **Shared intimate experience (2.1.3)**
- **Technically mediated shared spaces (2.1.4)**

Haans & Ijsselsteijn argue that "since touch is indispensably related to intimacy, mediated social touch allows personal and intimate connections in ways that words or images presumably cannot" (Haans & Ijsselsteijn 2006, p.153). Until quite recently, however, research into **Human Computer Interaction (HCI)** systems for, among others, applications for healthcare, teaching, telepresence, therapy, and entertainment industry (Van Erp & Toet 2015), has concentrated on physiological and technological aspects of social touch and less on human experience as a research and design starting point (Jewitt et al. 2021).

Such HCI research has dominantly focused on incorporating *discriminative touch* (Morrison et al. 2010) (in addition to audition and vision) for information processing, or "message passing" based on touch signals (Wang et al. 2012). Attention was paid to aspects of efficiency, immediacy, categorization, and automation, for interface design in the fields of VR, AR, robotics, art, therapy and remote communication.

In this approach, the potential of technologies to 'mimic' physiological aspects, in *seemingly not disrupted "perceptual illusions of non-mediation"* (Lombard and Ditton 1997) is key. Examples include research into cutaneous, tactile feedback and perception of pressure, movement, vibration, skin stretch, duration (Van Erp & Toet 2015; Huisman 2017) and thermal signals (Willemse et al. 2018); for devices and protheses that support, among others, stroking a hand (Eichhorn et al. 2008); hand holding (Gooch and Watts 2012); stroking an arm (Huisman et al. 2013); hugging (Cha et al. 2008,[7],[8]); massage (Chung et al. 2009; Haritapan 2018);

[7] "Huggy Pyama" models pneumatic telematic interaction of night wear for children https://link.springer.com/chapter/10.1007/978-3-319-94730-3_3

[8] "Hug Shirt": https://designandinterior.wordpress.com/2019/06/13/hug-shirt/

artificial skin compositions[9]; and intimate sexual touches (Solon 2014). Related experiments include stimulation of the tactile receptors (for sensations of an itch, a tingle, a vibration, pain) based on electric current through the skin (Haans & Ijsselsteijn, 2006, p.150).

The influence of other senses on the haptic experience of touch has been explored, such as of proprioceptive, kinaesthetic and vestibular aspects (discussed in section 2.1.1.1), in XR applications (Bailenson et al. 2007; Della Longa et al. 2022); agents and robotics (Erp & Toet 2015; Huisman 2017); chatbots and avatars (Huisman et al. 2013) [10] ; remote sexual connections (Gomes 2017; Kiiroo[11]) or cyber sexual connections (Parisi 2018; Rheingold 1991); bodily prosthesis (George et al. 2019)[12]; and emotion transmitting (Bailenson et al. 2007). Applications in the arts are discussed in section 2.3.3.1.

Emergent HCI research includes social touch for establishing social bonds by robots with their users; and exploring potentially friend or partner relations between robots and humans (Bickmore and Schulman 2010; Bickmore & Picard, 2005; Leite et al. 2013; Willemse 2018). For example, research into neurofeedback systems including haptic connections between humans and conversational agents, social robots, chatbots and avatars, has increasingly been focussing on cognitive empathy and meaning making (Huisman et al. 2013; Van Der Zwaan, Dignum, Broekens & Jonker 2011) combined with research into 'grounding' (Clark & Brennan 1991), and interpretation (f.e. of context, expectation, intention, attitude) (Wang et al. 2012).

Ethical concerns have only recently entered the digital landscape. While previous research into social touch interfaces focused on the performative potential of technology, more recently the ethical perspective puts human experience of social touch (enabled by technology) center stage (Jewitt et al. 2021). Issues of ethical concern include aspects of agency, trust, intention, bias and control (Jewitt et al. 2020a).

The approach to social touch taken in this thesis, and the interface design of social touch, introduces touch interaction as a form of **'mutual touch creation'** (Jewitt et al. 2021) from which social imaginaries[13] emerge (Jewitt et al. 2020b, p.90). Starting point in this design approach is that 'Sociotechnical' imaginaries inform the fabrication of social life in technically mediated interaction, in future 'Technoscapes' (Appadurai 1990, in: Jewitt et al. 2020b, p.90). The Sociotechnical imagination has been explored as a Design Resource, with a focus on ethical implications.

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[9] Patented Artificial skin compositions include Cyberskin, Futurotic http://www.sextoyspro.com/cyberskin.shtml, last accessed 2019/9/25

[10]https://www.newscientist.com/video/2315719-robotic-fingertip-has-human-like-sense-of-touch/robotic therapy

[11] https://www.kiiroo.com/a/press-kit

[12] https://www.medicaldevice-network.com/news/prosthetic-arm-gives-wearers-a-sense-of-touch/

[13] Social Imaginaries are considered to contain symbols, visions and associated feelings about something, that inform the social fabrication of human lives (Appadurai 1990 (in: Jewitt et al. 2020 (b) p. 90)).

Value-sensitive design approaches to social touch relate to participatory design (emphasizing empowerment and democracy) and feminist HCI (with attention to multiple perspectives) (Jewitt et al. 2020a), promoting shared design processes by different stakeholders, based on reflectivity, responsiveness, diversity and inclusion, and privacy. This is in line with claims that intimate experience of social touch (subject to this thesis), emerges from personal expression of self-disclosure and public discourse (Berlant 2008) in different culturally specific contexts, to which re-negotiation of social values is vital (Butler 1990).

Such participatory processes of mutual creation and meaning making, in the context of the public gaze and as a form of social discourse, are centre point of attention to artistic practice. Artistic orchestrations of social touch, in interactive media performance art, are discussed in section 2.3.

2.1.1 Physical Social Touch

This section explores characteristics of physical social touch interaction. Social touch has shown to support profound, meaningful experience of sharing emotions, intimate connections, togetherness, and trust (Haans & Ijsselstijn 2006; Huismans 2017; Saarinen et al. 2021; Paterson 2007). Social, or interpersonal touch enhances physical and emotional well-being and has often been described to be foundational to social and behavioural child development (Field 2003). Social touch can diminish stress, and facilitate intimate bonding, such as between lovers, or a parent and child. Crucially, touch is vital to a sense of *embodied* existence (Paterson 2007, p.1).

Haans & Ijsselstein characterize "*unmediated interpersonal interaction* as *all those instances in which people are in each other's presence and have a reciprocal influence on each other's actions, whatever this influence entails"* (2006, p.151). In reference to **social touch,** as a form of ***physical*** **interpersonal interaction**, they add: "*Social touch entails all those instances in which people touch each other".* Others however argue that social touch must take place on the basis of an intended message (Saarinen 2021).

The next sections explore the following physiological, affective and communication aspects of physical social touch interaction, on the basis of which Table 2.1.1.4 defines characteristics:

- **Physiology of (Affective) Touch (2.1.1.1)**
- **Social Touch Communication (2.1.1.2)**

2.1.1.1 Physiology of (Affective) Touch

This section discusses physiological aspects of (affective) social touch. *Note*, that research into the brain on the working of social touch is out of the scope of this thesis. Nevertheless, some background insights are included in this section.

The five classic human senses include vision, hearing, smell, taste and touch (Haans & Ijsselsteijn 2006). Different types of stimuli (among others pressure, vibration, pain, position, temperature) can be detected through the touch sense (Van Erp & Toet 2015). Pleasant or unpleasant experience of touch depends on the stimulus (e.g. experience of pain may be evoked through hitting gestures) and place on the body (e.g the erogenous zones), among others.In multi-sensory interaction (**Fig.1**), touch can co-inform meaning perceived through other senses including tactile, audible, and visual connections (Van Erp & Toet 2015).

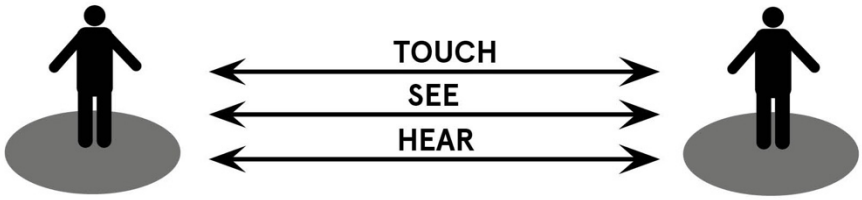

Fig. 1. Multi-sensory reciprocal interaction of touch including tactile, audible and visual connections.

The bodily system that supports social touch has often been divided in two sub-systems (although a strict division is not always possible (Stenslie 201, p. 82)): the "*cutaneous"* (or "*tactile"* system); and the "*kinaesthetic"* system (Haans & Ijsselsteijn 2006).

The *cutaneous* or *tactile* system provides information to the central nervous system. This information derives from receptors (nerve endings in the skin) and receptive afferents (transferring the information). The *kinaesthetic* system facilitates people's awareness of limbic positions and movement, in space and time, by means of sensory organs (proprioceptors) in the muscle and joins. *Haptic* perception includes both cutaneous or tactile, and kinaesthetic perception (Paterson 2007).

This thesis focusses on performance, experience and perception of **Affective Touch Gestures,** as a perceived route to *social* communication. Specific receptors in the human skin provide social communication, through touch. C-tactile (CT) afferents[14] in human hairy skin react to soft, stroking touches (Björnsdotter et al. 2005; Van Erp and Toet 2015; Saarinen et al. 2021; Ijsselsteijn et al. 2006).[15] fMRI research shows that tactile experiences of these touches and slow gentle stroking of the skin are associated by participants with affection and social connection, if performed between 1–10 cm/s, for example though shaking hands, or caressing. Optimally, stimuli are perceived at skin temperature (Ackerley et al. 2014).

[14] In **CT Afferents, 'C' referes to Group C nerve fibers**. "C fibers are one class of nerve fiber found in the nerves of the somatic sensory system. They are afferent fibers, conveying input signals from the periphery to the central nervous system (CNS)". Citation: https://en.wikipedia.org/wiki/Group_C_nerve_fiber, last accessed 2022/10/22.
[15] Huisman et al. have argued that "CT afferents have not been found in genitalia, supporting the distinction between CT afferent touches and sexual functions" (2013).

In social touch interactions, stroking touches have been considered to play an important role Huisman et al. (Huisman et al. 2016, p.2).[16] This is in line with the "Social Touch Hypothesis" (Björnsdotter et al. 2005), stating that "caressing touches, to which CT afferents are sensitive, are particularly pertinent in affiliative interactions with other humans" (Huisman et al. 2013).[17],[18] Perceived pleasantness, comfort and safety evoked by affective touch gestures, has been related to licking and stroking gestures by mother animals, cherishing and cleaning their new-born mammals; influencing touch perception later in life (Erp & Toet 2015). Nevertheless, CT afferents only "serve as a filter, that operates in conjunction with other mechanoreceptors in order to determine whether a certain touch has social relevance or not." (Huisman et al. 2016, p.2).

Relations between affective touch gestures and perceived **body ownership,** through visuo-motor (data) interaction, are explored by among others Ijsselsteijn et al. (2006) and Ramachandran (1998), discussed in section 2.2.3.[19] Similar relations to body-ownership through affective touch are, up to the authors knowledge, still subject to research.

Contemporary understanding of the sense of touch, however, replaces its focus touch as *one* sense, by an increasing interest in touch as a result of neural and cognitive processes within a large, complex network (Stenslie 2010); based on perception of touch and touch responses, primarily happening in the brain, and not 'on the body' (Stenslie 2010, p.87).

Among others, *subjective experience* of social touch has shown to be influenced by neural processing that includes both bottom-up and top-down factors, among others contextual information, or information that is toucher-related (Saarinen 2021).[20]

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[16] Huisman et al. present research including that "CT afferents project mainly to the insula, an area of the brain implicated in processing affect; whereas receptors for **discriminative touch** mainly project to the somatosensory cortices" (2017 p. 392).

[17] "CT afferents were discovered by Åke Vallbo using the technique of microneurography."(…) "CT neurons are a class of low-threshold C neurons, that innervate the human skin. In animals, these neurons are referred to as C low-threshold mechanoreceptors (C-LTMRs). CT neurons belong to a group C nerve fibers; these are unmyelinated and have slow conduction velocities". Citations: https://en.wikipedia.org/wiki/C_tactile_afferent

[18] Trotter, who created a "**Touch Experiences and Attitudes Questionnaire"** (TEAQ) argues that "CTs are slowly conducting and their stimulation leads to activation of limbic-related **brain regions**, rather than the somatosensory cortex (Bjornsdotter et al. 2009). CTs have been proposed to have a key role in encoding the **rewarding properties of positive social touch** (Morrison et al. 2010)".

[19] For example, Crucianelli et al. (2018) found that "interoceptive sensitivity, as measured by a heartbeat counting task, did not relate to the perception of ownership or of CT-optimal, affective touch more generally."

[20] Saarinen (2021) argues that "Although there are some differences in the neural processing between different sorts of touches (e.g., CT-optimal touch, or hand holding), there are some common phases of processing social touch. First, before touch, there are anticipatory responses in the prefrontal and parietal cortex that adjust later phases of touch processing in a top-down manner. After social touch exposure, the tactile signal is generally first transmitted through a spinothalamic tract to the thalamus. From there, the signal is mediated to the primary and

2.1.1.2 Social Touch Communication

Social touch can be characterized by 'non-verbal communication' (Van Erp & Toet 1015). Non-verbal communication is the primary modality for conveying intimate emotions, for example in greetings, corrections, play, and (sexual) relationships (ibid.). One of the primary purposes of non-verbal behaviour, including facial expressions, prosody, gesture, and touch, is to communicate emotional states.

For example, touch can convey signals of anger, disgust, fear, gratitude, harassment, formality, happiness, love, sadness, sympathy, embarrassment, envy, pride, or surprise (Thompson and Hampton 2011). Profound emotions are better recognized through social touch than through any other sensory expressions (Van Erp & Toet 2015; Huisman 2017, p.395). Nevertheless, "a myriad of additional verbal and nonverbal cues (e.g., posture or facial expressions)" supports the receiver while interpreting the intentions of a partner during physical, haptic interaction (Haans & Ijsselssteijn 2009).

Different types of non-verbal touch gestures have been characterized as 'social touch' (e.g., tapping on shoulder, embracing, holding hands and caressing): if conveying information about a toucher's feelings and intentions toward the received (Gliga et al. 2019).

Note, that perception of different types of social touch gestures and their intentions towards the received in different cultures is not within the scope of this thesis. Different types of perception have been explored in for example the fields of cultural studies (Classen 2012, 2020), and (neuro-) psychology (Gallace & Spence 2010), including behavioural studies; and research into 'the Midas Touch' (Haans & Ijsselsteijn 2009); and blindness (Heller & Schiff 1991) and cross disciplinary fields including neuroscience (Saarinen et al. 2021)). Perception of physiological 'affective touch gestures' (such as (self-)caressing) are discussed in section 2.1.1.1.

Reciprocal influence of social touch (like cuddling and holding hands) includes interchangeable sensations of the toucher and the touched (Paterson 2007, p.160, Merleau-Ponty 1962), subject and object; in ambiguous, reversible, and interdependent positions. In reciprocal social touch interaction, being sensate and sensible, witnessing and being witnessed, negotiating and tuning (Nevejan 2007), happen at the same time.
Stenslie (2010) argues that, in reciprocal interaction[21], perception of *passive* touch, like 'being touched', through the stimulation of the skin by some outside agent, has often been contrasted to *active* exploratory action of touching, and manipulative touch. Critical questions

secondary somatosensory cortices, the insula, and other cortical regions" (….) "and the superior temporal sulcus. Moreover, the ventral striatum and amygdala are involved in the processing of social touch."

[21] Erp & Toet (2015) argue that "Dynamics of *reciprocal* social touch rely on different mechanisms with different time scales. Detection of a touch (discriminative touch) takes milliseconds, experience of pleasurable touch takes hundreds of milliseconds and up, and physiological responses (including changes in hormone levels)touched take seconds and up."

about this contrast focus on prioritizing attention to either categorizing 'active' or 'passive' touch; or to the factual reception of touch (in the brain) (Stenslie 2010, p.87). *Note,* in this thesis the term 'tactile' is used for both 'passive' and 'active' touch perception.

Table 2.1.1.3. Characteristics of:

Shared embodied experience of PHYSICAL social touch interaction.

1). Physically touching and being touched,
with Reciprocal influence on each other's actions.

Table 2.1.1.3 presents characteristics of shared embodied experience, of **PHYSICAL social touch interaction**, including **Touching and being touched** (Paterson 2007, p.31,160) of **Physically** touching each other**,** with **Reciprocal influence on each other's actions** (Haans & IJsselsteijn 2006, p.151).

2.1.2 Technically Mediated Social Interaction

This section discusses characteristics of mediated social touch interaction, on the basis of which table 2.1.2.1 is extended.

One the one hand, technical mediation limits the social touch experience, and leads to less "social richness"[22] (Lombard & Jones 1997; Lombard & Jones 2013; Lomanowska & Guitton 2016). Technically mediated social touch disrupts sensory perception physiological processes of direct social touch interaction. Firstly, direct skin-to-skin contact is disrupted. Secondly, although technical mediation does allow some forms for reciprocal influence on each other's actions (f.e. through tactile or kinaesthetic feedback technology), there are fewer (qualitative) channels for non-verbal cues and signalling (Lombard & Jones 1997), to support the process of sensory perception. Similarly, shared processes of meaning making and reflection are limited, essential to intimate interaction (discussed in section 2.1.3). Moreover, a-synchronous, or non-simultaneous communication (Haans & Ijsselsteijn 2006, p.152) "limits the neuronal mirroring management" (Boivert 2015) of social touch.

On the other hand, Parisi (quoted by Jewitt et al. (2020b, p. 116)) argues that "even if

[22] Lombard and Jones (2013, p.28) argue that: "as a characteristic of a medium, **social richness** generally refers to the amount of information that can be transmitted through one or many sensory channels; as a characteristic of the medium user, it refers to the subjective experience of warmth and intimacy in the mediated interaction."

the reproduction of touch falls short of fully synthesizing the full range of tactile sensations, [...] low-definition can be emotionally meaningful." Erp and Toet (2015) found that technically "*mediated affective touch* can modulate physiological responses, increase trust and affection, help to establish bonds between humans and avatars or robots, initiate pro-social behavior and (…) intensify the perceived social presence of remote communication partners".

In the artistic context, technically mediated corporeal scripts have been explored for a new kind of body awareness (Kwastek 2013, Hansen 2012; Salter 2010) through social touch, discussed in section 2.3.2.1.

Building on their definition of social touch (section 2.1.1) Haans & Ijselstijn (2006, p.152) characterize *technically mediated* social touch as:

> "The ability of one actor to touch another actor over a distance, with influence on each other's actions, by means of *tactile or kinaesthetic feedback technology*".

Note, that this definition no longer includes the term **reciprocal.**[23]
It has been argued that "unlike actual social touch, technically mediated social touch interaction is not necessarily reciprocal, and the touch sensation perceived by the sender can be very different from that perceived by the receiver" (Huisman 2017), thus leading to a different **sense of shared sensations**. The different **contexts** from which the interaction takes place are not the same. Furthermore, it can occur **a-synchronously**; and technically, it could even be stored and perceived at a later moment. Overall, "some of the *reciprocal* i**nfluences** that are essential to and guide interpersonal interactions in non-mediated situations (such as social facilitation and inhibition) are less prevalent in technically mediated interaction" (Haans & Ijsselsteijn 2006, p.153).

However, absence of reciprocity effects **mutually shaped** touch interaction as a shared experience; and **shared meaning making** on such experience (discussed in section 2.1.3). Moreover, it effects ethical aspects such as of control, consent and trust (Jewitt et al. 2020b p.115).[24] It may even "obscure the **identity** of who is touching or being touched*"* (ibid. p.116). Senders need to be aware that a physical sensation is caused by their inputs at the receiver's end. In turn, the receiver needs to be convinced that the felt sensation is elicited by a specific sender (Huisman 2017). Intimate experience of reciprocity, such as in in social touch interaction, is discussed in the next section (2.1.3).

[23] The term 'reciprocity' has been be defined as "shared, felt, or shown by both sides, with mutual dependence, action, or influence" (https://www.merriam-webster.com/dictionary/reciprocity); or "mutual exchange" (https://www.dictionary.com/browse/reciprocity).

[24] Likewise, it has been argued to be crucial for emerging human-(tele-present) robot interaction (Van Erp & Toet 2015).

Table 2.1.2.1 presents the characteristics of shared embodied experience of **TECHNICALLY mediated social touch interaction**, including **Sensory disruption** (Haans & IJsselsteijn 2006; Huisman 2015; Jewitt et al. 2020; Lombard & Jones 1997; 2013); named in the literature including: (tactile or kinaesthetic) **Haptic feedback technology** (Haans & IJsselsteijn 2006 p.153); and **Reciprocal influence** (Jewitt et al. 2020b, p.115).

Table 2.1.2.1. Characteristics of:

Shared embodied experience of TECHNICALLY MEDIATED social touch interaction.

1). Sensory Disruption, of Physically touching and being touched,
through:

- **Haptic feedback technology**

with Reciprocal influence on each other's actions.

2.1.3 Shared Intimate Experience

This section discusses characteristics of *intimate experience,* such as in social touch interaction; on the basis of which table 2.1.2.1 is extended in table 2.1.3.1.

Note, that the subject of *Empathy* is discussed in section 2.2. The next section (2.1.4) discusses technically mediated *Shared spaces* for shared intimate experience.

Although in all cultures different forms of intimacy are being practiced, the term 'intimacy' does not express a universal meaning (Jamieson 2013). Research into different perceptions in different cultures is not subject to this study, and can be found in literature by among others: Andersen (2011); Classen (2005, 2020); and Field (2014)).

Within the context of media performance art (discussed in section 2.3), intimate experience has been explored in co-presence of, or through, participation by multiple audience members (Chatzichristodoulou 2012; Kwastek 2013). Chatzichristodoulou (2012) has characterized *intimate experience* as follows:

> "Intertwined with feelings of closeness, trust and familiarity, intimacy occurs through effective communication between people in some kind of relationship. Intimacy enables (…) sentient beings, who feel comfortable enough with each other on an emotional and/or physical level, to reveal something about themselves and connect in some form of meaningful exchange."

From this perspective, reciprocal intimate experience relies on 'being sentient', in emotional and/or physical exchange. Crucial to the 'sentient beings' is a sense of feeling 'comfortable', safe enough to be '**vulnerable'** in each other's presence and to **'**reveal' something about themselves. Intimate experience assumes a form of **self-revealing**, in relation to **response** and social support. A 'meaningful exchange' presumes shared awareness of meaning, that relies on a process of **shared** (non-)verbal meaning making and **reflection** (Lomanovska & Guitton 2016; Lambert & Winkel 2019, Verhaeghe 2018).

This thesis applies the above-described characteristics, of 'intimate experience' to shared embodied experience of technically mediated social touch.

Table 2.1.3.1 extends the previous table with **Self-revealing touch gestures and response**; in **Vulnerable interplay**; and **Shared Reflection**; in line with Chatzichristdoulou's (2012) argument.

Table 2.1.3.1. Characteristics of:

Shared embodied INTIMATE experience of technically mediated social touch interaction.

1). Sensory Disruption of Physically touching and being touched,
through:
- Haptic feedback technology

with Reciprocal influence on each other's actions, in Vulnerable Interplay,
through:
- **Self-revealing touch gestures and response**

2). Shared Reflection.

2.1.4 Technically Mediated Shared Spaces, with Multiple Participants

This section discusses characteristics of embodied intimate experience of technically mediated shared spaces for social touch, shared by multiple participants; on the basis of which table 2.1.3.1 is extended in table 2.1.4.1.

It was long assumed that physical proximity is a prerequisite for intimate experience of social touch, in 'a physically shared space' (Hall 1963). And this form of touch certainly offers one of the most "socially rich" forms of intimacy (Lombard & Ditton 1997; Lombard & Jones 2013), or "thick intimacy" (Lambert & Winkel 2019, quoting Jamieson).

However, technical mediation enables intimate connections, such as of social touch, to be spatially extended to hybrid spaces. Increasingly, intimate interaction in physical, singular, sometimes secluded spaces, shift to digitally networked spaces, in which private and public connections are often entangled (Lambert & Winkel 2019). These hybrid spaces facilitate multiple participants to explore and share intimate experience among each other, via personal combinations of different forms of multi-modal interaction (**Fig. 2**.) (Lomanovska & Guitton 2016), in different (non-)simultaneous social configurations.

In these hybrid spaces, forms of public intimacy[25]; "extimacy"[26]; or "ambient intimacy" (coined by Hjorth et al. (2012) and discussed by Lambert and Winkel (2019)) take place.

For example, in technically mediated environments for intimate sexual experience (Lombard & Jones 2013), participants adapt multi-modal types of sensory input and stimulations for different levels of feeling intimately connected (ibid. p.28).[27] Such combined, interactive, a-simultaneous, and distributed communication forms have been orchestrated to substitute face-to-face sense making and negotiation (that has shown to emerge from direct social touch and proximate sexuality) (ibid. p.33).

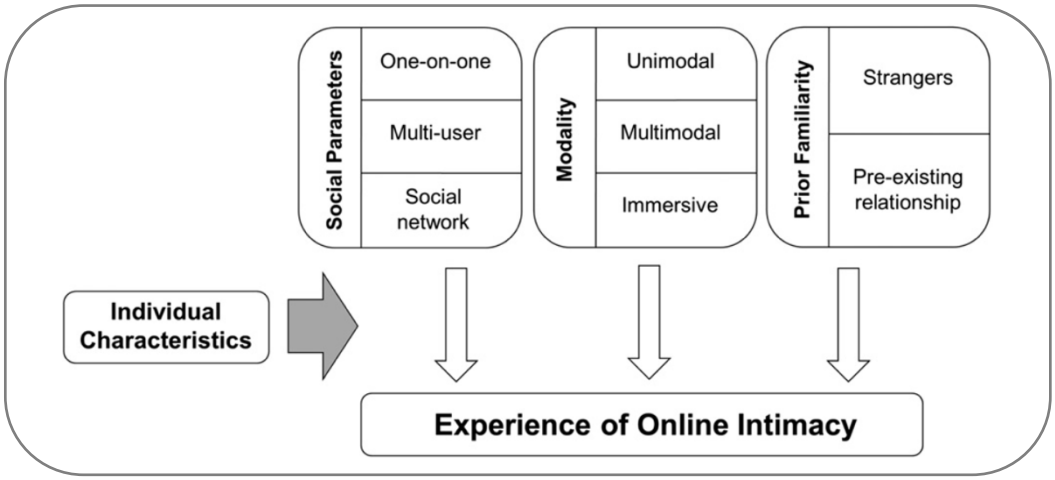

Fig. 2. Potential factors influencing the experience of online intimacy (Lomanovska & Guitton 2016)

Shared mediated spaces that support simultaneous interaction, with verbal and visual communication for shared meaning-making, have shown to have the potential to increase a sense of sharedness in intimate interaction (Lomanovska & Guitton 2016; Lombard and Jones 2007, 2013). They have the potential to "ground" (Clark and Brennan 1991) an experience as

[25] The notion of 'Public intimacy' has been critiqued by among others Illouz (2007) and Turkle (2011), addressing the way "social and mobile media encourage a mediated, public, performative practice that produces *erzats* relationships and narcistic personalities" (Lambert & Winkel 2019, p.304).

[26] https://www.gamescenes.org/2011/02/event-extimacy-the-intimate-is-other-museum-of-contemporary-art-palma-de-majorca-spain-29012011-0105.html, last accessed 2022/7/15

[27] Interaction is explored in direct (f.e. through prosthetics) and indirect corporeal interaction (between actors and spectators), or in combination.

a shared, social experience (Freedberg and Gallese 2007; Huisman 2017; Zimmerman et al. 2007). Moreover, such shared spaces have shown to partly replace a shared physical context, essential to shared intimate experience, such as of social touch (Wang et al. 2012).[28] Absence of a shared context has shown to limit the potential of intimate experience. Emerging research focusses on different shared (social) contextual factors in mediated interaction (f.e. through communication about the type of touch, location, or the partner's culture; through sharing narratives (ibid.), and shared emotional feedback data (Huisman 2013).

Interaction in shared social contexts, among familiar or intimate partners, is often experienced as more intimately meaningful (Lomanovska & Guitton 2016) than interaction with strangers or unfamiliar others (Saarinen et al. 2021). The effects of the mediated, social private-public context on different touch behavioral patterns (ibid.) are yet unknown.

Shared *mediated spaces* have been facilitating tele-matic or virtual reciprocal haptic interaction that may create a sense of social touch; through identification with a shared action (Sermon 2020, Packer 2018) or avatar (f.e. in multi-player virtual (game) platforms for social encounters.[29]

However, shared spaces for multiple participants have rarely been designed for shared intimate experience of social touch, as defined in table 2.1.3.1. Limited focus has been on physically touching and being touched, in a vulnerable interplay **for multiple participants**, through self-revealing actions and response, and shared reflection. Often, HCI research has prioritized social touch interfaces for 'users', as 'senders' and 'receivers' of biofeedback (Salter & Howes 2016), and less for shared performance in *empathic and reflective* '*self-other'* interaction (discussed in section 2.2.1).

In the artistic field, shared spaces for multiple participants, for shared mediated social touch, have been orchestrated in interactive media performance art. Kwastek has discussed shared spaces for staging artistic performances, based on Fischer-Lichte description of "performative" spaces (2013, p.100). In these spaces, the gaze of spectators frames the social touch performance as subject to reflection (Kwastek 2013). Nevertheless, in these spaces, interaction *among multiple participants* has rarely been combined with *shared* reflection, as part of the performance script, discussed in section 2.3.3.2.

[28] Appreciation, sense making and clarification of the meaning of social touch are social context dependent (Wang et al. 2012).

[29] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8075606/

Table 2.1.4.1 extends the previous table, with characteristics of shared embodied intimate experience *for multiple participants*, namely: a **Technically mediated shared space** and **Technicall**y **mediated verbal and/or visual communication** (Lomanovska & Guitton 2016; Lombard & Jones 2007, 2013).

Table 2.1.4.1. Characteristics of:

Shared embodied, intimate experience of **technically mediated social touch interaction FOR MULTIPLE PARTICIPANTS.**

1). Sensory Disruption of Physically touching and being touched,
through:
- Haptic feedback technology
- **in a Technically mediated shared space**

with Reciprocal influence on each other's actions, in Vulnerable interplay,
through:
- Self-revealing touch gestures and response.

2). Shared Reflection.
- **Technically mediated verbal and/or visual communication**

2.2 Empathy in Technically Mediated Social Touch Interaction

This section explores characteristics of 'empathic' processes, in shared intimate experience of technically mediated social touch interaction.

This section's exploration is fundamental to research into the role of social touch for the regulation of physical and emotional well-being (Huisman 2017); and for research into autism[30], which however exceeds this thesis.

Intimate experience relies on a sense of empathy, or 'Einfühlung' (Vischer 1873). Empathy enables to feel what others feel; to share emotions of pain, death, fear and loneliness, of illness, happiness and desire, in profound connections (Jamieson 2013, Turkle 2018, Verhaeghe 2018).

In intimate experience of social touch interaction, empathic processes take place in reciprocal interaction, between people who touch each other.

These empathy processes includes entangled, physiological and cognitive processes (Decety & Moriguchi 2007).[31] Often, 'empathy' has been understood as only a *voluntarily* cognitive process; while physiological, *involuntarily* processes have been understood as forms of "mimicry" (motor-empathy); while others claim that physiological processes underly the cognitive processes (Bollen 2023). Gerdes & Segal (2009) argue that based on entangled physiological and cognitive processes, empathic action taking can occur. [32]

Below are discussed characteristics of cognitive, reflective processes and physiological processes, on the basis of which Tables 2.2.1.2 and 2.2.1.3 are extended:

- **Characteristics of Cognitive Empathic Processes in Interaction (2.2.1)**
- **Characteristics of Physiological Empathic processes in Social Touch Interaction (2.2.2)**
- **Characteristics of Body-centred Response to Motor Data Interaction (2.2.3)**

[30] Studying empathy in the field of autism research, Bollen (2023) states that "What is actually being understood as empathy varies substantially: the term empathy can refer to co-feeling, to mentalizing, to something inherently good, to something inherently biased, etc."

[31] MRI research into musical interaction shows that such oscillating self-other awareness improves collaborative performance of co-creating musical acts (Fairhurst et al. 2019).

[32] While it has been widely accepted that the mirror perception and cognitive processes are essential for empathy, Gerdes and Segal (2009, p.122) include the element of *action taking* as equally essential. From their perspective of social workers "committed to social justice", they state that: "Being empathic means understanding the situation of others and taking action in response to the interpretation of the situation".

2.2.1 Cognitive Empathic Processes in Interaction

In general, **Cognitive empathic processes** concern "*voluntary* mental thought processes, used to interpret one's affective response" to observed emotions and actions of others; that "enables one to take the other person's perspective" (Gerdes & Segal 2009, p.120). In line with the components of empathy identified by Decety and Moriguchi (2007), the cognitive empathic process includes aspects of "self-awareness", "mental flexibility", and "emotion regulation" (Gerdes & Segal 2009, p.121). Crucial is self-awareness (Decety & Moriguchi 2007), or conscious "self-other distinction" (Ward 2018), without confusion between self and the other person. Only through distinct self-other awareness, a *conscious identification* process can take place with the other person, in the imagination. It enables understanding of the (sometimes very) different experiential world of others.

Empathic processes in social touch interaction include affective responses to observed emotions and actions of other persons touching and being touched.

Processes that enable such response, for understanding and imagination of emotions and actions of others, have been described by Merleau-Ponty (1992). Merleau-Ponty considers the body to be "the embodied ground of all perceptions" (Svanæs 2000, p.89). In his view, 'being in the world' with others is firstly based on pre-cognitive and pre-reflective perception of experience. Conscious reflection, then, is evoked through perceived **ambiguous** and incomplete **experience.** Recognition of experience is suspended, evoking attention and heightened awareness; stimulating cognitive processes of reflection and meaning making, interpretation and imagination (Merleau-Ponty 1962; Stenslie 2010, p.182). Ambiguous experience can thus be understood to instigate cognitive processes of **reflection on the experience**.

Damasio (2003) builds on Merleau-Ponty's argument, stating that the body plays an essential role in cognitive processes arising in the higher parts of the brain, through emotional processes. Processes of embodied cognition are embedded in intersubjective interaction. This interaction takes place between the body and the world (and with others). Behavior and experience (such as of social touch) are constrained by the interaction, that in turn, influences the processes of embodied cognition.

Three concepts are important to his theory of core consciousness: "emotion", "feeling" and "feeling a feeling" (or core consciousness) (Damasio 1999, in: Bosse, Jonker & Treur 2008). Damasio (1999) further suggests that "having a feeling' is not the same as 'knowing a feeling'; that reflection *on* feeling is yet another step up" (Damasio 1999, p.283–284 (in: Bosse, Jonker & Treur 2008)).

From the perspective of Dewey (1997), ***reflecting on experience*** and meaning making moves a person into a deeper understanding and connections with other experiences and ideas (Rodger 2002). Such experience can include a wide spectrum of thought, feeling, doing, handling, and perceiving. Experience includes human beings in relation to one another and to

their environment, in a continually changing contexture.[33] Reflection, then, is directed to improving the *quality of experience*. From Dewey's perspective, such reflection "requires attitudes that not only value the personal and intellectual growth of oneself but also that of others", and "needs to happen in community, in interaction with others" (Rodgers 2002). From this perspective, reflection on experience, enhances individual *and* communal growth, **shared in interaction with others**.

Shared cognitive empathic processes, on *shared experience* of social touch interaction, rely on constructing a shared understanding and reflection, in a communication process called "**Grounding**" (Clark & Brennan 1991, Huisman 2013). Grounding refers to a process of mutual attuning and confirmation, while assuming "a vast amount of shared information or common ground – that is, mutual knowledge, mutual beliefs, and mutual assumptions" (Clark & Brennan 1991). [34] During this communication process, grounding can happen through expression of utterances that influence and interact with each other in a meaningful manner, further discussed in section 2.3.3.2. Crucially, through grounding, both parties must perceive to be talking about the same thing, in a process of constructing a shared understanding (Clark & Brennan 1991).

In grounding processes during social touch interaction, cognitive empathic interpretation of the other person's intentions is supported by *(non-)verbal* cues (e.g. of gestures or facial emotional expressions) (Haans & Ijsselsteijn 2009, p.139).

The other person's emotional states and behaviour must be understood in the (among others social and cultural) context, in which the interaction takes place (Wang et al. 2012). In direct physical interaction, *non-verbal* cues can be used to confirm mutual understanding; while shared cognitive empathic processes in technically mediated interaction at least partly rely on *verbal* interaction (Lomanowska & Guitton 2016).

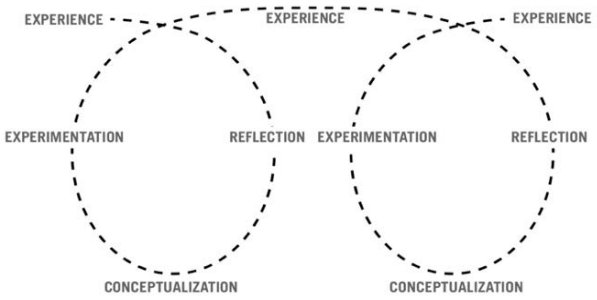

Fig. 3. Model for reflection on experience in a spiraling process; based on models by Dewey (1938) and Kolb (1984).[35]

[33] https://www.americanphilosophy.com/dewey.html

[34] DOI:10.1037/10096-006

[35]https://www.brikbase.org/sites/default/files/Vol0502_04_Interdisciplinary_Training_in_Medical_Simulation.pdf

Empathic cognitive processes of shared reflection have been applied to art, science, design:

- **Human Computer Interaction (HCI)**. Emotional and cognitive components, that support empathetic processes and meaning making between humans, and conversational agents (or chatbots) and humanoids, have been subject of recent HCI research. Examples include emotional and practical support by affective agents, to victims of cyberbullying (Van Der Zwaan, Dignum, Broekens & Jonker 2011).
- Increasingly, empathic processes of touch are subject to research into human agent interaction (Bickmore and Schulman 2010; Van Erp and Toet 2015; Morrison et al. 2011).

  This research focusses on aspects of interpretation of (social) context, expectation, intention. Recent research explores social interaction between humans and social agents through touch (Huisman 2013). Shared meaning-making in a dialogical process of 'grounding', between participants and agents, is a challenge.

- **Learning.** From a transformational learning perspective, *reflection on experience* enables understanding and informs new actions, in an ongoing **process**. This process has been visualized in a model by Dewey (1938), adapted by Kolb (1984), among others. The model depicted in **Fig. 3,** visualizes the processual spiral character of Dewey's model, combined with the four stage circular model by Kolb for Experiential Learning; including components of Experience, Reflection, Conceptualization and Experimentation. **Participatory Design.** In the context of Participatory Design, reflective processes have been explored to help participants to become co-designers, with influence on design; from the perspective that "All people are creative" (Sanders & Stappers 2012, p.20). On some occasions, participants have been helped to communicate their personal wants, needs and dreams, for example in relation to design of connections in shared urban spaces (Slingerland 2022, p.33). To this purpose, processes of shared reflection ***on* experience as 'an experience'**, and on the 'co-experience', with fellow participants (Zimmerman & Forlizzi 2007) have been applied.
- **Live Art.** Similarly, in the context of Live Art (section 2.3.3.2), Loke and Khut (2014) have focussed on evoking reflection on experience, to formalize **the experience as 'an experience'**. In this context, the participants personal authorship of the experience is center point of attention, of creating a '**reflective narrative'** (further discussed in section 2.3.3.2). This approach focusses on supporting participants to stimulate a process of giving meaning and "embed their experience within a network of other life experiences"[36]. It enables them to discuss their experience with others.

[36] Loke and Khut (2014) have stated that "The objective is two-fold: to create representations of and reflections on subjective experience that can serve as visual stimulus for formal and informal conversations; and to facilitate the articulation of personalized narratives describing experiences of embodiment, and body-mind interconnectedness." (Loke & Khut 2014, p.100).

This thesis embraces the definition of shared cognitive empathic processes of shared reflection in mediated social touch interaction for multiple participants as: 'Shared reflection on experience', in interaction with others (Clark & Brennan 1991, Dewey 1997, Zimmerman & Forlizzi 2007, Loke & Khut 2014).

This thesis defines *Shared cognitive empathic processes*
in technically mediated social touch interaction for multiple participants as**:**
'Shared Reflection on Experience'.

Table 2.2.1.1 extends the previous table with characteristics of shared cognitive empathic processes, namely: Shared reflection **On experience** (Clark & Brennan 1991, Dewey 1997, Zimmerman & Forlizzi 2007, Loke & Khut 2014).

Table 2.2.1.1. Characteristics of:

***Shared cognitive empathic processes,* in**
Shared embodied, intimate experience of technically mediated social touch interaction for multiple participants.

1). Sensory Disruption of Physically touching and being touched,
through:
- Haptic feedback technology
- in a Technically Mediated shared space

with Reciprocal influence on each other's actions, in *Shared Empathic,*
Vulnerable interplay.
through:
- Self-revealing touch gestures and response

2). Shared Reflection
On Experience, through:
- Technically mediated verbal and/or visual communication

2.2.2 Physiological Empathic Processes in Social Touch Interaction

This section discusses physiological empathic processes, in social touch interaction.

Physiological empathic processes, such as in social touch interaction, take place through spontaneous, *involuntary* reactions to emotions and actions of another person (Gerdes & Segal 2009, p.120). It is based on 'Affective Sharing': **"**The experience of similar emotions between the self and another, based on automatic perception-action coupling and shared representations" (Decety & Moriguchi 2007 (in: Gerdes & Segal 2009)). Iacoboni (2008) describes these processes as follows: "According to the mirror neuron hypothesis of empathy, our mirror neurons fire when we see others expressing their emotions, as if we were making those (facial) expressions ourselves. By means of this firing, the neurons also send signals to emotional brain centres in the limbic system to make us feel what other people feel."

In reference to the Simulation Theory, activities of the **mirror neuron** system (Ward 2018, p.59) can be described as 'stimulating' or 're-creating', with the actions and reactions of the other person as if 'in our own neurological architecture' (Ward 2018, p61). Subsequently, the empathic **mirror perception** of social touch causes a synthesis of bodily processes and action (Elkins 1996; Langer 1989; Merleau-Ponty 1962). Even a purely visual stimulus of seeing others touching or being touched establishes such embodied centred responses, as **vicarious experiences** of touch (Ward 2018).

In a pronounced, somewhat different way, vicarious experience is the case in 'mirror-touch synaesthetic' perception (Martin 2018). Mirror-touch Synaesthesia connects perception of seeing someone else being touched, to sensations on the own body of being touched (Ward et al. 2018). In reference to the Threshold Theory, MTS leads to less clear thresholds between another person's body and one's own body (Ward 2018, p.59-60). It has been defined as a body centred response that "expands the body schema" (Martin 2018, Ward 2018). Ward has proposed that such body centred response leads to a form of 'self-other confusion' (Ward 2018 p.63), and to a sense of being *one* with another person who is being touched. The ability of recognizing facial expression, essential to support cognitive empathic processes, often relies on a person's ability to distinguish between self and other (Ward et al. 2018).

Ward (2018 p.58) has argued that, to a limited extent, MTS neural processes also play a role in non-synaesthetic perception. Moreover, immersive body centred responses to visual stimuli of touch not only occur in relation to other persons, but also to (mediated, virtual) images of others (on a screen) (Gallese 2008 in: Ward 2018, p65); and art (Freedberg & Gallese 2007; Robert Vischer 1872).

This raises the question whether (and to what extend) the human capacity of mirror perception of social touch can be stimulated in mediated interaction. This question is discussed in the next section 2.2.3.

Table 2.2.2.1. Characteristics of:

***Physiological empathic processes,* in**
Shared embodied, intimate experience of technically mediated social touch interaction for multiple participants.

1). Sensory Disruption of Physically touching and being touched
through:
- Haptic feedback technology
- in a technically mediated shared space
- **Visual perception: Mirror-perception and Emotional (facial, touch) expression**

with Reciprocal influence on each other's actions, in *Shared Empathic,*
Vulnerable interplay.
through:
- Self-revealing touch gestures and response

2). Shared Reflection
On Experience, through:
- Technically mediated verbal and/or visual communication

Table 2.2.2.1 extends the previous tables with characteristics of Physiological empathic processes, namely: **Visual Perception: Mirror-perception** (Ward 2018) and **Emotional (facial) expression** (Iacoboni 2008), crucial to orchestration of an empathic interplay.

2.2.3 Body-centred Response to Motor Data Interaction

This section explores perception of tactile sensations on the own body *in technically mediated interaction,* when seeing other persons being touched. The question whether such tactile sensations can be established **through visuo-haptic connections**, with technically **mediated present others**, is explored.
Instead of focusing on technological design of *tactile signal sending* (discussed in section 2.1.4), this section explores empathic motor processing of tactile perception in the brain when seeing to be touched. (*Note*, that the next section (2.3) explores an empathic interplay of emotional expressions; and cognitive processes (reflection) in line with Table 2.2.1.1)).

Visuo-haptic **body centred response connections** to mediated others and images on a screen, have been explored in the fields of psychology and neuroscience. Such research (Ijsselsteijn et al. 2006) focussed on the plasticity of the brain and flexible sense of body ownership (with a less clear awareness of distinction between self and other), explained below.

Building on previous analogue experiments with visuo-haptic motor feedback loops of affective touch gestures (f.e. the "Rubber Hand Illusion" (Ramachandran 1998; Ijsselsteijn et al. 2006)), other experiments have explored visuo-haptic motor feedback *data* loops. These experiments investigate whether affective touch gestures stimulate motor agency to be transferred (Petkova et al. 2008) to visual, *technically mediated* bodily representations of others. As a result, many studies found that body ownership awareness can be transferred to these visual representations (f.e "Mirror-Box", "Virtual Hand Illusion", "Enfacement Illusion" (Ijsselsteijn et al. 2006; Ma & Hommel 2013; Tajadura-Jiménez et al. 2012)). These visual representations are no longer perceived as distinct 'others'; instead, participants identify with these representations and respond to them with a similar affective bodily response as to their own physical bodies (Ma & Hommel 2013).[37]

Crucially, in these experiments, physical, affective touch gestures emerge in congruent and simultaneous movements with the technically mediated visual representations, in visuo-haptic motor feedback data interaction (Petkova et al. 2008; Ma & Hommel 2013)[38],[39]; with fluidly integrated technologies (Ijsselsteijn et al. 2006).

In these visuo-haptic experiments, affective touch gestures were found to stimulate body ownership while sensations of being touched were attributed to both the own physical body and the technically mediated image, without clear distinction; leading to a 'negotiable body image' (Ijsselsteijn et al. 2006, p.3).

Emerging research into similar visuo-haptic experiments, has explored perception of being touched by a virtual agent (Huisman 2013), and body ownership with bodily representations in shared VR spaces (Della Longa et al. 2022). As yet, limited research has focussed on touch transfer with robots (Jewitt et al. 2020b, p.47; Bickmore & Schulman 2010).[40]

The above described visuo-haptic motor data experiments focussed on research into *individual* body centred response, that led to *individual* identification with technically mediated images and representations. They do not purposefully facilitate cognitive reflection, emotional expressions, and reciprocal interplay (essential to empathic interaction); discussed in the next section 2.3.

[37] These experiments effect one's entire body even if only a part of the body part (f.e. a face or a hand) is represented (Petkova 2008).

[38] Ijsselsteijn et al. (2006) argues that "…the ability to distinguish what's contained within versus what's beyond our familiar biological shell — is a flexible, temporary construct and not a fixed property."

[39] The physiology of affective touch gestures has been previously discussed, in section 2.1.1.2.

[40] Shared *intimate* social touch experience with virtual agents and robots is still in its infancy; such experience would require a sense of *shared physical experience* (of touching and being touched) and *shared reflection*, described in the previous sections.

The next section focusses on similar visuo-haptic experiments, in 'artistic orchestrations', that explore the potential of body centred responsiveness to *shared* embodied experience of touching and being touched, among multiple participants.

Table 2.2.3.1. Characteristics of:

***Body-centered response to motor-data,* in**
Shared embodied, intimate experience of technically mediated social touch Interaction for multiple participants.

1). Sensory Disruption of Physically touching and being touched,
through:
- **Visuo-haptic motor data interaction**
- in a Technically Mediated shared space
- Visual perception: Mirror-perception and Emotional (facial, touch) expression

with Reciprocal influence on each other's actions, in *Shared Empathic,*
Vulnerable interplay.
through:
- Self-revealing, **Affective** touch gestures and response

2). Shared Reflection
On Experience, through:
- Technically mediated verbal and/or visual communication

Table 2.2.3.1 adapts the previous tables, with a focus on body-centred response to motor data interaction; replacing characteristics of haptic feedback technology with **Visuo-haptic motor data interaction** and **Affective** touch gestures (Ijsselsteijn et al. 2006; Tajadura-Jiménez et al. 2012; Huisman 2013; Ma & Hommel 2013).

2.3 Interactive Media Performance Art of Shared Social Touch Experience

This section firstly explores characteristics of interactive media performance art orchestrations (2.3.1); followed by the characteristic 'disruption' (2.3.1); and examples of disruption in artistic visuo-haptic motor data interaction (2.3.2); leading to adaptions in Table 2.2.3.1.

- **Characteristics of orchestration of interaction in media performance art among multiple participants (2.3.1)**
- **Characteristics of 'disruption' in orchestrations of social touch interaction in media performance art (2.3.2)**
- **Examples of artistic orchestrations of affective touch, in disrupted, visuo-haptic motor data interaction (2.3.3)**

2.3.1 Characteristics of Orchestration

This section explores characteristics of interactive **media performance art**, involving **multiple participants.** Discussed are the terms 'Performance' (and non-digital performance art involving audience activity); 'Interactive'; 'Performance art scripts'; 'Play*full* Performance'; 'Participation'; 'Performativity'; 'Response' and 'Spectatorship'. This section ends with Conditions of performance scripts, including Performative phases.

Kwastek (2013) argues that in a diversity of disciplines, including ethnography, psychology, linguistics, and literature studies, anthropology, the concept of 'performance' has been used and studied.

The term is "used to denote public presentations of exceptional abilities (such as artistic skills), to describe representational behavior that is separate from daily life, and also to characterize the quality of the execution of an activity" (Kwastek 2013, p.81).

Characteristically, performance is addressed to an audience. In performance studies, Schechner (1977) has characterized performance "an activity done by an individual or group, in the presence of and for another individual or group". This can also take place even without the actual presence of such group, public or audience, in which case the performance is observed only by the performer himself. Schechner asserts that "performing on stage, performing in special social situations (public ceremonies, for example), and performing in everyday life are a continuum" (Schechner 2002, p.143) including routines, rituals, and everyday life conventions. From this perspective, "engaging in *real life* is often indistinguishable from *role play"* (UKEssays November 2018).

***Interactive* media performance art** focusses performance of interaction, through action and reception. It emphasizes self-reflection on the experience of the processuality and interpretability of the interaction itself, through interaction (Kwastek 2013, p.128). Actors in

these interactive processes can be human and non-human, including technology, objects, contexts, concepts, that each in their own way can authorize, permit, influence, and afford the performed interaction (Latour 2005, in: Kwastek 2013, p.97).

Interactive[41] **media performance art *scripts,*** that specifically direct the attention to *social connections*, (subject to this thesis), often build on *non-digital performances art that involved audience activity*, developed since the 1960s. These performance art scripts were developed to shift the role of the audience to actively share engagement and responsibility to the performance. Among others, they were developed to re-direct audience attention, to the (vulnerable) embodied presence of the artist/performer[42]; to collective, bodily participation (Clark (1964-1988) in: Lepecki (2014); Osthoff (1997)[43]); to shared creative power to (re)shape society (Beuys[44]); and to shared critical negotiation and reflection on 'conviviality' (Bourriaud 1998), the context and meaning of relationships in social interaction. Different conceptual approaches include, among others: 'Social Sculptures'[45]; 'Happenings'[46] (Kaprow 1959); 'Body Art' (Goldberg 2001); 'Social Practice' or 'Socially Engaged Participatory Art' (Bishop 2012), 'Relational Aesthetics' (Bourriaud 1998); and (including digital interaction) 'The Artwork as a Living System' (Sommerer & Mignonneau (in: Ohlenschläger et al. 2022)).

> *Note*, that 'Relational Aesthetics', a term coined by Bourriaud (1998), has sometimes been associated with interactive media performance art.[47] However, although Bourriaud wrote his book in the emerging internet cultures of the 1990s, he does not make the link with digital and internet art. His approach focusses on negotiation of interpersonal systems through *transparent '*formations'. In contrast to his approach, interactive media art has (partly) been considered *non-transparent design* of technological 'black boxes' (Kwastek 2013, p.59). Complete media transparency has been considered impossible (ibid., p.143).

[41] In reference to Paul (2008) Kwastek argues that "a clear distinction" can be made "between the use of digital technology as a tool for producing artistic works in different forms (photography, graphics, sculpture, music) and its use as a processual artistic medium" (Kwastek 2013, p.269).

[42] Pre-electronic experiments exploring vulnerability of the artist's body in control of the audience include Chris Burden giving a rifle to others to shoot him ('Shoot', 1971). In 'Velvet Water' (1974) Burden has spent five minutes attempting to breath water while a live audience watched. In another example, 'Rhythm O' (1974) Marina Abramovic has surrounded herself by objects of potential violence (a knife, razor blades, and a loaded gun), letting the audience choose to use these objects (Federova 2020, p.68).

[43] Osthoff (1997) argues that "There is a significant conceptual link between these "collective body works" and the characteristic of telecommunications art Roy Ascott calls "distributed authorship"."

[44] Joseph Beuys. https://en.wikipedia.org/wiki/Joseph_Beuys, last accessed 2022/5/24.

[45] https://en.wikipedia.org/wiki/Social_sculpture; https://www.tate.org.uk/art/art-terms/s/social-sculpture,last accessed 2022/10/2-.

[46] https://www.artsy.net/article/artsy-editorial-what-were-1960s-happenings-and-why-do-they-matter.

[47] https://www.tate.org.uk/art/art-terms/i/interactive-art, last accessed 2022/24/5.

> From an opposite perspective, others *promote* artistic exploration of (non-transparent) technically mediated interpersonal relations, stating that "The human today is embodied in and through technics" (Hansen 2012). Arguing against a dualism between physical body and (non-transparent) technological media, Haraway claims that "the machine is us, our processes, an aspect of our embodiment." (Haraway 2004, p.37-38).

Live art has emphasized the *innovative and exploratory* character of performances or events, created, explored and/or staged by (individual) artists (Goldberg & Anderson 1998).[48] At the intersection of Human Computer Interaction (HCI), Computing and Live Art is Digital Live Art. Digital Live Art includes computer mediated live performance, as "an orchestrated, temporal witnessed event occurring for any length of time and in any place using technological means.".[49]

Play*full* performance scripts have focussed on aspects of 'aimless play' and 'ludic play' (Huizinga 2008; Kwastek 2013, p.74; Scheuerl 1968), with freedom of activity, voluntarily performed, without a fully predictable course, in an artificial realm. Most often, the above described performance art practice does not aim at constituting a (social) reality (Gould & Sermon 2015) outside the art work. It has however often challenged the line between a play, ('participatory') performance art and a social event (Kwastek 2013, p.15).
In interactive performance art, audience members have been referred to in different ways, including 'Recipients' (in Kwasteks words (2013, p.94)); or volunteers (id p.15). In this chapter, the term 'participants' is applied. **Participation** can take place through different (more active or passive) levels of activity. A participant's activity, however, is not a form of theatrical role-playing or interpretation of a sign system; but a **performative action** (Fischer Lichte, in: Kwastek 2013, p.88).

The term **performativity** was introduced by Butler (1990) to feminist theory, adding identity construction to action, critically pointing at emergent narratives and power structures *through every day acts*. This understanding of performativity was then extended to performance art by Schechner (2003). In this context, 'performativity' points at a type of behaviour that ambivalently takes place as both and actual execution and a symbolic representation. Through performativity, actors (or participants) present the reality, or materiality, of an act. The constitution of reality is artificial, but not representational. Ambivalence between artificiality and reality replaces the 'doubleness' of theatre (with its distinction between real life and performance) (Kwastek 2013, p.84). Fischer-Lichte, quoted in Kwastek (2013, p.88), argues that "the perception of a performance can switch between

[48] https://www.thisisliveart.co.uk/about-lada/what-is-live-art/

[49] Digital Live Art uses the concept of *performance frame* (stemming from the social sciences, anthropology (Bateson (https://www.wikiwand.com/en/Gregory_Bateson)), and ethnography (Goffman 1978) described as a cognitive context, with rules of behaviour, symbols and interpretations bound within a particular activity, within its own structure. https://en.wikipedia.org/wiki/Digital_Live_Art, last accessed 2023/2/10.

'representation' and 'presence', as there are constant ambivalent shifts in the relationship between subject and object, and materiality and signification.".[50]

In today's technically mediated society, with networked infrastructures of pervasive, ubiquous digital media, deeply influence ways of the enactment and appearance of performativity (Leeker et al. 2017), for example in social media (selfie) cultures and smart city surveillance infrastructures. The meaning of performativity has shifted to Posthumanist meanings of interaction, or 'intra-action' (Barad 2003) between human and digital agency.

Participants, in interactive media performance art works, explore performative actions designed by artists. Participants present the reality, or materiality, of an artistically designed act; while interactive feedback systems show often fluid boundaries between their personal self-expression, self-representation, and digitally programmed interpretations (Kwastek 2013, p.154).

This participant's performative action has been described, among others, as an **aesthetic response**; as a form of 'realizing' or 'completing' the artwork (ibid., p.224); or as a means to self-perception within the artwork. Some argue that the artist remains the author (id. P.91); while others state that participants are invited to "make the work together *with* the author" (Eco 1989); or that they 'co-create' the artwork, because "the participants' experiences and interpretations constitute the work." (Kluszczynski 1995). Other artists invite participants as narrators and autobiographers of possible scenarios facilitated within the artwork (Shaw 1989).[51],[52]

In interactive media performance art, the participants' actions are not being performed *for spectators* (as theatrical role play). Instead, the actions take place in the context of the *public gaze.* The presence of the public gaze frames the intimate encounters and gestures as subject to collective reflection (Kwastek 2013). In many cases, the participant's performative actions are observed by spectators, who are **potential participants**. The spectator's mental anticipation, of *potential* interaction, has been considered vital to their sense of engagement (Blunck 2005, Kwastek 2013, p.75).

[50] From this perspective on performativity, Fischer-Lichte encourages to go beyond normative definitions of action - for variable relations between reality constitution and action to be explored.

[51] Kwastek (2013) describes that "Several artists working with new media explicitly declare that they are primarily interested in an aesthetics based on action and process." She quotes Krueger (1977): "It is the composition of the relationship between action and response that is important. The beauty of the visual and aural response is secondary. Response is the medium!". A similar view has been expressed by Ascott: "The aesthetics in this transformative work lies in the behavior of the observer." (Kwastek 2013, p.48).

[52] Shanken (2001a) describes "the transformation of the viewer into an active participator" (Shanken 2001b) in Ascott's practice and theory (Ascott 2003). The participator "collaborates in creating the work, which is never a static product, but always remains in process throughout its duration". Telematic Art embraces and connects participators meeting in cyberspace's hybrid field, where they "collaboratively create and transform - in a process of negotiation and unification that embodies and generates 'love'." (Shanken 2001b).

Conditions of interactive and participatory **performance scripts** often include aspects of:

(1) **Space:** spatial orchestration (f.e shared 'performative spaces' for artistic practice (Fischer-Lichte, in: Kwastek 2013), or telematic 'third spaces' (Packer 2018; Sermon 2020).

(2) **Contexts,** such as social contexts (section 2.1.4) and environmental contexts (f.e. in public space and the smart city (Verhoeff & Cooley 2014; Pop et al. 2016, Mcquire 2008; Mcquire et al. 2009; Nijholt 2019), further discussed in section 5.1).

(3) **Time:** including duration, repetitive gestures, infinite time frame.

(4) **Action:** Actions and involvement rely on participatory strategies to engage participants (f.e. as "volunteers" or explorers, by means of sensitive or sometimes "repressive strategies" (Kwastek 2013, p.15)) and conditions of agency. Engagement in relations of performativity or spectatorship, through action, identification, and reflection, has required design of **performative phases** (f.e. 'participatory transitions', and 'trajectories' (Benford & Giannachi 2011; Loke & Khut 2014), discussed in section 2.3.3.2. Often, artists or trained performers play a central role, they interact with and /or guide participants (further discussed in section 2.3.3).

2.3.2 Characteristics of 'Disruption'

This section discusses characteristics of orchestration of disruption, in interactive media performance art. In both Art and Human Computer Interaction (HCI) research contexts disruption guides the design, but from different perspectives.

In the HCI context, sensory disrupted social touch has been redesigned into forms of mimicry and perceived illusion of *non*-mediation of technology (discussed in section 2.1). To this purpose, multi-sensory and multi-modal feedback systems and technologies have been explored to stimulate a sense of presence and face-to-face communication, as a way to replace direct social touch perception.

In contrast to this HCI approach, interactive media performance art radically explores design of disruption. In the artistic field, the interest in disrupted bodily connections, and the subject of 'disembodiment' is, in fact, a return to new perceptions of embodiment, in technically mediated interaction (Kwastek 2013, p.151).[53] In interactive media performance art, design of **disruption** has been applied for orchestration of both a) technically mediated embodied experience, and b) reflection *on* the experience, discussed in the following sections:

- **Disruption, for shared embodied experience, in technically mediated interaction (2.3.1.1)**
- **Disruption, for reflection *on* the experience, of technically mediated interaction (2.3.1.2)**

[53] *Combined* Art and HCI approaches have been explored by among others Gill (2013) introducing the concept of 'Relational Interfaces'. Her concept refers to shared exploration of embodied experience, and to reflection *on* the experience; based on personal bodily (tacit) knowledge and dialogue, through movement, negotiation, synchronizing rhythm, play.

2.3.2.1 Disruption, For Shared Embodied Experience, in Technically Mediated Interaction

This section discusses the term 'disruption' as a characteristic of artistic design, of *embodied experience in* technically mediated haptic connections found in the literature.

From an artistic perspective, the technically mediated body is intimately intertwined with digital data spaces and information flows (Hansen 2012). To encourage new forms of (dis-)embodied awareness, a shift of senses (Sermon 2020), different sensory qualities for perceived interaction with these data flows (with human and non-human others (Haraway 2020, Latour 2005)) have been explored through different types of **disrupted sensory** interaction.

Familiar sensory connections have been disrupted, and re-orchestrated, exploring experience of technically mediated sensory connections extending the body (Mcluhan 1964)[54],[55] replacing each other into new multi-modal, digital synaesthetic feedback syntheses (Gsoelpointner et al. 2016). They have been **disrupted, differently scripted,** and turned into technically mediated "intercorporeal" systems (Paterson 2007) embodied "entanglements" (Salter 2010); assemblages (Haraway 2020); and orchestrations for experience of "collective corporeity" through technology, in shared **intercorporeal**, interactional spaces (Hansen 2012, pp.84,101). Datafication of the disrupted interaction has been orchestrated as co-actors, influencing, and affording the process and interpretability of interaction (Latour 2005 (in: Kwastek 2013, p.128)).

Many artists have explored *individual* "fluid interpenetration of realms" (Hansen 2012) of physical bodies interacting in spaces of data flows (Manuel Castells 2020). Subjects to exploration varies from the changing relations between the self, the other and the world at the level of the interface (Federova 2020) to the impact of digital materiality on love's practices and meanings , on affect, emotion and feeling -and reversely, how the the material world's transformation and production is being influenced by (digitally embedded) love (Malinovska & Gratzke 2017).

Often, the participant's interaction in such orchestrations have been supported by 'expressive' and 'magical interfaces' (Reeves et al. 2005), with seducing accessible, and seemingly magical interaction between bodily movements and data.

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[54] Marshall Mcluhan argues that media extend the body: "The giving to man of an eye for an ear by phonetic literacy is, socially and politically, probably the most radical explosion that can occur in any social structure." (McLuhan 1964, 1987).

[55] As Jewitt et al. (2020) bring forward: "Drawing on Rheingold's early 90s visions of telesex, Parisi quotes Rheingold stating that it might 'eventually be possible "to map your genital effectors to your manual sensors and have direct genital contact by shaking hands," [Rheingold 1991: 352] resulting in the transformation of social touch" (Parisi 2018, in: Jewitt et al. 2020b, p.111)).

2.3.2.2 Disruption, For Reflection *on* the Experience of Technically Mediated Interaction

In the artistic context, the concept of disruption has often been explored to evoke reflection, in reference to the philosophical concept of 'perceptual breakdown' of an immersive 'flow', explained in section 1.2. Disruption has been established through orchestration of **ambiguous** social and sensory connections, that facilitate both immersion (a flow of interaction) and 'aesthetic distance' (disrupting the flow) for a process of self-reflection, *through* interaction (Kwastek 2013, 2016[56]).

These ambiguous orchestrations rely on connections that are, for example, both **comfortable and discomfortable** (Benford et al. 2012); **physical *and* technically mediated**; **immersive *and* disrupted**; **predictable *and* unpredictable**; familiar and non-familiar; with **potential and disrupted** agency (Kwastek 2013).

In interactive media art, specifically, ambigious *predictable* and *unpredictable* interaction has been orchestrated, with ambiguous relations between chance, risk and control (Kwastek 2013). In interactive media *performance* art, in which the artists and participants (social) actions are put central, also the *performative acts are the source of unpredictability*, turning these acts into being part of the aesthetic experience (Kwastek 2013, p.12). Kozel (2007, p.193) argues that "Some interactive principles can be programmed or choreographed, but fundamentally the richness of interactive systems is the *unpredictability* in how people respond to what they are offered and in turn how the environment responds to them."

The spectator's vicarious experience (discussed in section 2.2.2), of the performer's **disrupted interaction**, may lead to self-reflection too (Kwastek 2013, p.163). However, the difference between the aesthetic experience of the spectator's vicarious interaction and that of a participant's performative interaction, is that in the case of the spectator, the *reflective* elements are in the foreground (Shaw 1989).[57]

[56] Kwastek argues that "Experience of interactive art is specifically shaped by the interplay between immersion and distance, for only in this way can one's own actions become available as an object of reflection" (Kwastek 2013, p.163)

[57] Kwastek (2013, p.95). Kwastek and Muller, interview with Golan Levin, question 12. See also Sutton, "Vicarious Interaction. A Learning Theory for Computer Mediated Communications" (2000).

2.3.3 Artistic Orchestrations, of Visuo-haptic Motor Data Interaction for Social Touch

This section discusses characteristics of artistic orchestration in visuo-haptic motor data interaction of affective touch gestures (line with the experiments discussed in section 2.2.3) *for multiple participants.* Design characteristics of *disruption* of experience are explored; and the orchestration of *reflection* (building on the disrupted, ambiguous design).

- **Artistic Orchestration of Disruption of embodied experience (2.3.3.1)**

- **Artistic Orchestration of Reflection (2.3.3.3)**

Note, that background literature discussing Interactive Media Performance Art in the **Smart City** is presented in section 5.1.
Section 8.1 discusses **Artistic Brain Computer Interfaces.**

2.3.3.1 Artistic Orchestration of Disruption of Embodied Experience

This section explores examples of artistically orchestrated, disrupted *visuo-haptic motor data interaction of affective touch gestures,* shared by multiple participants. Similar to the experiments described in the literature discussed in section 2.2.3, these artistic orchestrations are based on body centred response to congruent, predictable, simultaneous visuo-haptic motor data interaction, and synthesizing perception.

Different to the experiments described in the literature discussed in section 2.2.3, congruent interaction with the visuo-haptic data has been **sensory disrupted** (Kwastek 2013), differently scripted and re-orchestrated in multi-sensory multi-modal, digital synaesthetic syntheses (Gsoelpointner et al. 2016). Familiar connections between 'touching' and 'feeling to be touched'; of seeing, and being seen, and of sharing emotional facial expression, have been disrupted. Biometric data of the performer's or participant's actions have provided feedback with fluid boundaries between what could be categorized as self-expression, self-representation and digitally programmed interpretations (Kwastek 2013).

In almost all orchestrations, the performer's body has been instrumental to the participants and spectators' touch interaction, as part of the interface (Federova 2020). Participants have touched a performer's body, but, up to the authors knowledge, almost never perform reciprocal touch with other participants.

Reciprocal influence between artists and participants, on each other's actions of touching and being touched, has often been crucial to the artistic design. Engagement in their interaction has been facilitated through **interdependent, intimate connections** in line with the argument by Chatzichristodoulou and Zerihan (2012) (section 2.1.3): including **self-revealing affective touch gestures**[58], a sense of **physical vulnerability** and **social support;** as part of the performance scripts. Most often, in these interactive orchestrations, **affective touch and facial expressions** have been visible to artists, participants and spectators, to establish empathic connections for all to share.

In many cases, artists have situated themselves in physical, psychological and social vulnerable relations to potential participants, provoking them to approach, caress, hold or even abuse their bodies, or experience vicarious touch interaction in the imagination; in environments that are hybrid (f.e. Cillari 2006-09, 2016; Van der Vlugt 2010) and/or networked (f.e. Cheang SL 1998; Stelarc 2015). The socially challenging interpersonal connections often evoked self-reflection and renegotiation concerning ethical values of shared well-being, responsibility, consent, trust (Kwastek 2013; Benford et al. 2012).

In case of participants performing with other participants, multiple orchestrations have explored sensations of disrupted physical proximity, in playful, kinaesthetic relations and motor interaction (f.e. Lozano-Hemmer 2001; Salter, TeZ & Lamontagne 2017), without self-touch or reciprocal touch. Roosegaarde (2022) evoked direct touch connections, but without congruent emergent kinaesthetic visuo-haptic motor data interaction.
In some cases, interfaces that visually mirror and merge participants' bodily representations (f.e. 'The Mirror-Box' (Daalder 2011) or 'Unstable Empathy' (Casalegno & Varriale 2012)), have played successfully with identification with another person through body centred responses in visual interaction, but did not include design of haptic interaction; and/or did not focus on shared experience by multiple participants and spectators as part of the performance script (Park 2018).

Representations of haptic movements and gestures have been shared in hybrid VR and online **shared spaces,** but without physically touching and being touched (f.e. Sermon 1992; Bennett 2020). Shared, VR multiplayer spaces with visuo-tactile or visuo-kinaesthetic connections, with live and/or pre-recored feedback, have been successfully designed to evoke illusions extending the sense of body-ownership (f.e. Crew 2016; Beanother Lab (2012, ongoing), Body Echoes (2020)); but with the artists/performers as replacing bodies for tactile interaction; or without participants autonomy to express touch gestures; often leading to limited shared *spatial* embodied memory (Van der Ham & Keizer 2021).[59]

[58] *Note*, that the designed touch *gestures* point *at* the body, signalling the importance of embodied awareness in technically mediated environments (Verhoeff 2014).

[59] In shared VR spaces, participants have expressed immersive embodied experiences; but they have also reported that their body knowledge, awareness and memory, of the space and moving *through* the space, remain limited (Van der Ham 2021); limiting meaningful reflection on the 'shared embodied experience'.

Devices and virtual environments stimulating tactile perception, for participants among each other but without physical reciprocal touch, have been explored by Morawe (2001) for challenging painful haptic connections, by de Nijs (2022) for online simultaneous touch connections, and by Stenslie (1993) through wearables ('CyberSM suits') for full body, technically mediated haptic feedback. Niederhauser (2018) has explored shared haptic dancing connections through holding hands, combined with individual visual VR feedback. Similarly, tongue-screen-touching interaction has been explored, in 'The Big Kiss' (Abrahams 2007).[60]

In other cases, involuntarily embodied responses (of heartbeats) have been translated to evoke audio-haptic and breath connections, without visual connections, for example between two participants holding devices in tele-present settings, in 'Mobile Feelings' (Sommerer & Mignonneau 2003, 2004).

Visual and sonic feedback of touching plants (not including participants touching each other)[61] has been explored by Sommerer & Mignonneau (1993) to establish artificial "Living Systems" (Ohlenschläger et al. 2022), that show behavior and growth like natural living organisms, created and shared through multiple participants' touching actions.

2.3.3.2 Artistic Orchestration of Reflection

The orchestration of reflection builds on the design of disruption and ambiguity, as discussed in the literature described in section 2.3.2.2.

Central to the artistic orchestrations, is the participants' sentient awareness (Chatzichristodoulou 2012) of disrupted, ambiguous interaction. Their performative actions, emotional and physical processes have been staged, shared with spectators (section 2.2.2). In turn, the spectator's gaze frames their interaction as subject to self-reflection (Kwastek 2013). Self-reflection on the sometimes lasting neurological effects (Sermon 2020) is evoked to establish transformative awareness (Hansen 2012).

However, *intimate* experience for participants requires an even more dedicated design of facilitating reflection. Loke and Khut (2014) state that conditional to intimate experience is cognitive reflection *on* embodied experience as 'an experience' (Zimmerman et al. 2007), in a process of grounding (Clark and Brennan 1991, Huisman 2017 p.4), described in section 2.2.1. Moreover, important to cognitive reflection on social touch, grounding supports the understanding of 'an experience' to be shared as 'social': "Only when an interaction is grounded it becomes social as both parties are talking about the same thing, their utterances are influencing and interacting with each other in a meaningful manner." (Huisman et al. 2013,

[60] The commercially developed online device "Kissinger" makes use of two-way mouth-vibration design (https://mixedrealitylab.org/kissenger/, last accessed 2023/2/17), similar to "MUA", (https://www.theguardian.com/world/2023/mar/23/chinese-startup-invents-long-distance-kissing-machine?CMP=share_btn_link, last accessed 2023/4/24).

[61] Sonic feedback of touching plants (not including participants touching each other) has been explored by Laserre and met den Ancxt (2007).

p.4). “Humans check if they understood the other and if they themselves are understood.” (Ibid, p.4).

In their ‘Facilitated Interaction Framework’ (**Fig. 4**), Loke and Khut advocate that artists not only must facilitate (or **host**) safety and guide the performance, but also support processes of meaning-making and creating reflective narratives. To this purpose, the framework includes not only performative phases of introduction (‘Entry’ (‘Welcoming’, ‘Fitting’)) and ‘Transition’ (‘The Ride’), but also of artists facilitating self-reflection (‘Incorporation’ (‘Debriefing’)) as part of the performance script. The artists’ facilitating **social acts** do not focus “on social exchange or conviviality, but on providing a space for participants to reflect on the internal world of felt experience – and the transformative possibilities offered within facilitated aesthetic experiences.” (Loke and Khut 2014).

Loke and Khut’s framework re-orients the previous theoretical Framework by Benford and Giannachi (2011), for human-computer interaction (HCI) and mixed reality performance art. This Framework includes the notion of “Interactional Trajectories", to explain theatrical “user experiences as journeys through hybrid structures, punctuated by transitions, in which interactivity and collaboration are orchestrated”.[62,63]

However, instead of focussing on “large-scale theatrical action in urban spaces and public institutions”, Loke and Khut’s Framework focusses “on a more intimate, proximal context operating at the scale of the body – and within the body.” In intimate contexts of Live Art, their Framework challenges **characteristics of vulnerability**, privacy, risk and trust “both in terms of the facilitator-participant interaction and the participant-spectator relationship.” (Loke and Khut 2014, p.107).

<table>
<tr><td colspan="4">Facilitation of Experience, by artists</td></tr>
<tr><td colspan="2">Entry
(Separation)</td><td>Core
(Transition)</td><td>Exit
(Incorporation)</td></tr>
<tr><td>1. Welcoming</td><td>2. Fitting and Induction</td><td>3. The Ride</td><td>4. Debriefing and Documentation</td></tr>
<tr><td colspan="4">Witnessing of Experience, by audience</td></tr>
</table>

Fig. 4: ‘Facilitated Interaction Framework’, Loke and Khut (2014).

In the context of critical design (Cermak-Sassenrath 2018), reflection and sense making through play have been facilitated on the basis of: a) disrupting familiar relations of perception; b) providing feedback to users for reflection, as part of the design; and c) involving users in open ended meaning-making and interpretation processes. Such design strategies

[62] Instead of making more "usable" HCI systems, Digital Live Art intends to mediate "participatory transitions" – between observation and participation, participation and performance, "witting and unwitting”. https://www.wikiwand.com/en/Digital_Live_Art, last accessed 22-4-2022.

[63] Benford Giannacchi (2012) point at the “often-neglected” aspects of reflection and retelling in mixed-reality performance, which they nevertheless consider vital.

(f.e. in 'critical design', 'reflective design', 'ludic design'), have been applied to gain critical insight in (implicit) value systems, educational purposes, processes of change and transformation, and for experience of joyful play. (Self-)reflection has been the goal of shared practice of play, playing and seeing each other play, through actions, settings, (social) contexts and experience, in dynamic relations.

However, to the author's knowledge, cognitive *shared* reflection, on shared embodied, intimate experience in hybrid or online interaction has been rarely subject to (artistic) design; and even less on the subject of shared, disrupted, technically mediated social touch experience.

Table 2.3.3.3 extends the previous tables with the characteristics discussed in the literature, including sensory disruption (Kwastek 2013), through: **Multi-sensory multi-modal synaesthetic syntheses** (Gsoelpointner 2016); with **Ambiguous**, **predictable and unpredictable, (un)comfortable** connections (Benford et al 2012, Kwastek 2013); and **Hosting** reflection, both socially (Loke & Khut 2014) and technically (Table 2.1.4.1); with **Potential or Actual (co-)participation for all participants** (Kwastek 2013).

Table 2.2.3.3. Characteristics of:

***Artistic orchestration of Reflection,* in**
Shared embodied, intimate experience of technically mediated social touch Interaction for multiple participants.

1). Sensory Disruption of Physically touching and being touched,
through:
- Visuo-haptic motor data interaction
- in a technically mediated shared space
- Visual perception: Mirror-perception and Emotional (facial, touch) expression
- **Ambiguous, predictable and unpredictable connections,** in
- **Multi-sensory multi-modal synaesthetic syntheses.**

with Reciprocal influence on each other's actions, in *Shared Empathic,*
vulnerable interplay,
through:
- Self-revealing, Affective touch gestures and response
- **in Ambiguous, (un)comfortable connections**
- **Potential or actual participation for all participants**

2). Shared Reflection
On experience, through:
- **Socially and** Technically **Hosting** mediated verbal and/or visual communication

2.4 Knowledge Gap and Statement

There is a gap in current understanding of how to design shared, embodied intimate experience of technically mediated social touch, for multiple participants, defined as **Shared Social Touch** in this thesis.

The literature shows that two elements are required: 1) Sensory Disruption Design (through ambiguous interaction) with Reciprocal influence, in Shared empathic vulnerable interplay; and 2) Shared Reflection Design (through social and technical hosting). The combination of these two elements has to the author's knowledge not been explored. This thesis proposes an interaction model, on the basis of the literature.

This thesis proposes an interaction model for:

Shared Social Touch:
Shared, embodied intimate experience
of technically mediated social touch interaction for multiple participants.

This model is based on:

1. **Sensory Disruption,**
   of touching and being touched,
   with Reciprocal influence, in Shared empathic vulnerable interplay.

2. **Shared Reflection,**
   on Experience, through Socially and technically
   Hosting mediated verbal and/or visual communication

3 Interaction Model 'Can I Touch You Online?'

This chapter explores QR2: 'Can an interaction model for shared embodied, intimate experience of technically mediated social touch be designed for multiple participants, and how?". The Interaction Model 'Can I Touch You Online?' (CITYO) (Fig. 5), for Shared Social Touch is presented, of which characteristics are based on the literature (chapter 2) and presented in Table 2.3.3.3.

As shown in the literature, shared embodied, intimate experience of technically *mediated* social touch interaction mandates reciprocal influence and perception of physically touching and being touched (Haans & Ijsselsteijn 2006, Jewitt et al. 2020b).

Physical perception of technically mediated touch has shown to be established in Visuo-haptic motor data interaction, on the basis of Affective touch gestures (Ijsselsteijn et al. 2006; Tajadura-Jiménez et al. 2012), characterized by Predictable, simultaneous, congruent sensory connections between individual bodily movements and emerging (bodily) images on a screen.

The CITYO interaction model for Shared Social Touch introduces technically mediated shared spaces (Lombard and Jones 2007, 2013), for embodied intimate experience of social touch in reflective empathic interplay, on the basis of Visuo-haptic motor data interaction.

This requires the Design of Sensory Disruption and Ambiguous connections (Merleau-Ponty 1962, Ward 2018), in shared multi-sensory multi-modal synaesthetic syntheses (Gsoelpointer et al. 2016), characterised by interaction that is Predictable *and* Non-predictable, both in terms of social interaction and technically mediated interaction (Kwastek 2013).

Reciprocal influence in shared empathic interplay requires types of touch performativity that are (un)comfortable (Benford et al. 2012), Self-revealing and Vulnerable in relation to Response of observing co-participants (Chatzichristodoulou & Zerihan 2012). Co-present participants must be able to Respond (either Actually (Co-)acting) or Potentially (Kwastek 2013)), on the basis of Visual perception (Mirror Perception (Ward 2018) and Visibility of Emotional (facial, touch) expression (Ward 2018).

Shared Reflection on the experience (Dewey 1997) and mutual creation (Jewitt 2021) must be socially and technically Hosted (Loke & Khut 2014); in Shared technically Mediated spaces supported by verbal and/or visual communication (Lomanowska & Guitton 2016; Lombard and Jones 2007, 2013).

3.1 Essential Elements in the CITYO Interaction Model

Based on the previous section, the essential elements are:

1. **Sensory Disruption of Physically touching and being touched,**
   through:
- Visuo-haptic motor data interaction
- in a Technically mediated shared space
- Visual perception: mirror-perception and emotional (facial, touch) expression.
- Ambiguous, predictable and unpredictable connections, in multi-sensory multi-modal synaesthetic syntheses.

   with Reciprocal influence on each other's actions,
   in Shared empathic vulnerable interplay.
   through:
- Self-revealing, affective touch gestures and response
- in Ambiguous, (un)comfortable connections
- Potential or actual participation for all participants.

2. **Shared Reflection**
   On experience,
   through:
- Hosting socially and technically mediated verbal and/or visual communication.

3.2 Interaction Model for Shared Social Touch

This section presents the interaction model 'Can I Touch You Online?', based on the essential elements discussed in section 3.1. The model is depicted **(Fig. 5**) with a Legenda; followed by and explanation of the symbols and pictograms used in the model (section 3.3).

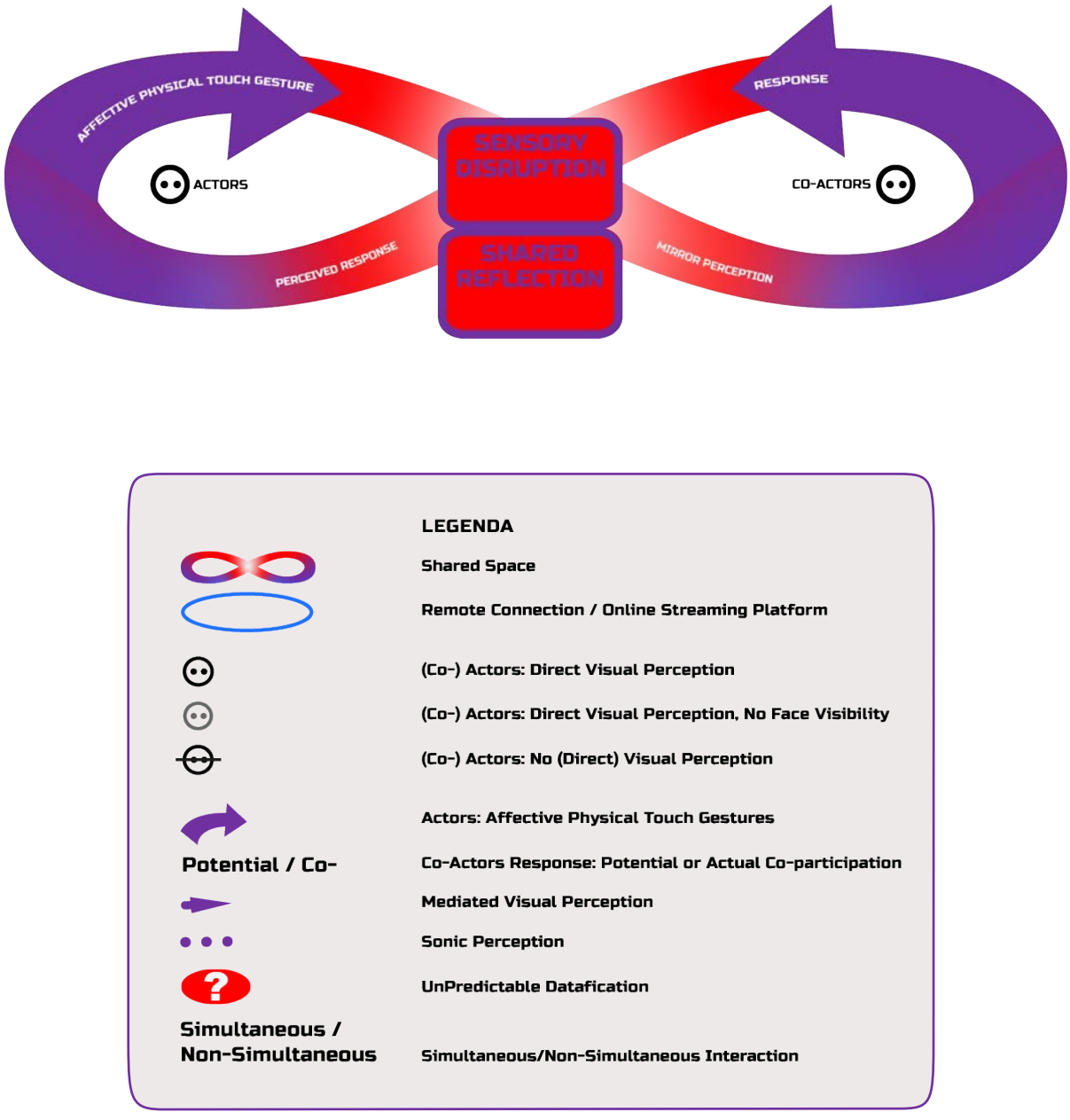


Fig. 5. Interaction model: 'Can I Touch You Online?' (CITYO) for Shared Social Touch, and Legenda

3.3 Legenda Explanation, of the CITYO Interaction Model

The legenda corresponds with section 3.1 and includes the symbols in the interaction model:

- **Shared Spaces.** The interaction model's Shared Spaces are depicted by the **infinity symbol**, facilitating multi-actor reciprocal connections in hybrid configurations, including:
- **Remote Connections**; and/or an **Online Streaming Platform,** depicted by a **blue circle**.
- **Multiple Participants**. Interaction is facilitated among multiple persons, either as **Actor** (active participant) or as **Co-Actor** (spectator or less active participant)**.**

- **Visual perception** for (Co-)Actors is depicted in the **pictograms of faces**, that are black (direct visual perception) grey (partly visual perception) or with invisible eyes (no visual perception). Two black faces depict mutual visibility. Different combinations can be explored.

- **Physical Affective Touch Gestures** can be explored by Actors.
- Co-Actors **Respond** through **Potential** participation, or actual (**Co-)**participation (Kwastek 2013).

- **Sensory Disruption (1)** facilitates visuo-haptic motor data interaction, transferred to multi-sensory, multimodal syntheses, including **Mediated visual perception;** and **Sonic Perception** (ASL4,5,6).
- Ambiguous datafication of Touch gestures and Responses exist of:
    - **Unpredictable Datafication.** Components of both predictable *and* unpredictable datafication. **Unpredictable** datafication is depicted in the interaction model by a **question mark (?)** (f.e. on the basis of *involuntarily* ('passive') interaction (ASL4,5,6: brain interface recordings); or through voluntarily ('active') interaction that leads to *not congruent* motor data interaction (ASL3)); in
    - **Simultaneous** (ASL4,5,6), **Non-simultaneous** (ASL1,2) or combined (ASL3) reciprocal influence.

- **Shared Reflection (2)** on the experience is facilitated through Socially and Technically **Hosting** (verbal/visual communication).

Different combinations of symbols are depicted in chapters 5-9.

Part 3

Artistic Social Labs: Case-studies

This thesis describes artistic orchestrations and their performance scripts as case-studies; it provides analyses of these orchestrations based on the interaction model for Shared Social Touch, and the results.

Part 3 includes Chapters 4-9, in which the artistic research in these orchestrations is presented, from the perspective of the artists Lancel and Maat, on shared embodied intimate experience of technically mediated social touch, for multiple participants.

Chapter 4 describes the overall design approach to the artistic orchestrations and performance scripts. The design of the Artistic Social Labs (ASL) is introduced, in line with the interaction model based on design for Sensory Disruption and Shared Reflection.

Chapters 5-9 present the different ASL orchestrations in detail, and relate to the main research question, QR 3: "Can this interaction model be used, a) to describe and analyse, and b) to artistically orchestrate, shared embodied intimate experience of technically mediated social touch, for multiple participants, and how?" `

In relation to the interaction model, these chapters offer insights into the types of social touch orchestrations; and findings. The findings are discussed in **Chapter 10**.

4 Artistic Social Labs

This section describes the overall design approach to the artistic orchestrations, and their performance scripts. It introduces the design of Artistic Social Labs (ASL); in line with the interaction model that is based on Design for Sensory Disruption and Shared Reflection. The below five sections describe:

- **Orchestrations of 'Artistic Social Labs' (ASL) (4.1)**
- **ASL design in line with the interaction model (4.2)**
- **Shared Data Compositions: 'Reflective DataScapes' (4.3)**
- **Performance Scripts (4.4)**
- **Overview of the ASL orchestrations research explored in Chapters 5-9 (4.5)**

4.1 Orchestrations of 'Artistic Social Labs' (ASL)

This section introduces the design of the Artistic Social Labs (ASL), from the artistic perspective by Lancel and Maat.[64] Their overall design approach to the artistic orchestrations and performance scripts is described, in line with the CITYO interaction model for Shared Social Touch.

The ASLs have been created in the context of current merging realities, of shared 'smart', hybrid and online public spaces.[65] In this context, human social connections have been increasingly shaped by technologies *outside, on*, and *inside* their bodies. Their connections take place within globally distributed networks and complex systems; indoor and outdoor, in public, semi-public and in private environments, voluntarily and involuntarily; effecting (practices of) intimate experience.

Often, interface design to this purpose focussed on automation and efficiency, quantification, and categorization. Private information is collected and processed, used for scanning and profiling, by different organizations and authorities. Less focus has been on ethical aspects of connecting; on reflective 'self-other' awareness, of trust and shared autonomy, vital to shared empathic environments.

In this context, a different approach to shared empathy and social touch interaction in Artificial and Emotional Intelligent (A.I./.E.I) neural networks is explored by Lancel/Maat. From an Art and Science perspective, the artists explore a transformative sense of biological and synthetic embodied experience, in human and non-human entanglement. Playful aesthetic experiments are designed for a sense of interdependent body-ownership beyond the boundaries of the skin, for new forms of autonomy and interconnectedness, assemblage and

[64] https://www.lancelmaat.nl/, last accessed 15-7-2022

[65] Background literature on artistic design of **smart city interaction** is presented in section 5.1.

kinship, with each other and data as co-actors.

For the Artistic Social Labs (ASL) the artists deconstruct and re-orchestrate automated biometric interaction systems. Sensory connections between touching, seeing and hearing are disrupted; and *individual* mirror perception is re-directed into *shared* neuro feedback data interaction.

In the ASLs, participants are invited as 'co-researchers' (Lancel/Maat 2009-2021) [66], to explore and rethink technically mediated social touch connections, with each other. While carefully hosted by the artists, the participants' private bodies are extended with face-recognition technologies, smart textile, and brain computer interfaces[67], for multi-sensory synaesthetic perception. Participants meet through (self-)touching gestures of caressing, hugging and kissing. They share intimate experiences and reflection, narratives, and imagination about a shared future of touch and being touched. Lancel and Maat call these orchestrated meetings forms of '**co-creation'**: participants are co-creators, they mutually create intimate experience.

Note, that Lancel/Maat's concepts of **'Meeting Rituals'** and '**Trust Systems'**[68], used to describe the artistic orchestrations, exceed this thesis.

The ASLs have been designed to function as "public experiments, i.e., as configurations of unfinished knowledge, in which participants express 'one more articulation to what it is to have a body' (Latour 2004), opening up the possibility to inhabit the world of merging realities differently" (Lysen 2019). Through the ASLs, the artists propose unique, poetic forms of 'distributed embodiment' in hybrid shared spaces, configurations, and networks.

Since 2000, the ASLs have been presented as Meeting Places in (semi-) public spaces internationally, in different cultural contexts; in cities of Europe, Asia and USA (including Seoul, New York, Melbourne, Berlin, London, Istanbul, Paris, Amsterdam, Beijing, Shanghai).

4.2 ASL Design in Line with the Interaction Model

This section describes the ASLs in line with the interaction model, including:

- **Sensory Disruption, with Reciprocal influence in Shared empathic vulnerable interplay, through self-revealing touch gestures and response (4.2.1);**
- **Shared reflection, through Hosting (4.2.2).**

[66] https://www.lancelmaat.nl/, last accessed 15-7-2022

[67] Back ground literature to artistic design of **brain computer interfaces** is presented in section 8.1.2.

[68] https://www.lancelmaat.nl/about/about/

4.2.1 Sensory Disruption

This section describes the ASL design for Sensory Disruption, with Reciprocal influence, in Vulnerable, Empathic interplay, through self-revealing touch gestures and response.

The artistic design for technically mediated social touch has been inspired by neuro-scientific research into plasticity of individual *body ownership identification* and oscillating forms of *self-other distinction (section 2.2.)* This research has included experiments with visuo-haptic motor data interaction of affective touch gestures; for body centred connections (or identification) with visual, technically mediated bodily representations of others to emerge (Ma & Hommel 2013; Ijsselsteijn et al. 2006; Tajadura-Jeminez et al. 2012). These experiments have been based on fluid integrated technologies, in individual interaction.

Inspired by this research, the artistic ASL design has explored the potential of perceived ***shared*** **body centred connections with technically mediated bodily representations of others.** To this purpose, the design not only focusses on affective gestures as a 'stimulans' to *immersive* body ownership (Ijsselsteijn et al. 2006), but on affective touch gestures as 'carriers' to social experience, through shared cognitive reflection (Ward 2018). This artistic approach to visuo-haptic motor data interaction design, in the ASLs, is described below.

In the ASLs, different forms of *shared* neuro visuo-haptic motor data interaction have explored through the design of sensory disruption. Instead of using only 'fluid' integrated technologies (Ijsselsteijn et al. 2006), technically mediated interaction has been disrupted and ambiguously re-orchestrated. Visuo-haptic motor data, of affective touch gestures, have emerged in congruent, **predictable** movements with the touch gestures; while ambiguously, **unpredictable** interaction has been included to support cognitive reflection. Moreover, the visuo-haptic data have been transferred to multi-sensory, multi-modal synaesthetic syntheses, in ambiguous ways. Biometric data of different designs of **simultaneous** and/or **non-simultaneous reciprocal interaction** between participants has produced 'Shared Data Compositions' (described in section 4.3).

Different participatory multi-actor configurations have been explored, in hybrid and online shared spaces. They have been orchestrated for multiple participants (individuals, couples or multiple persons); either as **Actor** (active participant) or **Co-Actor** (spectator or less active participant); with Co-Actors as potential Actors.

Physical, reciprocal affective touch gestures (kissing, hugging, caressing) have been designed, for **Actors** to be performed and tacitly perceived**.** These gestures have been designed for two or more Actors, to **Reciprocally touch** each other; and for individual Actors to touch themselves, as a form of **Self-touch**. Different **affective** touch gestures have been explored to stimulate a sense of body ownership in relation to the visuo-haptic motor data; as a new form of social interaction.

The gestures have been made visible to **Co-Actors** to facilitate **Mirror-Perception** and vicarious interaction. An empathic interplay between Actors and co-Actors have been explored through orchestration of interdependent connections, between *self-revealing* affective touch gestures and response, and social support, in ambiguous, both comfortable and dis-comfortable positions. Different forms of shared emotional (facial) expression, and questions of how and by whom they must be shared, have been subject to exploration.

4.2.2 Shared Reflection

This section describes the ASL design for shared reflection among multiple participants. Shared reflection relies on *self*-reflection, facilitated through the Ambiguous orchestration.

Performative phases of introduction, transition, and self-reflection have been hosted by the artists. ***Shared* reflection** has been hosted in the concluding performative phases of the ASL performance scripts. To facilitate Shared Reflection among multiple participants, it has been evoked either through hosting a 'Staged Dialogue' (by Actors, to Co-Actors) or a 'Shared Dialogue' (among Actors and Co-Actors). Participants have been asked to express and share their experience in words, with the host and with each other, to make their social and embodied experience explicit.

Hosts have invited the participants to describe their experience as a form of "grounding" (Clark & Brennan 1991), expressing new images and emotions; and to describe the unfamiliar visuo-haptic (shared) embodied experience of touch and *feeling-touched,* intertwined with visually emerging data-visualizations on screen, shared with others. The Host has raised questions to explicitly reflect, to take time and wonder.

In the ASLs, shared reflection functions, firstly, as an essential component of intimate experience of social touch. Secondly, from an artistic point of view, reflection has been orchestrated as a public 'message' (Mcluhan & Fiore 1967), calling for reflection *on* empathy and trust in merging realities, on ethical values and social bonds. The ASLs emphasize the importance of human **agency and authorship of emergent, future narratives** in community with others in line with Dewey's perspective (Dewey 1997; Rodgers, C. 2002).

Note, that *shared reflection among participants* is also part of the *research method* (section 1.3).

4.3 Shared Data Compositions, for Sharing Artificial and Emotional Intelligence

"While in science, data represent things, in art, data point at themselves." (Morton 2018).

This section describes the design of the artistic and scientific approaches to Artificial and Emotional Intelligent (A.I./E.I.) aspects of the ASL design.

The Artificial and Emotional Intelligent (A.I./E.I.) aspects of the ASL designs are developed in the contexts of Complex social technical systems. Each ASL re-orchestrates such system to facilitate shared embodied intimate social touch experience. Such intimate experience requires *ambiguous connections* (shown in this thesis' literature), that can be designed through sensory disruption, for shared reflection to emerge. These ASL's A.I. aspects, based on disruption, include:

a) Sensor Data Collection with pattern recognition.

b) Data Interpretation, of shared, participatory data-collections,
with **disrupted,** individual data identification.

Note, that the technical A.I. aspects of all ASLs are presented in Appendix 1.

The sensor data-collections ('**Shared Data Compositions**') emerge from datafied and transferred actions of Reciprocal Influence, of touching and being touched.

Interpretation of these compositions are based on artistic and scientific approaches. Morton (2018) argues that (1) in science, data *represents* something outside; while in art, (2) data instigate *reflection, on* the data themselves. Inspired by this perspective, the ASLs combine shared artistic and scientific data-interpretation, in 'intra-action' (Barad 2007).

In the ASLs, as part of the *shared* intimate experience, personal interpretation of the data compositions have been shared with participants. Shared interpretation has been based, firstly, on **biometric** measurements (defining the body within a digitally, measurable frame).

Secondly, from an **artistic approach**, shared reflection ***on*** these data has been evoked; based on personal and shared memories and imagination, of embodied experience and tacit knowledge.

The Shared Data Compositions are named by the artists as**: 'Reflective Data Scapes'.**

4.3.1 Privacy of Data and Trust

Fundamental to the ASLs is the design of privacy. The design focusses on awareness of privacy and trust in sharing personal data; both in social connections, and in relation to digital systems that have been developed for commercial means. In the ASLs, during acts of touching, personal data-traces are socially, publicly exposed (both from a biometric and an artistic perspective, discussed in sections 4.2.2 and 4.3). However, these data are *saved only* in entangled and merged forms, difficult to digitally trace back to individual participants.From an artistic point of view, the entangling and merging of data in the ASL designs (**Shared Data Compositions)** is a poetic form of ***data-encryption***.

Note, however, that the design of 'privacy' is not the subject of this thesis and is not discussed in findings and insights.

4.4 Performance Scripts and Performative Phases

Participation in the ASLs is facilitated in distinct performative phases, part of performance scripts; inspired by frameworks of Loke and Khut (2014) and of Benford and Giannancchi. (2011), discussed in section 2.3.3.2. The terms 'Welcoming', 'Fitting', 'Transition' and 'Incorporation', derive from Loke and Khut's framework. The ASLs performance scripts extend their framework with a performative phase of Socially Hosting *Shared* Reflection. Below, the ASL performative phases are described. *Note,* that in the different ASLs the performative phases may occur in varying (combined) compositions but always in the same order:

Performative Phases in the ASL Performance Scripts

- **Introduction** ('Welcoming'):
  The Host explains and contextualizes the orchestration.
- **Fitting** ('Welcoming'): The participants' private bodies are extended with immersive, digital synaesthetic technologies.
- **Concentration**: The Host instructs the participants to focus their attention on the shared embodied experience of social touch.
- **Transition**: Performative acts of touching (f.e. kissing, caressing) and merging processes of data-visualizations and -sonifications take place. The Host guides the interaction and provides physical safety, if needed.
- **Memory building** ('Incorporation'): The Host initiates individual dialogue with the participants to enhance memory building of the embodied experience.
- **Shared Reflection**: The Host socially initiates a shared or staged dialogue on the 'shared embodied experience', with participants.

4.5 Overview of research aspects, included in Chapters 5-9.

This section describes research aspects included in Chapters 5-9, on the basis of which the ASLs have been analysed. Each chapter starts with introduction to the ASL; and a reference to the published paper in which the text of the chapter has been published (if available). The detailed descriptions of the ASLs are structured as follows:

- **Orchestration ASL**
A research question specific to each ASL; and a description of the orchestration (the aesthetic, visual, social, technical set up and interaction design).

- **Interaction model**
CITYO, presented in Chapter 3, is applied to the ASL orchestration; combined with specific descriptions.

- **Design Choices**
Aesthetic, social, spatial and technological design choices are described, combined with a visual scheme of the spatial orchestration.

- **Design Rationale** (ASLs 1 and 3)
An iterative process of (interaction) design choices.

- **Performance Script**
Tables presenting the Performative Phases of the interaction design.

- **Results**
Descriptions of observations by a 'Host' of participant actions, reactions and behaviour of: watching; decision to participate; participation in performance scripts (of social touch and shared reflection); attending and supporting others in the orchestration; open ended dialogues.

- **Discussion**
Major findings are discussed, *in line with the research question*.

- **Conclusion**
A summary of the orchestrations, major findings, and future research, contextualized by the specific research question and literature.

- **Conclusion in line with the interaction model.**
The discussion and conclusions in relation to the interaction model.

ASL 1: Saving Face

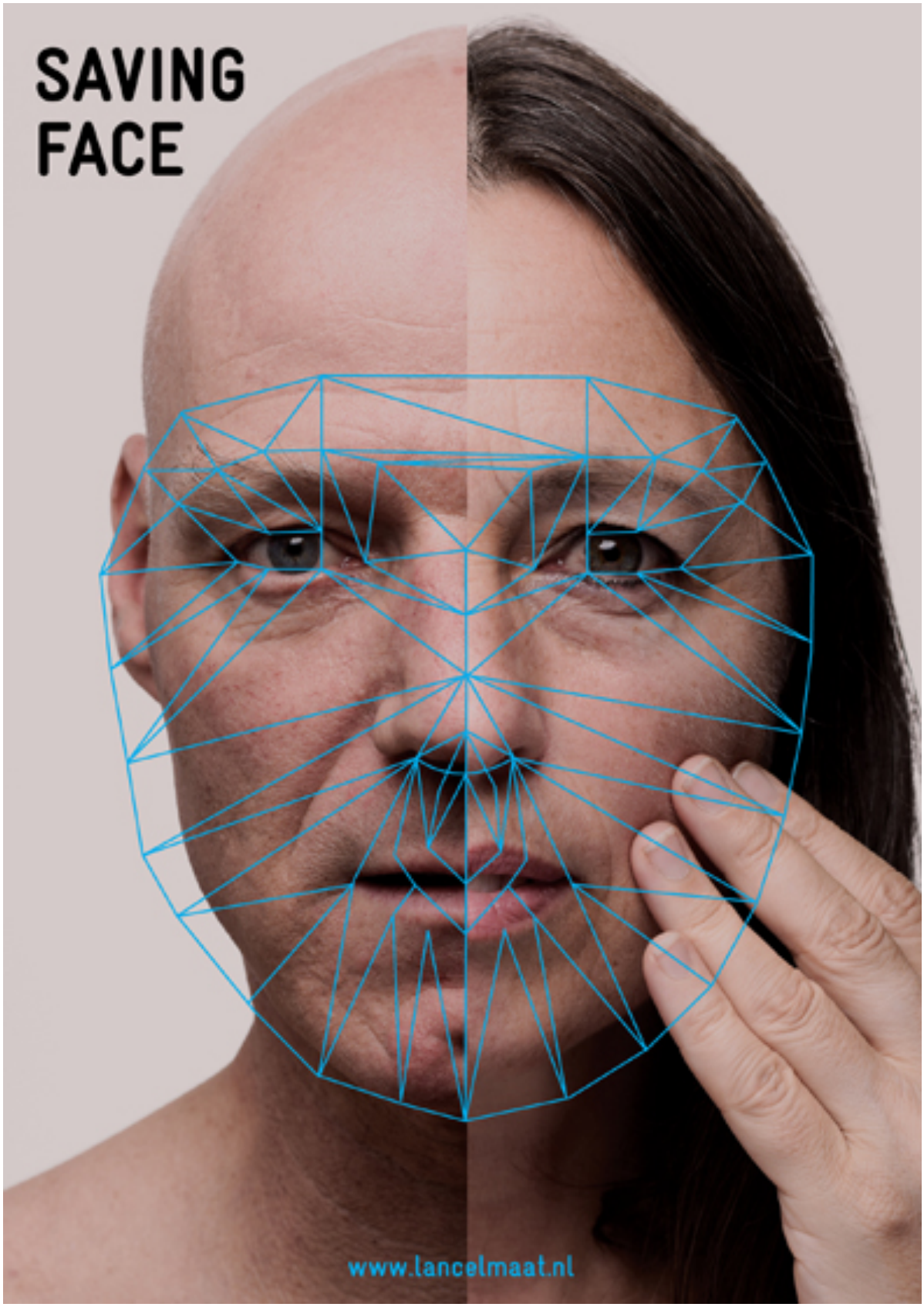


Fig. 6. ASL1 ‘Saving Face’. Promotion Photo © Lancel/Maat and Studio Matusiak 2015

5 ASL 1: Saving Face

This chapter presents ASL1 Saving Face (Lancel/Maat 2012-2016) by first presenting relevant background literature about interactive art in the smart city (5.1); and then the ASL1 orchestration (5.2); the interaction model (5.3); the design choices (5.3.1) and design rationale (5.3.2); and the performance script (5.4). This is followed by three sections (5.5, 5.6, 5.7) that present results and discussions of three ASL1 orchestrations, that have been presented in contexts of different smart city public spaces. A conclusion based on the three orchestrations is presented at the end of this chapter (section 5.8). Section 5.9 focusses specifically on aspects of hosting. Discussed are (non-)human hosted aspects of the design, presented with results and a conclusion. Section 5.10 presents a combined conclusion based on all orchestrations in this chapter, in relation to the CITYO interaction model. The technical A.I. aspects are discussed in Appendix 1. In summary, the ASL1 includes:

ASL1 *Saving Face* explores shared experience of social touch, in playful smart city public spaces, for multiple participants.
The Sensory Disruption design uses facial recognition and urban screen technologies to create a shared *Virtual Persona* interface, for visual-haptic motor data interaction.
Actors visibly share face-caressing gestures with Co-Actors. Through caressing, Actors' portraits visibly appear on an urban screen; and merge with portraits of previous Actors into unique, unpredictable Virtual Persona's - that can be downloaded from a database.
Shared Reflection is staged between Actors and Co-Actors.

This chapter is based on:

- Lancel, K., Maat, H., Brazier, F.M. (2020) 'Saving Face: Shared Experience and Dialogue on Social Touch, in Playful Smart Public Space'. In: Nijholt A. (eds) *Making Smart Cities More Playable. Gaming Media and Social Effects*. Springer, Singapore
- **Section 5.3.2.8 is based on:** Lancel, K., Maat, H., Brazier, F.M. (2020) 'Designing disruption for social touch, in public spaces of merging realities: a multi-sensory model'. In: Int. J. of Arts and Technology. Special Issue: ArtsIT 2018 Arts and Technology. Inderscience Publishers.
- **Section 5.9 is based on:** Lancel, K., Maat, H., Brazier, F.M. (2020) 'Hosting social touch in public space of merging realities'. In: ArtsIT 2019 proceedings. Publisher: Springer Verlag.

5.1 Background Literature: Interactive Media Performance Art in the Smart City

In city hybrid public spaces, inhabitants are connected with globally distributed networks and complex technological systems (Mcquire 2008). Emerging systems, however, enable city inhabitants to monitor the city themselves, to share their experience of social, cultural, ecological, and economic developments, of their city (Nijholt 2019; De Waal 2017).

Adopting a dynamic perspective towards the publicness of today's cities, McQuire (2016) argues that the city is "a social experiment whose ends remain uncertain". As the city is conceptualized as an 'experiment', the role of technology as the determinant component is eliminated. In addition, the element of uncertainty encourages a playful approach which renders the social aspect of the city unfinished, or to be constituted in the future. Characterizing the role of digital technologies as posing an ambivalent condition, McQuire urges to discover "how we negotiate social encounters, and how we experience relations of proximity and distance, presence and absence". In this regard, Chantal Mouffe's (2007) understanding of public space (*Yavuz 2017)* offers a way, in which artistic practices can enrich the discussions on social encounters in the city. According to Mouffe, the driving force behind any democratic society is contradictions and dissent, which should not be reconciled for the sake of unity; instead the public space needs to be approached as an "agonistic space" (Mouffe 2007).

Systems that are critically designed to enable different levels of public exposure and connection, are currently being explored in public digital art interventions. Participatory performative systems, (f.e. of gestures, movement, connecting and 'showing face', have been orchestrated to evoke reflection on identity (Butler 1990), and on shared (*political)* ability in the public space, in line with Ahrendts concept of the Vita Activa (Arendt 1958, p.65, 66). To this purpose, smart city technologies are purposefully deconstructed and re-orchestrated enabling participants to play and rethink emerging social connections, relations, and encounters (Pop 2016; Struppek 2007; McQuire et al. 2009).

For example, participants play with cameras to visually expose and 'mirror' themselves, their behaviour, and movements on the screen. Simultaneously, they 'transform' themselves into 'digital others' exposed on the screen (Verhoeff 2016), to be explored as part of a hybrid physical and digital reality. Examples of these art works are created by Blast theory (2007): Ga (2004); Lozano-Hemmer (2001); Sermon & Gould (2014). The mirroring screen, in fact, facilitates both public communication and shared reflection on social connections in the smart public space (Mul 2009; Verhoeff 2016).

'Magical' and 'expressive' interface design (Reeves 2005), and public interfaces that expose experience of discomfort and vulnerability (Benford 2012), entice participants to engage in artistic design for playful experimentation (McQuire 2008, p.153-154).

5.2 Orchestration ASL1 'Saving Face', 3 x in City Public Space

ASL1 addresses the question: 'Can shared experience and dialogue on social touch be orchestrated in playful smart public spaces?'. To explore this question a city sculpture with camera and a small screen are connected to a large public screen.

In front of the camera, participants are invited to become as Actors to caress their own faces. Through caressing their faces, they 'reveal' their portraits on the public screen. Their portraits appear and slowly merge with the portraits of previous Actors , who have been caressing their faces. Together, over time, they realize untraceable networked 'identities', as Virtual Personae on the screen.

Each composed Virtual Personae is saved in a database from which composed identities are shown auto play when no interaction occurs. All composed identities can be downloaded by participants and be printed, for a Saving Face Passport.

ASL1 is created to explore technically mediated 'self-touch for social touch', in the context of smart city public spaces across the world. Hosting is an essential part of the design, to entice members of the public to participate, to guide them through the performance script, and to engage in dialogue on their shared experiences facilitating individual and shared reflection.

5.3 Interaction model ASL1

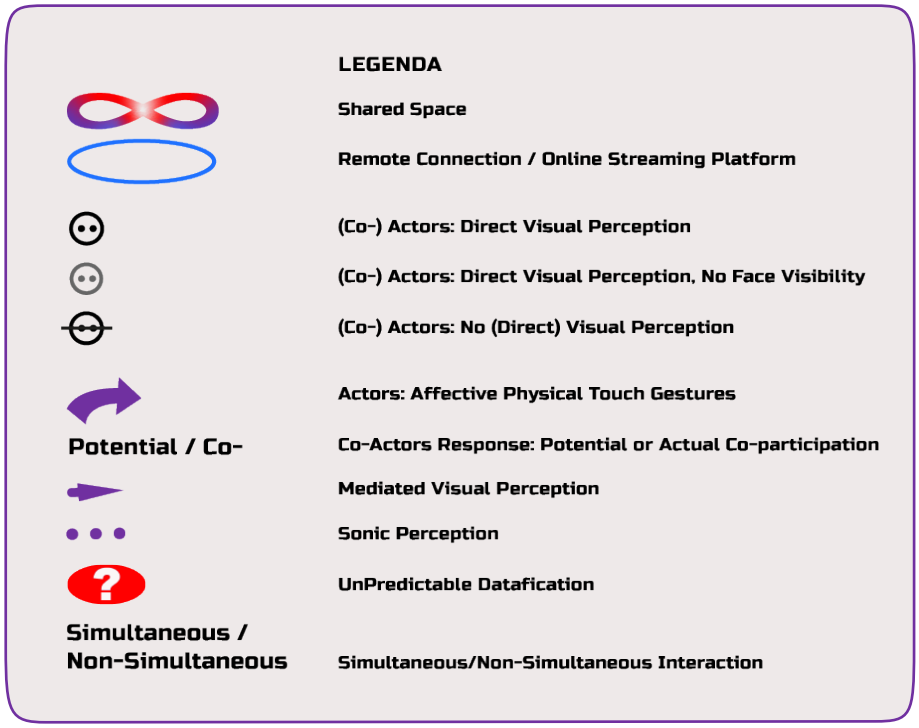
Fig. 7 depicts the ASL1 'Saving Face' (2012) in relation to the CITYO Interaction Model.

Description CITYO Interaction Model ASL1

1) Sensory Disruption. Actors visibly share face-caressing gestures with Co-Actors. Visual connections between Actors and Co-Actors are direct, facilitating mutual visibility of emotional facial expression.
The Actor's individual perception of direct self-touch, of affective self-caressing gestures, is sensory disrupted through the Virtual Persona interface. The Actors' caressing gestures are transferred to a predictable data-visualization, visible to all.
Co-Actors are potential, non-simultaneous Actors. **Reciprocal** Responses by Co-Actors takes place through non-simultaneous **performative acts (of caressing), over time. Together, Actors and Co-Actors realize unique,** unpredictable **shared composed** data-visualizations, **of portraits merging into** Virtual Persona's, in unpredictable ways**.**

2) Shared Reflection is staged, through Hosted Dialogue with Actors to Co-Actors.

Fig. 7. CITYO Interaction Model ASL1 'Saving Face' (2012) and Legenda



5.3.1 Design Choices ASL1

This section describes the social and spatial design, depicted in **Fig 8.** *Note,* that the technical A.I. aspects of ASL1 are presented in **Appendix 1**.

Technically, the multi-modal interface consists of an interactive, aluminium sculpture with a camera and a small, in-built mirroring screen with face-recognition technology (A), connected to a city public screen (B).

Socially, the interface invites participants to interact with each other in one of 3 possible roles: that of Actor (this notion is used to describe an active rather than passive role of audience), Co-Actor and Virtual Persona. As Actors (1), people from the public are invited to caress their faces in front of the camera and publicly 'paint' their portraits on the city public screen. They then can choose to save their portraits and merge them with the portraits of previous Actors, people they have often never met before. The merging process of portraits into Virtual Personae is visible on the public screen. Co-Actors (3) view from a distance (and can become Actors themselves). Aspects of the Virtual Personae (2) and Hosting (C) are described in the sections below.

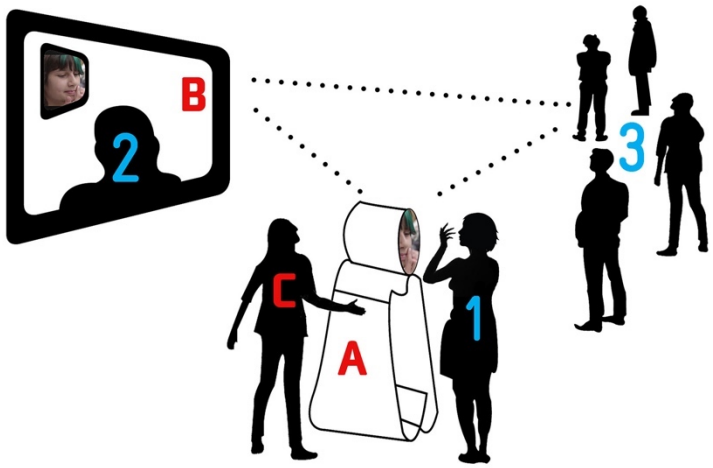


Fig. 8. Spatial model of ASL1 'Saving Face' © Lancel/Maat and Studio Matusiak 2015.
A) Aluminium City Sculpture (camera, face recognition technologies), B) City Public Screen, C) Host. (1) Actor, (2) Virtual Persona, (3) Co-Actors (potential Actors).

5.3.1.1 The Virtual Personae

Fig. 9 depicts the merged portraits of participants, described as Virtual Personae (2). These Virtual Personae are designed to 'virtually gaze' into the public domain, as contemporary 'fellow men and women' (Figs. 13, 16). They emerge from the interplay between Actors, Co-Actors, the technological system and caressing gestures as described above.

The Virtual Personae emerge and are visualized from all Actors' caressing gestures, visualized real-time on a city public screen. The gestures are translated into visual, slowly emerging 'data traces'. While caressing, only the caressed part of the face is highlighted as 'data trace', building up to a (full) portrait.

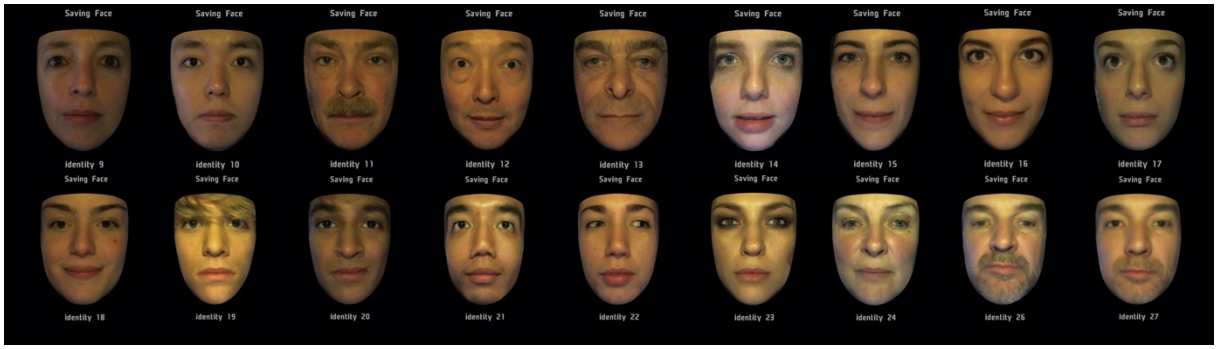


Fig. 9. Excerpt of online, generative database collection of merged portraits ('Virtual Personae').[69]

These data traces then merge with previous participants' portraits from a database.

When no Actors participate, the Virtual Personae morph with portraits in the database through auto play, visually displaying the process of merging with others on the screen.

5.3.1.2 The Host

A *Host* (C) is part of the designed orchestration, often performed by the artists or by volunteers. The Host introduces a) the aim of the orchestration to explore social engagement through technically mediated touch and b) explains the physical interaction. It is explained using words such as 'touch', 'digital', 'mobile phone', 'see', 'connect', 'meeting', that are internationally understood. Through both words and body language, words such as 'caressing', and 'being close' are visualized. The explanation serves both as a spoken manual and as contextualization. The Host then c) witnesses the performativity of the Actor from a distance, ensuring a safe space for concentration when necessary and d) engages in dialogue with Actors afterwards. The Host mediates between physical and virtual presence, between public space and intimate space. The Host, in fact, mediates the mediation.

5.3.2 Design Rationale ASL1

This section explores the effects of design choices on participant experience in nine technical and interaction design tests.

5.3.2.1 Test 1: Face recognition and merging: Forms and Faces

During the first studio test, open source face recognition technology (McDonald K & Saragih J. Open source Facetracker library) was used to merge different portraits into a Virtual persona. However, as the shapes of different participants' faces are never equal in size, the merging processes often resulted in Virtual personae with facial mismatches. As a design solution, software was designed to detect facial elements (nose, eyes and mouth) as points of reference. These points of reference are used to place elements on top of each other to subsequently, average out the differences between shapes of faces, such as wide and long faces. This design solution most often results in coherent Virtual Personae portraits.

[69] Generative database collection of merged portraits © Lancel/Maat, 2015. Each merged persona is automatically uploaded to Flickr: https://www.flickr.com/photos/savingfaceportraits/page1/

5.3.2.2 Test 2: Face recognition and merging: Skin Colour

During the second studio test, 5 participants with different skin colours were asked to caress their faces, to acquire portraits that were then merged. As the merged portrait (Virtual Persona) is built from fragmented parts of the face that have been touched, the merging process resulted in what can be called a 'fragmented colour field', instead of a coherent portrait. Again, averaging provided the solution: weighted averaging of skin colours, favouring the colour in the last portrait.

5.3.2.3 Test 3: Portrait Appropriation (A)

During the third studio test, participants were asked whether they felt related to the merged portrait (Virtual persona) on the screen, to which all previous portraits (including their own) contributed equally. Participants did not relate the effect of caressing their faces with the resulting portrait on screen, not recognising themselves; as expressed by statements such as: "I believe the portrait is a result of my caressing acts and the emerging traces. But the resulting face has nothing to do with me." and "The interaction was mine, but that portrait is weird." The final merged portrait (Virtual Persona) was rejected by most as a self-representation.

The design of the interface was adapted to enhance the Actors' visual self-recognition and appropriation of the merged portrait on screen, through weighted averaging, tested in Studio Test 4.

5.3.2.4 Test 4: Portrait Appropriation (B)

During the fourth studio test, four participants tested a new version in which every layer of the merged portrait (Virtual Persona) contains 50% of the caressing participant, 20 % of the previous participant and 20 % of the second but last participant. The last 10% is based on the "average" participants' portrait. As a consequence, the portrait shows some resemblance to the actual participant. From that moment on participants appropriated the portraits, expressed in words such as: "I felt my face when making this portrait and now, in a way, it looks likes me", "I made this, it doesn't really look like me but it must be me" and "I caressed my face, it is me.".

5.3.2.5 Test 5: Studio User Test for Relation with the Screen (A)

During the 5th studio test, 11 participants were asked to caress their faces in front of a camera and screen in different roles – as Actors and as Co-Actors. After their acts of caressing, Actors described unfamiliar, embodied experiences, for example "It thrilled me. I could feel my face appear on the screen", "This is weird, the softness of touching feels different", "It feels as an extended touch." However, Co-Actors surrounding the Actors seemed to lose interest fast. They stated that "It is nice to do it yourself but not special to watch for a long time" and "I found it special to look at the person carefully caressing her face, but the emerging picture on the screen did not directly relate for me to the caressing gestures." Based on these reactions, the design was adapted to insert a real-time 'mirror-image' of the caressing Actor, next to the emerging Virtual Persona on the screen; tested in the following tests **(Fig. 10).**

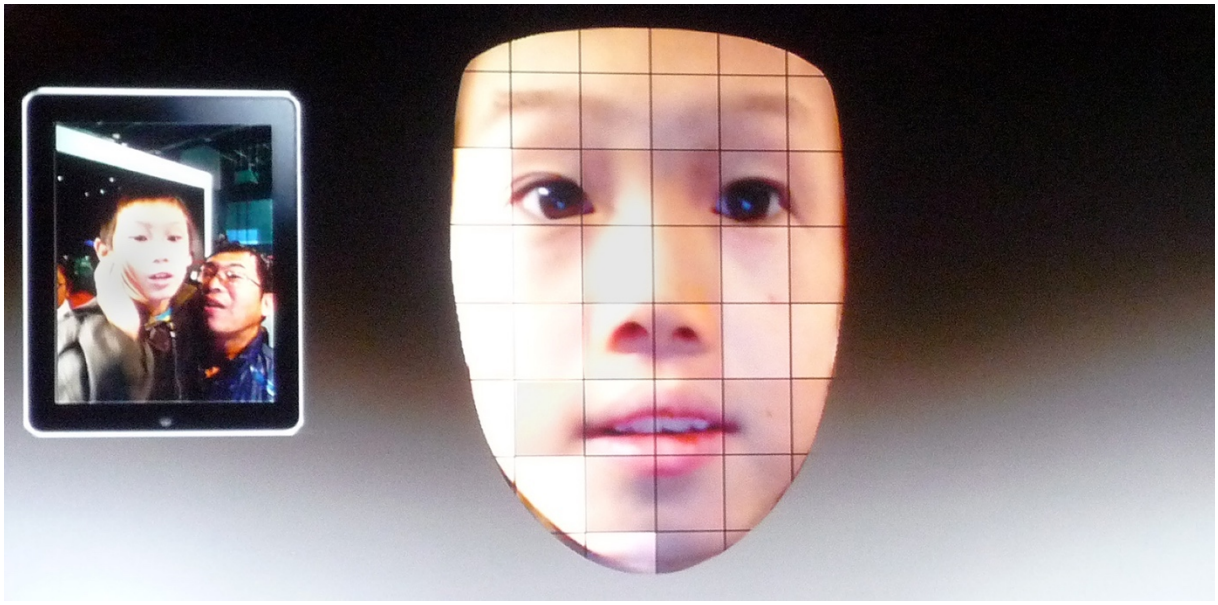


Fig. 10. Mirror-image of caressing participant visible in the inserted screen (left in the screen), while his caressing acts are lightning up in his portrait (right). © Lancel/Maat (2012).

5.3.2.6 Test 6: Studio User Test for Relation with the Screen (B)

During the 6th studio test, four participants tested the new version, in which a 'mirror-image' of the caressing Actor was inserted on the screen as shown in **Fig. 10**. In this inserted image, both Actors and Co-Actors could see themselves and each other in the same physical space that was simultaneously represented realtime on the screen. As a result, Co-Actors watched for a long time while talking with each other. Their gazes shifted between watching the caressing Actors, and the screen.

5.3.2.7 Test 7: Spatial Relations between Sculpture, Screen and Participants.

The 7th test took place outdoors and focused on the position of the sculpture in relation to both the screen and participants' engagement. The effects of the sculptures' different positions, at various distances and visual angles to the screen, were explored.

Several tests showed that, if both the act of caressing and the screen cannot be seen from the same spatial position, participants (Actors and Co-Actors) show less engagement and connection with the interaction and the merged Virtual Personae on screen – they seem to 'lose touch' and leave. As a result, the design choice was made to position the sculpture and the screen in such way that participants can see both from one spatial position (**Fig. 8** in 5.3.1).

Fig. 11. Actor caressing her face in ASL1 Festival a/d Werf, in presence of the artist hosting. Utrecht (NL) © Lancel/Maat 2012

5.3.2.8 Test 8: Spatial Relations between Participants.

The 8th test took place outdoors and focused on spatial positions of participants to each other.

In a first orchestration, co-located Co-Actors were standing behind the Actors, invisible to the Actors. In fact, direct reciprocal facial connections were disrupted.

This orchestration did not lead to the shared experience for which it was designed; instead, Actors described the experience of caressing as purely instrumental to producing a portrait on the screen, transforming Virtual Personae, with little engagement from the public.

In the final orchestration the spatial design was adapted. Instead of standing behind the Actors, Co-Actors were invited to stand around the interactive sculpture facilitating direct visual face-to-face connection between Actors and Co-Actors, thus facilitating reciprocal visibility of facial expression. This is depicted in the spatial design (**Fig. 8** and **Fig. 11**).

Actors could then see reactions by Co-Actors to their caressing gestures, gesture tracing on screen, and on the resulting shared Virtual Persona. Adding these reciprocal visual facial connections between Co-Actors and Actors was successful for the experience of social touch. Even though some Actors indicated that they 'lose touch' with surrounding Co-Actors while caressing, the exposure and witnessing presence of the Co-Actors are needed to make the interaction socially meaningful.

1. Actors arrive at the screen, watching a Virtual Persona.

2. (left) The Actor's photo portrait is made, visible on the screen.
3. (right) A face recognition technology grid is layered over the portrait.

4) Participants caress their faces (left). On the screen (right), the facial parts that have been caressed become visible. In an insert screen, the Actor's face caressing gestures are real-time mirrored.

5) Actors can choose to 'save' their facial parts to be 'merged' with facial parts of previous Actors into a new Virtual Persona on the screen.

Fig. 12. Stills from demonstration video.

5.3.2.9 Test 9: Demonstration video of Interaction Flow.

In the 9th studio test, a demonstration video was made to explain the interaction design (of which stills are depicted below (**Fig. 12**)) to trigger participant imagination and interaction.

The performance script, and the performative phases implemented in the final design of the orchestrations, are explained in the next section.

5.4 Performance Script ASL1

ASL1's 'Saving Face' performance script is depicted in Table 5.4.1

Table 5.4.1. Performance Script: ASL1 'Saving Face'.

Phase 1: MEET (Introduction).
The Host describes Actors the intention of the work and the spatial interaction

Phase 2: MIRROR (Fitting and Concentration).
The Actor's photo portrait is made, visible on the small screen in the interactive sculpture (if Actors are not content with the portrait, they can start again). A facial technology grid is layered over the portrait. Once the portrait is ready, Actors can start caressing; if needed, the Host signals them to start. The Host tells them to caress slowly and take all the time they need.

Phase 3: CARESS (Transition).
The Actors caress their faces. On the big screen, **parts of the face** that has been caressed, becomes visible. In an insert screen, the Actor's face caressing gestures are mirrored real-time. While caressing, Actors can watch their emerging portrait on the screen, simultaneously. In those cases that the Actors caressing gestures move too fast, the Host tells them: 'Caress your face slowly, as if it is your lover's face'. The Host witnesses the Actors' performativity of caressing from a short distance ensuring a feeling of safety.

Phase 4: MERGE (Transition). Actors can choose to 'save' parts of their faces to be 'merged' with parts of previous Actors' faces, into a new Virtual Persona on the big screen. The newly composed portrait is saved in a database.

Phase 5: Memory building ('Incorporation') **/ Shared Reflection.**
The Host initiates a dialogue on 'shared embodied experience' with Actors, in the same space. The dialogue is staged to other participants, on a distance (**Staged Dialogue**).

5.5 Results, Discussion ASL1: Utrecht (2012)

This section discusses the Results and Discussion of ASL1 in Utrecht. This ASL focusses on the question: Can shared experience through playful participation in social touch be orchestrated in smart public spaces? This ASL1 orchestration took place in the Netherlands in the lively city centre of Utrecht during the 10 days Art Festival "Festival aan de Werf" in 2012.

5.5.1 Results ASL1 Utrecht

In the city centre of Utrecht, The Host stands near the sculpture and observes the public stopping and viewing the ASL1 orchestration from a distance. The Host observes that when portraits emerge on the screen as a result of caressing, they show interest, come close and ask the Host to explain what's happening. They express their interest and amazement with words such as: "This is magical! Can I appear there, on the screen?" or "Can my face be there?". Many first watch between 10 and 30 minutes before participating, although some come back the next day to participate.

The Host also observes how Co-Actors turn to the screen, look back at caressing acts by Actors and back to the screen again, relating the caressing gestures and the Virtual Personae on the screen, while being immersed in a disrupted, two-fold gaze. They stay between 5 and 30 minutes watching and often take pictures of the screen after an Actors' portrait has merged into a composite Virtual Persona. Often, the Host observes that once a Co-Actor decides to become a caressing Actor, more follow, similar to what is called "the honeypot effect" (Wouters et al. 2016).

Having decided to become a caressing Actor, standing in front of the screen (**Fig. 8),** many Actors express a feeling of nervousness, and wary about caressing in public. In some cases, however, Actors expose their caressing gestures in what can be called a 'theatrical' manner. This mostly happens when friends are around.

A feeling of nervousness, however, is more common, as expressed by a participant to the Host: "Do you think I would succeed to do this?" before participating as an Actor. In another case, observed by the host, a woman stands in front of the screen and brings her hand slowly towards her face, almost touching her skin. She then suddenly stops to turn to her friend behind her, who smiles while nodding her head. Then, carefully, the woman touches her face and starts caressing. Another Actor first touches her face and then stops, giggles, and tries to push forward a friend. Then she starts again, caressing her face in a slow, concentrated, and precise manner. In another case, three men have a long discussion with the Host after which they decide to not participate and leave. When after a few minutes, one comes running back, the others follow and surround him closely. With their bodies encircling them, they isolate him visually from the surrounding public, while he caresses his face.

In all cases, the feeling of discomfort seems to disappear once Actors are absorbed in the interaction between themselves and the screen, losing touch with their surroundings. The Host invites Actors to caress their own faces: 'Caress your face as if it was your lover's face' and 'Take your time'. Actors strongly respond to this intimate reference, smile, giggle and concentrate. Various video recordings capture people slowly and intensively caressing their faces, again and again in many ways of caressing over time. The Host observes Actors showing body language of immersion, intensity, alienation, stillness, and unfamiliarity**.** Their faces express disbelief, pleasure, wonder, joy, concentration.

Fig. 13. Actor caressing her face in ASL1 Berlin-Dessau, for a Virtual Persona to appear on the screen. The Virtual Personae appear as 'fellow men and women in the public domain' (section 5.3.1.1).
Image by Ruthe Zunz © Lancel/Maat, 2013.

In two sessions, a student explores the effect of keeping his eyes open or shut when caressing his face, leading to what he expresses as "I discover the machine as part of my imagination while I feel myself caressing my own skin".

Different forms of caressing are explored. Some hesitantly caress their faces partially, some eagerly grasp their full faces. Some Actors do not look at the screen in front of them while touching, but follow their own caressing hand from the corners of their eyes. Instead of caressing, some mimic putting crème on their faces or 'shaving' their faces. Others just softly touch one spot on their face and then another.

Once they have overcome their nervousness, Actors seem eager to be exposed in a Virtual Persona. They sometimes caress each other's faces, in this way co-creating the shared Virtual Personae. Video recordings show, for example, a child caressing the face of her father, tracing his face with her finger. He then caresses the face of his child and her mother, after which the mother caresses the father's face. A group of six women friends all caress each other. Furthermore, the Host observes that many Actors come back to merge with friends and family, to embrace the visual effects and the co-created Virtual Personae over time. For example, a

girl having participated once comes back the next day with her parents and her brother to co-create merging portraits, as a family.

In another case, the Host observes three young men caressing each other's faces. During caressing, they talk with each other about how it feels to appear on the screen though touching their faces. Another example is a father who wanted to surprise his daughter by 'painting' his moustache in her portrait that she previously created on the screen. However, although starting the caressing act as instrumental to surprise his daughter, the Host witnesses a transition to a intimately *shared* experience, of exploring and discussing the feeling and effects of the unfamiliar orchestration.

In a few cases, when no Co-Actors are around and exposure (of their caressing acts) is not part of the interface, Actors describe the experience of caressing as purely instrumental to produce a portrait on the screen.

In dialogue with Actors and Co-Actors, after the experience of caressing and rendering a Virtual Personae, discussions range from individual personal experience, to more general discussion on the 'use of social media' and about the 'difference between local embodied connections and ubiquitous digital connections'. Orchestration of these hosted dialogues in smart public spaces is the focus of the second orchestration.

5.5.2 Discussion ASL1 Utrecht

The multi-modal, sensory social synthesis is activated by interaction between Host, Actors and Co-Actors. Relations between caressing gestures, gesture tracing on screen and a resulting shared Virtual Persona, incite playful immersion for both Actors and Co-Actors. This immersion is established only when both screen and caressing gestures can be seen and experienced from one spatial position.

Exposure of the intimate character of the self-caressing acts incites shared experience and participation. The Hosting design creates conditions for all kinds of caressing and allows Actors to fully concentrate on this process. People experiment with acts and experiences of caressing, while expressing and sharing pleasure and wonder. Even when acts of intimately caressing result in merely 'losing touch' with surrounding Co-Actors, Actors still need the exposure and witnessing presence of the Co-Actors' gazes around them, to experience their gestures as socially engaging. Co-creation of the Virtual Personae on screen, through acts of caressing, incites participation.

The unfamiliarity with the role of caressing creates a safe space to embrace interdependency, experiment and sharing conversations both with the Host and Co-Actors around. Participants share expression of reflection among each other, to accompany each other when caressing and seduced by the unpredictable, exposed outcome of merging portraits.

The next orchestration of ASL1 Saving Face focusses on the orchestration of hosted shared experience and dialogues in the context of smart city public spaces.

5.6 Results, Discussion ASL1: Berlin/Dessau (2013)

The ASL1 Saving Face orchestration in Berlin/Dessau addresses the question: 'Can shared experience through dialogue on social touch be orchestrated in smart public spaces?'.

This orchestration was presented[70] during 2 days from late afternoon till midnight in between Dessau's historical Bauhaus buildings. The sculpture was positioned to mirror its silvery aluminium in the fading daylight, seemingly floating without gravity, connected to the digital network.

Actor's acts of caressing were projected on a very large wall (instead of an electronic screen as in ASL1 Utrecht), as shown in **Figs. 13 and 14**, in high quality. A device showing the video demonstration described in section 5.3.2.9 was implemented in the sculpture showing the procedure and participants reactions, to explore whether this would stimulate agency to use and play with the interface with, and without, a Host.

In this context, hosting of dialogues was explored. Participants were invited to discuss their experiences and imagination, of touching their faces and the influence of technology in creating their mirror image; and of sharing the mirror-image with others. Furthermore, personal, embodied appropriation of the digital mirror images on the screen that are merged with images of previous participants are discussed.

Over 130 people participated over this 2-day period, often together with friends or family. As part of the orchestration, after participation, most Actors are asked by the Host to reflect and answer questions about their experiences and emotions.

Often, Actors express that they are fascinated by the experience of caressing their faces and that they have never had an experience like this before. The experience of touch in public space is often stated to be a totally different experience, described as "disturbing" involving "co-location of oneself". They often state that it felt strange, and that they do not have words to describe this experience as a sense of touch. And yet they try. It often leads to stuttering and to finding new words and images, expressing their experiences, as a form of reflection. One Actor commented: "When I closed my eyes caressing in front of this technology, knowing that that my caressing act was exposed, it seemed as if a hand outside caressed me, as if it was not my hand but the hand of God." Another Actor stated that he felt he was giving away a piece of themselves to a "digital grid".

Furthermore, the Host inquires whether Actors embrace the Virtual Personae as a mirrored self-image. Actors tell the Host that they have mixed feelings about this image, for example by stating: "I think it is me. Yes, maybe. I was here. It must be me", "These are my eyes, but whose mouth is that?", "Yes, a technological but sensitive me", "It could be family", "No, I never look at me like that", "Yes but alienating".

[70] Presented by Public Art Lab Berlin, for the Connecting Cities Network (European infrastructure of Urban Screens and Media Facades for Artistic Content) http://connectingcities.net/, last accessed 2022/2/27.

Fig. 14. ASL1 Berlin-Dessau. Image by Ruthe Zunz © Lancel/Maat, 2013.

To answer the question whether Actors feel the Virtual personae have been created by the machine or by themselves, they often describe a form of relation with the machine through statements such as: “The machine is part of me”, “This is technology in a sensitive way”, “The machine changed my face”, “The machine was scanning me”, “I feel merged with other people”, “It feels only natural”.

The Host observes that Co-Actors not only watch the Actors’ caressing gestures and the emerging Virtual Persona on the screen, but also listen to the dialogue between the Host and the Actors after fact. In contrast, if no dialogue takes place, Co-Actors seem less involved. In this orchestration, as stated above, the influence of the Host was explored, especially on shared dialogue and reflection. The demonstration video (described in section 5.3.2.9) itself

was sufficient for participants to autonomously use and play with the interface. Participants even 'teach' each other how to use the interface and play. However, without guidance and dialogue with a Host, the emphasis shifts from concentrated and haptic exploring, to 'fun' forms of exposure, such a making weird and funny faces, exploring technical possibilities and limitations of the face recognition software.

5.6.1 Discussion ASL1: Berlin/Dessau

ASL1 Berlin/Dessau explored the influence of the Host on the shared experience and dialogue on social touch, in smart public spaces. In dialogue, the Host provokes Actors to describe their experiences of the socio-technological synthesis that include disrupted self-touch through technical mediation. All participants try to remember and describe their embodied sense of mirroring versus the scanning, tracing, and emerging information on screen. Furthermore, they describe their relations to the Virtual Persona, that emerges through intimate acts of caressing and which they visually share with previous participants. The visuo-haptic experience of *caressing-and-feeling-caressed* intertwined with visually emerging on screen was described as unfamiliar by all participants. Actors take time to explore new words, while stuttering and remembering, expressing new images and emotions.

Shared experience for Co-Actors not only emerges from exposure of caressing, and the emerging Virtual Persona on the screen (discussed in section 5.3.1.1), but also from the dialogue between Host and Actors, and between participants. Without the dialogue with the Host, Actors and Co-Actors tend to focus on "fun" forms of exposure and less on exposure of their intimate acts of social touch.

5.7 Results, Discussion ASL1: Beijing (2015)

The ASL1 Saving Face orchestration in Beijing addresses the question: 'Can shared experiences through participation and dialogue on social touch be orchestrated in smart public spaces in different cultures?'.

In Beijing, the ASL was performed in Beijing's Culture and Art Centre (BCAC), as part of the opening ceremony of the art Centre. It was presented in the historical *hútòng* courtyard, in one of Beijing's old and crowded streets, for a period of 10 days. The sculpture (**A in Fig. 8**) was positioned in a glass architectural space between the crowded street and the first museum courtyard. The sculpture and the screen were positioned between these two glass walls (**Fig. 15**).The urban electronic screen was two-sided, to allow the Virtual Persona to 'gaze' in two directions: both indoor and outdoor. The Virtual Persona gazes at both the outdoor passers-by in the street, and to visitors in the indoor gallery in the historic courtyard. To incite involvement and support dialogue, a text describing how to participate, is made available in both English and Chinese. The text is accompanied by a project description and an invitation to participate. It is placed on the glass window to read from the outdoor street

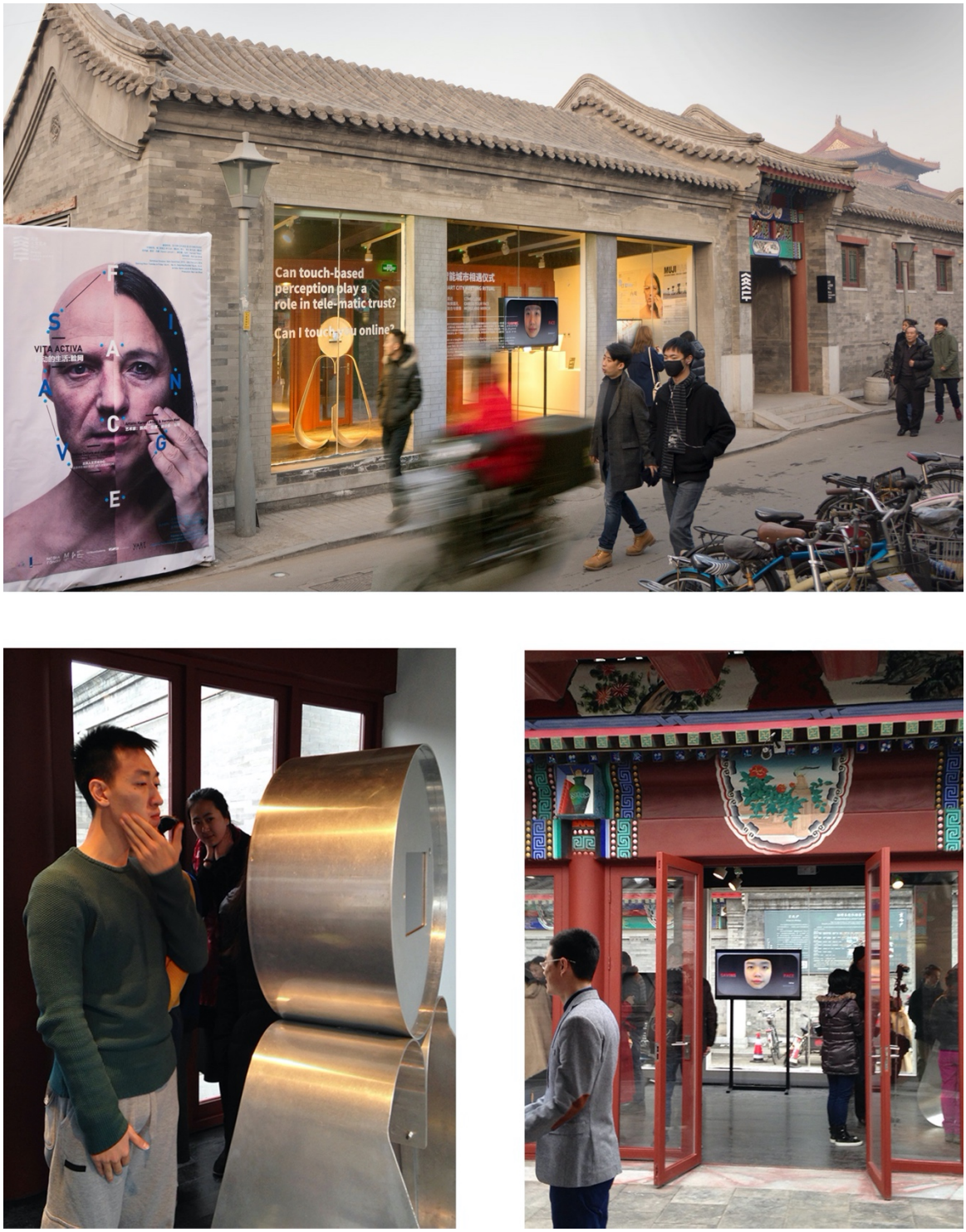


Fig. 15. ASL1 'Saving Face'at Beijing's Culture and Art Centre (BCAC) Beijing. Image © Lancel/Maat, 2013.

and on the walls in the indoor gallery:

1. Can I touch you online?

2. Come close

3. Caress your face

4. Merge & Mirror.

The role of the Host is again subject of study. The initial role of the Host is performed by both the artists and by the Art Centre's staff. This is observed in cases by the artist Host standing on a distance.

5.7.1 Results ASL1 Beijing

On the opening afternoon, young designers, cultural entrepreneurs, staff-members of art institutions and sponsors crowd the space indoors and outdoors. The outdoor street is crowded with businessmen, neighbourhood inhabitants, school children and shop-owners walking, on bikes and on scooters. The air is heavy with pollution, many people have used thick facial creams and face protecting and oxygen filtering mouth caps.

The Host observes that many people watch the touch gestures and interaction from outside through the window, while pointing at the text on the window. Instead of watching the screen, Co-Actors endlessly watch specifically the Actors' acts of caressing, both from inside and outside the glass window. They watch the caressing gestures in the orchestration's technological system and take pictures.[71]

In Beijing, there is closer physical interaction between Co-Actors and Actors compared to the previous orchestrations, in Utrecht and Berlin/Dessau. Co-Actors gather closely together around the interactive sculpture and around the caressing Actor, watching the caressing acts and following the emerging digital traces on the screen. Together they wait for the unpredictable portrait on the screen to emerge, helping each other to participate, making pictures and posing for pictures. They point at the sculpture and explain to each other how it works.

Moreover, compared to previous orchestration, the Host is approached by more Co-Actors for additional information and for serious discussion. The title 'Saving Face' is often subject to discussion, as it is stated to be a somewhat disturbing title, expressed with words such as: "Are you aware what that means for Chinese people?" or "Do you know that 'saving face' is very important to Chinese people?" Discussions focus on 'hiding behind a social mask' and aspects of 'hiding' and 'shaming' mechanisms when meeting each other, both on social platforms and in the city.

Whereas in previous orchestrations the Virtual Persona was referred to as someone that may resemble the Actors themselves, in Beijing, Co-Actors describe the Virtual Persona as someone they socially relate to, for example as "A friend", "A sort of relative", "Someone I might know". The artists hosting the interaction are assisted by a Chinese speaking Host. Dialogue evolves between Actors, and the artists-Hosts or the Chinese speaking Host. The Host observes that

[71] While the opening day is very busy, the days after a few people step into the gallery. In the streets, throughout all days, people keep stopping to read the text on the window, watch the video documentation and to watch the screen with the transforming Virtual Personae.

once Actors start caressing, they keep concentrated while others keep watching and talking.

Most Actors tend to caress their faces very fast or tap them softly, carefully. When the Host suggests that they caress their faces 'as a lovers' face', they try to adhere. For example, a young woman who hardly actually touched her face, changes her caressing rhythm into long, slow strokes. Another woman who initially tapped her face, seemingly afraid to remove her make-up, changed her gestures into slowly outlining the contours of her face. A third Actor, a middle-aged man, touched his face for a long time without moving, watching the still screen responding his absence of moving, until being explained to move slowly.

After caressing, Actors express wonder, for example stating that "Caressing my face is a nice feeling" and "I never touch my face consciously, only for creaming" and "I only touch my face to remove pollution".

Although stepping out of social comfort is experienced as a challenge, the orchestration was well received and participated. The use of printed texts and questions to incite participation appears to be effective, for all surrounding public. The Host observes people reading the texts, before participating. Actors still discuss with the Host, but independently start the touch gestures and interaction, and, if necessary, help each other to perform. The Host also observes that younger people are more inclined to not wait for a guiding Host but to start while being helped by each other.[72]

Exposure of individual dialogue between Host and an Actor (as a staged dialogue) is less effective compared to the previous ASL1s. The Host finds that in dialogue with a group of people, more and more people will participate.

Many times, after their caressing acts, Actors wanted to be reassured by the Host that the Virtual Persona on screen will keep transforming, without a final face that might be identifiable.

5.7.2 Discussion ASL1 Beijing

Although an act of caressing in public can be considered as embedded in cultural meaning, caressing in the ASL1 opens playful participation and dialogue in different cultures including Utrecht, Dessau, Beijing.

Overall, exposure of caressing and dialogue are observed as more communal activities compared to ASL1 in Utrecht and Dessau. People gather around the interactive sculpture, they stand closer to each other while caressing and communally discover how the interface works and teach each other. Exposure of intimacy of social touch in public space through dialogue emerged in collaboration between the Host and Co-Actors around. The resulting Virtual Personae on the screen are interpreted rather as socially relational than individually mirroring.

In Beijing, the combination of unfamiliar caressing and technology appears to be a safe seducer for individual reflection on historical and social interdependency and coherence.

[72] Due to this accessible character, the exhibition period was pro-longed.

Dialogue happens within the socially gathering, with or without a host, slightly decreasing the importance of the role of hosting, especially in case of a language barrier. Moreover, the technical interface and interaction through caressing gestures is found to be more accessible if texts and questions are on the windows, especially for young people.

5.8 Conclusion ASL1: Utrecht, Dessau/Berlin, Beijing

This chapter explores the design of three artistic orchestrations of ASL1 Saving Face, for shared experience of social touch in smart public space. ASL1 Utrecht (2012) explores shared experience through playful participation of social touching in smart public spaces; ASL1 Berlin/Dessau (2013) explores such shared experience through dialogue on social touch; and ASL1 Beijing (2015) focusses on participation and dialogue on social touch in different cultures. The effects of specific design choices are analysed.

New types of social interfaces, with unfamiliar, ambiguous and disrupted sensorial connections, are key to the ASL1 orchestrations. They enable embodied, emphatic relations with others through touch, based on the design of socially and technically mediated 'self-touch for social touch'. This form of mediated self-touch disrupts familiar social, sensory relations between 'who you see, who you touch and who is being touched'. In all orchestrations, caressing has shown to evoke an intimate and affective social touch experience for Actors touching and Co-Actors.

In these orchestrations, interaction is evoked between Actors and Co-Actors, in various time relations. Through acts of touch, Actors synchronize ambiguous virtual and sensory connections over time. Synchronization is acquired by 1) perceiving all virtual and sensory connections from one spatial position and 2) co-creation of unpredictable merging portraits, to facilitate shared experience of social touch.

Staged dialogue with a Host, as part of the orchestration, evokes shared experience and reflection for both Actors and Co-Actors. Orchestrations in different cultures showed that although participants explore and expose both caressing acts and dialogue, hosting needs to be adapted to differences of dynamics in individual or joint exploration.

All three ASL1 orchestrations, show that shared experience and dialogue on social touch can be technically mediated by playful smart cities technologies in public spaces, but rely on design of socially and technologically mediated, intimate and exposed forms of 'self-touch for social touch', ambiguous relations, exposure of dialogue, and hosting.

Fig. 16. The 56th Venice Biennial 2015. ASL 1 'Saving Face' at The Chinese Pavillion.
Image by Lancel/Maat © Lancel/Maat, 2015.
The Virtual Personae on the screen appear as 'fellow men and fellow women in the public domain' (see section 5.3.1.1). At the Venice Biennial the artificiality of the Virtual Personae is further emphasized, mirrored by the water in a pool.
The engaging impact of inviting an audience to perform social touch gestures in the context of this visual art exhibition, exceeds this thesis, and is part of Future research discussed Chapter 11.6.

5.9 Hosting of Shared Reflection Design, in 3 ASLs

This section explores the question: 'Is human hosting essential to social touch in the public space of merging realities?' focusing on whether artist-based hosting (section 4.4.) can be (partly) replaced by participant-based hosting, and additional non-human-hosting.

The question has been explored in three artistic orchestrations designed for social touch in public space, two of which were described above in section 5.6-5.8. (ASL1 Berlin/Dessau (2013) and Beijing (2015)). ASL Master Touch (2013) is the third orchestration considered in this section.[73] The effects of different hosting designs are analysed.

5.9.1 Research Context

In each of these 3 orchestrations of ASL1, the design of shared reflection relies on purposefully disrupting and re-orchestrating multi-sensory connections in unfamiliar and unpredictable ways, and hosting.

ASL1 Berlin/Dessau and ASL1 Beijing are artistic orchestration in which participants are invited to caress their faces in front of an interactive sculpture. This interactive sculpture (equipped with cameras and face recognition technology) is connected to a large electronic public screen in the public space. Actors 'paint' their portraits on the public screen, where they first appear slowly; and then slowly merge with the portraits of previous visitors into new, unpredictable, and untraceable networked 'identities', or 'Virtual Personae'. Each Virtual Persona is saved digitally, to be shown later in an auto play mode on the electronic screen.

ASL Master Touch (Rijksmuseum Amsterdam, 2013) (**Fig. 17**), is very similar to ASL1. Differently, in Master Touch, participants' faces appear and merge slowly with portraits of the digital portrait collection of the Rijksmuseum in Amsterdam, for example with a portrait of Rembrandt or of Van Gogh (instead of with portraits of other participants from the public).

5.9.2 The Role of Hosting, Compared in 3 ASLs

ASL1 Berlin/Dessau[74] explored whether hosting could be replaced by a demonstration video, showing the interaction rules of play; and showing examples of people participating, their performative acts and being in dialogue with each other. This experiment took place during an orchestration in Berlin-Dessau, at a crowded festival. Many people of different ages, cultural and geographical backgrounds and genders visited and participated in this orchestration, in either hosted or non-hosted interaction. In absence of the Host, people watched both the demonstration video and performative acts by Actors on site, whilst the Host observed.

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[73] The Rijksmuseum Amsterdam collection of digitized portraits can be found on: https://www.rijksmuseum.nl/en/search?q=portraits&ii=0&p=1, last accessed 2019/9/25

[74] In Berlin-Dessau, the Saving Face orchestration was performed during two days at festival Connecting Cities Network, curated by Public art Lab Berlin, September 2013. http://connectingcities.net/project/saving-face, last accessed 2019/9/25

Fig. 17. ASL'Master Touch'. Rijksmuseum Amsterdam 2013. Image © Lancel/Maat, 2013.
The Virtual Persona at the center of the screen is composed of the participant's portrait, and a portrait from the Rijksmuseum digitized collection. Fig. 17 presents a participant's portrait merged with "Portrait of a Girl Dressed in Blue" (1641) (om the right side of the screen) by Johannes Cornelisz Verspronck.
In 'Master Touch', Actors merge past and present time portraits through acts of face-caressing.

ASL1 Beijing explored whether attention to affective and embodied experience could be enhanced by means of other than a *human* host. In addition to the demonstration video, large, printed texts were used to introduce the social context of the orchestration and rules of play. This experiment took place in a museum[75], in a space with a large window facing the street. The large, printed texts on the walls were visible from outside, through the window on the street[76], and, from inside as text on the walls. Again, participants' autonomous interaction took place while the artist host observed from a distance.

ASL Master Touch, Rijksmuseum Amsterdam explored whether the hosted dialogues could be replaced by questionnaires.[77] The questionnaires were introduced, to replace the role of hosting evoking dialogue among participants. Open questions, asked in ASL1 by an artist Host, were printed and placed on tables close to the participants. These questionnaires included the questions:

- Is this your portrait on the screen, and why (not)?
- How does it feel to become visible on the screen through caressing your face?
- Are you part of a machine in Master Touch?
- What is the difference between watching a painting from a distance and *watching through touching?*

5.9.3 Results ASL1 Berlin/Dessau, ASL1 Beijing and ASL Master Touch

The three ASLs, (ASL1 Berlin/Dessau; ASL1 Beijing; and ASL Master Touch) explored whether aspects of human hosting on site can be replaced partially by participant hosting.

In orchestration ASL1 Berlin/Dessau, the Host observed that Actors and Co-Actors: **1)** helped and showed each other how to participate throughout the performance script, while **2)** guarding each other's embodied safety. However, the Host observing the interaction from distance, also observed that participation shifted from concentrated and haptic exploration to making funny faces, exploring possibilities and limitations of the face recognition software and exposure of their faces. After having participated in the visuo-haptic interface, often, **3)** the (Co-) Actors' dialogue among each other focussed on experience of 'fun', 'surprise' and 'wonder', while pointing at the portrait on screen. Sometimes, afterwards, they then asked the Host questions about the unpredictable technological and seemingly 'magical' (Reeves 2013) interaction.

In the orchestration ASL1 Beijing**,** the Host observed that, in comparison to the previous ASL, people were less disrupted and more focussed. They **1)** watched the demonstration video and read the texts together, pointing at parts of these texts while interacting. In particular younger people participated in acts of caressing using the

[75] In Beijing, the Saving Face orchestration was performed at Beijing Culture & Art Centre (BCAC), for a period of 10 days during December 2015-January 2016. Due to success, the period was prolonged with a month.

[76] These texts also functioned to solve disrupted communication due to a language-barrier.

[77] Master Touch was performed at Rijksmuseum Amsterdam; at the Jubilee Night of the Rijksstudio (responsible for digitizing the portrait collection) and the Museum Night, November 2013.

technological interface often in joint exploration, while socially gathering, laughing, stimulating and **2)** guarding each other. During and after acts of touching, the host observed **3)** participants being in dialogue while pointing at the screen and at their faces. The Host then was sometimes approached to answer conceptual questions about context and societal meaning of the orchestration, in particular with respect to privacy.

In the ASL Master Touch (Rijksmuseum Amsterdam), participants filled in the questionnaires with one-word-answers and little dialogue took place between participants. After fifteen participants reacting in this way, the experiment was ended, after which one-to-one Hosting was successfully based on the questionnaires.

5.9.4 Discussion ASL1 Berlin/Dessau, ASL1 Beijing, ASL Master Touch

These three ASLs show that video documentation introducing rules of play and participation, and additional large, printed texts introducing both the rules of play and the social context of the orchestration, can partly replace human hosting.

However, although participants can 1) autonomously use and play with the interface, they less focus on social context and less focus on performative gestures of touch occurs. 2) Corporal and social safety are supported by co-participants who are, in this aspect, fulfilling a role of 'participant hosting'. 3) Although participants engage in dialogue, the type of dialogue differs. Participants are less inclined to take the time to reflect on the unfamiliar embodied experience and to express the unfamiliar embodied experiences in words, making the experience explicit, and to discuss with others.

5.9.5 Conclusion ASL1 Berlin/Dessau, ASL1 Beijing, ASL Master Touch

Section 5.9 addresses the role of hosting in current mediated social, communication design for social touch, for social robotics and tele-matic environments, exploring the question: 'Is human hosting essential to social touch in the public space of merging realities?'.

All three ASL orchestrations show that human hosting seems to be essential, to achieve a sense of safety and shared reflection. Furthermore, aspects of artist hosting can be replaced partially by participant hosting. Participants have shown to be able 1) to autonomously use and play with the orchestration, but with less focus on context and performance of touch; 2) to support corporal and social safety as co-participants and in this aspect, fulfilling a role of 'participant hosting'; and 3) to engage in dialogue during and after a performance. The type of dialogue, however, differed. Participants were less inclined to take the time to reflect on the embodied experience and to express the unfamiliar embodied experiences in words, making the experience explicit, to discuss with others.

5.10 Conclusion ASL1, in relation to the CITYO Interaction Model

These orchestrations provide insights in relation to the use of the CITYO Interaction Model.

1. Sensory Disruption Design, with reciprocal haptic influence in empathic interplay.

- Predictable visuo-haptic **connections** are required for immersive connections between touch, emerging image on screen and body ownership.
- Actors and Co-Actors engage in the orchestration if all visual-haptic, direct, and virtual sensory connections are perceived from **one spatial position**, for each individual.
- **Visuo-haptic influence** by the Actors, on each other's actions, is vital and can be established in non-simultaneous, leading to (partly) unpredictable outcome (Shared Data Composition).
- Social and sensory connections must be **ambiguously** orchestrated, to evoke engagement in cognitive reflection.
- The **Co-Actor's gaze** is vital, for the Actors to experience their technically mediated touch gestures **as *social***. However, paradoxically, Actors must be able to partly 'lose touch' with the Co-Actors, in order to immerse and concentrate in the personal haptic experience.
- Often, **Actors react** both nervously *and* playful. They experience different touching and skin perception through the interaction. Especially the shared, emerging (shared) self-representation (Virtual Persona) elicits interaction.

2. Shared Reflection Design.

- **Socially Hosting is essential to: 1)** introduce and enhance focus (contextualizing the orchestration; rules of play, guiding participants through performance of disrupted, unfamiliar forms of touch); **2)** ensure social and corporal safety; and **3)** evoke dialogue, to express the experience in words, making the experience explicit.
- **Human Hosting** can be partly replaced by participants hosting, but with limiting effect on **a)** the introduction, contextualization; **b)** focus on performance of social touch gestures; and **c)** to taking time, to make the unfamiliar experience explicit in words.
- **Shared Reflection through staged dialogue is essential for** Co-Actors to stay involved.
- In different cultures, **hosting needs to be adapted to differences of dynamics in individual or joint exploration.**

ASL 2: Touch My Touch

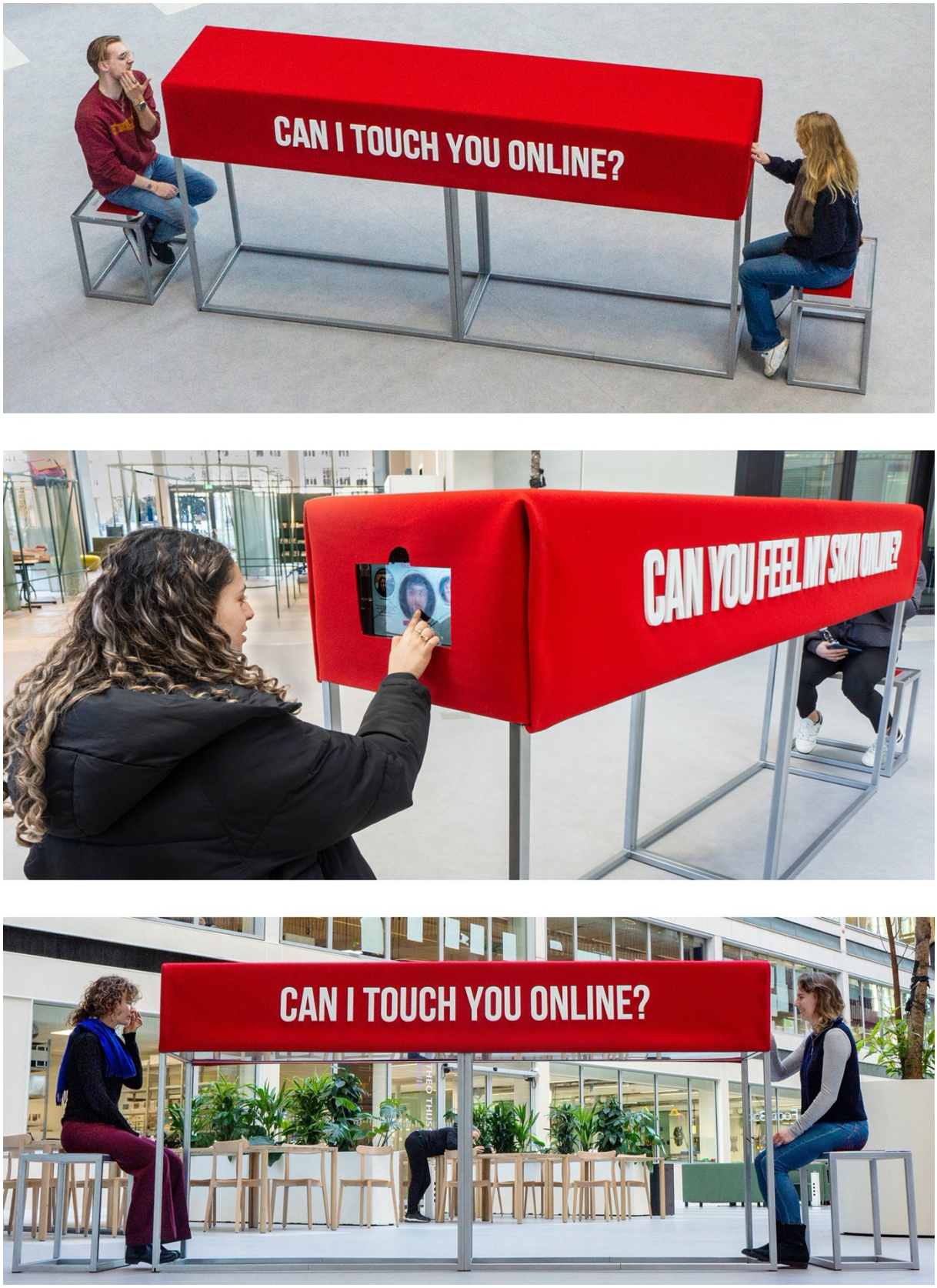


Fig. 18. ASL 2 'Touch My Touch', performance Installation, University of Applied Science of Amsterdam. Image by Lancel/Maat © Lancel/Maat 2021.

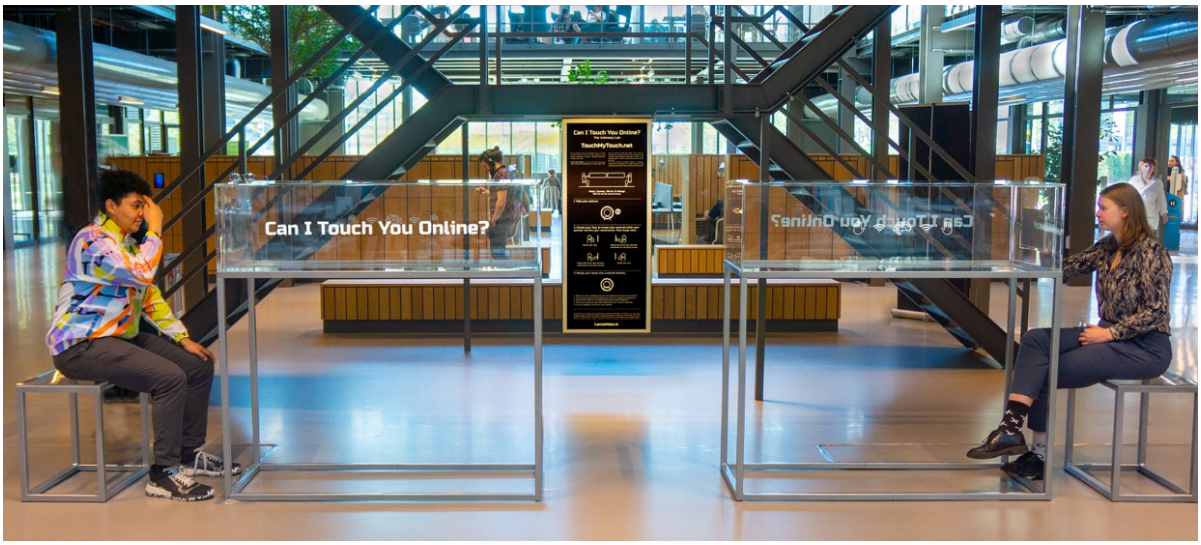
6 ASL 2: Touch My Touch

This chapter presents ASL2 'Touch My Touch' (Lancel/Maat 2021) by presenting the orchestration (6.1); the interaction model (6.2); the design choices (6.3); and the performance script (6.4). This is followed results (6.5) a discussion (6.6) and a conclusion (6.7) based on the orchestration. A conclusion in relation to the CITYO interaction model is presented at the end of this chapter (6.8). Technical A.I. aspects are discussed in Appendix 1.
In summary, the ASL2 includes:

ASL2 *Touch My Touch* is a streaming platform for 'online touching each other', for two participants.
The Sensory Disruption Design uses streaming, facial- and merging technologies to create a *Virtual Persona* interface, for visuo-haptic motor data interaction, and sonic connections.
Actors and Co-Actors visibly share simultaneous, bi-directional caressing gestures. Actors caress their faces, while synchronously, Co-Actors mirror these gestures through screen-touching (in shifting roles). From their shared gestures a unique visual Virtual Persona emerges; that can be downloaded from a database.
Shared Reflection takes place through shared dialogue.

This Chapter is based on:

- Lancel, K., Maat, H., Brazier, F.M. (Submitted) 'Touch My Touch: Sharing Intimate Experience of Social Touch in Remote Interaction, through Artistic Design'.



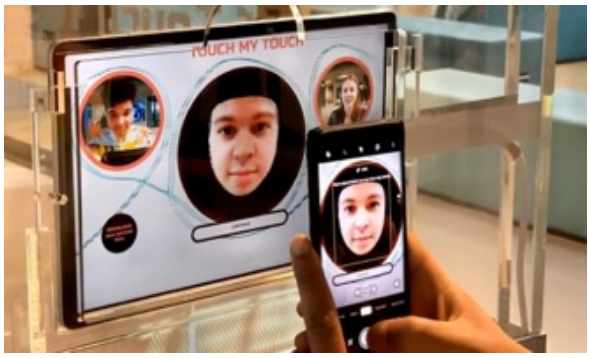


Fig. 19a. *(Upper image)* ASL 2 'Touch My Touch'; performance Installation at the University Twente.
Two participants meet on TouchMyTouch.net, the *Streaming platform for online touching each other*.
Fig. 19b. *(Four images below)*. 'Touch My Touch' performance Installation Gallery the Meerse Hoofdorp/Amsterdam. Image © Lancel/Maat 2021.
Caressers and Co-caressers shift roles between caressing their own faces *(image left under*) and mirroring the caressing gestures on the screen *(upper image left)* .
Fig. 19c. (*Images left):* through caressing their faces, participants visually 'unveil' their faces from facial technology grid layers.

6.1 Orchestration ASL2: 'Touch My Touch' (2021)

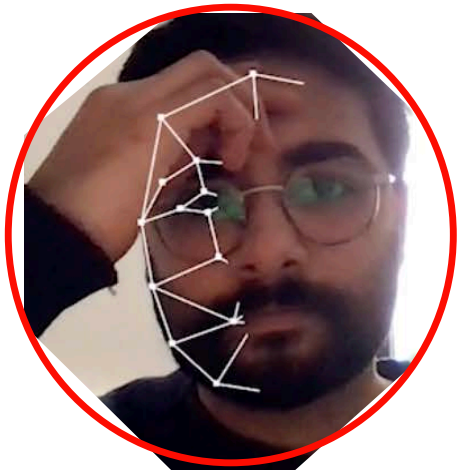
ASL2 explores the question: 'Can shared intimate experience of social touch be orchestrated for online connections?', in an online shared space TouchMyTouch.net, using streaming, facial- and merging technologies.

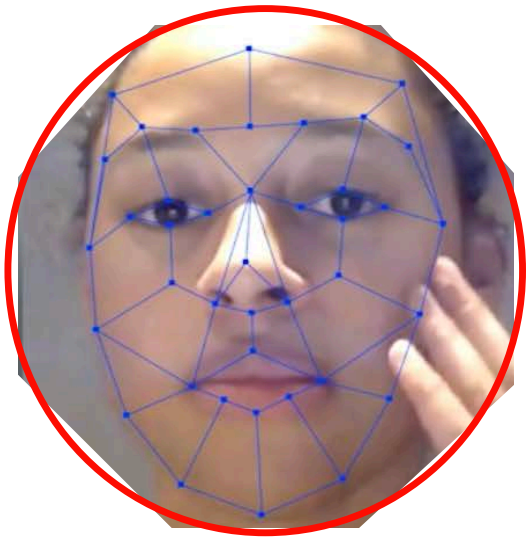
In this space, two participants meet in roles of 'Caresser' (Actor) and 'Co-Caresser' (Co-Actor). They share their photo-portraits, that are then over-layered with facial recognition grids, like 'data-veils'.

Caressers and Co-Caressers together 'unveil' their mutual photo-portraits on the screen (**Fig. 19,21**). Caressers slowly caress their own faces, while Co-Caressers mirror these caressing gestures through moving over their screens, over the photo-portrait, in synchronizing movements. They then shift roles. Finally, both the participants caressed facial parts on the screen 'merge' into a unique, unpredictably composed Virtual Persona; that becomes part of an online 'community' of Virtual Personas.

In Touch My Touch participants share visuo-haptic motor data interaction (discussed in section 2.2.3) with a technically mediated self-portrait; emerging through another person mirroring and drawing their self-caressing gestures on the screen, in congruent, synchronizing movements.

The streaming platform supports visual, sonic and haptic connections. Participants share reflection through dialogue. They discuss, negotiate, and reflect together, on shared stories and imaginations - about the future of social touch and about ways of connecting with touchable and untouchable friends, family, lovers, and strangers worldwide.





6.2 Interaction Model ASL2

Fig. 20 depicts the ASL2 'Touch My Touch' (2021) in relation to the CITYO Interaction Model.

Description CITYO Interaction Model ASL2

1) Sensory Disruption. The online streaming platform enables visual and audible connections between Actors and Co-Actors, facilitating mutual visibility of facial and audible emotional expression. Actors visibly share face-caressing gestures with Co-Actors.

The Actor's individual perception of direct self-touch, through affective self-caressing gestures, is sensory disrupted through the Virtual Persona interface. Reciprocal Response by the Co-Actor takes place through simultaneously caressing the screen, in synchrony with the Actors caressing gestures, leading to a predictable shared data-visualization. They then shift roles. Finally, based on their separate data, Actors and Co-Actors realize a unique, unpredictable *shared* data-visualization, of portraits merging into Virtual Persona's, **in** unpredictable ways**.**

2) Shared Reflection takes place through shared dialogue between the two (Co-)Actors.

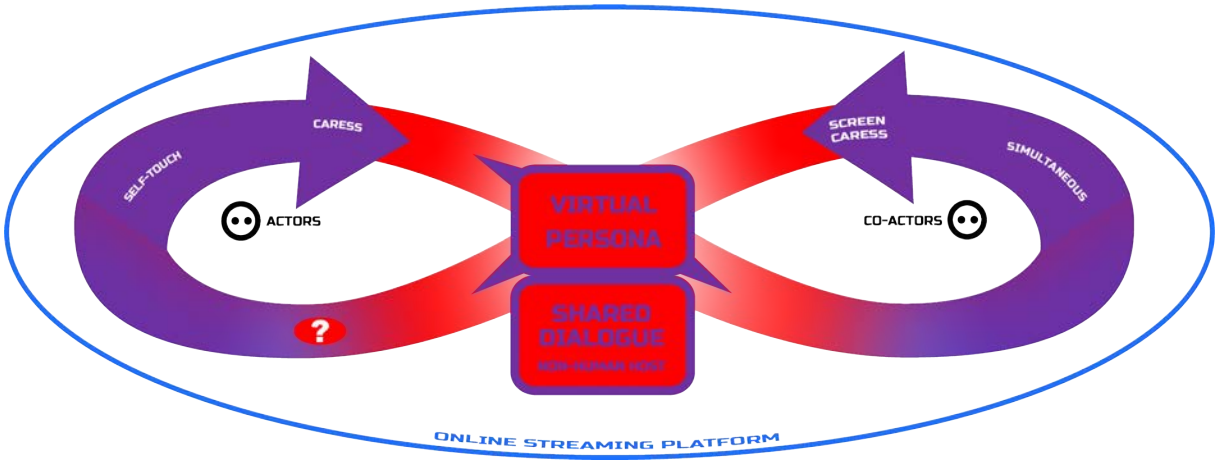
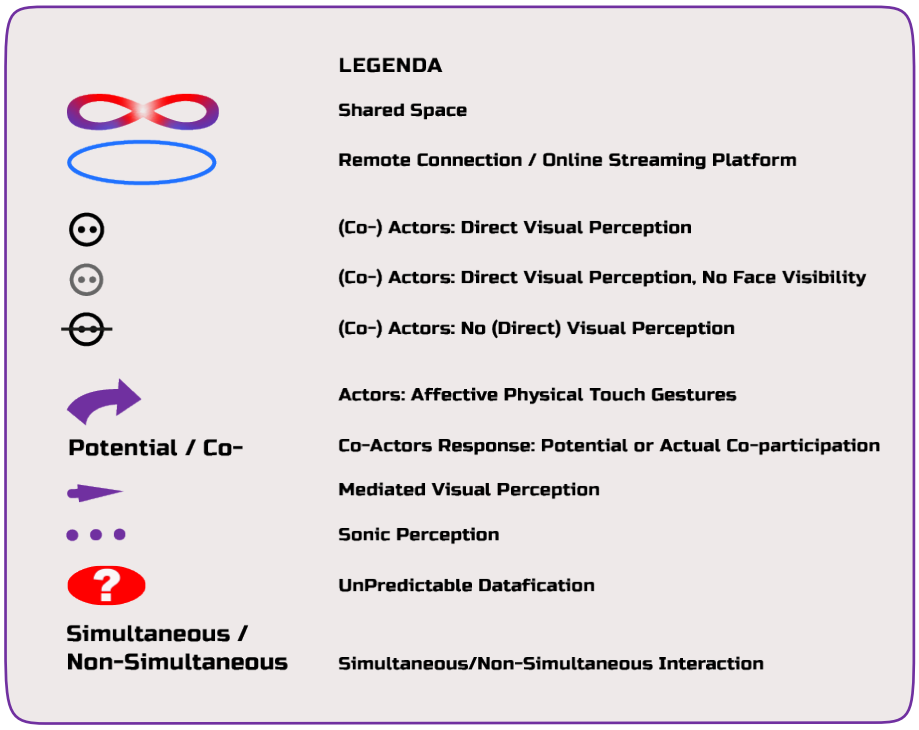
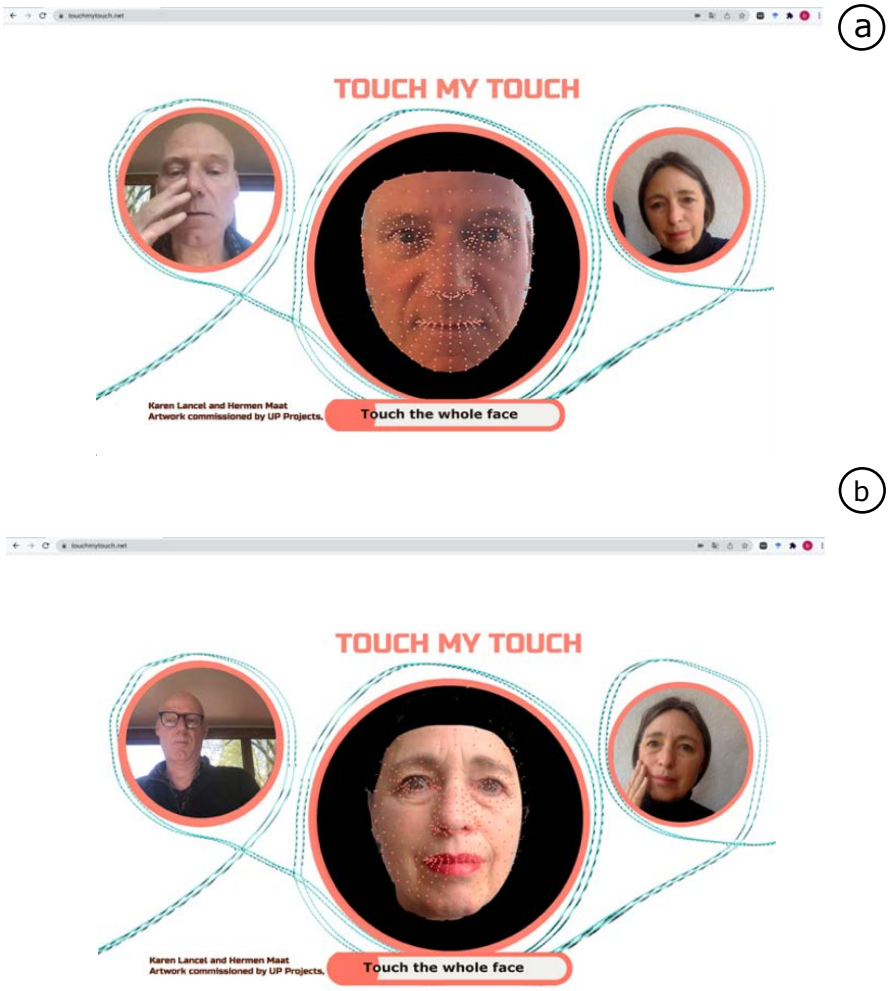


Fig 20. CITYO Interaction Model ASL2 'Touch My Touch' (2021) and Legenda.





Figs. 21a,b. ASL2 www.TouchMyTouch.net (2020)**;** in reference to the script in Table 6.4.1, Phase 3.

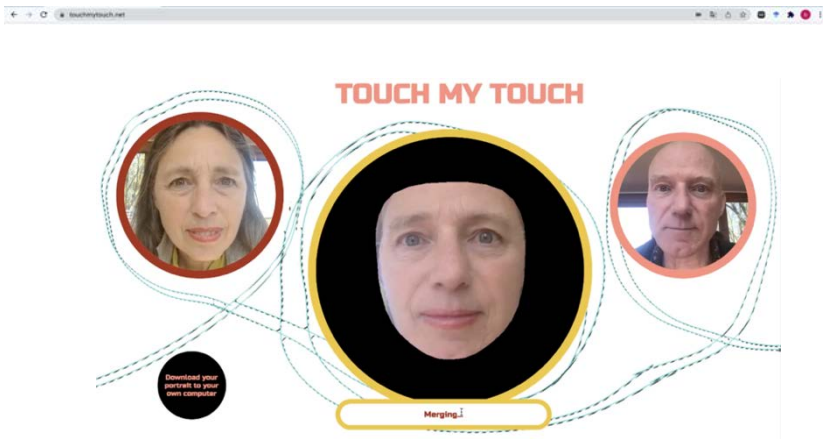


Fig. 21c. ASL2 www.TouchMyTo**u**ch.net (2020)**;** in reference to the script in Table 6.4.1, Phase 4.

6.3 Design Choices ASL2

This section presents the interaction design of the Touch My Touch streaming platform.

The visual design of the streaming platform presents three circles. The left and right circles are dedicated to streaming interaction between both participants; and the middle circle to the shared data visualization.

The technical set up of the streaming platform has been built with Microsoft Teams Azure network protocol, using opensource TensorFlow javascript Technology for face recognition. Face tracking en Face rendering have been build in Java-Script & C++.
Note, that the technical A.I. aspects of ASL2 are presented in **Appendix 1**.

Ethical concerns. GDPR protocols for consent and privacy have been applied. No online sound or images are saved nor distributed. Only the last 20 undecodable, merged digital personas are temporarily saved. Inclusiveness and merging of skin colors are subject to dedicated design.

Visual interaction design. Three of the six performative phases (phases 3, 4 and 5) of the performance script (section 6.4) are described below.

In ***Phase 3*** (**Fig. 21a**), the central circle shows the photo-portrait of the Actor (Caresser) who is visible in the right circle. The Co-Actor (Co-Caresser) is visible in the left circle. The photo portrait is over-layered with a facial recognition grid, 'like a veil'. During the performance, the Caresser directly caress the own face.

Simultaneously, the Co-Caresser caress the photo-portrait on the screen, in mirroring, synchronising movements with the Caresser's gestures. This shared form of caressing results in 'unveiling' the facial recognition grid from the photo portrait.

Actors and Co-Actors then shift roles (**Fig. 21b**): the person in the right circle becomes Co-Caresser, and the person in the left circle becomes Caresser.

In ***Phase 4*** (**Fig. 21c**), the central circle shows a portrait, that has been created through merging the caressed facial parts of the two participants in the left and right circle.

Participants can choose to agree to merging their caressed facial parts with those of their caressing partners, into new Virtual Personas. The merging process includes that first, one portrait is visually emphasized, transforming into the other persons portrait.
Finally, both portraits merge in averaged (50-50%) balance. A black button at the left gives access to download the image of the Virtual Personas on the participants' personal computers.

In ***Phase 5***, the middle circle encourages participants to start a dialogue, to share reflection on the embodied experience of the performance.

The dialogue is evoked by means of a list of questions (as a form of **'**non-human hosting'). Table 6.5.2.1 presents the questions and the collected responses (section 6.5.2).

6.4 Performance Script ASL2

ASL2's 'Touch My Touch' performance script is depicted in Table 6.4.1.

Table 6.4.1 Performance Script: ASL2 'Touch My Touch'.

Phase 2: Mirror (Fitting and Concentration)
The participants photo portraits are made, separately visible on their individual screens. *Note*, that if they are not content with the portrait, they can start again. Once both portraits are agreed to, participants can continue the performance.

Phase 3: Caress (Transition)**.**
Participants are invited in the roles of as either a 'Caresser' (Actor) or a 'Co-Caresser'(Co-Actor). On their individual screens, they both see the Caresser's photo-portrait, with a facial recognition grid layered over it, like a veil. Caressers slowly caress their own faces, while Co-Caressers trace and mirror these face caressing gestures, on the on the screen photo-portrait, in synchronizing movements, thus 'unveiling' the portraits. While caressing, they both watch the emerging portrait on the screen, simultaneously. Actors 'save' the visual facial parts that they have been caressing, temporarily in a database.
They then shift roles with Co- Actors.

Phase 4: Merge (Transition)**.** Portraits of both Actors visually merge.
The newly composed face (Virtual Persona) is saved in a data base.

Phase 5: Memory building (Incorporation) **/ Shared Reflection**.
Participants share a dialogue on based on presented questions and share memories of the embodied and performative experience (*Shared Dialogue*). he composed face (Virtual Persona) becomes part of an online Virtual Persona Community, transforming auto play from the growing database, visible on the platform.

Phase 1: Meet (Introduction)
Two participants enter the online streaming platform, through either a mouse interaction or touch screen. A text on the platform invites them to connect audio-visually with each other.

6.5 Results ASL2

This section presents the results of ASL2; the method (6.5.1), data mapping and data analysis.

6.5.1 Method

This section describes and analyses the effect of performative and interface design choices, based on a questionnaire provided after the interaction. The questions and responses are described in section 6.5.2; discussed in section 6.6. Four questions were asked: three focussed

on the experience of mutually (self)-caressing the skin and tracing the caressing gestures; while the fourth focussed on the participant's relation to the co-created Virtual Persona. The interaction design has been tested during two online Touch Labs. The results presented below originate from the second Touch Lab. 16 participants in the workshop included colleagues, friends, students from the UK, Netherlands, USA. They were invited to enter the online interaction flow and share it with a partner. (*Note*, that at this stage in the development, interaction was only possible with a mouse pad; not yet on a touch screen). 12 couples responded to the questionnaire, 4 did not. Responses are given in English, no translation took place.

6.5.2 Results

This section presents the responses to the questionnaire (Table 6.5.2.1); data mapping (section 6.5.2.2); and data analysis (section 6.5.2.3).

Table 6.5.2.1: Responses to Questionnaire Touch My Touch.

LEGENDA . (The use of colours and symbols is explained in section 6.5.2.1):

1) Intimate

2) Intimate related

3) Challenging, ambiguous relation to Intimacy

4) Intimate related: 'Empathic'

5) Shared embodied experience

6) Less or no emotional involvement

7) Fun

8) Individual relation (to the image)

9) Shared familiarity (to the image)

10) Other

11) - (No Response)

Q1. 'How did you find the experience of caressing your skin?'
2 found it a bit uncomfortable and alien as I am never that aware when touching my own face
3 It felt interesting being watched while you do is, it was **intimate,** maybe a bit akward but also very open
4 Nice
5 It felt weird at the beginning but I think at the end, that's the point of it. Getting more comfortable with touching your skin while someone else is watching you and copying your movements, I think the experience depends a lot on who is in the other side. For example, if a stranger is in the other side it makes the experience even more interesting because it can take a while until you feel connected with a stranger, it could also be fun
6 weird because it **is intimate**
7 Almost like I was touching someone else
8 strange feeling, something you do with someone looking an following
9 -
10 We agree that it felt a little uncomfortable at first to caress our own skin. We touch our face a dozen times a day but when you do it fully aware there's something strange about it at first. We did get used to it.
11 It was fine, but I knew what to expect so my response may not be so helpful.
12 Kind of therapeutic.
13 Only through my fingers. Like I was someone else touching my face. Little experience of being touched.

Q2. 'How was your experience when tracing your partners caressing movements?'
2 It was a strange experience but interesting to connect with a person like that virtually. 3 I was very foccused and present, a sort of hyperfocus 4 It went a bit fast 5 It was very interesting to see my partner touching her face and I was wondering how was she feeling, if it was uncomfortable for her or if it felt nice. I was curious about that. 6 - 7 I first thought my computer was following my own touch. After I figured out that it was someone else, it became very **intimate.** 8 strange but fun movement 9 I try my best to be accurate with her movement, and I was thinking what will happen if I go in a wrong direction 10 While it was weird (unusual) to trace our respective partners caressing movements we got used to it quite quickly. It might be due to us but it did require a lot of focus so it wasn't associated with too many emotions 11 It felt **intimate and friendly**. Nice to properly see her face 12 Reminded me of Etch-a-sketch... 13 Quite intense, almost with a feeling of embodiment as my partner's fingers as my own.
Q3. 'Describe the experience of synchronising the caressing of your face with your partners tracing on the mousepad.'
2 It felt quite **intimate**, especially because I did not know my partner too well 3 It was interesting because you tend to change up the speed for the other person, while they probably do the same 4 funny to look at both images and switching 5 It went smooth, nothing to comment further on that part 6 less weird, one is more focused on getting the movements right 7 I felt like I was looked at very carefully, but not in a negative way 8 the progam makes you connect with someone in movement 9 I was really curious about the result, and at the same time tried to be focused 10 Took some focus was less emotional. 11 It was fun to watch my partners marks covering my face and it made me see where the gaps were and go back 12 Increased attention span and engagement – made us giggle a couple of times. 13 –
Q4. 'Describe your response to the digital persona you created. Did you relate to the image on screen?'
2 **I did, it was familiar.** Therefore, I did feel some emotion to the image 3 I did**!,** at first it felt a lot like me, but looking closer it I, so **i saw the other person in it as well** 4 Yes but it was a bit blurr, **could recognize parts of both of us** 5 It was so interesting, my partner at the beginning thought it was just a picture of herself but I was confused and intrigued because I **could somehow see myself also in there**. It is cool 6 mmm the image was a bit blurred, but the one I viewed from the students was quite impressive, both faces were merged nicely into one 7 **It doesn't look that different to how we both look** 8 **I recognized myself** in the picture 9 **I felt me and my partner are quite similar which felt nice**, I am not sure it may happened every time our its exceptional 10 **Me and my mom could relate** to the person created on screen but my brother said he could not truly feel a connection to the digital persona because it felt too far away from how he sees himself 11 It looked quite **like me** and less like my partner. 12 Both personas we created looked overwhelmingly **like my partner** with a feature of mine thrown in here or t–ere - does this imply her genes are stronger? I got to wondering! Or perhaps she took a closer-up picture? Anyway - slightly weird but cool to be part of this morphed community. 13 Not a being (partly) me, more a squire close to **my partner's face** but a bit weird and unreal. Maybe even 'uncanny'.

6.5.2.1 Data Mapping

Responses in Table 1 have been clustered based on the use of **words**. The words have been chosen in line with the research question: the experience of being 'intimate' (including words both related and ambiguous to intimate); and concepts related to 'empathy' and 'shared embodied experience', described below.

(1) Intimate. In these cases responders use the word 'intimate' to describe their experience.

(2) Intimate related. In these cases, responders use words related to 'intimate' [78], [79], such as 'comfortable', 'friendly', 'familiar', 'nice'. In addition, the responses Q1(12): "Kind of therapeutic" and Q3(7):"I felt like I was looked at very carefully, but not in a negative way." have been interpreted as related to intimate experience.

(3) Challenging, ambiguous relation to 'Intimacy'. This the study chooses to position words related to 'discomfort' (f.e. 'uncomfortable', 'awkward', 'strange', 'weird') as challenging, but not opposite to, intimate experience. This choice is explained in section 9.

(4) Intimate related*: 'Empathic'*. In line with the literature in section 2, an '*empathic* interplay' is a characteristic of 'shared intimate experience of social touch'. This has been expressed in for example Response Q2(5): "I was wondering how was she feeling (.....)."

(5) Shared embodied experience. In line with the literature in section 2, '*shared embodied experience'* is a characteristic of 'shared embodied intimate experience of social touch'. This has been expressed in for example responses Q2(13): "(...) almost with a feeling of embodiment as my partner's fingers as my own.", Q1(7): "Almost like I was touching someone else" (while self-caressing) and Q3(8) "(...) you connect with someone in movement".

(6) Less or no emotional involvement. Specific expressions of such absence of involvement are not considered signals of intimate experience, in the context of this paper.

(7) Fun. Fun (or 'giggling') is interpreted as part of intimate experience, if expressed in combination with (the) words (related to) 'intimacy' within the same or other responses, by the same responders.

(8) Individual relation (to the image). In individual relations, responders describe their sense of relation as for example: "I could see myself", "I felt myself in the image".

(9) Shared familiarity (to the image). Responders describe their sense of relation as for example: "I felt me and my partner are quite similar", "Me and my mom could relate".

(10) Other. These responses include other, often technological aspects of the interaction.

(11) - (No Response).

[78] https://www.merriam-webster.com/thesaurus/intimate
[79] https://www.thesaurus.com/browse/intimate

6.5.2.2 Data Analysis

Table 6.5.2.4 presents the analyses of the results (presented in Table 6.5.2.1).
In the 11 responses to Questions 1, 2, 3, 4:

- The word 'Intimacy' is expressed 5 times;
- Words related to 'Intimate' are expressed 5 times;
- Words related to 'Challenging, ambiguous relation to Intimacy' are expressed 6 times;
- Words related to 'Shared, embodied experience' are expressed 5 times.

Table 6.5.2.4: Analysis of Responses	**Q1-Subject:** Experience of skin-caressing	**Q2-Subject:** Tracing the partners movements	**Q3-Subject:** Synchronizing Experience	**Q4-Subject:** *Relation to the image*
(1) Intimate	2 (3,6)	2 (7,11)	1 (2)	
(2) Intimate, Related	3 (4,5,12)		1 (7)	
(3) Challenging, ambiguous relation to Intimacy	3 (2,8,10)	2 (2,8)	1 (6)	
(4) Intimate, Related: Empathic		1 (5)		
(5) Shared embodied experience	2 (7,13)	1 (13)	2 (3,8)	
(6) Fun			3 (4,11,12)	
(7) Less/not emotional		2 (3,10)	1 (10)	
(8) Q4: Individual Relation to image				*5 (2,8,11,12,13)*
(9) Q4: Shared Relation to image				*6 (3,4,5,7,9,10)*
(10) Other	1 (11)	3 (4,9,12)	4 (5,9)	*1 (6)*
(11) No response	1 (9)	1 (6)	1 (13)	

6.6 Discussion ASL2

The discussion presented in this section is based on the subjective experience of the participants, as expressed by use of a) the word 'intimate' (and related words) and of b) terms related to 'shared embodied experience', to answer the question this section addresses: 'Can shared intimate experience of social touch be orchestrated for online connections?'

6.6.1 Discussion, based on the Meaning of 'Intimate' in the Interaction

Analysis of the data show that, overall, 9 of the 11 participants mention the word 'intimate' or words related to intimacy. This section discusses the understanding of the notion of 'intimate interaction' used in this study.

In line with the literature (sections 2.1.3, 2.2), this study considers words including 'self-revealing', 'self-disclosure', 'vulnerability', and 'social support', in 'empathic' interplay; to express a sense of intimate experience. Related words include 'comfort' or 'comfortable', 'friendly', 'familiar'[80] and 'nice'[81]. Crucially, the word '*dis*comfort' (and related words including 'uncomfortable', 'awkward', 'strange', 'weird') is *not* interpreted as absence of intimacy; but instead as an expression of intimacy that is ambiguously experienced (f.e. Q1(6): "Weird, because it is intimate"). The ASL design approach purposefully orchestrates *ambiguous* experience, to stimulate personal commitment and awareness of shared intimate experience (Benford et al. 2012).

Q1 In response to Q1 (about the experience of skin-caressing), five times (related) words expressing intimacy have been used (Q1(3,4,5,6,12)); while words that challenge intimate experience have been used three times (Q1(2,8,10)). While in some cases, self-caressing the face (Q1) has been described as 'intimate', in other cases, the experience has been described as 'discomfortable' at first, followed by increasing 'comfort' (f.e. in Q1(5,10)).

Q2 Q2 (about the Co-Caresser's activity of *tracing, synchronizing* a Caresser's movements) has led to expressions of intimacy (Q2(7,11), empathy (Q2(5)) and pleasure (Q2(11)). Nevertheless, often, the attention seems to shift to the activity of *tracing itself*, with less attention to the other person. Co-Caressers seem to be less emotional involved; for example expressed in: "Interesting to connect with a person like that virtually" (Q2(2,4,9,12)).

Q3 Q3 (about the Caresser's experience of *being traced* (through the Co-caressers synchronizing gestures)) has often led to expression of playful connections; of Caresser's play with movement (Q3(8)), speed (Q3(3)), voyeurism (Q3(7)) and playfulness in uncovering the face together (Q3(11)). In general, Caressers seem to be more emotionally involved compared to Co-Caressers: they express playful and fun interaction of reciprocal influence.

Q4 Q4 deals with the (shared) relation to the co-created Virtual Persona, emerging from synchronizing touch gestures. Different responses emerge from specific interactions with the portrait; often relying on the degree to which the portraits resemble the participants faces (due to the algorithm design choices).

[80] https://www.merriam-webster.com/thesaurus/intimate

[81] https://www.thesaurus.com/browse/intimate

6.6.2 Discussion, based on the Meaning of "Shared Embodied Experience" in the Interaction

Analysis of the data show that, overall, 'shared embodied experience' has been expressed in 5 of 11 responses, by 4 different responders.

Three of these responses specifically describe *confused perceived body ownership*. Participants describe confusion between perceiving the own body, or the partner's bodies, or someone else's body. This is in line with findings of body ownership identification experiments (Petkova & Ehrsson 2008, Tajadura-Jiménez et al. 2012, Ijsselsteijn et al. 2006) discussed in section 2.2.3. In these experiments, congruent, synchronized affective gestures with an emergent digital bodily image evokes transfer of motor agency to a bodily image outside the body, leading to identification with that image.

In contrast to these experiments, that focus on *individual* experience, ASL2 explores interaction for *shared* experience, in reciprocal social touch interaction with a partner. The responses in this section provide the first promising results.

6.7 Conclusion ASL2

'Can shared intimate experience of social touch be orchestrated for online connections?' This question is explored in ASL2 'Touch My Touch' (2021) using a novel streaming platform for shared intimate experience of social touch, supported by facial and merging technologies. The online streaming platform, a shared space, has been designed to facilitate online interaction between two participants. The artistic design of this space has been inspired by body-ownership identification experiments (Huisman 2013, Ma & Hommel 2013, Petkova & Ehrsson 2008, Ijsselsteijn et al. 2006), explained in section 2.2.3. Enfacement illusion experiments (Tajadura-Jiménez et al. 2012) have shown that individual visuo-haptic motor-feedback perception of synchronized affective self-touch gestures can lead to (facial) body ownership identification, with a virtual persona on a screen.

In the online shared space for socially shared embodied connections, participants share motor intention with another person mirroring and drawing their gestures on a screen, from which a self-portrait emerges, as a Virtual Persona. Conditional to the design is that affective social self-touch gestures are reciprocally synchronized in a shared online visuo-haptic space; with shared motor-feedback data simultaneously emerging in synchronizing movements. During the shared performance, both partners must depend on each other to a) perform the gestures; and b) co-create the synchronizing bio-metric data.

Data analysis of participants' subjective responses to a questionnaire shows that shared intimate experience of social touch can indeed be orchestrated for online connections. Analysis of the questionnaire's data show that, firstly, 9 different responders out of 11 mention the word 'intimate', or words related to intimacy, while 5 responders express enhanced shared awareness and emotional ambiguity to the interaction.

Secondly, analysis of the data show that, 'shared embodied experience' has been

expressed 5 times out of 11 responses. In 3 cases, motor agency was confused between the own and the partner's actions, in line with the above-mentioned body-ownership identification experiments.

Subject to future research is, firstly, the design of shared synchronizing gesture performance. On the one hand, this novel design has shown to often heighten the immersive and emotional involvement, with promising effects on awareness of 'shared embodied experience'.

Secondly, a point of concern includes that in some cases, the questionnaire shows that the role of 'Co-Caressing' limits the emotional involvement, thus limiting shared reflection on such involvement. Possibly, the absence of a human host who introduces and guides the performance, is due to this sometimes limiting effect

Thirdly, future research includes the potentially different experience of intimacy and shared reflection among partners, family, friends, colleagues, or strangers.

6.8 Conclusion ASL2, in relation to the CITYO interaction model.

These orchestrations provide insights in relation to the use of the CITYO Model.

1. **Sensory Disruption Design, with reciprocal influence in empathic interplay.**
   - *Both* Participants must perceive ambiguous, direct, and technically mediated connections, and **shared visual perception of affective touch gestures**, in congruent, simultaneous, and **shared synchronizing movements**, for shared (immersive) embodied connections to emerge.
   - Vital to direct and vicarious affective touch perception is shared, **simultaneous performance** of synchronous touch gestures and biofeedback. In some cases, this leads to ambiguous sense of shared performativity, and a sense of **transfer of motor agency** (discussed in section 2.2.3).
   - **Intentional** performance by two Actors of affective touch gestures (self-caressing the face), must lead to shared biofeedback data, in a shared space.
   - **Interdependent performativity of shared gestures** is crucial to the shared embodied experience.
   - Having the potential of **mutually gazing** at each other's faces (and thus observing each other's facial, **affective expressions**), and verbal negotiation, is vital to empathic interaction (section 2.2.2)

2. **Shared Reflection Design.**
   - The shared dialogue takes place between the *two* participants, which has not been subject to research in this thesis.

ASL 3: Tele_Trust

Fig. 22. ASL3 ‘Tele_Trust’ (2009). Image by Adrian Norman © Lancel/Maat, 2009

7 ASL 3: Tele_Trust

This chapter presents the *iterative design process* of ASL3 'Tele_Trust' (Lancel/Maat 2009), by presenting the final orchestration (7.1); the first and the final interaction models (7.2); the first and final designs and the design rationale (7.3.1); and the final performance script (7.4). A conclusion in relation to the CITYO interaction model is presented at the end of this chapter. The technical A.I. aspects are discussed in Appendix 1.

In summary, the ASL3 includes:

ASL3 *Tele_Trust* explores social touch interaction for multiple participants, in the public space of merging realities.

The Sensory Disruption design reorchestrates wearable smart textiles with touch sensors (DataVeils), mobile phone and urban screen technologies, into a *DataVeil interface,* a network for visual, haptic, and sonic hybrid interactions.

Multiple Actors, wearing the textile DataVeils (disrupting face-to-face connections), caress their own bodies to connect with Co-Actors. *In response,* Co-Actors connect with the Actors by caressing their phones, visually revealing the Actors faces; and by sending them an audible message answering the question: 'Do you need to see my eyes to trust me?'.

Through caressing and responding, simultaneously, (Co-)Actors co-create semi (real-time) an unpredictable, shared data composition of images and audio statements, in a participatory growing networked database.

Shared Reflection is staged between Actors and Co-Actors.

This chapter's rationale and discussion (sections 7.1.3, 7.1.4) are based on:

- Lancel, K., Maat, H., Brazier, F.M. (2020) 'Designing disruption for social touch, in public spaces of merging realities: a multi-sensory model'. In: *Int. J. of Arts and Technology. Special Issue: ArtsIT 2018 Arts and Technology*. Inderscience Publishers.

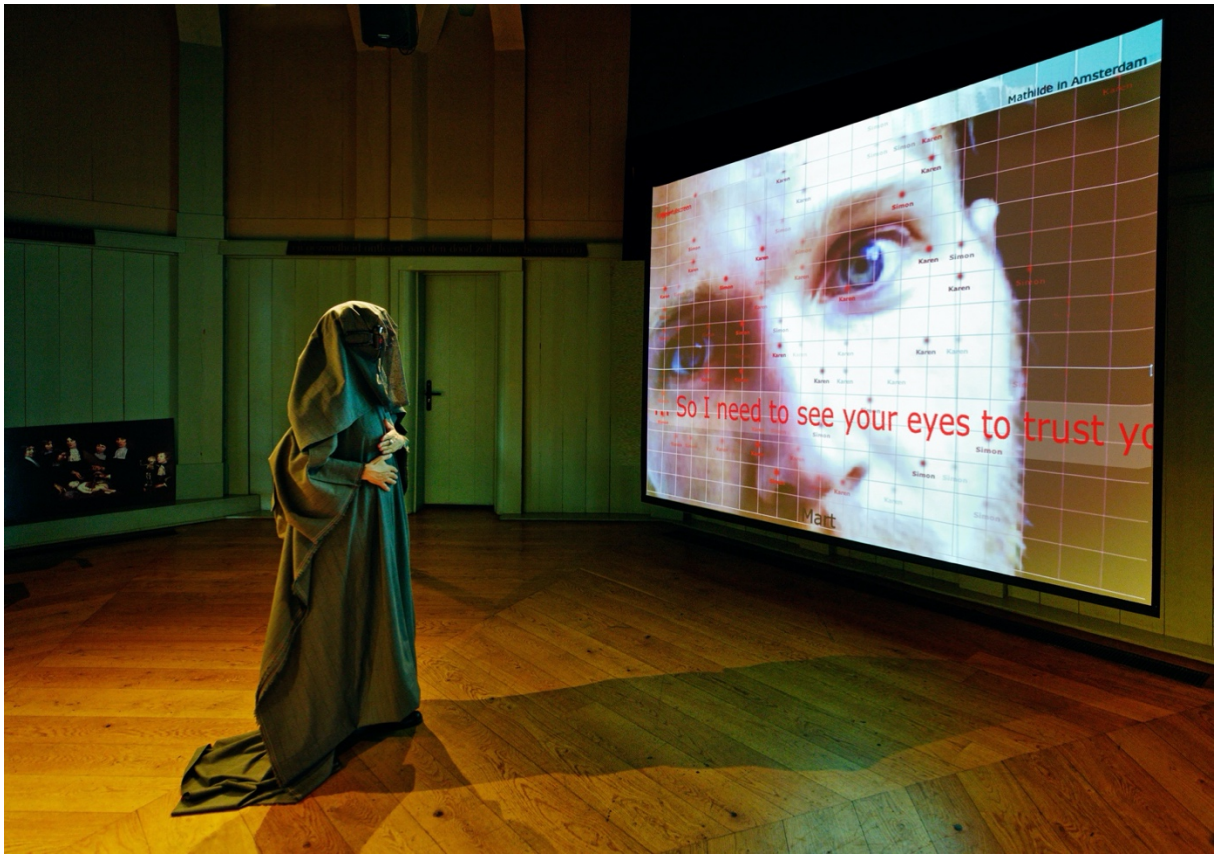


Fig. 23. ASL3 'Tele_Trust' (2009). Waag Society, Amsterdam. Image by Pieter Kers © Lancel/Maat, 2009

7.1 Orchestration ASL3 Tele_Trust (2009)

This section presents the orchestration of ASL3 'Tele-Trust' (2009), addressing the question: 'Can haptic connections through social touch be orchestrated in merging realities?'. The ASL3 has been designed for, and internationally presented in, smart city public spaces.[82]

[82] **The Tele-Trust DataVeils have travelled internationally in different cultures and contexts of public spaces, stating that: "Everyone can wear a DataVeil".**, The DataVeil design and interaction have provoked discussion and intense dialogues. Although exploration of the contexts and dialogues is not part of this theses, some examples are summarized below:

1) In Amsterdam (2010), performance with the DataVeils on the Central Train Station led to a police arrest and a fine, for 'Terrorist dressing behaviour' **(Fig. 32).**

2) In Istanbul (2011), the DataVeil was understood to bridge feminist, opposite viewpoints on women dress codes, including muslim (body covering) and western (nudity based) dress codes. It was argued, that the Dataveil was 'fully physically covering, yet providing full networked transparency'.

3) In Dubai, the DataVeil, accepted at the the ISEA exhibition, was excluded due to prohibited exposure of women's faces.

4) In Amersfoort, the DataVeil was explored as a novel control device replacing the medieval city wall, by a hybrid surveillance 'DataVeil network'.

5) In Banff Center Canada (2010), the DataVeil was explored as a hybrid body interface, connecting wearers in three city public spaces and time zones simultaneously: Amsterdam, Banff, Adelaide.

Note, that background literature on artistic, interactive media art in the context of smart city public spaces has been described in section 5.1.

In the ASL3 orchestrations, Actors wear full body covering, 'DataVeils', with touch sensors interwoven into the textile.[83] While these textile DataVeils cover their faces, the touch sensors allows Actors to haptically and audibly connect with Co-Actors. Through caressing their bodies, Actors and Co-Actors can connect, through a multi-modal digital network of smart textiles, phone app and urban electronic screens (**Figs. 23,26-30**).

Before veiling, the Actors faces are visually portrayed and added to a digitally networked database. Co-Actors can visually 'unveil' these digital portraits on their smart phones. Via a dedicated smart phone app, they respond to the question: 'Do you need to see my eyes to trust me?'. Their messages are saved in a database. Through caressing their bodies, Actors can hear the Co-Actors voices and messages, audible in their headsets.
The ASL3 Tele-Trust designs technically mediated haptic interaction, while identification of senders and receivers is disrupted (section 2.1.2).

All Actors portraits and Co-Actors messages are saved in a participatory generated database. Over time, the database *randomly* exposes the portraits of actual and previous Actors on a screen; *randomly* combined with transcriptions of the auditory messages.

Actors participating in the ASL3 'Tele-Trust' have expressed their haptic experiences, of connecting with unidentifiable others, through affective self-touch gestures, as: "When I touch myself, I am together with others, when I hold off, I am alone" and "I could hear your voice in my skin. I remembered you remembering. My body is your body."

[83] **Dataveil Design.** The Data Veil design has been produced in collaboration with Muslim Women Group 'Jasmijn' (Groningen) and designer AZIZ Amsterdam.
The design parameters include that the veils must be like a 'second skin', that is:
a) Inclusive;
b) One size fits all,
c) Easy to wear;
d) Not standing out visually in public space.

7.2 Interaction Model ASL3

Figs. 24 and 25 depict the iterative design process of ASL3 'Tele-Trust' (2021) in relation to the CITYO interaction model, and the Legenda.

Description CITYO Interaction Model ASL3

1) Sensory Disruption. Actors visibly share body-caressing gestures with Co-Actors. Visual connections between Actors and Co-Actors are direct; however, for the Co-Actors, visibility of the Actors' emotional facial expressions is disrupted.
The Actor's individual perception of self-touch (direct self-caressing gestures) is sensory disrupted through a Data Veil Interface. The Actors' caressing gestures are transferred to an unpredictable data data-sonification (individually perceived); and data-visualization (with shared visibility to all).
In the *first interaction model* (**Fig. 24**), Co-Actors are potential, non-simultaneous Actors. The *final interaction model* (**Fig. 25**) adds Reciprocal simultaneous, auditory responses by Co-Actors (and haptic gestures of direct screen caressing); which are perceived by Actors, *semi real-time*. Over time, together, (Co-)Actors realize unique, unpredictable shared, composed data-visualizations (of Actors portraits) and transcriptions of auditory responses (by Co-Actors).
2) Shared Reflection occurs through human hosted Dialogue with Actors, staged to Co-Actors.

Fig. 24. *First* CITYO Interaction Model ASL3 'Tele_Trust'.

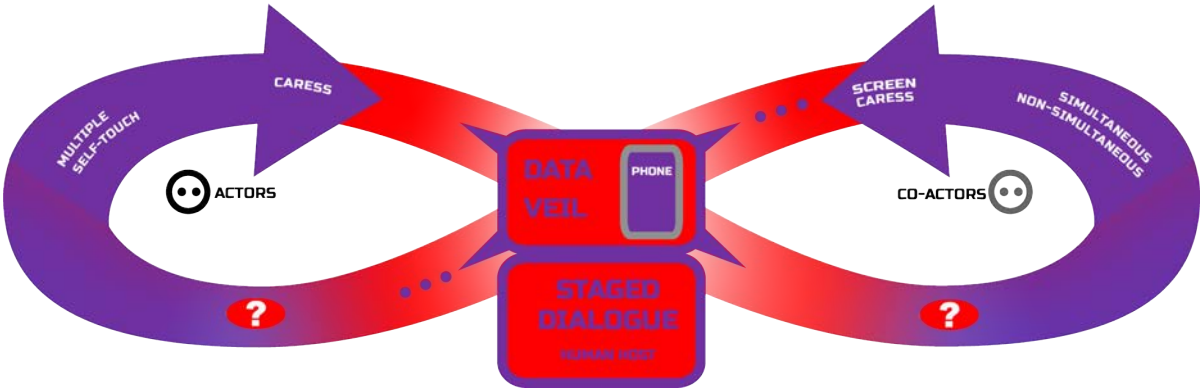


Fig. 25. *Final* CITYO Interaction Model ASL3 'Tele_Trust' and Legenda.

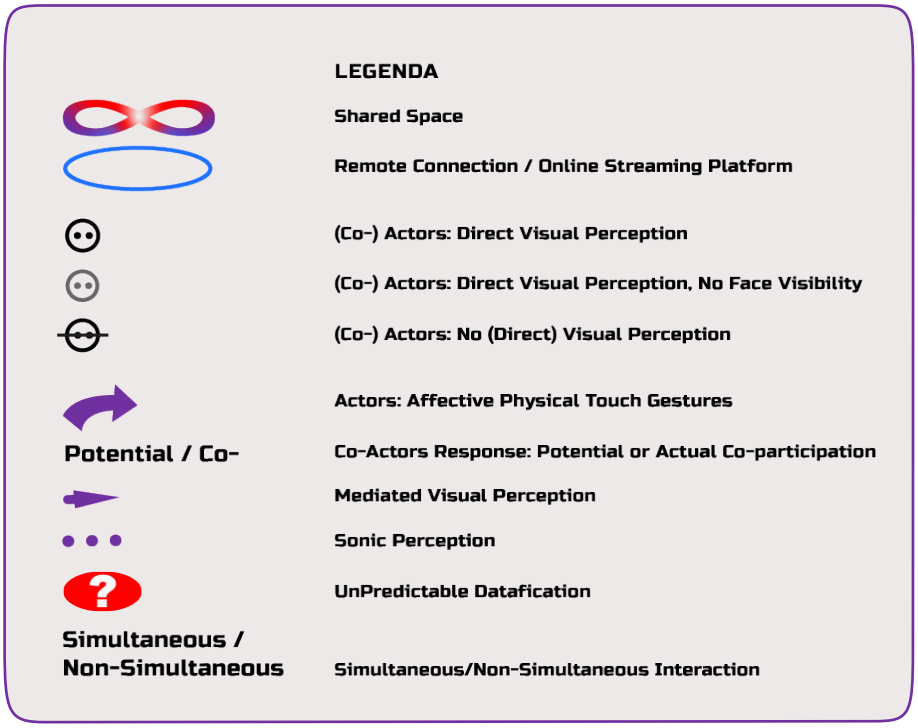


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Fig. 26. ASL3 'Tele_Trust' (2009). Amersfoort[84]. Image Lancel/Maat © Lancel/Maat, 2009.

7.3 Design Choices ASL3

This section describes the ASL3 design choices. The ASL3 has been designed in an iterative process, of which this section presents the first and the final design. The below images explain both: ASL3 spatial design (images left); and the textile DataVeil (images right).

Note, that the technical A.I. aspects of ASL2 are presented in Appendix 1.

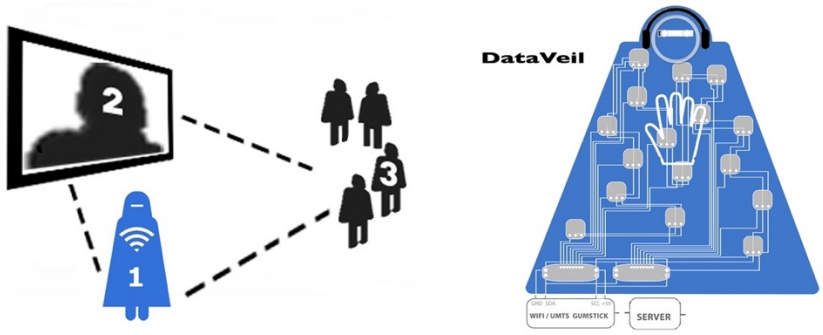

Fig. 27. *First* ASL3: Spatial Design of Actors , Urban Screen and Co-actors (image left) and the Textile DataVeil with touch sensors (image right).

Fig. 27 depicts the first spatial design. The left image depicts the spatial orchestration, including: 1) Actor in the textile DataVeil, 2) Urban screen showing digital portraits (of actual and previous Actors); and 3) Co-Actors. The image right depicts the textile DataVeil (a full body wearable with touch sensors).

Fig. 28. *Final* ASL3 design. Additional to Fig. 27, the images left and right depict a smart phone.

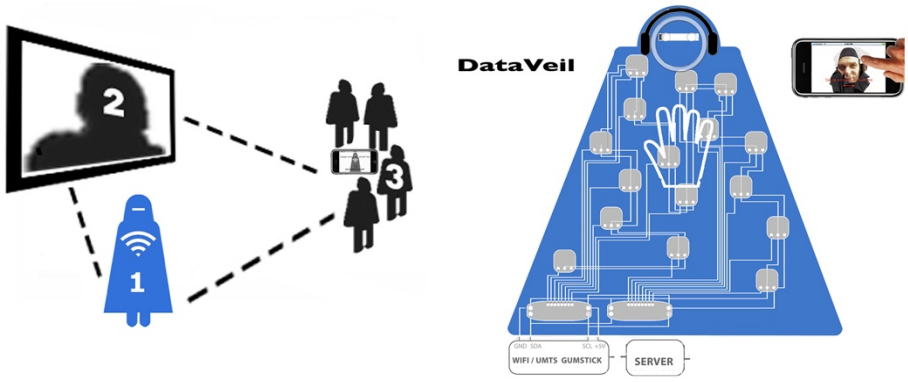

Fig. 28 depicts the final design for which an additional smart phone app has been developed, for non-simultaneous response by Co-Actors, to connect with Actors. The smart phone is presented in the left image, among the Co-Actors (3). In the right image, the smart phone is depicted at the right side of the Dataveil. The hand depicted on the phone's screen, visible in visually 'unveils' a digital portrait, of an Actor's veiled face, through caressing the screen.

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[84] Commissioned by Lumineus Amersfoort. In the historical city of Amersfoort, the DataVeil was explored as a novel control device, replacing the medieval city wall by a hybrid surveillance 'Dataveil Network'.

Fig. 29. ASL3 Tele_Trust (2010), Final design. Banff Center Canada Image © Lancel/Maat 2010.

			als niemand me aankijkt. dan denk ik OK iedereen is op zich, ik voel me daardoor een beetje ongemakkelijk, maar niet onveilig.
16	☐	16	Als ie mij eigenlijk wel aan kijkt vetrouw ik het niet, als ik merk van whooooooo wat moet ie nu eigenlijk...Het hangt er wel vanaf hoe dat ie er nu uit ziet en gestalte...misschien helemaal anders dan ik, iemand vreemd....ja, waarschijnlijk ook van andere origine, dan voel ik mij bij oogcontact niet op mijn gemak.
22	☐	17	als je niet in de ogen kijkt dan heb je een heel ander gevoel bij de mens zelf. en als iemand steeds weg kijkt dan lijkt het alsof iemand niet de waarheid vertelt, dus dan zou ik hem niet vertrouwen.
23	☐	18	dus ik wil je ogen zien. want anders dan is het nu gesprek afgelopen. dus gewoon, ik wil oogcontact hebben. want dat geeft meer vertrouwen aan mij. dus anders kan het niet. want anders ga ik achterdochtig doen.
24	☐	19	moet je elkaar in de ogen kunnen zien om elkaar te vertrouwen? als je elkaar in de ogen kijkt dan kun je zien of de ander liegt. en dat kan ik heel goed.
25	☐	20	ik voel meer een soort algemeen vertrouwen in mensen als je elkaar niet kunt zien. maar als je elkaars hart wil beroeren, wederkerig, en je wilt zeker weten dat dat bij die ander ook gebeurt, dat ie jou ook vertrouwt...daar moet je elkaar voor in de ogen zien.
29	☐	21	ik vetrouw mijn vriendin volledig. ook aan de telefoon.
27	☐	22	vertrouwen komt van binnen uit. dus dat heeft niet zo gek veel met die ander te maken, wat mij betreft.
30	☐	23	het gaat om de hele interactie, om jouw voorstellingen en jouw gedachten en hoe jij op mij reageert. dus het gaat niet alleen om kijken.
31	☐	24	als je elkaar kent, dan neem ik aan dat je elkaar vetrouwt. dus als je elkaar dan belt, dan kun je elkaar vertrouwen.
32	☐	25	dat ligt aan de functies die iemand in je bestaan vervult. als dat een emotionele activiteit is dan moet je elkaar wel in de ogen zien, maar als het een zakelijke activitiet is dan hoeft het niet. want dan kan je iemand ook vetrouwen op functie en reputatie. omdat zakelijk vertrouwen gebaseerd is op meetbare resultaten. en instinctief vetrtrouwen heeft te maken met een besef van veiligheid.
33	☐	26	er zijn mensen waarmee ik niet in een bootje op de oceaan zou willen belanden. Maar dat wil niet zeggen dat ik met zo'n iemand geen zakelijke transactie zou kunnen afsluiten.
34	☐	27	in een isolement totaal op iemand aangewezen zijn doet een beroep op totaal andere vaardigheden: reflectie en dominantie. als je bij iemand niet met je verhaal terecht kan, moet je niet tegenover met hem belanden in een bootje op de oceaan.
35	☐	29	ik email heel weinig, ik ziet niet op hyves, ik log ook nooit in op websites. want ik vind dat je daarmee het systeem te veel macht geeft. want dat hou je niet in de hand, dus daarmee laat je een geest uit de fles.

Fig. 30. Excerpts of the database: transcriptions of Co-Actors' spoken responses. Exposorium, Vrije Universiteit Amsterdam 2009

Fig. 32. ASL3 Tele_Trust (2010). DataVeils in the city public space of the Amsterdam Central Train Station © Lancel/Maat 2010.

7.4 Design Rationale

In the first design, depicted in **Fig. 27,** Actors could hear Co-Actors responses (to the question 'Do you need to see my eyes to trust me?') based on previous recordings through their headsets, and see transcribed audio responses on the screen.

This first orchestration did not achieve the shared experience of connection and immersion for which it was designed. Immersion was achieved for Actors but not for co-located Co-Actors; while interdependent connections between them were not established.

In the second design, co-located Co-Actors were enabled to directly send audio-responses (socially and technically mediated through an interviewing Host), semi real-time audible for Actors in their headsets. As a result, Co-Actors followed Actors and their caressing gestures, interacting with the Actors through mediated audio-responses, visible on the screen, and discussing the events with other co-located Co-Actors.

In the final orchestration, depicted in **Fig. 28,29** a smart phone app was used to transfer the Co-Actors' audio-responses, of which results are depicted in **Fig. 30** (excerpts of the database). *Note*, that Co-Actors only felt connected with Actors if a visual representation of the Actor accompanies the app's text environment.

Fig. 33: ASL3 Tele_Trust (2010). Exposorium, Vrije Universiteit Amsterdam. Image © Lancel/Maat 2010. The Hosts dress the participant carefully in the DataVeil *(left);* Host in dialogue with participant *(right).*

7.5 Performance Script ASL3

ASL3's 'Tele-Trust' performance script is depicted in Table 7.4.1.

Table 7.4.1 Performance Script: ASL3 'Tele_Trust'.

Phase 1: Meet (Introduction).
Two Hosts dress Actors carefully into the DataVeil, explaining the (technical) interaction and the performance script.

Phase 2: Mirror (Fitting and Concentration).
The Actors' photo portraits are made. Once the Actors' faces are covered by veils, they can start self-caressing their bodies. The Host tells them to caress slowly and take all the time and space needed.

Phase 3: Caress, simultaneous
Phase 4: Merge (Transitions).
Through self-caressing their bodies, the veiled Actors make their portraits visible on the screen. Through further caressing, portraits of previous and future participants become visible.
Co-Actors visually 'unveil' the Actors' portraits on their smart phones and respond with a spoken message to the question: 'Do you need to see my eyes to trust me?'. Their statements are audible in the Actor's headsets; and they are transcribed and randomly combined with the portraits visible on the screens.
The Host witnesses the Actors' performativity of caressing from a short distance, ensuring a feeling of safety and technical support.

Phase 5: Memory building (Incorporation) **/ Shared Reflection**.
While undressing the Actors, the Host initiates dialogue, as part of the performance script, in the same space. The Dialogue is staged to Co-Actors, on a distance.

7.6 Conclusion ASL3, in relation to the CITYO Interaction Model.

These orchestrations provide insights in relation to the use of the CITYO Interaction Model. Tele_Trust has shown that a sensory social touch synthesis can be based on disrupted connections, if reciprocal touch is replaced by direct and disrupted self-touch, supported by disrupted visual face-to-face connections and by direct and disrupted auditory connections. In line with the interaction model, insights are:

1. Sensory Disruption Design, with reciprocal haptic influence in empathic interplay.

- All direct and disrupted *connections must be attuned through synchronization*, with clear reference points in time.
- Disrupted *connections* can be partly **replaced** by other *interdependent, sensory connections:*
  - Reciprocal caressing can be partly replaced by sensored self-caressing.
  - Direct, tacit perception of touch can be partly replaced by vicarious interaction, through mirror-perception and shared feedback data.
  - Disrupted auditory connections can be replaced by immediate technically mediated feedback of self-touch, and responses by Co-Actors (direct, simultaneously).
  - Disrupted mutual direct visual connections can be supported by mediated resemblance.
  - Disrupted direct visual connections between all can be supported by semi-unpredictable visual and transcribed audio connections, shared by all.
  - *An audio-visual data repository* is needed to share data representations and responses over time.

2. Shared Reflection Design.

- Co-Actors only feel part of the experience, and *reflect on* the experience, if they can influence the Actor's experiences.

ASL 4: EEG KISS,
Digital Synaesthetic EEG KISS

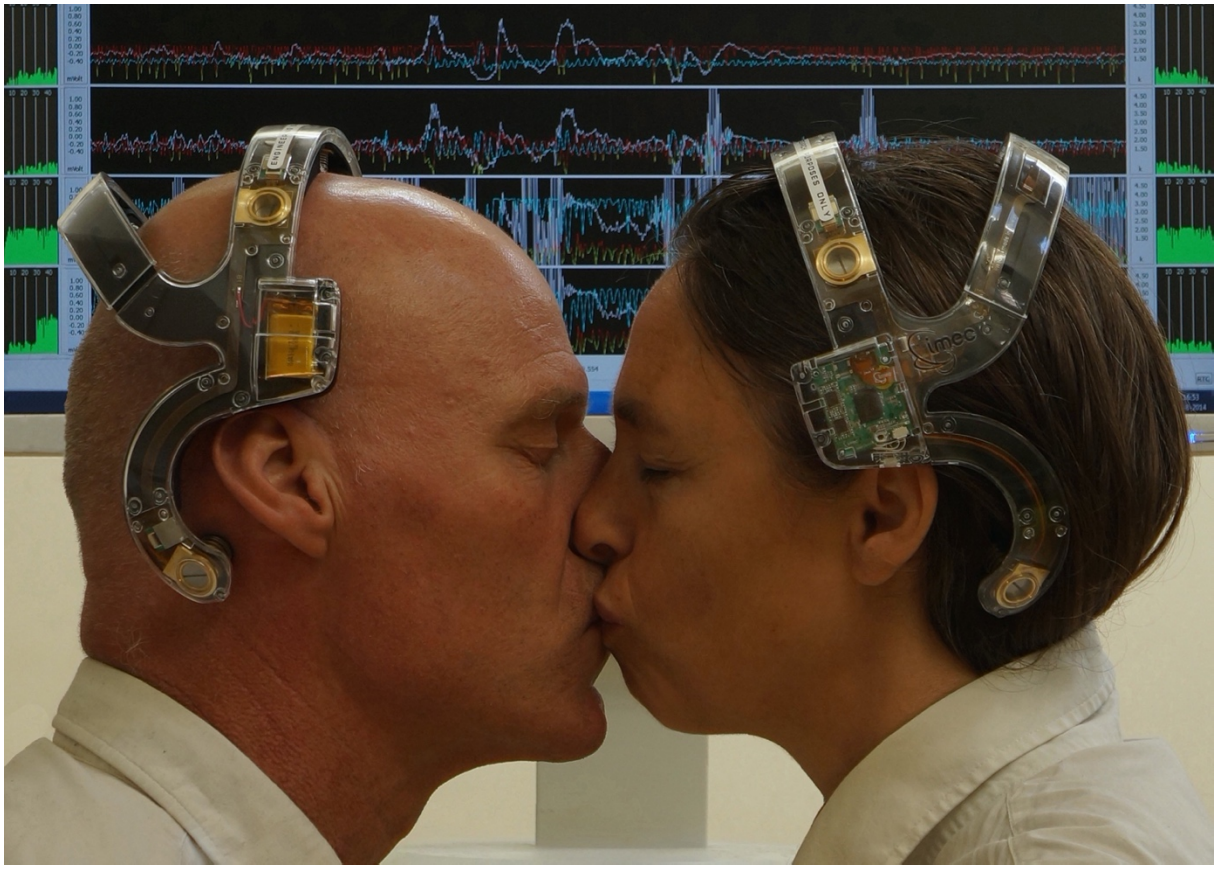

Fig. 34. ASL3 EEG KISS (2014). Video still © Lancel/Maat, 2016

8 ASL 4: EEG KISS, Digital Synaesthetic EEG KISS

Chapter 8 presents ASL4. ASL4 includes two 'EEG KISS' orchestrations, namely 'EEG KISS' (2014), and 'Digital Synaesthetic EEG KISS' (2016), that have been developed in an iterative process (Lancel/Maat 2014-2016). The first section presents relevant background literature on artistic Brain Computer Interfaces (8.1). This is followed by presentations of both orchestrations (8.2), interaction models (8.3), designs (8.4); and the performance script of Digital Synaesthetic EEG KISS (8.5).

Section 8.6 presents the results and discussions of both EEG orchestrations. A combined conclusion, based on both orchestrations, is presented in section 8.7. A second combined conclusion, in relation to the CITYO Interaction Model is presented at the end of this chapter (section 8.8). The technical A.I. aspects are discussed in Appendix 1.

In summary, the ASL4 includes:

ASL4 *EEG KISS* and *Digital Synaesthetic EEG KISS* explores shared intimate experience of social touch, mediated through a Multi-Brain Computer Interface (Multi-BCI), for multiple participants.
The Sensory Disruption Design creates a Multi-BCI with a shared *EEG KISS* brain interface, with visual, sonic and haptic hybrid connections.
Actors kiss while their brain activities are EEG recorded, and transferred into a spatially streaming, data-visualization; and into a sonification for a soundscape, shared with Co-Actors. All personal data-sonifications, generated over time, are accessible, in a public accessible database.
Shared Reflection is staged between Actors and Co-actors.

This chapter is based on:

- Lancel, K., Maat, H., Brazier, F.M. (2019) 'EEG KISS: Shared Multi-Modal, Multi Brain Computer Interface Experience, in public Space'. In: Anton Nijholt (ed.) *Brain Art: Brain-Computer Interfaces for Artistic Expression*. Springer Verlag, Human-Computer Interaction Series.

8.1 Background Literature: Artistic Brain Computer Interfaces

Brain Computer Interfaces are being explored by a growing community of international artists (Lysen 2019; Prpa and Pasquier 2019). In interactive performance art, installations, cinema, multi-user game and theatre, artists are exploring new types of BCI interaction that are often not primarily anchored in scientific understanding of physiological data (Delft University of Technology, 2015). These installations often focus on aesthetics, ethics, and affective experience (Gürkök & Nijholt 2013; Roeser, Alfano & Nevejan 2018).

Brain Computer Interfaces (BCI) enable direct communication between brain activity (the input) and control of (internal or external) devices (the output). Often, BCIs process and combine representations of brain activity with other audio,visual and haptic information. BCI interfaces combined with virtual reality(VR) and augmented reality (AR) technologies have, for example, been designed to enhance realistic, immersive experiences, using haptic sensors, motor imagination and feedback based on action visualization, for art, entertainment, training, therapy, sex, gaming, robotics (Gomes & Wu 2017; Lupu et al. 2018; Nijholt and Nam 2015; Ramchurn et al. 2019). In other works, functional Near Infrared Spectroscopy (fNIRS) has been used in BCI Interfaces to explore arousal of shared engagement (Bennett et al. 2013; Lancel/Maat et al. 2017).

Research of direct brain-to-brain communication between humans, or between humans and robots enhanced with Artificial Intelligence technologies, using EEG to record electrical activity in the brain and transcranial magnetic stimulation (TMS), is still in an early stage, but is promising (MIT 2018, Jiang et al. 2019). BCIs are designed for single users, or for multiple users in multi-brain interfaces (Multi-brain BCI) (Nijholt 2015). Multi-BCIs process brain activity of two or more participants as input for shared experience of joint (parallel or sequential) brain activity.

In some cases, output is based on ‘spontaneous’ (Gürkök & Nijholt 2013) participant input (Fernandez 2014; Sobell 1974; De Boeck 2009; Casey 2010). In other cases, output is based on ‘controlled’ (Pike et al. 2016) or ‘directed’ input (Mori 2005; SPECS 2009). Sobell (1974) for example, explores the influence of different augmented representations of joint brain activity as output, predominantly based on ‘spontaneous’ participant input. In contrast, Abramovic and Dikker (2011) and Gabriel (1993) have designed systems in which individual participants purposively influence their individual input (e.g. altering between level of arousal) to collectively ‘direct’ the output of the multi-brain BCI. In other systems, the threshold between ‘spontaneous’ and ‘directed’ is mixed (Novello 2016; Rosenboom 1990, Sobell 2001). In other artistic orchestrations, Multi-BCIs have been used to direct brain activity synchrony in coordinated social interaction to explore empathy and connectedness (Dikker 2016). However, although current BCI research includes hedonic and affective touch experience, intimate touch communication is not yet well understood (Björnsdotter et al. 2014).

fMRI research shows that tactile experiences of slow (1–10 cm/s), gentle stroking

Fig. 35. ASL4 'Digital Synaestehtic EEG KISS' (2016). HeK, Haus der Elektronischen Künste Basel © Lancel/Maat.

(caressing) of the skin and the system is associated by participants with affection. This is in line with research that shows that intimate touch provides a means to share empathic, intimate emotions (Van Erp and Toet 2015). Essential to shared intimate emotions are a sense of a) vulnerability and self-disclosure, b) physical proximity and c) witnessing and responsibility (Lomanowska and Guitton 2016). Multi-modal, Multi-BCI orchestrations, for shared intimate experiences, through orchestration of social touch, are, to the authors' knowledge, not yet explored.

8.2 Two Orchestrations ASL4 EEG KISS: EEG KISS, Digital Synaesthetic EEG KISS

This section presents two orchestrations of ASL4, 'EEG KISS' and 'Digital Synaesthetic EEG KISS', to explore the question: 'Can shared intimate experience of social touch be mediated through a multi-brain-computer interface (Multi-brain BCI) interaction in public space?'. In ASL4, participants are invited to feel, see, touch, and share an intimate kiss to incite both an aesthetic and a sensory experience. ***In the first orchestration*** (**Fig. 38b**)**,** Actors are invited to kiss while wearing EEG headsets. Their 'kissing' brainwaves are recorded and made visible as real-time emerging EEG data, shared with surrounding Co-Actors. Co-Actors, in turn, are invited to watch the kiss. ***In the second orchestration*** **'**Digital Synaesthetic EEG KISS' (**Fig. 38b**), the emerging, visual EEG data of kissing brain activities, are real-time transferred to a streaming floor projection that encircles the kissers. The EEG data are used as a 'music score' and translated to a soundscape (based on a novel algorithm design to this purpose). All personal data-sonifications of kissing are saved in a database, for all participants to download.

A Host facilitates this process, through guiding the Actors, based on the performance script; including a dialogue with the kissing Actors, staged to the Co-Actors, for reflection about the social, sensorial interplay.

8.3 Interaction models ASL4

Figs. 36a and 36b depict ASL4 EEG KISS (2014) and Digital Synaesthetic EEG KISS (2016) in relation to the CITYO Interaction Model.

Description CITYO Interaction Model ASL4

1) Sensory Disruption. Direct reciprocal touch gestures between two Actors are visibly shared with Co-Actors. Actors close their eyes (while kissing), disrupting all visual connections. Direct visible connections are only perceived by Co-Actors, who can visibly perceive the Actors emotional facial expressions.

The Actors' perception of direct reciprocally touching, through kissing gestures, is sensory disrupted through the EEG KISS Brain Interface, for audio-visual and haptic connections.

In the first orchestration, the kissing Actors' brainwaves activities are transferred to a unique, partly unpredictable EEG data-visualization.

The second orchestration extends the first, by translating the kissing Actors' brainwaves to a unique and partly unpredictable EEG data-sonification; shared by all.

Actors perceive sonic-haptic, and Co-Actors visual-sonic-haptic interaction. In terms of Reciprocity, Co-Actors are potential, non-simultaneous Actors. In their co-presence, Actors realize a unique, partly predictable, shared audio-visual data composition**.**

2) Shared Reflection. Hosted Dialogue with Actors is staged to Co-Actors.

Fig. 36a. CITYO Interaction Model ASL4 '**EEG KISS'** (2014)**.**

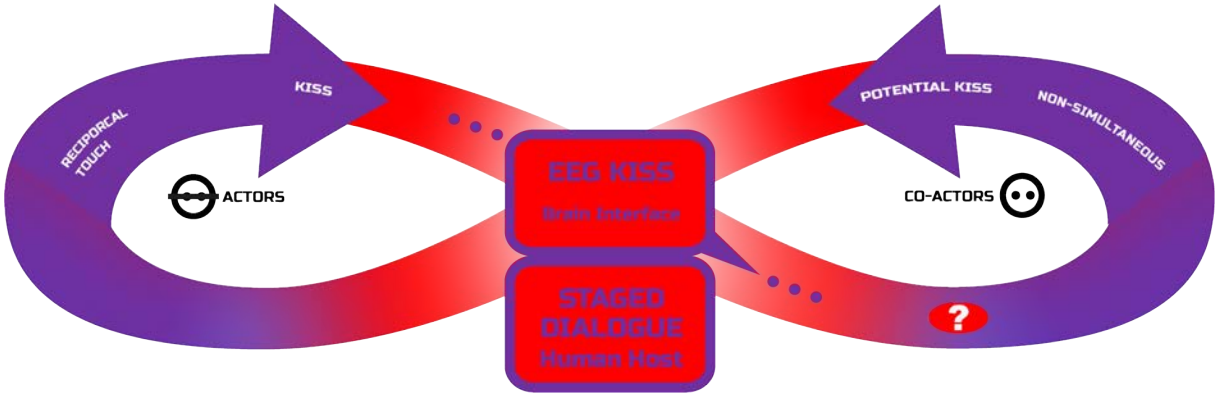

Fig. 36b. CITYO Interaction Model ASL4 **'Digital Synaesthetic EEG KISS'** (2016) and Legenda**.**

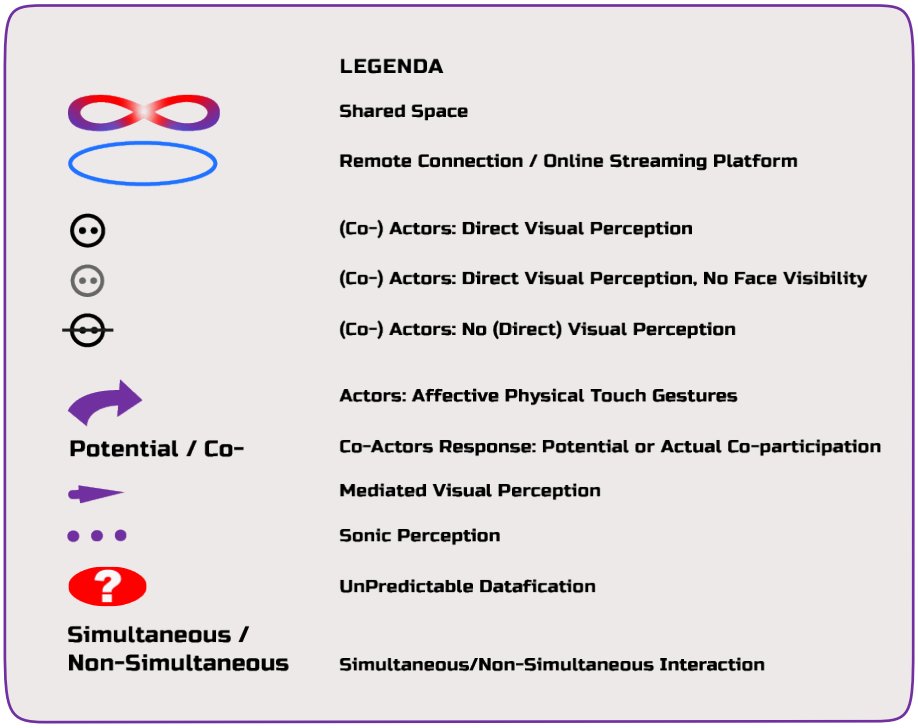

Fig 37. EEG KISS NIRS (2017). Stedelijk Museum Amsterdam. Stedelijk Statements / Worlding the Brain. Image © Lancel/Maat.

8.4 Design Choices ASL4: EEG KISS, Digital Synaesthetic EEG KISS

This section describes the *Spatial, Aesthetic* and *Social* design*,* of the two ASL4 orchestrations, depicted in **Figs. 38a,b**. Aspects of data visualization, data-sonification and Hosting are described in the sections below. *Note,* that the technical A.I. aspects of ASL2 are presented in **Appendix 1**.

Spatially, in both orchestrations, two chairs are positioned across from each other, central stage, together forming 'a love seat', for Actors to take place and for Co-Actors to gather around. Depicted in **Figs. 38a,b** by 'AA', two wireless EEG headsets (described in section 8.4.1) are used for Actors brain activity to be recorded and transferred to a data visualization.

In the first orchestration EEG KISS (2014), the Actors' brain activities are translated to *two separate data-visualizations*, on two individual screens (**2b in Fig. 38a**)**.**

In the second orchestration Digital Synesthetic EEG KISS (2016), both data sequences are integrated into *one data-visualization* (described in section 8.4.1), as a floor projection that encircles the kissers (**2b in Fig. 38b**); and data-sonification is added (described in section 8.4.2).

The visualization of data is based on aesthetic choice: the visual familiarity with medical EEG data-representations is purposefully deployed by the artists to evoke reflection, on current expectations towards scientific validations of intimate interaction. Ethical concerns include that participants can only participate as Actors by giving verbal consent for recording

all EEG data *non*-anonymously, by adding their first names; for them to identify their own contribution, to download their personal data-sonification at a later date.

8.4.1 Data-visualization

In both ASL4 orchestrations, the EEG data visualization emerges real-time from acts of kissing. To this purpose, the ASLs consist of 2 EEG headsets (**AA in Figs. 38a,b**) (with four contact points on the skull of which three positioned in the motor cortex[85]).

The first orchestration presents individual data of two kissing Actors on separate screens (**Fig.38a, 2b**).

The second orchestration integrates both data sequences into one visualization (**Fig.38b, 2b**). The separate data sequences are visually placed on top of each other[86] in different colours, to both compare individually and merge.

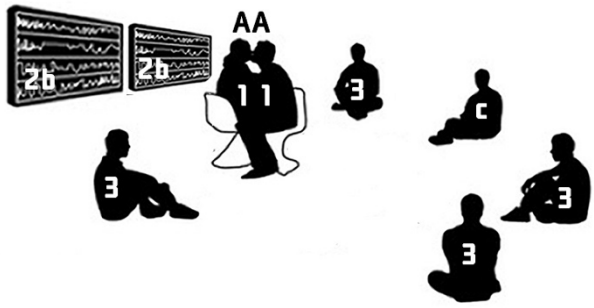

Fig. 38a. Spatial model of **ASL4** EEG KISS (2014) © Lancel/ Maat & Studio Matusiak (2015).
A) EEG headsets, **B)** EEG data, **C)** Host; and (1) Actor, (2b) 2 Screens, (3) Co Actors).

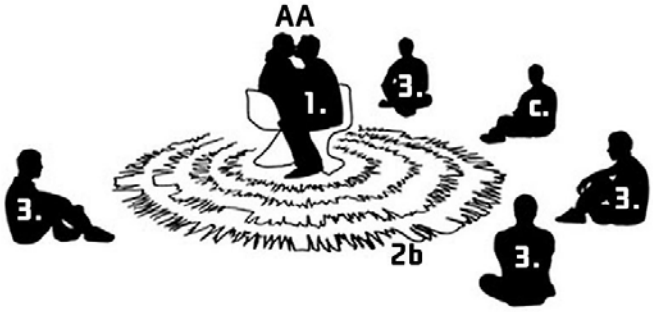

Fig. 38b. Spatial model of ASL4 Digital Synesthetic EEG KISS (2016) © Lancel/ Maat & Studio Matusiak (2016).
A) EEG headsets, **B)** Streaming EEG Data, **C)** Host; (1) Actors, (2b) Floor projection (3) Co-Actors.

[85] The wireless EEG headsets (IMEC 2014) are instrumented with dry electrodes They measure at four contact points on the skull (cz, pz, c3, c4 (teplan (2002)). Measuring emotional arousal is not the focus of these headsets as the locations primarily associated with emotions ((pre)frontal cortex) are not measured.
https://www.elektormagazine.com/news/wireless-activeelectrode-eeg-headset last accessed 2018/12

[86] The data-sequences are visually placed on top of each other without fusing them previously.

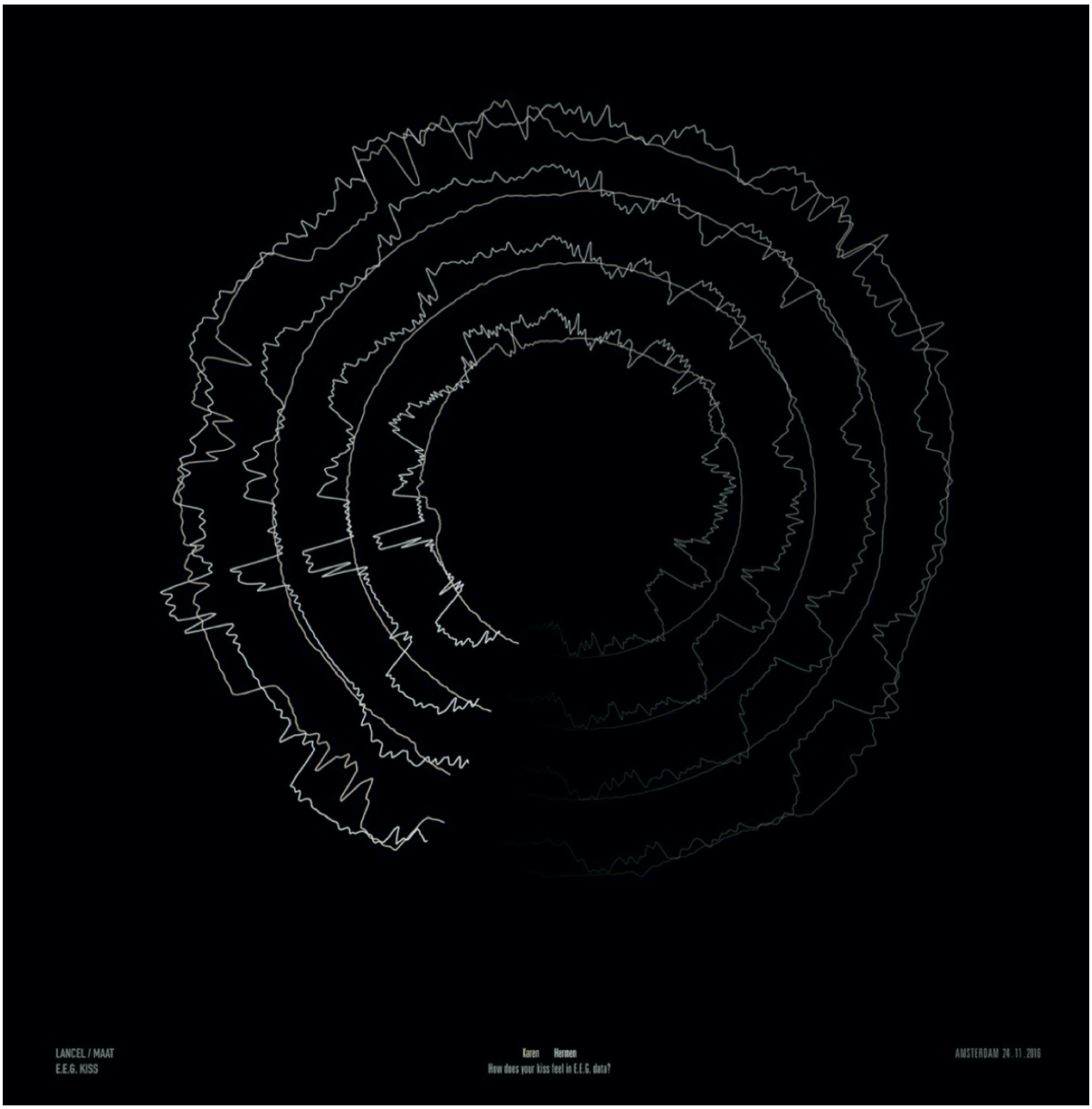

Fig.39a. 'Portrait of a kiss'. Printed selection of EEG Data visualization sequences ('Dancing Data'), co-created by two kissing participants. 1x1.10 meters, D-Bond, Gold and Silver. Acquired in Private collection 2018.

Spatially, the combined data sequences are projected real-time around the Actors kissing as 'Dancing Data', as a floor-projection designed to function as a dynamic stage, bridging and isolating Spectators and Actors in communal patterns and flow.[87]
In this second data-visualization, the feedback of starting and ending of kisses enable Co-Actors to synchronize the Actors kissing to the visualization of EEG data. The markers are activated by the Host, based on observing participants starting and ending their acts of kissing.

[87] In both orchestrations data sequences differ in each performative phase (**Fig. 39a, 40, Table 8.5.1**). When Actors close their eyes from Phase 1 to Phase 2, waves become smaller. Sometimes, they seem to synchronize and 'flow.' In those cases, visual sequences move like waves that cross each other rhythmically.

The data sequences in both orchestrations are derived directly from the four electrodes of the EEG devices, shown as separate 'lines' on in the data-visualizations. Top-down, the first three 'lines' are the data from the channels C3, Cz and C4, showing measurements from the motor cortex, including measurements of sensory and motor functions (Teplan 2002)[88], and weak motory intention (mu rhythms) (although more activities are reflected in C3 and C4 in comparison to Cz). In measurements of all positions (including Pz), motor artefacts (such as of neck, face and tongue muscles) measurements and alpha rhythms (due to the participants having their eyes closed while kissing and reflecting) and cognitive relaxation are measured. In the visual feedback, the measured arousal activity is not separated from the measured motor cortex activity. As a consequence, the data-visualization predominantly shows motor intention, and body movement of kissing.

Fig.39b. Analysing EEG data visualization patterns of EEG KISS (Dancing Data), at the Phillips Lab Eindhoven 2016.

8.4.2 Data-sonification

In the second orchestration, Digital Synaesthetic EEG KISS (2016), a sound based sensory feedback module has been added[89] to enable Actors and Co-Actors to share multi-modal neurofeedback of the act of kissing as a form of 'digital synaesthesia' (Gsoelpointner et al. 2016). The sound of each kiss is unique.

[88] These functions relate to processing touch and sensation as well as keeping track of the location of body parts (proprioception).

[89] The algorithm and sound were designed in collaboration with Tijs Ham (STEIM Amsterdam). In his artworks he applies and system design, live-electronics techniques and programming.
https://www.soundlings.com/staff/tijs-ham/, last accessed 2019/1/30

Technically, the algorithm on which the sound is based makes use of pre-defined combinations and averages of both participants' EEG data signals, to generate sound patterns. The algorithm adapts to the various Performative Phases (Table 8.5.1) with different sound patterns, separated manually by the Host.[90]

A 'sound flow' is acquired by crossfading separate sound patterns, as 'spheres', based on artistic choices.[91] In phases 1 and 5, the algorithm generates soft, 'ticking and crackling' sound patterns (by electric disturbances of the 50Hz system). In phases 2 and 4, 'water bubbles tickling' sound patterns are dominant (based on low tones). In phase 3 (during kissing), the sound of phase 2 is combined with sparks of bells tingling (achieved through soft high tones). The sound of each kiss is unique.

8.4.3 The Host

A Host, performed by the artists or by volunteers, is part of the interface design.

Photo documentation of the Performance Script and Performance Phases in which the Host interacts is depicted in **Figs. 42**; and explained in section 8.5.

*In **Phase 1,*** Actors interact with the Host. The Host explains that the artistic orchestration explores and studies social engagement through technically mediated touch and performative interaction, using words such as 'online kissing', 'digital touch', 'kissing online', 'brain technology', 'share', 'privacy' that are internationally understood. Body language is used to visualize 'kissing' and 'being close'. The explanation serves both as a spoken manual and as contextualization indicating that EEG data primarily measure muscle tension and that scientific interpretation of EEG data from intimate kissing is not possible in this artistic orchestration. The Hosts then collect their names, for them to identify their personal data-sonifications (of kissing) in the database.

Actors are asked to firstly close their eyes before kissing, secondly take all the time they need to kiss and thirdly, to keep their eyes closed when they feel the kiss is ending and to remember how the kiss felt. The Host then places EEG headsets on the Actors' heads and asks them to close their eyes, to concentrate and to reflect on the experience to come.

*In **Phase 2,*** the Host's choices to proceed are based on observations of the Actors' embodied behaviour and movements, and the visual EEG data sequences. Once the Host observes that the participants have their eyes closed and that they are sitting quietly and the EEG data sequences depict low frequencies, the Host softly tells them they can start kissing.

*In **Phase 3,*** the Host then witnesses the Actors' performativity of kissing from a short distance, ensuring a feeling of safety.

[90] In the data processing, EEG signals are translated via OSC to Super Collider.

[91] This section does not focus on soundtrack valences in relation to emotion elicitation.


Phase 1 *(left, right):* Interaction with the Host, who explains and places the headsets.


Phase 2 *(left):* Brain activity is measured with eyes closed, of Actors concentrating.
Phase 3 *(right):* Brain activity is measured while kissing.


Phase 4 *(left):* Brain activity is measured with eyes closed, of Actors concentrating.
Phase 5 *(right):* Host in dialogue with Actors on experience of kissing.


Phase 5 *(left, right):* Host in dialogue with Actors, relating experience of kissing to EEG recordings

Fig. 42. Photo documentation of the performative phases
of ASL4 'Digital Synaesthetic EEG KISS' (2016) performance script.

*In **Phase 4,*** after kissing, the Actors keep their eyes closed to remember how the kiss felt. When necessary, the Host reminds Actors to keep their eyes closed and remember what they have experienced.

*In **Phase 5***, the Actors again interact with the Host (the headsets are only removed if participants want this). The Host then socially mediates reflection through an open-ended dialogue, with questions such as:

1) How did your kiss feel and how did your kiss feel in EEG data?
2) Did you hear the sound during kissing, and did it affect your kiss?
3) Did you feel the audience around?
4) How is this kiss different from your other kisses?
5) How intense did you experience the presence of Co-Actors, the artificial system and the data-sonification, while kissing?
6) Can your kiss be measured? On a scale of 1-10: how intimate was this kiss?
7) Would you agree to save your kisses in a database to be used by others?

The Host, in fact, socially mediates between physical and virtual presence, between experience of kissing and representing datafication, between public space and intimate space. The Host mediates the multi-modal and multi-brain feedback processes between Actors, Spectators, data visualization and data-sonification.[92]

[92] *Note*, that these conversations are an essential part of the artwork and are not recorded.

Fig. 40. *Upper image:* ASL3 Digital Synaesthetic EEG KISS (2016). Image: Anna van Kooij @ Lancel/Maat, 2016.

Fig. 41. *Image below:* ASL4 'Digital Synaesthetic EEG KISS' (2016). HeK, Haus der Elektronischen Künste Basel. Image © Lancel/Maat. Some participants caress each other's faces with closed eyes.

Fig. 43. Gallery Angewandte Innovation Lab (AIL) Viennna. *Upper images*: Co-Actors watching Actors kissing. *Images below:* artist Host in dialogue with Actors about their experiences. Images © Lancel/Maat 2016.

8.5 Performance Script ASL4

The ASL4 'Digital Synaesthetic EEG KISS' performance script is depicted in Table 8.5.1. **Fig. 42** depicts photo documentation of the different ASL4 performative phases.

Table 8.5.1 Performance Script: ASL4 'Digital Synaesthetic EEG KISS'.

Phase 1: Meet (Introduction, Fitting).
The Host brings 'Kissers' in the middle of the circle, to explain the (technical) interaction script. The Hosts places the EEG headsets, collect their names, for them to identify their personal data-sonifications of kissing in the database.

Phase 2: (Concentration).
Kissers close their eyes before kissing to concentrate. The Host signals the Kissers to start and take all the time they need to kiss, while keeping their eyes closed.

Phase 3: Kissing or Caressing (Transition). The Actors perform kissing. The Host witnesses the Actors' performativity of kissing from a short distance, ensuring a feeling of safety.

Phase 4: Memory building (Incorporation).
After kissing, Kissers keep their eyes closed to memorize how the kiss felt.

Phase 5: Shared Reflection.
The Host initiates dialogue with Kissers, as part of the performance, in the same space, in the middle of the data-visualization circle, where the Kissers remain seated. The dialogue is staged to other participants on a distance (*Staged Dialogue).*

8.6 Results and Discussions of ASL4 Orchestrations

This section analyses the two ASL4 orchestrations described above; focusing on the question: 'Can shared intimate experience of social touch be mediated through multi-brain-computer interface (Multi-brain BCI) interaction in public space?'. Results of two orchestrations are evaluated, based on interaction between the components described and depicted in this chapter. A shared conclusion is presented in section 8.7.

8.6.1 Results, Discussion: ASL4 EEG KISS (2014)

ASL4 EEG KISS was held during the exhibition Reality Shift, during the Discovery Festival at Tolhuistuin in Amsterdam in 2014.[93] 14 couples and 300 spectators participated. This orchestration explores the reactions of the public to disrupted connections, and new sensory and social connections and data visualization.

8.6.1.1 Results 1 ASL4. EEG KISS

Many visitors of the festival stop to see the orchestration, seemingly attracted by people kissing. The Host observes that many Co-Actors s become immersed in the orchestration once they are told that they too can become Actors and see that others are also participating.

While Actors are kissing, the Host almost always observes that Co-Actors are immersed in a disrupted, two-fold gaze, shifting between kissing acts and data representations on the screens. They turn to the data on the screens, look back at the kissing act and back to the screens again, seemingly linking the kissing gestures and the emerging data traces. Their focus remains on the Actors after the act of kissing, when the Actors eyes are still closed, even if this phase takes up to 5 minutes. Couples, friends and strangers, people of all ages, kiss.

Initial reactions expressed to the Host such as: "Oh look at all those people watching people kissing!" often include indications of shyness, nervousness and discomfort, but also enthusiasm.

As indicated above, Actors are asked to firstly close their eyes before kissing, secondly take all the time they need to kiss and thirdly, to keep their eyes closed when they feel the kiss is ending and to remember how the kiss felt. Some couples start kissing right away while others wait a few minutes to seemingly overcome shyness. The duration of kissing is between 20 seconds and 2 minutes. Different ways of kissing are observed and interpreted by the Host to vary between still, silent, tender, dynamic and expressive. Giggling a little before or during the kiss is not unusual.

The Host observes that if Actors do not close their eyes and reflect on their kiss, both Actors and Co-Actors do not concentrate on the act of kissing. When Actors open their eyes after the kiss, different reactions are perceived by the Host: some Actors express exaltation, others express tension, others are silent, perceived by the Host to be opening their eyes as if

[93] Discovery and Transnatural Festival 2014: Beyond Biennial Exhibition, Tolhuistuin Amsterdam.

awakening, needing time to find words and staring in mid-space. Expressions include “I feel disoriented” or “I forgot where I was”.

Not all but many Actors state that while kissing, they are first aware of the surrounding Co-Actors, but that after some time they lose touch with the Co-Actors, expressed e.g. as “I felt fear at the beginning but soon forgot all around us. Our kiss was all that mattered”. Nevertheless, during some performances, the Host observes that the Actors’ hands dwell towards sexually arousing parts of the body but stop at that.[94] One Actor expressed the role of Co-Actors as that they “come and go” in his mind “like waves”.

Comparably, in most cases, Actors state that they forget about the visualization of the data. However, ambiguously, the Host observes that Actors only start kissing if they have seen the data visualization before kissing. In the few cases that Actors started kissing without Co-Actors being present, they indicated to the Host that they experienced their act of kissing as instrumental to digital data production and interpretation, and not as an intimate act. A few of these Actors also expressed concern about what data-visualization of their kiss may be "giving away". One these Actors stated “I am concerned that these data are judged by others.”

Actors are always interested in the data-visualization of their kiss. Although at forehand Actors have been told that scientific interpretation of EEG data from intimate kissing is not possible in this artistic orchestration, and not the focus of this research, almost all participants seem to be convinced that the artistic orchestration reveals information about their kiss, their ‘kiss-qualities’, and even the quality of the Actors’ relationships (as expressed to the Host).
Although the individual data sequences are visible on two different screens, Actors often talk about both sequences as a composed representation of the kiss and often refer to the combination of sequences as “**the portrait of our kiss**”, as an act of “co-creation”.[95]

When discussing the data in dialogue with the Host, Actors’ expressions include ‘an enigmatic mirror of their kisses’: “Only we know what these traces mean” and “It leaves sense making to ourselves”, interpreting data as depicting their experience of intenseness (“on fire”), concentration (“like waves of a river”), or the feeling of togetherness during their kiss (“This reminds me of the intimate moment we just had together.”). In some cases, Actors are observed to silently gaze at the data, smile, and seem to lose all sense of time with expressions interpreted by the Host to indicate tenderness, disbelief and curiosity.

Co-Actors express attribution of meaning to the data sequences, sometimes based on their observations. Examples of such attributions are: “I can clearly see from the data sequences that one of the persons kissing was more passionate than the other.”, and “I love how these data-lines move together and many times I could see whose line belongs to whom

[94] Visible in video documentation.

[95] A selection of co-created sequences has been printed, on the participant’s request, depicted in **Fig 39.**

from the way they kiss." One of the Co-Actors stated "I could see the kiss being mirrored in the data visualization. Although in fact I don't know what I was seeing, I felt I could see it." Others expressed other experiences related to emergent data: "I could see they were passionate, and I could see that feeling in the data too.", "You really see them going in the data", and "I love the data emerging. Of course, I knew they were emerging from kissing." Some Co-Actors indicate the importance of synchronization between the beginning and end of physical kissing and its visualization of EEG data, for their experience. Often lively discussions start about data interpretation, intimacy in public, and issues of privacy in relation to information value of EEG data of kissing.

8.6.1.2 Discussion 1 ASL4. EEG KISS (2014)

Couples, friends and strangers of various ages and diverse cultural backgrounds have participated in these experiments, in the roles of Actors and Co-Actors, some for hours. Ambivalence, both purposefully designed and emergent, is shown to be essential to evoke engagement and immersion of Actors and Co-Actors in the shared orchestration.

Firstly, Kissing Actors need to ambiguously trust the Host while simultaneously risking judgement of their vulnerable act of kissing and the resulting data by Co-Actors. For immersion in intimate experience, it has shown to be important for Actors to 'semi- lose touch' with Co-Actors. However, ambiguously, they also have expressed the need to have confirmation that Co-Actors are present**.**

Secondly, ambiguously, individual Co-Actors have expressed the need to witness the Actors' physical (intimate kissing) gestures and simultaneously give meaning to the emerging abstract data visualization. In this process, seeing the Actors kissing gestures is shown to be needed to 'feel' the data visualization as being intimate.

Thirdly, to individually interpret the EEG data visualization as an expression of intimacy, Co-Actors and Actors have indicated the need to be confirmed of each other's presence during the kiss. Ambiguously, they express the need of a shared experience to interpret individually. Co-Actors also express the need to be able to witness other Co-Actors. Actors have shown the need the presence of Co-Actors witnessing their emerging BCI data, to appropriate the data visualization in retrospect as 'their portrait' of shared intimacy. Importantly, shared intimate experience is only reported if reflection is facilitated, for all to share and co-experience.

8.6.2 Results, Discussion: ASL4 Digital Synaesthetic EEG KISS (2016)

Orchestration 2 took place at the Frascati Theatres Amsterdam, 2016. 11 Couples and 43 Co-Actors participated. In this adapted orchestration, Actors are surrounded by sound and by a visual, abstract, streaming EEG data floor projection witnessed by Spectators. This orchestration explores whether spatial data visualization and data-sonification enhance shared engagement for BCI mediated intimate connections, as described above.

Note, that in this second orchestration, Actors and Co-Actors behaviour observed by the Host was comparable to Orchestration 1. Only new aspects are described below.

8.6.2.1 Results 2 ASL4. Digital Synaesthetic EEG KISS

When asked by the Host, Actors indicate that they experience kissing the other person as both familiar and unfamiliar. Actors follow the Host's invitation to close their eyes, to listen to the sound, and to immerse in each other's kiss.

As in the previous orchestration, in phase 5, Actors are asked to reflect about the kiss in dialogue with the Host. Actors refer to the impact of sound with words such as: "The sound made my kiss more intense and more focused. The tickling sound, that emerged from my brain activity, made me imagine electric rain drops that enhanced and merged with my experience of electrified kissing." and "It felt like our kiss was being borne by the music". A few Actors, who indicated that they tried to control the sound through different ways of kissing, referred to their kiss as 'fun' rather than as intimate.

Co-Actors are observed by the Host to be more concentrated and immersed in the circular data environment and data-sonification, in comparison to the first Orchestration. Both Actors and Co-Actors express for example: "This situation is weird but feels strangely safe.", "The sound makes the space reflective", "This feels like a kind of trance" or "I could stay here forever." Some stay for hours, talking quietly with each other. More often than in the first Orchestration, the Host observes that Co-Actors encourage each other to become Actors and kiss. Even strangers kiss.

While the average time for Actors to start to kiss is between 1 and 30 seconds, strangers starting to kiss can take up to 5 minutes. These 5 minutes are reported by all Actors and Co-Actors to be experienced as being very intense. Furthermore, in this second orchestration, the duration of kissing is longer (between 20 seconds and 10 minutes) in comparison to the first orchestration in this chapter.

The circular data visualization is designed for Co-Actors to stand around the Actors. A few Actors indicate that they experience the circular, emerging data visualization as "a radar." Co-Actors are observed to never enter the floor projection while Actors kiss. Most Actors and Co-Actors describe their experience of the data visualization as immersive, indicated by for example "Can I step into it?", "Is this a sort of brain data space?", "These lines here are moving more wildly than those lines over there" (while observed to be pointing at the projection on the ground proximate to their bodies) or "Am I staying in their brain activity?".

The Host observes that Actors seem more comfortable entering the staged space and to being exposed, in comparison to the first Orchestration. Furthermore, after kissing, Actors take more time to talk about their kisses with the Host, to explore their memories of kissing. They are, in general, seen to be more comfortable, talking while watching the streaming data around them, indicated by one Actor to be both "beautiful and strange".

8.6.2.2 Discussion 2 ASL4. Digital Synaesthetic EEG KISS

The second EEG KISS orchestration shows that circular, streaming visual data and the sonified data, of the multi-brain BCI, enhances focus and immersion for all participants. Ambiguously, spatially, the data visualization distances Actors from the Co-Actors, while at the same time bridging them. Furthermore, ambiguously, Actors have shown to need the data visualization to experience and remember an intimate kiss, but most Actors express forgetting the data-visualization while kissing. For Actors, often, the shared data-sonification is perceived to be shared feedback of their performativity, merging with their kissing experience. The combination of shared sound and spatial data visualization has been observed to increase embodied, immersive experience of the BCI data for Co-Actors. This multi-modal BCI orchestration with spatial visualization and shared sound has shown to increase participants' feeling of safety and involvement, both in time and in intimate connection with each other.

8.7 Conclusion ASL4 and Future Research.

This chapter explores design syntheses for artistic orchestrations of shared intimate experiences, of multi-brain, multi-modal BCI interaction, through touch. Digital synaesthetic, shared intimate social touch experience is explored through disruption of familiar relations between 'who you kiss and who is being kissed, what you see and what you hear'.

The two ASL4 orchestrations explored are 'EEG KISS' (2014) and 'Digital Synaesthetic EEG KISS' (2016). Both orchestrations show that for engagement in shared, intimate experiences mediated by multi-brain BCI, sensory connections and feedback processes through seeing, hearing, and touching need to be disrupted. They need re-orchestration into multiple ambiguous connections, such as connections between participants (Actors and Co-Actors), senses, actions and connections, between physical presence and virtual, spontaneously emerging BCI representations. Sonification of BCI data of touch, enhances the Actors and Co- Actors' experience of feedback. Spatial data visualization provides an embodied, immersive relation to the BCI data, both isolating and bridging Actors and Co-Actors.

The combination of spatial BCI data visualization and data-sonification increases focus, concentration, immersion, and feelings of safety. Central stage intimate touch is essential to shared experience and reflection. Meaningful shared intimate experience mandates an orchestration that includes vulnerable self-disclosure, witnessing, dialogue and reflection, embedded in individual and shared interpretation, in co-presence with all participants. The role of the Host, socially mediating this interpretation, and reflection through dialogue, is a crucial element of the design.

The next chapter discusses ASL5, a BCI interface including brain activity of both Actors (touching) and Co-Actors (mirror-touching) for a Multi Brain BCI visualization (Lancel/Maat 2018).

Fig. 44: ASL4 'Digital Synaestehtic EEG KISS' (2016). Gogbot Media art Festival, Enschede. Image © Lancel/Maat.

Future research includes correlations of EEG KISS datato to experiences of connectedness (synchronization), in a social-technical performative synthesis. First experiments into the possibility of such correlations have been conducted as part of EEG KISS data performed at Phillips Lab Eindhoven (2016), **Fig. 39b;** and EEG KISS fNIRS data, performed at Stedelijk Museum (2017), **Fig. 37**. The EEG data visualizations have been studied from an aesthetic perspective, for a new approach to understanding the data patterns (**Fig. 39a** and **Appendix 1**). This approach is explored in dialogue with participants in the artistic orchestrations, to critically explore emotionally intelligent machine learning systems for intimate experience. These researches are subject to future research and exceeds the focus of this thesis.

8.8 Conclusion ASL4, in relation to the CITYO Interaction Model.

These orchestrations provide insights in relation to the use of the CITYO Interaction Model.

1. **Sensory Disruption Design, with Reciprocal Influence in empathic interplay.**
   - **Sensory** connections and feedback processes of seeing, hearing, and touching must be direct and disrupted, re-orchestrated into multiple **ambiguous connections**.
   - All visual-haptic-sonic, direct, and virtual sensory connections must be perceived from **one spatial position**, for each individual participant.
   - The Actors Brains sensors must produce shared output with **individual feedback recognition**.
   - Feedback must be predictable *and* **unpredictable**, emerging from **spontaneous** (passive) brain activity.
   - In case of direct reciprocal touch for two Actors (instead of self-caressing gestures in ASL1,2,3,4), the motor-feedback loop can present an **abstract representation** of the touch gestures (instead of a bodily image).
   - Direct visual connections can be **partly replaced** by shared data-sonification.
   - **Shared,** spatial sensory datafication between Actors/ Co-Actors is vital to increase focus, concentration, immersion, **safety.**
   - **Co-Actors gazes** are essential to establish a social context (or potential judgement).
   - **Absence of Co- Actors** increases sensitivity to judgement of data interpretation.
   - The shared orchestration must be based on intentional, **vulnerable affective** kissing gestures.
   - Actors must be able to *'semi-lose touch'* with the Co-Actors, to immerse and concentrate in the personal haptic experience.

2. **Shared Reflection Design.**
   - **Dedicated phases of** a) concentration and b) **memory-building** are essential to be part of the performance script, to support dialogue. The Host observes that if Actors do not close their eyes and reflect on their kiss, both Actors and Co-Actors do not concentrate on the act of kissing.
   - Both Actors and Co-Actors require a **staged dialogue, in the same space**, to stay involved and to find words for the experience.
   - Actors must **trust the Host**, to perform kissing gestures with unfamiliar others. Actors need support to *not* **trust the data** more than humans (the host, Co-Actors or themselves). **Appropriation of data** by Actors is essential, f.e. through requiring shared visual datafication (f.e. as a *portrait of a kiss*) or sonification saved in a publicly accessible database.

ASL 5: Kissing Data Symphony
ASL6: Intimacy Agents

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Fig. 45. ASL5 'Kissing Data Symphony' (2018). Ars Electronica Festival Linz, in collaboration with European Cultural Programme EMAP. Image © Lancel/Maat, 2018

9 ASL 5: Kissing Data Symphony ASL 6: Intimacy Agents

Chapter 9 presents two ASLs: ASL5 'Kissing Data Symphony' (Lancel/Maat 2018) and ASL6 'Intimacy Agents' (Lancel/Maat 2020). The ASL5 orchestration is presented in section 9.1 (including the interaction model (9.1.1); the design choices (9.1.2); the performance script (9.1.3)); and the ASL6 orchestration in section 9.2 (including the interaction model (9.2.1); the design choices (9.2.2); the performance script (9.2.3). This is followed by section 9.3 that presents results and combined discussions; and a combined conclusion based both orchestrations in section 9.4. A combined conclusion in relation to the CITYO Interaction Model is presented at the end of this chapter (section 9.5). The technical A.I. aspects are discussed in Appendix 1. In summary, ASL 5 and 6 include:

ASL5 *Kissing Data Symphony* (2018) and ASL6 *Intimacy Agents* (2020) explore whether empathy can be shared through (online) Multi-Brain Computer interaction (Multi-BCI), for multiple participants.
The Sensory Disruption Design uses Multi-Brain Computer technologies to create a *Kissing Data* Brain Interface, for visual, sonic, and haptic hybrid connections. In ASL5, Actors and (Co-)Actors together experience a Kissing Data Symphony: a shared data composition of kissing each other, and of seeing to be kissed, resonating in the brain. Brain activities of kissing are transferred to shared data-visualizations and data-sonifications, for multiple participants simultaneously. ASL6 explores a multi-player *online* streaming platform for kissing. Actors audio-visually share their kissing brain activities, with Co-Actors who share their heartbeats, emerging from seeing to be kissed. All data-sonifications can be downloaded from a participatory generated, public accessible database.
Shared Reflection takes place through a shared dialogue.

This chapter is based on:
Lancel, K., Maat, H., Brazier, F.M. (submitted) 'How Close Can We Get? Artistic Design for Shared Empathy in Intimate Connections, through Online Multi-Brain Computer Interfaces'.

9.1 Orchestration ASL5: Kissing Data Symphony (2018)

ASL5 addresses the question: 'Can empathy be shared through online Multi-Brain Computer Interfaces (Multi-BCI)?'.

ASL5 'Kissing Data Symphony' has been designed to involve participants in multi-modal multi-BCI interaction; for sharing empathy in intimate connections of social touch. They are invited to feel, see, touch and share an intimate kiss in hybrid (physical and online) connections. In this Multi-BCI, both 'Kissers' (Actors) and 'Co-Kissers' (Co-Actors) wear EEG headsets. The spontaneous brain activity of Actors is recorded during their kissing performativity, while the Co-Actors' spontaneous brain activity is recorded, in response to 'seeing to be kissed', resonating in the brain and in the imagination. (*Note,* that gestures of kissing are sometimes replaced by acts of caressing each other's faces.[96])

Brain activities of both *Actors and Co-Actors* are transferred real-time into a shared data-visualization, a floor projection encircling the Actors **(Figs. 45,46,48).** Direct feedback of individual participation is provided through differently coloured lines, for multiple participants.

The multiple, individual BCI-data lines become real-time visible as *emergent traces*, together 'writing' a shared social space. Simultaneously, these data are transferred to a shared soundscape, based on a novel algorithm designed to this purpose.

In ASL5, multi-BCI data-visualizations and data-sonifications emerge from multi-sensory and multi-modal brain activities of both Actors and Co-Actors simultaneously. Hosted, shared reflection is based on the shared embodied experience, with both Actors and Co-Actors.

[96] During the ASL5 orchestration in **Gwangju, South Korea (ISEA 2019)** and at **HeK Haus for Electronic Art Basel,** Actors participated by caressing each other's faces. Interestingly, the Host observed that these different touch gestures resulted in similar intensity of shared intimate experience in public, for Actors and Co-Actors. The option of caressing increased accessibility in the orchestration, for among others family members (**Fig. 41**) and colleagues **(Fig. 42).**

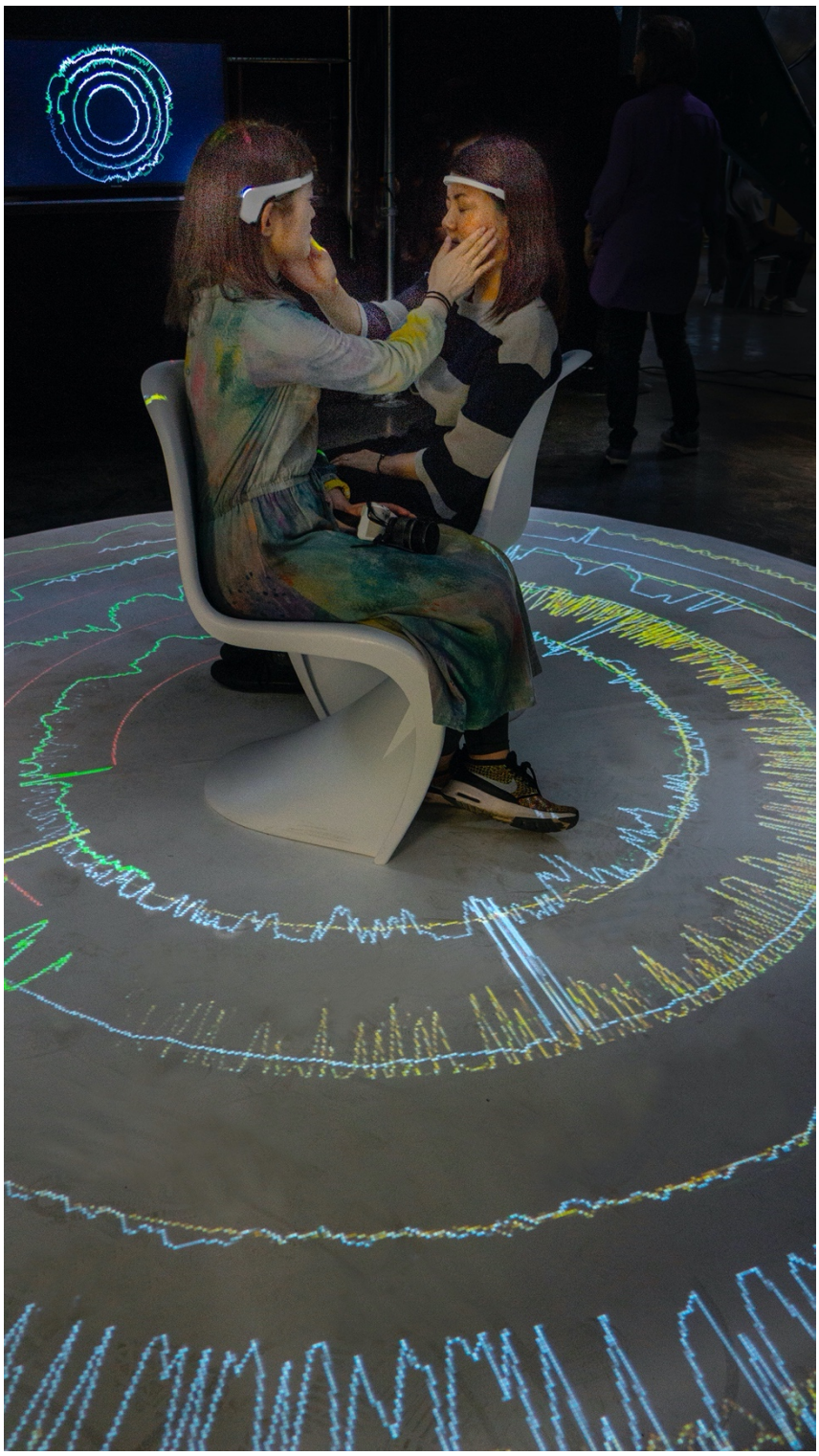

Fig. 46. ASL5 ‘Kissing Data Symphony’ at ISEA 2019, Gwangju South-Korea. Image © Lancel/Maat.

9.1.1 Interaction Model ASL5

Fig. 47 depicts The **ASL5 'Kissing Data Symphony'** (2018) in relation to the CITYO Interaction Model.

Description CITYO Interaction Model ASL5

1) Sensory Disruption Direct reciprocal touch gestures between two Actors kissing are visibly shared with Co-Actors. Actors close their eyes (while kissing) disrupting all visual connections. Direct visible connections are only perceived by Co-Actors, who can visibly perceive the Actors emotional facial expressions.

Sensory connections between two Actors, namely reciprocal gestures of kissing, are disrupted through the Kissing Data Brain Interface, for visual-sonic-haptic connections.

The ASL5 extends the ASL4 multi-BCI with EEG recording devices for both Actors, and Reciprocal, spontaneous responses by Co-Actors. The devices record their brain activities simultaneously. Both their brain activities are translated to a real-time joint, unique, partly predictable data visualization (visible to Co-Actors) and EEG data-sonification, shared by all. Actors perceive sonic-haptic, and Co-Actors visual-sonic-haptic interaction.

2) Shared Reflection. A hosted dialogue is shared by Actors and Co-Actors.

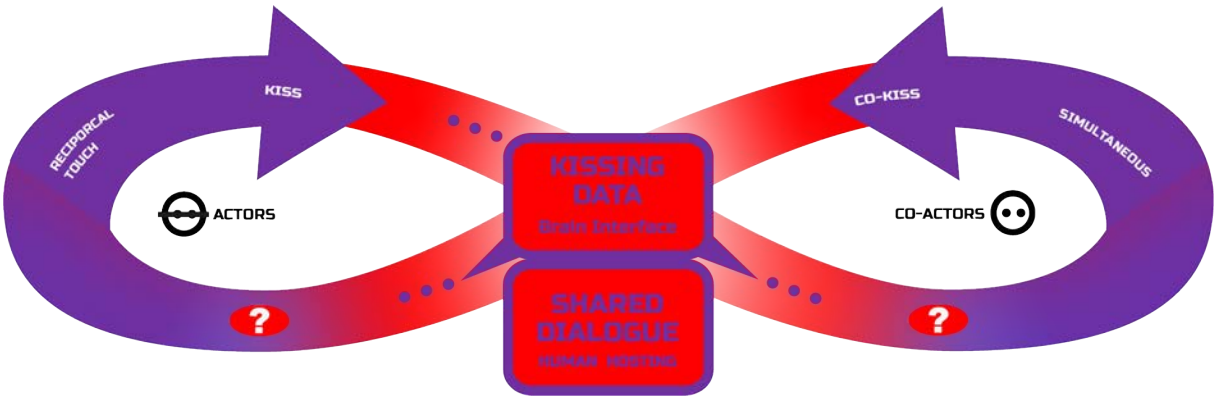

Fig. 47. CITYO Interaction Model ASL5 '**Kissing Data Symphony'** (2018) and Legenda.

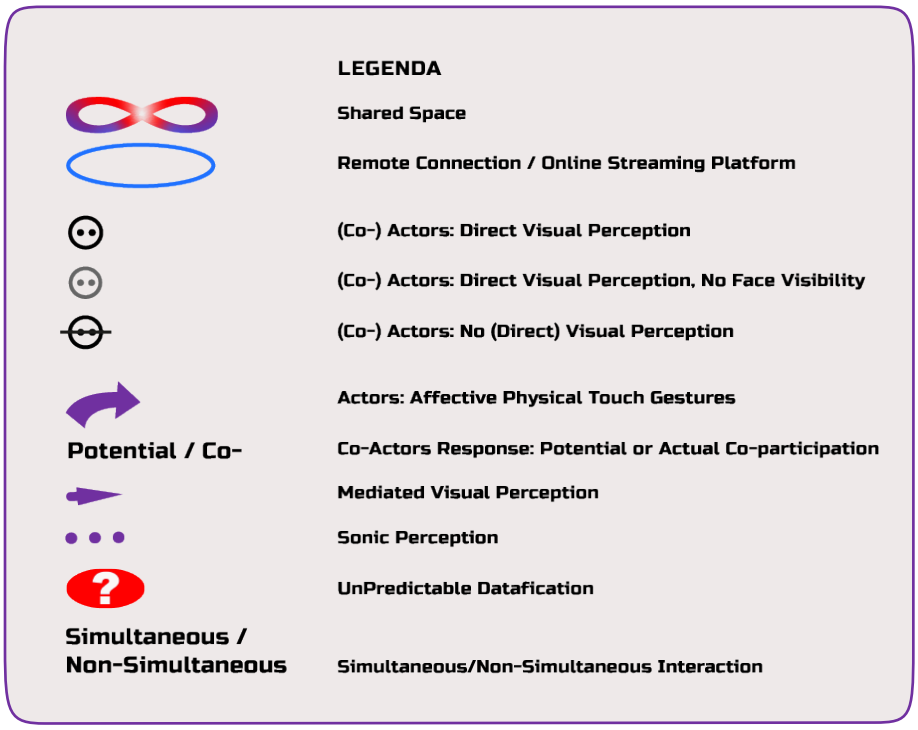

Fig. 48. Spatial model of 'Kissing Data Symphony'. Actors Kissing and Co-Actors watching, wear EEG devices (headsets). A real-time data-visualization 'streaming' around the kissing , shows combined Actors and Co-Actors brain activity, real-time.

9.1.2 Design Choices ASL5

This section describes the design of ASL5, that extends the ASL4 design with shared, simultaneous motor data interaction, from Co-Kissers' brain activities with Actors emerging brain activities. *Note,* that the technical A.I. aspects of ASL2 are presented in **Appendix 1**.

The next sections describe technical aspects of the data visualization and data-sonification. The data visualization, depicted in **Figs. 45a,48** (described in more detail in section **9.1.2.1**), emerges real-time from both Actors and Co-Actors involved in acts of kissing (or caressing each other's faces). The EEG Data sequences of both Actors and Co-Actors are integrated into one data visualization. The separate data sequences are visually placed on top of each other[97], in different colours, to both compare individually and merge.[98]

Spatially, the combined data sequences are projected real-time around the Actors as 'Dancing Data', a floor-projection designed to function as a dynamic stage, bridging and isolating Actors and Co-actors in communal patterns and flow.[99] The Multi-BCI data-visualization and data-sonification (the Shared Data Composition) emerges from multi-sensory and multi-modal interaction between both Actors and Co-actors.

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[97] The data-sequences are visually placed on top of each other without fusing them previously.

[98] In this visualization, the feedback of starting and ending of kisses enable Co-Actors to synchronize their own brain activity, and the kissing activities by Actors, to the EEG data visualization. The markers are activated by the Host, based on observing participants starting and ending their acts of kissing.

[99] In both orchestrations, data sequences differ in each performative phase (Table 9.1.3.1). When Actors close their eyes from in Phase 2, waves become smaller. However, sometimes, interestingly, the waves seem to synchronize and 'flow.' In those cases, visual sequences move like waves that cross each other rhythmically.

9.1.2.1 Data-visualization

This section describes the Multi BCI EEG recordings leading to the data-visualization.

The Multi-BCI made use of the MUSE2[100] device, measuring EEG (electroencephalogram). Four data-visualization sequences, deriving directly from four electrodes, were shown as separate 'lines' in the data-visualization. Top-down, the four 'lines' presented data from the channels TP9, AF7, AF8, TP10. In measurements of all positions, raw spectra are provided "(delta (1-4Hz), theta (4-8Hz), alpha (8-13Hz), beta (13-30Hz), gamma (30-44Hz)), total power, artifact detection (eye blink, jaw clench)" by the BCI (motory arousal is not directly measured). It is possible to categorize "three possible states such as relaxing, neutral and concentrating" (Alpha-waves), "based on a few states of mind defined by cognitive behavioural studies" (Bird 2018). Relevant to the ASL5, motor artefacts of face muscles (such as jaw clench, eye blink, lips and tongue movements) and alpha rhythms (due to the participants having their eyes closed while kissing and reflecting) and cognitive relaxation are measured.

9.1.2.2 Data-sonification

The Multi-BCI data-sonification emerges from multi-sensory and multi-modal interaction between Actors and Co-actors. A sound based sensory feedback module enables Actors and Co-actors to share multi-modal neurofeedback interaction of the act of kissing.[101]The sound of each kiss is unique. Described in more detail in section 8.4.2, technically, the algorithm on which the sound is based makes use of pre-defined combinations and averages of both of the participants' EEG data signals, to generate sound patterns.[102] The algorithm adapts to the various performative phases **(Table 9.1.3.1),** with different sound patterns, separated manually by the Host. A 'sound flow' is acquired by crossfading separate sound patterns, as 'spheres', based on artistic choices. In section **8.4.2**, the artistic choice for sound design is described.

[100] https://choosemuse.force.com/s/article/What-electrode-channels-does-Muse-use?language=en_US

[101] The algorithm and sound were designed in collaboration with Tijs Ham at STEIM Amsterdam, http://www.soundlings.com/staff/tijs-ham/, last accessed 28-1-2021.

[102] In the data processing, EEG signals are translated via OSC to Super Collider.

9.1.3 Performance Script ASL 5

ASL5's 'Kissing Data Symphony' performance script is depicted in Table 9.1.3.1.

Table 9.1.3.1. Performance Script: ASL5 'Kissing Data Symphony'.

Phase 1: Meet (Introduction, Fitting).
The Host brings Actors and Co-actors together in the middle of the data-visualization circle, to explain the (technical) interaction script to them all. Actors and Co-actors introduce themselves to each other, connecting socially (including handshaking, face-to-face connection and personal name exchange). The Host places the EEG headsets.

Phase 2: (Concentration).
Actors and Co-actors close their eyes before kissing, to concentrate.

Phase 3: Kissing or Caressing (Transition).
The Host signals the Actors to start and take all the time they need to kiss, while keeping their eyes closed. The Co-Actors are signalled to open their eyes and watch. They are encouraged to move freely (or stand still) around the performance space (on and around the data-visualization, that encircles the Actors kissing).

Phase 4: Memory building (Incorporation).
After kissing, Actors keep their eyes closed, to memorize how the kiss felt.
The Co-Actors do the same, for which they need to close their eyes again.

Phase 5: Shared Reflection.
The Host initiates dialogue shared with Actors and Co-actors, as part of the performance script, in the same space. All are brought together, in the middle of the data-visualization circle, where the Actors remain seated. The Host first focusses on the Actors experiences,
then on the Co-Actors experiences, followed by a group conversation (*Shared Dialogue*).

9.2 Orchestration ASL6: Intimacy Agents (2020), Online Multi-BCI

The ASL6 'Intimacy Agents' (2020) adapts the orchestration of ASL5 to *online* interaction, between Actors and Co-Actors. Similar to ASL5, the question addressed is: 'Can empathy be shared through online Multi-Brain Computer Interfaces (Multi-BCI)?'.

In the ASL6, all Actors and Co-Actors meet in an online virtual shared space. Similar to ASL 5, Actors and Co-Actors simultaneously contribute to a shared composed datafication. Differently, the datafication emerges from:

● Two Actors kissing, while EEG recordings of their spontaneous brain activity are transferred real-time to a data-visualization and data-sonification, as explained in **9.1.1.**

● Heartbeats of Co-Actors. Previous to the interaction, these Co-Actors have been sent a personalized, pre-recorded heartbeat, enabling simultaneous, sonic influence on the Kissers' EEG data-sonification. From an artistic perspective, the pre-recorded heartbeats were explored as 'individual 'voices'.

Note, that ASL6 has been performed only one time, as a first experiment. Due to the very experimental character, the artists have decided to kiss, instead of inviting members of the public to become kissing Actors. Future research focusses a) inviting members of the public to become kissing Actors; and b) on Co-Actors adding their *own* heartbeats, real time.

9.2.1 Interaction Model ASL6

Fig. 43 depicts The **ASL6 'Intimacy Agents'** (2020) in relation to the CITYO Interaction Model.

Description CITYO Interaction Model ASL6

1) Sensory Disruption. Direct reciprocal touch gestures between two Actors are visibly shared with Co-Actors. Actors close their eyes (while kissing), disrupting all visual connections. Direct visible connections are only perceived by Co-Actors, who can visibly perceive the Actors emotional facial expressions.

Sensory intimate connections between two Actors, namely reciprocal gestures of kissing, are sensory disrupted through the Kissing Data Brain Interface, for visual, sonic and haptic hybrid connections. Their brain activities of kissing are EEG recorded and real-time transferred to a data-visualization and data-sonification. Reciprocally, in response, Co-Actors simultaneously contribute with the sound of their heartbeats.

Both spontaneous brain and heartbeat activities are translated to a real-time, joint, unique partly predictable data-visualization (visible to Co-Actors) and data-sonification, shared by all. Actors perceive sonic-haptic, and Co-Actors visual-sonic-haptic interaction.

2) Shared Reflection takes place through hosted dialogue shared by Actors and Co-Actors.

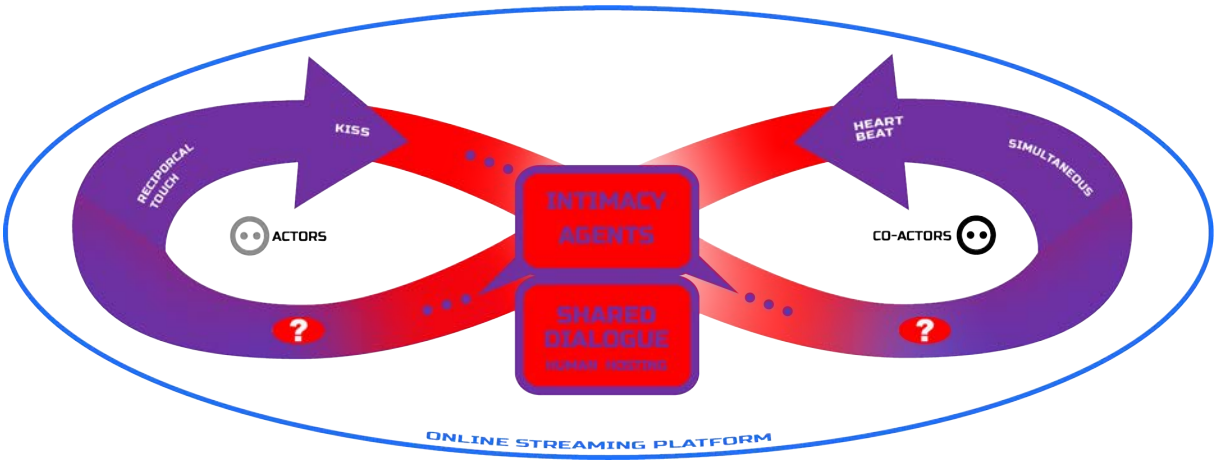
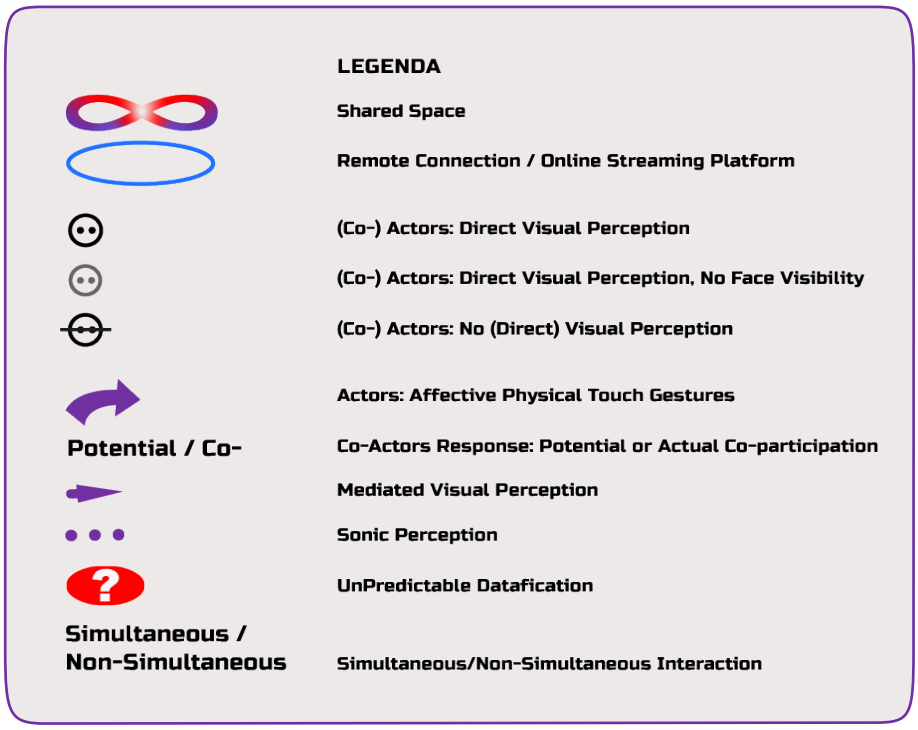


Fig. 49. CITYO Interaction model ASL6 'Intimacy Agents' (2020) and Legenda



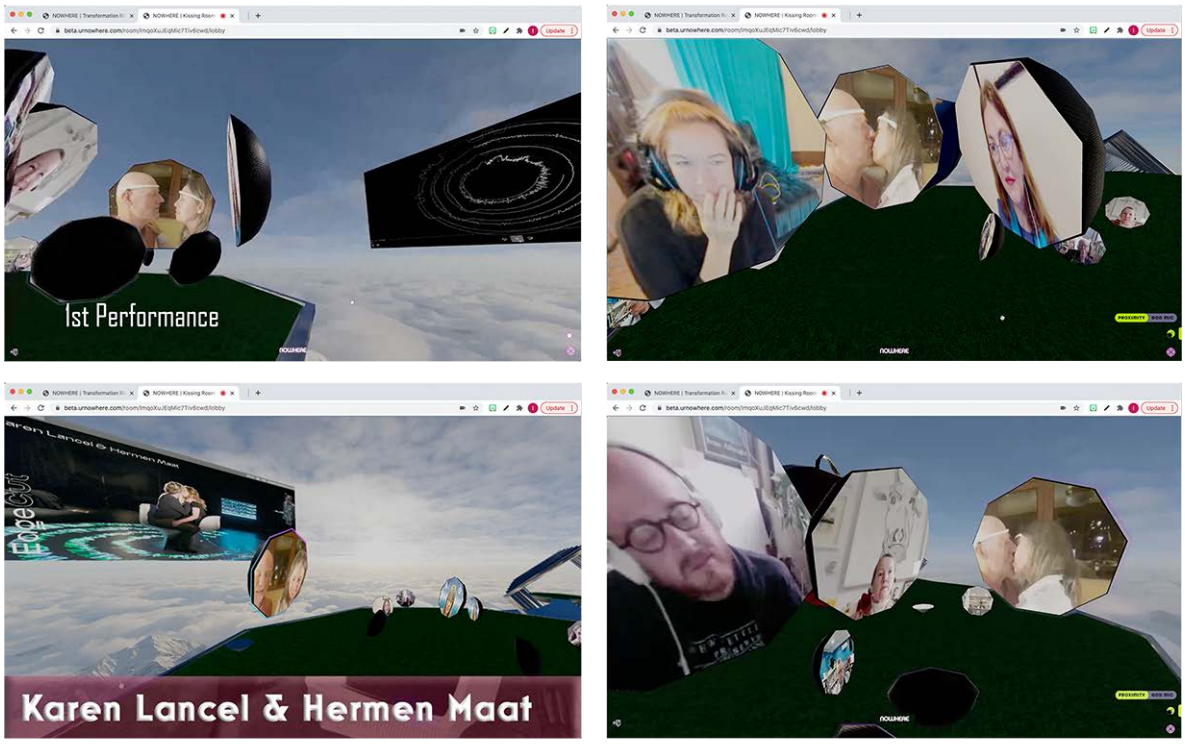


Fig. 50. 'Intimacy Agents', UareNowhere.net. *Images left:* 'Main Space'. *Images Right:* 'Intimate Space'. Co-Actors (visible to each other in nonangons) watch together two artists kissing with EEG headsets (visible in their own nonagon). The data visualization is visible on a big screen (left upper image).
Images Emer Beamer 2020 © Lancel/Maat 2020..

9.2.2 Design Choices ASL6

This section describes a) the online visual representations of Actors and Co-Actors; b) the online, virtual spatial design; and the c) Shared Data Composition. *Note,* that the technical A.I. aspects of ASL6 are presented in **Appendix 1**.

a) *The online visual representations of Actors and Co-Actors* are shown real-time in the shape of 3 dimensional nonagons. The nonagons are small frames that present a live feed of participants. The nonagons can move freely in the online 3D space, manipulated by the Co-Kissers at home. All Actors and Co-Actors are visible to each other in the nonagons.

b) *The online, virtual spatial design* includes two connected spaces: a *Main Space* and an *Intimate Space*. The *Intimate Space* provides for Actors to perform the kiss, in co-presence of Co-Actors. This space facilitates a maximum presence of 8 Co-Actors, to ensure each nonagon a close spatial relation to the Actors-nonagon. In the orchestration, similar to ASL4 and 5, Co-Kissers stand around the Kissers.

c) *The Shared Data Composition*. Similar to ASL4, a real-time data *visualization* emerges from the Actors' kissing brain activity, through BCI EEG recordings. Differently, a shared, real-time composed data *sonification* emerges from BCI EEG data (from the kissing brain activity), and Co-Kissers pre-recorded heartbeats (downloaded previously).

The EEG data visualization is visible on a big screen (not as a spatial floor projection, in ASL4 and 5); visible to all Co-Actors, both in the ***Main Space*** and in the ***Intimate Space***. Only in the *Intimate Space,* visual perception of the Actors kissing gestures, and sonified EEG and heartbeats recordings are perceivable.

9.2.3 Performance Script ASL6

The ASL6' 'Intimacy Agents' performance script is depicted in Table **9.2.3.1**. ASL6 adapted the ASL5 performance script to online interaction. The online environment introduced a *Main Space* parallel to an *Intimate Space*, explained in section **9.2.2.c.**

Table 9.2.3.1. Performance Script: ASL6 'Intimacy Agents'.

Phase 1: Meet (Introduction): *Main Space.*
The Host brings the nonagons of 'Actors and Co-actors together in a Main Space and explains the interaction script. Actors and Co-Actors introduce themselves and connect socially (including personal name exchange, chatting, moving around). The overall performative phases are explained.

Phase 1a: (Fitting): *Intimate Space.*
The Host explains the rules for the Intimate Space:
a) silence is required; and b) Co-Actors can choose to activate their pre-recorded heartbeats during the kiss. The host guides Actors and Co-Actors (maximum 8 people at a time) to the Intimate Space; where the Actors place their EEG devices.

Phase 2: (Concentration). Actors and Co-Actors close their eyes before kissing to concentrate.

Phase 3: **Kissing or Caressing** (Transition)**.** *Intimate Space.*
The Host signals the Actors to start and take all the time they need to kiss, while keeping their eyes closed. The Co-Actors are signalled to open their eyes and watch. They are encouraged to move freely around the performance space, in relation to the data-visualization and the Actors.

Phase 4: **Memory building** (Incorporation). *Intimate Space.*
After kissing, Actors keep their eyes closed, and Co-Actors close their eyes again, to memorize how the kiss felt.

Phase 5: **Shared Reflection**. *Main Space*
The **Actors** (who are the artists) initiate a dialogue with Co-Kissers, as part of the performance script. They first focus on the Co-Kissers experiences, then on their own Kissing experience, followed by a group conversation (*Shared Dialogue*).

9.3 Results and Combined Discussion ASL5 and ASL 6

This section presents results of the performance scripts in ASL5 and ASL 6. Both scripts make use of digitally shared spaces. ASL5 explores a hybrid shared space, for Actors and Co-Actors 'kissing' and 'seeing to be kissed', in shared multi-sensory, multi-modal multi-BCI EEG feedback interaction. ASL6 explores if and how the results of ASL5 can be applied in an online shared space, merging participants' BCI feedback loops and heartbeat signals.
Results of the orchestrations are presented in the following sections 9.3.1 and 9.3.2. *Separate* Discussions are presented in section 9.3.3; and the *combined* Conclusion in section 9.4.

9.3.1 Results ASL5 'Kissing Data Symphony' (2018)

ASL5 took place during the Ars Electronica Festival**,** Linz (2018). This yearly festival hosts more than 10.000 people per day, including international policy makers, artists, curators, scientists, people involved in technology and innovation related environments; a broad public including families.

People from all ages, multiple genders and cultural backgrounds participated. ASL5 was organized twice a day for 2 hours over a period of 5 days. Each **performed script** took about 20 minutes, hosted by 2 artists and a technician. During the full period, approximately 1250 people participated. **Each interaction** included: 2 Actors 'Kissing'; between 1 and 4 Co-Actors 'Co-Kissing', and approximately 30 Co-Actors watching.

9.3.1.1 Results ASL5

In ASL5, all Performative Phases of the Performance Script lasted between 15 and 25 minutes. Duration of phase 3, in which kissing or caressing faces takes place, lasted between 0.30 and 2 minutes.

During phase 1, the Host observed that, when meeting, *Actors and Co-Actors* share emotions and expectations, such as shyness and excitement, while observing each other.[103]

During phase 3, when Actors are kissing, Co-Actors express the importance of being able to explore the performative space: "...I enjoy seeing kissing and I felt more okay to watch since I was actively involved too, on the playing-field, I was part of the play, perceived by others around me." Video documentation shows *Co-Actors* describing their spatial involvement by for example in: "I wanted to look closer..." or: "First I felt awkward, intrusive, I wanted to get away, but didn't... But then later, I enjoyed watching, and especially at the end, when they were smiling at each other, I felt happiness."

[103] This in line with findings that social rich quality in online and distributed intimate connections, depends on the kind and quality of multi-modal features; and on the amount and social familiarity of users (Lomanowska & Guitton 2016)

In phase 5, during the dialogue, the Host observed that many participants (try to) describe their experience of empathic involvement, from the perspective of the unfamiliar interplay between direct and technically mediated, social and sensory experience. For example, a participant, stated that "I do not have words for this, but I could feel their kiss, I felt harmony". His befriended Co-Actor told the Host: "Sound and image disappeared; I immersed in this kiss. I know the kissing Actors personally; I could feel the touch and I imagine how it felt." Another *Co-Actor* told the Host that she felt the kiss was passionate: "It was beautiful and yes I was into it. But when I closed my eyes afterwards, I felt their kiss was mine!" Video documentation shows a Co-Actor describing: "Ich hatte das Gefühl es war weniger auf die personen, euch," (pointing at the Actors) "sondern als die Intimitat an sich. (...) Ein großes Glück." (I had the feeling that this was not so much about these persons, them, (pointing at the Co-Actors) but more about feeling of intimacy as such. (...) A great happiness.).

Other video documentation shows *Actors* expressing excitement about the ambiguous interplay in which private and public experience is merged through sound. For example, an Actor expressed: "It felt like a little sound pet. To me it was interesting to hear the sound patterns changing, so one time I shortly opened my eyes, and I saw you walking around" (pointing at to the Co-Actor), "this was not disturbing at all, but the sound changed....We created music". The Host observed that others expressed a more ambiguous reaction to the interplay of kissing and sound, for example an Actor explained: "I was closing my eyes when kissing so the sound was a sort of nice background music to it.". Another Actor responded to the sonic interplay with: "Yes, like water, makes a feeling (....) makes you feel comfortable. I didn't feel she was a witness, so it was very nice."

Actors expressed to the Host varying degrees of connection with Co-Actors. For example, one Actors expressed to the Host: "I forgot everything around me", while her partner told the Host: "I felt everyone around me". Video documentation shows Actors expressing their connections with Co-Actors, in detail, for example in: "It was more a kiss that, for me, energetically goes outside myself, not just to her" (pointing at the person he kissed with) "but in an omnidirectional way. It was like two layers of different wave frequencies. There were two waves, they" (pointing at the Co-Actors) "were in the first wave, and then there was a next wave of the people around. And I was feeling all the people around."

9.3.2 Results ASL6 'Intimacy Agents' (2020)

The ASL6 'Intimacy Agents' took place online at Nowhere.com[104], a virtual meeting place for participants who are visible to each other in nonagons, real- time. The nonagons are small frames that present a live feed of participants. Nowhere.com is a unique 3D environment (accessible from most browsers) in which visitors can move fluidly as in a real venue, chat and attend artistic live events. The ASL2 was presented in the context of the performance art series Edgecut[105], in partnership with New York Live Arts, to explore aspects of 'liveness' inside the 3D virtual platform. The streaming technology allowed a maximum of 25 people to simultaneously attend.

Duration of all Performative Phases of the Performance Script lasted approximately 25 minutes. In the ASL6, duration of the Performative Phases from 1a to 5 lasted between 5 and 10 minutes. Duration of phase 3, in which kissing takes place, lasted between 0.30 and 2.00 minutes. The whole event has been documented on video.

9.3.2.1 Results ASL6

In phase 1 of the script, Co-kissers moved and chatted, and introduced themselves to each other, while they could see each other's co-present nonagons moving through the space, and partly see each other's faces. During phase 3 of the script, Co-Actors move a little bit to avoid others to be in their way while watching, looking closer in the own camera, or moving closer in the virtual space.

During phase 5 of the script, the dialogue (that was announced at the beginning), took place in the Main Space (section **9.2.2.c**); where at the beginning all Actors and Co-Actors had gathered, and from where the data-visualization had been visible to all Co-Actors on the big screen. Most Co-Actors stayed for the dialogue. The question posed by the Actors (the artists) "Did you feel part of our kiss?" was asked previous to the kissing in Phase 1, and was asked again at the start of the dialogue (Phase 5). In response, Co-Actors expressed involvement and imagination in the interplay, between direct and technically mediated, social and sensory experience, for example: "I looked at the visualities, your embodied sensuality, between the two of you, in relation to the visual EEG forms, and to the heartbeat sound.... at how the beat changed the shape of the spiral." A second Co-Actaor added "Were the hearbeat data also related to the sound of the brain? It sounded like water...".

[104] Nowhere.com: https://www.urnowhere.com/

[105] Edgecut : https://www.edgecut.org/about, https://www.edgecut.org/sanity

Often, the sound of heartbeats was expressed as being an important connecting element, for example in: “The heartbeat was so nice, I identified with it.” The Actors asked: “Did you feel more ‘proximate’, more close?”, on which two Co-Actors responded “Yes!” at the same time, one of them continuing: “I felt the heartbeat drowned out every-thing else, the sound noise made my attention”. Another Co-Actor expressed that “The heartbeat brought me IN my body, this embodied sound worked for me to give a strong feeling of connecting online.”

One of the Actors remarks included: “It felt like others were present in our kiss, but not in a personal way. I liked the feeling. The heartbeat made our kiss less personal, yet bigger. At some point I needed to pay attention to your lips, they felt in a way fragmented in the total interplay.”, to which the other Actor responded: “I felt the same: at some point, I decided to pay attention to your lips as specifically touchable, although not ‘fragmented’.”

A feeling of liveness, of unexpectedness and unpredictability was expressed by a Co-Actor: “I was overwhelmed by the impact of the intimacy of you actually kissing. I was not expecting this, especially the first time.“ An Actor expressed that “It was weird looking the Co-Actors in the eyes after kissing, I could see them watching close to their camera’s, often smiling… curious and concentrated. I was happy though to have met all prior to the performance, being sure they were there, live, when we kissed with our eyes closed.”

9.3.3 Discussion ASL5 and ASL6

ASL 5 and 6 explore whether shared embodied experience of touching and being touched, vital to experience of empathy in intimate connections, can be designed through Multi-BCI.

Both orchestrations, in both physical and online settings, show that such experience can be facilitated through multi-BCI. Often, participants responses indicate an immersed, shared embodied experience and a sense of 'being part of the kiss'. These responses, that relate to the experience of social and sensory 'interplay', in a shared space, are focus to the results below. *Note*, that this discussion only shows new insights, in comparison to ASL4.

In the hybrid orchestration of ASL5, participants need to be introduced to each other directly, while the performative phases are explained, as part of the performance script. Embodied involvement requires all participants to realize a shared, data composition based on biofeedback interaction real-time, which in ASL5 includes spontaneous Multi-BCI brain-activity recordings of perceiving intimate social touch. This shared datafication must provide recognized visual personal feedback. In ASL6, online connections benefit from Co-Actors contributing with an 'embodied sound', for example the sound of a heartbeat.

In both orchestrations, for Actors, it is essential to have autonomy about their movements and the duration of the performativity of kissing, while for Co-Actors, it is vital to have autonomy to move around in the physical (or virtual) shared space.

Orchestration of simultaneous, shared embodied experience enables 'shared reflection' on the social touch experience as an embodied experience, between Actors and Co-Actors (different to ASL4, facilitating 'staged reflection'. Shared reflection requires that all (Co-)Actors' involvement in:

1) the performative phases of hosted 'concentration' and 'memorizing' (with eyes closed), on the experience of interplay, before and after the moment of touch; and
2) a hosted dialogue on the embodied experience, taking place in the shared space, as part of the performative script.

9.4 Conclusion ASL5 and ASL6; Current and Future Research.

Can empathy be shared through online Multi-Brain Computer Interfaces? This section presents two performance scripts for artistic orchestrations of shared empathic interaction. Both scripts explore a shared space, a data-scape emerging from spontaneous Multi-BCI brain-activity recordings of perceiving intimate social touch connections. The first orchestration focusses on multi-BCI in physical co-presence, the second on interaction via virtual, online platforms.

The orchestrations, based on performance scripts, have shown that empathetic interaction can emerge from 1) embodied experience, of a sensory, social and technological interplay, based on affective touch gestures and shared, emergent, partly predictable (motor) data interaction; and 2) hosted, shared cognitive reflection *on* the embodied experience, in

the same space.

In the ASL5 hybrid orchestration, firstly, the embodied involvement requires all participants to contribute to a shared, emergent datafication simultaneously, emerging from spontaneous Multi-BCI brain-activity recordings. Secondly, they need to be introduced to each other directly, while the performative phases are explained. Actors need autonomy of movement and duration of the performative phase of kissing, while Co-Actors, need autonomy to move around in the physical space.

In the ASL6 *online* orchestration, connections benefit from Co-Actors contributing with an 'embodied sound', for example the sound of a heartbeat.
In both orchestrations, recognized personal feedback from the datafication is essential.

Shared reflection on the shared embodied experience, in the same space, between both Actors and Co-Actors is essential. Such shared reflection requires performative phases of 'concentration' and 'memorizing' (with eyes closed), on the experience of interplay, for all participants present.

One of the main foci of future research concerns the potential of multi-BCI orchestrations for self-hosted, shared reflection in online environments.

9.5 Conclusion ASL5 and ASL6, in relation to the CITYO Interaction Model

These orchestrations provide insights in relation to the use of the CITYO Interaction Model (in addition to ASL4).

1. Sensory Disruption Design, with reciprocal haptic influence in empathic interplay.

- Vital are emergent, shared data compositions of biofeedback interaction by Actors and Co-Actors;
- that are spontaneously emerging, partly unpredictable, with individual feedback signalling.
- Vital is autonomy, for Actors in respect to movement and duration of touch gestures, and for Co-Actors, in respect to spatial movement, and
- introduction among Actors and Co-Actors.
- Online participation is enhanced by embodied sound, such as heartbeats.
- Compared to ASL4, individual appropriation of data after the performativity, is less vital.

2. Shared Reflection Design.

- Focus on the shared embodied experience, between Actors and Co-Actors,
- taking place in the same shared performative space: with performative phases of 'concentration' and 'memory building' (with eyes closed), for all participants present.

10 Discussion on Findings and Insights from the ASLs, in relation to the CITYO Interaction Model

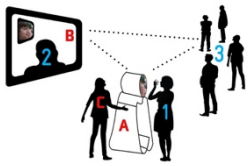
This chapter formulates findings and insights on the basis of the ASL orchestrations (chapter 4-9) for shared embodied intimate experience of technically mediated social touch, for multiple participants. These orchestrations are analysed to explore the question **QR3, whether the interaction model can be used, 1) to describe and analyse and 2) artistically orchestrate shared embodied intimate experience of mediated social touch for multiple participants, and how.**

Section 10.1 presents an overview of the ASL orchestrations, with specific characteristics of each ASL in relation to the interaction model. An additional Table that depicts correlations is presented in Appendix (1). Section 10.2 presents a summary of the findings and insights found in the ASL orchestrations. The findings are ingredients for the discussion in section 10.3.

10.1 Overview of ASL orchestrations and CITYO interaction models

This section presents an overview of the ASL orchestrations, with specific characteristics of each ASL in relation to the interaction model. Included characteristics are:

a) Physical affective touch gesture
b) Sensory Disruption: visuo-haptic motor interaction
c) Visual connections: Mirror-perception, visibility of touch and emotional (facial/touch) expression
d) Co-Actors response
e) Shared reflection, hosted

a) Physical affective Touch gesture	Self-caress (face)	1 Person
b) Sensory Disruption: Visuo-haptic motor data interaction	Direct Touch >	>Data-visualization
c) Visual connections	Direct mutual visible connection	
d) Co-Actors response	Non-Simultaneous	Potential Self-caress (face)
e) Shared reflection	Human Hosting Non-Human and participant Hosting	Staged Dialogue
ASL1: Saving Face (2012-2015), Chapter 5		

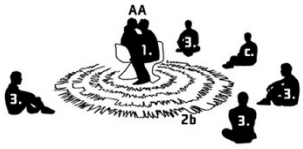
ASL1 explores the question: 'Can shared experience and dialogue on social touch be orchestrated in playful smart public spaces?'. Disruption ('Virtual Persona') uses Face-recognition and merging technologies, in a hybrid shared space. *In addition*, the need for human hosting is explored, and whether non-human hosting can be applied.

a) Physical affective Touch gesture	Self-caress (face)	2 Persons
b) Sensory Disruption: Visuo-haptic motor data interaction	Direct Touch >	> data-visualization
c) Visual connections	Mediated mutual visible connection	
d) Co-Actors response	Simultaneous and Non-Simultaneous	Co-Caress (screen) Potential Self-caress (face)
e) Shared reflection	Non-Human and participant Hosting	Shared among all
ASL2: Touch My Touch (2021) Chapter 6		

ASL2 explores the question: 'Can shared intimate experience of social touch be orchestrated for online connections?'. Disruption ('Virtual Persona') uses facial recognition and merging technologies in a shared online space.

a) Physical affective Touch gesture	Self-caress (belly)	Multiple persons
b) Sensory Disruption: Visuo-haptic motor data interaction	Direct Touch>	> Data-audio-visualization
c) Visual connections	Disrupted mutual visual connection	
d) Co-Actors response	Partly Simultaneous	Caress (phone); Audio-statement; Potential Self-caress (belly)
e) Shared reflection	Human Hosting	Staged Dialogue
ASL3: **Tele_Trust** **(2009)** **Chapter 7**		

ASL3 explores the question: 'Can haptic connections through social touch be orchestrated in merging realities?'. Disruption ('DataVeil') uses wearable textile touch sensors and an intuitive interface, in a hybrid shared space.

a) Physical affective Touch gesture	Kiss	2 Persons
b) Sensory Disruption: Visuo-haptic motor data interaction	Direct Touch >	> Data-audio-visualization
c) Visual connections	Disrupted mutual visual connection	
d) Co-Actors response	Non-Simultaneous	Potential Kiss
e) Shared reflection	Human Hosting	Staged to Co-Actors
ASL4: **Digital Synaesthetic** **EEG KISS (2016),** **Chapter 8**		

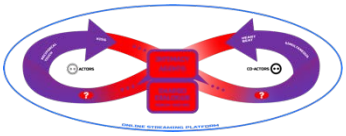
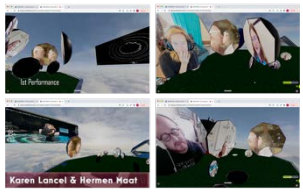
ASL4 explores the question: 'Can shared intimate experience of social touch be mediated through Multi-Brain Computer Interface (Multi-BCI) interaction in public space?'. Disruption ('EEG KISS') uses EEG, in a Brain Computer Interface (BCI); in a hybrid shared space.

- **ASL5: Kissing Data Symphony (2018), chapter 9**
- **ASL6: Intimacy Agents (2020), chapter 9**

ASL5 and ASL6 explore the question: 'Can empathy be shared through online Multi-Brain Computer Interfaces (Multi-BCI)?'.

a) Physical affective Touch gesture	Kiss	2 Persons
b) Sensory Disruption: Visuo-haptic motor data interactior	Direct Touch>	> Data-audio-visualization
c) Visual connections	Disrupted mutual visual connection	
d) Co-Actors response	Simultaneous	Co-Kiss > Data audio-visualization Potential Kiss
e) Shared reflection	Human Hosting	Shared among all
ASL5: Kissing Data Symphony (2018), Chapter 9		

ASL5: Disruption ('Kissing Data') uses EEG, in a Multi-Brain Computer interface (Multi-BCI), in a hybrid shared space.

d) Co-Actors response	Simultaneous	Mediated Heartbeat sound
ASL6: Intimacy Agents (2020) Chapter 9		

ASL6: Disruption ('Intimacy Agents') makes use of EEG data interaction via a Multi-BCI, and heartbeat sensors; in an online shared space:

10.2 Findings and Insights Found in the ASL Orchestrations

This section presents findings and insights found in the ASL orchestrations, discussed in chapters 5-9, based on analyses in line with the interaction model, including the Essential Elements (discussed below)**:** 1) Sensory Disruption (10.2.1); and 2) Shared Reflection 10.2.2.

1) **Sensory Disruption,** through ambiguous, (un)predictable, (non-)simultaneous connections, in multi-sensory multimodal synaesthetic syntheses **with Reciprocal influence, in Shared empathic vulnerable interplay,** based on:
   - Self-revealing and (un)comfortable performativity of touch gestures,
   - Response based on visual perception (for Mirror-perception; and for visibility of touch and emotional (facial/touch) expression)
2) **Shared Reflection,** on experience, through Socially and technically Hosting verbal and/or visual communication.

10.2.1 Sensory Disruption

This section focusses on the question whether design of **Sensory Disruption** can provide shared embodied intimate experience of technically mediated social touch for multiple participants; based on the characteristics (section 10.1):

a) Physical affective touch gesture
b) Sensory Disruption: visuo-haptic motor interaction
c) Visual connections: Mirror-perception, visibility of touch and emotional (facial/touch) expression
d) Co-Actors response

Findings and insights are that:

(a) Physical Affective touch gestures.

a.1 *Design of Touch Gesture Performativity:*

- Experience of *reciprocally* touching and being touched can either be performed by *two persons* touching each other; (ASL2,4,5,6) or through *acts of self-touch* (ASL1).
- The self-revealing touch gestures can either be performed *individually* (ASL1,3); or by *multiple persons* 'revealing an intimate bond', for example through kissing (ALS4,5,6).
- A *vulnerable* sense of self-revealing through affective touch is dramatically intensified, if performed and exposed in public space. The public space context enhances a sense of putting *embodied comfort at risk* (ASL1,3,4,5,6); especially in public city spaces (ASL1,3).

a.2 *Location of touch on the body*:

- Until recently, research into visuo-haptic motor data feedback loops have mainly focussed on touching body locations of the arm, the hand (by among others Cre 2016; Ijsselsteijn et al. 2006; Huisman 2016) and the face (Tajadura-Jeminez et al. 2012), discussed by Jewitt et al. (2020b, p.3). This thesis shows that this approach can be extended. Analyses of the orchestrations show that different places on the body can be stimulated to evoke visuo-haptic motor data interaction, including *(self-)touch gestures on the belly* (ASL3); and *reciprocally kissing* (ASL4,5,6).

(b) Sensory Disrupted Connections.

Shared multi-sensory multimodal synaesthetic syntheses of touch perception can be established by **sensory connections** that **partly replace each other**, including:

- Physical experience of *touch* can be partly replaced by shared *vicarious interaction* (all ASLs);
- enhanced by *sonic* motor data interaction (ALS4,5,6).
- In online interaction*,* physical experience of *touch* can be partly replaced by *shared visibility,* of synchronizing *(self-)touch* gestures with data-visualization on a screen (all ASLs); and mutual visibility of participants (sometimes resulting in perceived body ownership transfer (ASL2)).
- In online interaction, an individual body centered response to *mirror perception* of touch is enhanced by *data-sonification* of **'**Embodied sounds' (f.e. a heartbeats (ASL6)).

(c) Visual connections.

Mutual visibility of emotional facial expressions can be **partly replaced** by shared sonic motor interaction of affective touch gestures (ASL3,4,5,6).

- *Witnessing of the touch interaction by others* can partly replace *Individual visibility of the visuo-haptic motor data interaction* (crucial to body-ownership) (ASL4,5,6); enhanced in case of 3.1.

(d) Co-Actors response in shared visuo-haptic motor data interaction requires:

d.1 Appropriation of Shared motor data interaction ('Shared Data Compositions') in relation to experience of affective touch movements; requiring **individual data signalling**[106], through for example:

- A shared data scape of a kiss ('Shared portrait of a kiss') that provides *individual* EEG sequence lines (ASL4,5,6);
- A shared merging portrait that provides *partly identifiable* components (ASL1,2);
- A public accessible repository that randomly exposes and combines previously shared self-portraits and statements, that includes *individual identifiable* statements/portraits (ASL3).

d.2 Unpredictable Datafication Components stimulate shared reflection (discussed in section 10.2.2*).*

The unpredictable process can be implemented in the interaction model, on the positions of 'Mirror-Perception' (ASL4,5,6); and/or 'Perceived Response' (ASL1,2,3);
combined with real-time and/or previously produced *predictable* data (ASL1,2).

d.3 Simultaneous reciprocal influence leads to '*Shared* embodied intimate experience' of affective touch; for two Actors (ASL2,4) or for Actors *and* Co-Actors (ASL3,5,6). Requirements are that:

- Autonomy for Actors include choice of touching behavior and duration (all ASLs); and
- for Co-Actors freedom of spatial movement (ASL5,6) and
- choice for duration and participation as Actors (all ASLs).
- Participants must connect at the beginning of the touching interaction; and share all the script's performative phases.
- *Non-simultaneous* reciprocal influence leads to shared embodied experience for Actors, but limits such experience for Co-Actors (ASL1).

d.4 Design of **Physical Affective touch gestures,** discussed in **(a).**

[106] These findings are based on design that respects privacy considerations described in chapter 4.3.1. *Note,* that the theme of 'privacy' is not the subject of this thesis and is not discussed in findings and insights (section 4.3.1).

10.2.2 Shared Reflection

This section focusses on the question whether Shared Reflection, *on the perceived shared embodied experience*, can be orchestrated for multiple participants, through *shared* visuo-haptic motor data interaction of affective touch gestures. Based on the characteristic in section 10.1:

e) Shared reflection, hosted

findings and insights are that:

e) Hosting

Shared Reflection on shared embodied experience requires **hosting a dialogue.**

- The dialogue can be either shared among all participants (*Shared Dialogue* (ASL2,5,6)), or staged by Actors to Co-Actors (*Staged Dialogue* (ASL1,3,4)).
    - A *Shared Dialogue* among all participants requires design of *simultaneous* reciprocal influence (through touch gestures and haptic response).
    - *Non-simultaneous* reciprocal influence necessitates a *Staged Dialogue***.**
- *Reflection on embodied experience* requires Concentration (ASL1,3,4,5,6) that needs to be hosted (All ASLs). Concentration and memory-building on the shared experience (all ASLs), including personal appropriation of data (ASL1,4,5,6) and data-interpretation (ASL1,4,5,6), can be supported by Performative Phases in the performance script (ASL1,3,4,5,6).
- *Hosted Shared Reflection* and shared storytelling supports continuous involvement for all participants (ASL1,4,5,6).

f) Human and Non-Human Hosting

Human Hosting can be **partly replaced** by **participant hosting and non-human hosting**; however with limiting effect on the concentration and dialogue.

- *Non-human Hosting* can only partly support the rules of play (f.e. through video-documentation (ASL1,2,4,5,6); and dialogue (f.e. example through questionnaires in the shared space (ASL1,2)).
- In all cases, in different cultures, hosting needs to be adapted to different dynamics in individual or joint exploration.

10.3 Discussion on Findings and Insights

The CITYO interaction model has been used to describe and analyse, and orchestrate, shared intimate experience of technically mediated social touch for multiple participants, in six artistic orchestrations, 'Artistic Social Labs' (ASL), analysed in chapters 5-9. Findings and insights include that:

1. Sensory Disruption.

Physical social touch gestures can be shared in multi-sensory multi-modal connections, based on:

- **Physical touch connections,** that are **partly replaced by other sensory connections**, in interdependent configurations, including:
  a) **shared visibility**, of visuo-haptic motor data interaction (for shared (vicarious) mirror perception of touch gestures and datafication; and of emotional expression; enhanced by:
  b) **sonification**;
  c) **synchronous touch performance** between multiple participants.
  d) Reciprocal touch can be (partially) **replaced** by Self-touch.
- **Sensory Reciprocal Influence** can be established in **shared visuo-haptic motor data compositions** *('Shared Data Compositions')*, **co-created by all participants**.
  Simultaneous reciprocal influence is essential to a sense of *shared embodied* experience (which is limited in case of **Non-Simultaneous** influence).
- **Unpredictable** datafication components stimulate shared reflection; and supports shared storytelling and personal data interpretation.
- **Appropriation** of **shared motor data interaction** in relation to experience of affective touch movements, requires **individual data signalling**.[107]

Reciprocal influence in vulnerable, empathic interplay must include the **design of physical affective touch performativity**, through:

- individual acts of **self-touch**, or of **multiple persons touching each other.**
- **Self-revealing** touch gestures, for **individuals** (f.e. through self-caressing) or **multiple persons** ('revealing an intimate bond' (f.e. hugging, kissing), and:
- **A shared sense of vulnerability** to the response of others, safeguarded through hosting.
- **Autonomy** of choice for participation (involvement, duration, movement behaviour).

2. Shared Reflection.

Shared Reflection must be **hosted**, through dialogue *on* the shared embodied experience.

- This can take place through either a **Shared Dialogue**, shared among all participants; or a **Staged Dialogue**, staged by Actors to Co-Actors; created in mutually shared processes of memory building, imagination and storytelling, about the shared experience that includes appropriation of data and data-interpretation.
- Human Hosting can be partly replaced by **participant hosting** and **non-human hosting;** however with limiting effect on the concentration and dialogue.
- Hosting needs to be adapted to different (cultural) dynamics, in individual or joint exploration.

[107] These findings are based on design that respects privacy considerations described in chapter 4.3.1. *Note,* that the theme of 'privacy' is not the subject of this thesis and is not discussed in findings and insights (section 4.3.1).

Part 4

Part 4 includes **Chapter 11,** presenting a General Discussion and Conclusion.
The results in relation to all initial research questions posed are discussed, the implications of findings for the use of the interaction model, and directions for future work.

Three **Appendices** present 'Artificial Intelligent (AI) Aspects of the ASLs' (Appendix 1); ;Correlations between characteristics' of the ASLs (Appendix 2) and 'Credits' for collaboration in research, development and presentation (Appendix 3).
This is followed by a **Synopsis** of this thesis, and **References.**

11 General Discussion and Conclusion

The central question of this thesis "Can shared embodied intimate experience of technically mediated social touch be orchestrated for multiple participants?" has been explored on the basis of four sub-questions, summarized in the following sections:

- **Section 11.1** answers the sub-question (1): "Which characteristics are essential to shared embodied intimate experience of technically mediated social touch, for multiple participants?". The literature explored in chapter 2 identified the characteristics and the knowledge gap.
- On the basis of these characteristics and the knowledge gap, **section 11.2** answers the sub-question (2): "Can an interaction model for shared embodied intimate experience of technically mediated social touch, for multiple participants, be designed, and how?", explored in chapter 3. An interaction model is presented, and the different characteristics explained.
- **Section 11.3** answers the sub-question (3) "Can this interaction model be used, a) to describe and analyse, and b) to artistically orchestrate, shared embodied intimate experience of technically mediated social touch, for multiple participants, and how?", explored in chapters 4-9.
- **Section 11.4** answers the sub-question (4): "Can design findings and insights be formulated on the basis of these studies, for the use of the interaction model for shared embodied intimate experience of technically mediated social touch, for multiple participants?" explored in chapter 10.
- This is followed by the Conclusion **(11.5)**, Discussion **(11.6)** and Future Research **(11.7)**.

This thesis shows the importance for new performance scripts for shared embodied intimate experience of *technically mediated* social touch for multiple participants, defined in this thesis as **Shared Social Touch**. It argues that shared experience, of technically mediated social touch, can be based on orchestration of Sensory Disruption (of reciprocal, physical touching and being touched, in shared empathic vulnerable interplay), combined with Shared Reflection (that is socially and technically hosted) on the experience.

To support this argument, this thesis presents a prescriptive and descriptive CITYO Interaction Model. In line with this model, six participatory artistic orchestrations and performance scripts for multi-sensory, multi-modal interaction have been created by artists Lancel and Maat, evaluated and analysed. These orchestrations are called **'Artistic Social Labs' (ASL),** in which participants are 'co-researchers'. They participate in *mutual creation of social touch experience,* through caressing, kissing, and embracing each other.

The ASLs introduce a new design approach to perception of Shared Social Touch experience,

that is based on perceptual multi-sensory sensory syntheses in shared visuo-haptic motor data interaction. The interfaces are based on artistically created intimate technologies, that are placed outside, on and inside the body (van Est 2014); including facial recognition technologies, haptics interfaces for smart textiles and phone apps; and brain computer interfaces. The ASLs have been presented internationally in different social cultures and geographical contexts, in sensory and social configurations for hybrid and online shared spaces.

The fundamental research in this thesis, that has led to the new CITYO Interaction Model for social touch, are of importance to **Art, HCI Design** and **Science**.
The inter-disciplinary approach of this thesis combines:

a) Interactive Media Performance Art that explores awareness of shared experience of sensory disruption and reflection in intimate connections and kinship with (non-)human others (Haraway 2020), through the creation of 'intercorporeal' (Merleau Ponty 1962) digital systems in different hybrid social and spatial configurations (Hansen 2012, Paterson 2007).

b) HCI Design perspectives, that put *human experience* centre stage for value sensitive design, of social touch as a mutual form of creation, including ethical values (of vulnerability, inclusiveness, autonomy, trust (Jewitt et al. 2020a).

c) Scientific insights into empathy, intimate experience, perceived body ownership and social touch, in artificial neural and complex multi-actor networks.

1) The novel *artistic* approach to *Design of Sensory Disruption,* in this thesis, presents a new perspective on the concept of 'intercorporeality' (Merleau-Ponty 1962). In this approach, perception of touch *on the body, in the brain* and *in the shared imagination* (comparable but not the same as perceptual concepts of "emotion", "feeling" and "feeling a feeling" (Damasio 1999) are disrupted and synthesized, into *shared synaesthetic sensory connections, that partly replace each other,* in ambiguous configurations, for multiple participants.

2) The novel perspective on HCI design of technically mediated social touch experience builds on neuroscientific research**,** into *individual* visuo-haptic motor data interaction (through social touch), with *fluid* integration of technology, that leads to immersive body ownership perception (Ijsselsteijn et al. 2006, Huisman 2013)).

This research is extended to a novel a*rtistic* approach to *shared* social touch experience, based on aesthetic principles of *ambiguous interaction,* to enable *immersive and conscious perception of body-ownership,* as a new form shared empathic interaction.
This artistic approach includes the philosophical perspective of "*Phenomenology of perception"* (Merleau-Ponty 1962), for the orchestration of 'disruption' and 'ambiguity' as Aesthetic principles of interaction (Kwastek 2013), to facilitate *shared* embodied experience and *shared* reflection.

3) The novel *CITYO Interaction Model* puts Sensory Disruption and Shared Reflection central stage to facilitate a *sense of shared body ownership,* in distributed, hybrid, XR, online and human–agent interaction; in private and public domains digital domains (Mcquire 2008a). It extends the notion of empathic spectatorship (Freedberg & Gallese 2007) into a mutual creative act of social touch interaction (Jewitt et al. 2021), to support new perspectives on the design of emotional well-being (including social connection, disconnection, and isolation (e.g. through trauma, dementia, depression); and autism).

11.1 QR 1: "Which characteristics are essential to shared embodied intimate experience of social touch for multiple participants?"

Section 11.1 answers the sub-question (1): "Which characteristics are essential to shared embodied intimate experience of mediated social touch for multiple participants?". The literature explored in chapter 2 identified the characteristics presented in table 2.3.3.3, summarized below.

Essential characteristics of orchestration of mediated social touch for multiple participants are shown to include two elements: 1) Sensory disruption of touching and being touched, with Reciprocal influence on each other's actions in Shared empathic vulnerable interplay; combined with 2) Shared reflection on experience, through hosting socially and technically mediated communication.

The literature shows that the combination of these two elements in performance scripts for shared mediated social touch, for multiple participants, has not been explored.

Characteristics of:

Shared embodied intimate experience of mediated social touch interaction for multiple participants', based on the literature.

1. **Sensory Disruption of Physically touching and being touched,** through:
   - Visuo-haptic motor data interaction
   - in a Technically mediated shared space
   - Visual perception: Mirror-perception and Emotional (facial, touch) expression.
   - Ambiguous, predictable *and* unpredictable connections, in multi-sensory multi-modal synaesthetic syntheses.

   with Reciprocal influence on each other's actions,
   in Shared empathic vulnerable interplay, through:
   - Self-revealing, affective touch gestures and response
   - in Ambiguous, (un)comfortable connections
   - Potential or actual participation for all participants

2. **Shared Reflection**
   On experience, through:
   - Socially and Technically Hosting mediated verbal and/or visual communication

11.2 QR 2: "Can an interaction model for shared intimate experience be designed, to orchestrate technically mediated social touch for multiple participants and how?"

To answer QR2, an interaction model 'Can I Touch you Online?' (CITYO) has been presented in chapter 3 (Fig. 5). The model is based on characteristics for shared embodied intimate experience of technically mediated social touch, for multiple participants, discussed in the literature in chapter 2. This section presents the interaction model, including a Legenda (**Fig. 51b**) and Description of Legenda (**Fig. 51a**).

Description of Legenda: The CITYO interaction model for Shared Social Touch

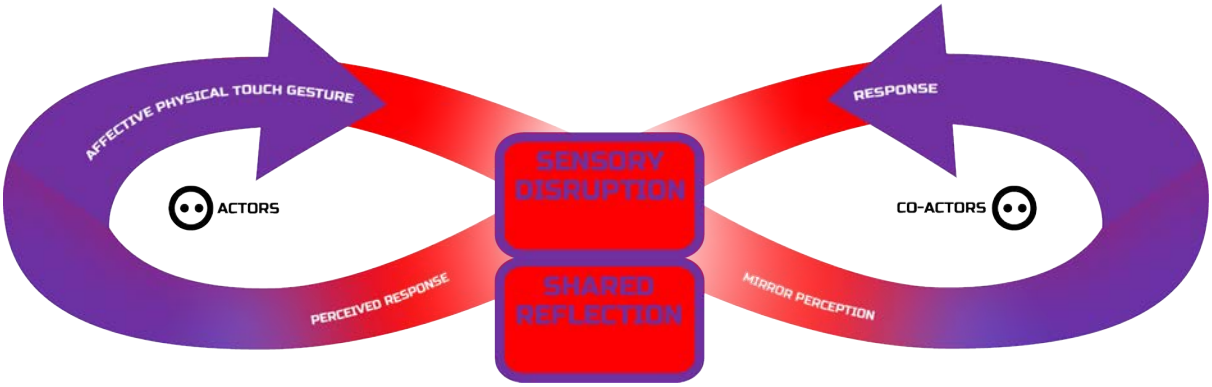
- The interaction model's **Shared Spaces** are depicted by the **infinity symbol**, facilitating multi-actor reciprocal connections in hybrid configurations; including
- **Remote Connections /Online Streaming Platform** depicted by a ***Blue Circle***.

- Participants are **Actor** (active participant) or **Co-Actor (**spectator/less active participant).
- Direct, technically mediated or no (facial) **Visual perception** between Actors and Co-Actors is depicted by ***Pictograms of faces*** and can be differently combined.
- Actors perform **Affective Physical Reciprocal Touch Gestures**.
- Co-Actors perform **Potential** participation, or actual **Co-**participation.

- **SENSORY DISRUPTION** facilitates visuo-haptic motor data interaction, transferred to multi-sensory, multimodal syntheses, including **Mediated Visual Perception**; and **Sonic Perception.**
- Datafication of touch gestures and responses exist of:
  - Predictable *and* **Unpredictable** datafication depicted by a ***Question mark* (?),**
  - in (**Simultaneous** and/or **Non-simultaneous**) reciprocal influence.

- **SHARED REFLECTION** on experience exists of socially and technically **Hosted** verbal and/or visual communication**.**

Fig. 51a: Description of Legenda, of Interaction model 'Can I Touch You Online?' (CITYO).



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The CITYO Interaction Model for Shared Social Touch is based on:

1) **Sensory Disruption** of touching and being touched, with Reciprocal influence in Shared empathic vulnerable interplay.
2) **Shared Reflection** on experience, through Socially and technically Hosted verbal and/or visual communication.

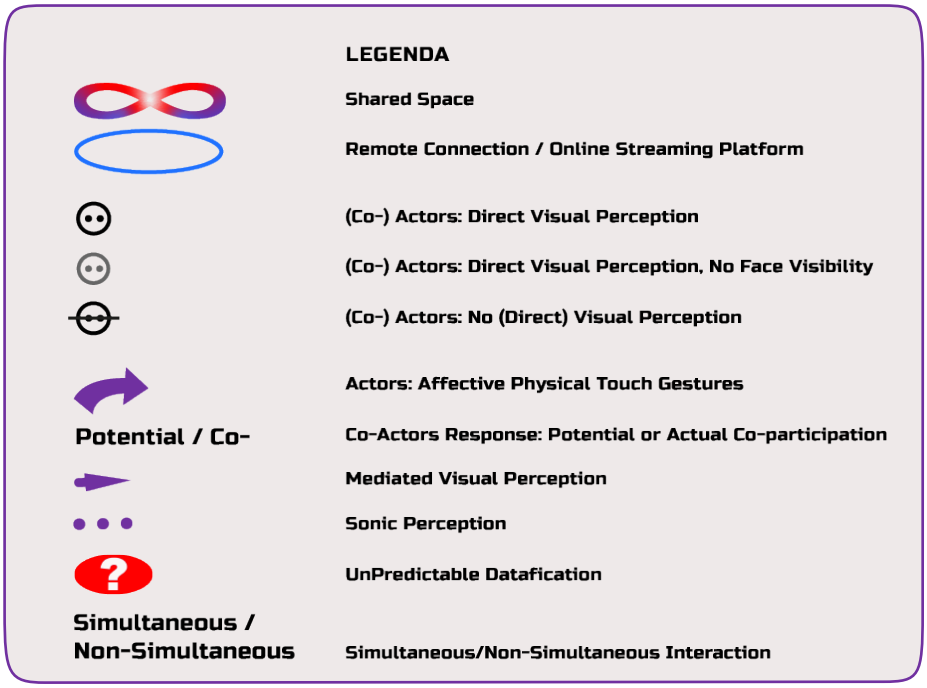


Fig. 51b: Interaction model 'Can I Touch You Online?' (CITYO) for Shared Social Touch and Legenda.

11.3 QR3: "Can this interaction model be used, a) to describe and analyse, and b) to artistically orchestrate shared embodied intimate experience of technically mediated social touch for multiple participants, and how?"

The CITYO Interaction Model for Shared Social Touch has been used to describe and analyse, and orchestrate, shared intimate experience of mediated social touch, for multiple participants, in six artistic orchestrations, 'Artistic Social Labs' (ASL), described in chapters 4-9. Each ASL orchestration is based on a unique social and sensory interaction design. Different technologies have been applied, including face-recognition and merging technologies (ASL1,2); brain computer interface (ASL4,5,6); streaming online platforms (ASL2,6); smart textiles; haptic sensors; phone app (ASL3); and urbans screen networks (ASL1,3). They have been orchestrated via hybrid (ASL 1,4,5), online (ASL2,6) and distributed (ASL1,3,5,6) connections. Ethical issues (transparency, privacy, vulnerability, responsibility, and trust) are subject to the ASL designs.

In respond to QR 3, this section presents the result, that:

Shared embodied intimate experience
of technically mediated social touch interaction, for multiple participants,
can be supported by the design of:

1) **Sensory Disruption**
   of touching and being touched,
   with Reciprocal influence in Shared empathic vulnerable interplay.

2) **Shared Reflection**
   on experience, through Socially and technically Hosted
   verbal and/or visual communication.

as part of the performance script.

11.4 QR4: "Can findings and insights be formulated, on the basis of these studies, for the design of shared intimate experience of technically mediated social touch for multiple participants?"

This section concludes this thesis by presenting and discussing insights and findings, emerged from the analyses in line with the interaction model, presented in chapter 10; followed by discussion, and directions for future work.

The first question central to the analyses has been whether: **1**) **Sensory Disruption, with Reciprocal influence, in Empathic vulnerable interplay** can be orchestrated, through shared, ambiguous neuro feedback data interaction of affective gestures, for multiple participants.

The second question has been whether: **2) Shared Reflection** can be orchestrated through 'hosting'. The different conditions of the interaction model, in interplay, have been discussed, presented below. Findings and insights are that shared intimate embodied experience of mediated social touch for multiple participants, can be established through shared, ambiguous, visuo-haptic neuro feedback data interaction of affective gestures, and hosted shared reflection on experience. Extending insights on the use of the CITYO Interaction Model for Shared Social Touch are described below, and depicted in **Fig. 52.**

Extending insights on the use of the CITYO Interaction Model for Shared Social Touch:

1. Shared data interaction must lead to:

- **Shared Data Compositions**
  - with individual data feedback signalling,
  - sensory connections that partly replace each other,
  - preferably with *Simultaneous* reciprocal influence.
  - Reciprocal touch gestures can be (partially) replaced by self-touch gestures.
- Performativity must be characterized by autonomy,
  - shared social and physical vulnerability,
  - in interdependent configurations.

2. Shared Reflection on *the shared embodied experience* must take place through:

- **Hosted, Staged or Shared Dialogue**, with a focus on:
  - Empathic connections (based on memory, imagination, storytelling).
  - Personal appropriation of data and data-interpretation.

11.5 Conclusion

This thesis explores future, potential artificial design for empathy, intercorporeal connections and social touch. It is driven by the need to recompose awareness of shared embodied experience and empathy in intimate connections and in kinship with human and non-human entities. To this purpose, routes of empathy have been artificially facilitated for multiple participants in different hybrid social and spatial configurations, through mutual creation of social touch experience.

In response to the main question: "Can shared embodied intimate experience of technically mediated social touch be orchestrated for multiple participants?", this thesis concludes positively, given that

1) Sensory Disruption, with Reciprocal influence on each other's actions, in Shared empathic, vulnerable interplay, and
2) Shared reflection, are part of the performance script.

Extending insights, on the use of the prescriptive and descriptive CITYO Interaction Model presented in this thesis, include:

a) The data interaction by participants must lead to **Shared Data Compositions,** including a) individual data feedback signalling, b) shared sensory connections that partly replace each other and preferably, *simultaneous* reciprocal influence.
b) Shared Reflection on the embodied experience must take place on the basis of **Hosted**, **Shared Dialogue** or **Staged Dialogue**. Vital to this dialogue is a focus on shared empathic connections, based on a combination of a) memory, imagination, and storytelling; and b) personal data-appropriation and data-interpretation.
c) Performativity by participants must be characterized by autonomous participation; while at the same time, a sense of shared social and physical vulnerability is vital.

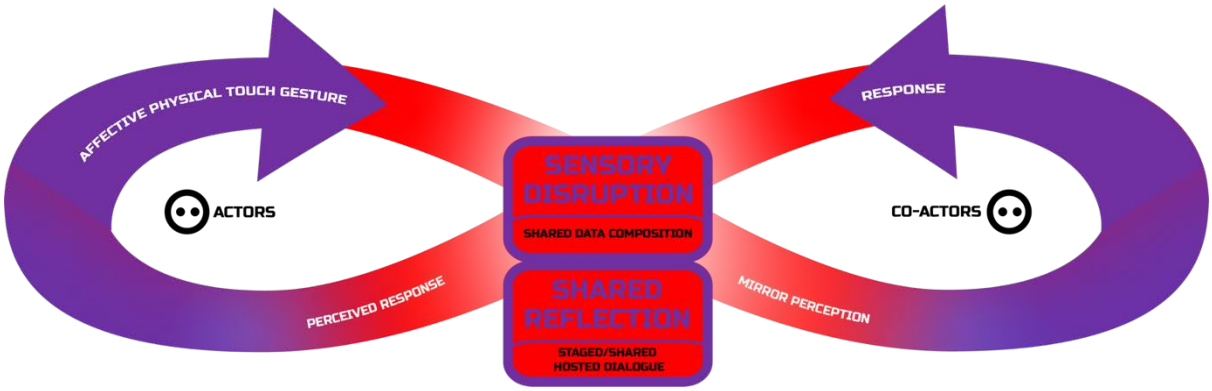
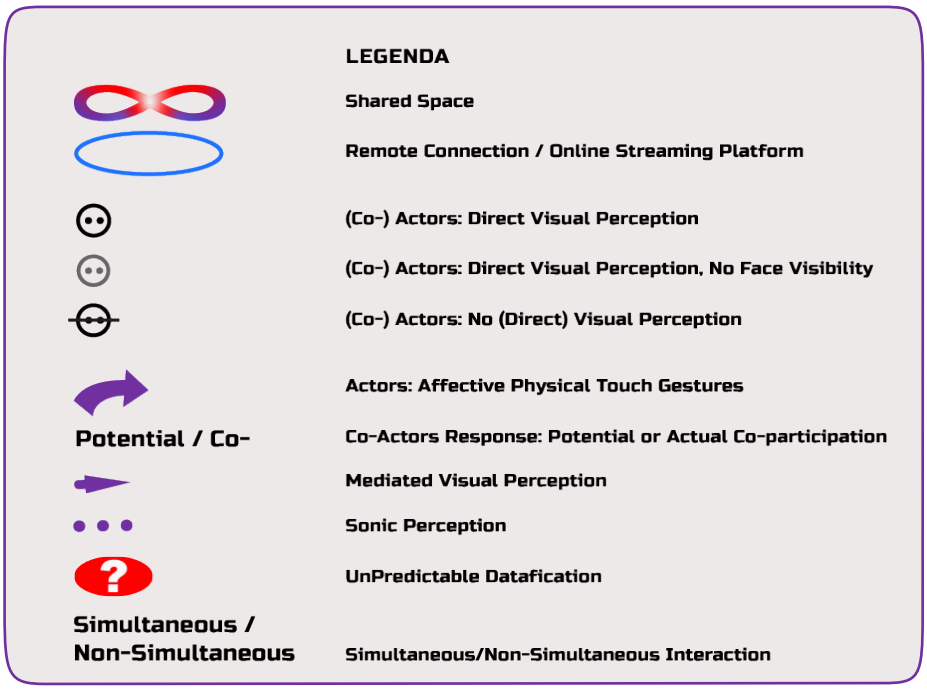


Fig. 52: CITYO Interaction Model for Shared Social touch, extended by insights on the use of the model, including: 'Shared Data Composition' and 'Staged / Shared Hosted Dialogue'.



11.6 Discussion: Limitations and Concerns

This section discusses limitations and concerns in this thesis, recognized by the author.

1) Multiple analyses of existing and emergent, artistic and scientific orchestrations, in line with the interaction model, will benefit the research. The first tests described in this thesis, however, have shown promising results.

2) Often, biofeedback data replaces trust in socially shared experience. Often, in the ASL orchestrations, presence of co-located others has seemed to enhance trust in biofeedback data, while limiting trust in each other (as discussed in ASL4,5). In these cases, participants trust data to be 'neutral'; while feeling vulnerable to the (potentially judging) human response. In contrast, in absence of co-located others, a reluctance to trust data occurs.

   Overall, as an ethical concern, this thesis found that biofeedback data of emotional states are overly trusted, which should be considered subject to value sensitive design.

11.7 Future Research

1) One of the main foci of future research concern the potential of self-hosted, shared self-reflection in online environments.

2) The design of privacy, fundamental to the ASL orchestrations (discussed in section 4.3.1) has been artistically explored in the different ASLs. However, privacy as a theme has not been subject to research analysed, and is subject to future research.

3) Questions to be studied are what quality of empathy emerges if co-present others are not human, or intelligent agents in complex systems.

   The potential of artificially evoked self-awareness, and shared (self-)reflection (essential to empathy and emerging future narratives of social touch) are to be explored. Performance of shared vulnerability, as a strength, opens possibilities for shared embodied experience in empathic interaction. Nevertheless, such design must be subject to ethical concern and sensitive design.

4) The specific different cultural implications of the interaction model have been artistically explored in the different ASLs; but have not yet been subject to research analysed. Similarly, the effects of *familiar or non-familiar others* participating are subject to future research.

5) Simultaneous, synchronous performance of touch gestures have shown to sometimes lead to transfer of perceived body-ownership.

Future research will focus on the potential of such shared performance for a sense of shared embodied experience and presence. Such approach will raise questions on the quality of empathetic connections, that not only requires a both body centred response such as of of mirror-touch (Ward 2018), but also on cognitive meaning making.

6) Design for reflection and imagination studied in this thesis (section 2.3), is partly based on 'expressive' and 'magical' interfaces (Reeves et al. 2005), with often *seemingly magical* relations between emotion, embodiment, and technology.

Future research is needed to understand the role of such 'magical' effects. Questions are, for example, the influence of seemingly magical interaction on the ethical aspects of consent and trust; and on a shared sense of agency to co-create future narratives of social touch.

7) *Intimate experience* of technically mediated social touch can be orchestrated as a form of mutual creation, or co-creation, in multi-actor networks. Part of these networks are also digital data, and data patterns, as co-actors.

Future research will focus on awareness of such orchestrations, that must function as **HyperTouching** Objects that stimulate dialogue.

APPENDIX (1)
Artificial Intelligent (AI) Aspects of the ASLs

This section presents an overview of technical Artificial Intelligent (A.I.) aspects, of ASLs 1-6. A.I. has been defined as "intelligence displayed or simulated by code (algorithms) and machines" (Coeckelbergh 2020, p.64). A.I. systems often rely on data-collection and interpretation.

This thesis focusses on AI systems in interaction with human *emotional* intelligence and *moral values* (autonomy, shared responsibility, reciprocal influence, shared empathy and trust).

It studies *intervention* in contexts of complex social-technical systems (Warnier 2022).

It *makes use* of emergent qualities and contexts of these systems, and the flexible character of their properties in interplay.

Basic properties of these systems are re-orchestrated into algorithms for shared interaction as a form of collective intelligence, between humans, technology, and neuro-feedback data as co-actors. Together they create shared embodied intimate experience of social touch.

The literature in this thesis has shown that such experience requires *ambiguous connections,* that can be designed through sensory disruption, for share reflection to emerge.

Design of Sensory Disruption, in the ASL's social technical A.I. systems, includes:

a) Sensor Data Collection with pattern recognition;

b) Data Interpretation of *shared,* participatory data collections,
with *disrupted* individual data identification ('Shared Data Compositions').

Overview of technical Artificial Intelligent (A.I.) aspects, of ASLs 1-6:

ASL1 - Saving Face (2012)

- **Context: Complex social technical system.** Distributed city networks (with electronic screens, cameras and face-identification sensors).
- **Intervention, through Disruption of:**
  a) **Sensor Data Collection,** with Pattern Recognition of sensor data of participants self-caressing movements enables synchronous visualization (of merged portraits) on the electronic screen.
  b) **Data Interpretation:** A.I. technology has been developed to merge multiple portraits into unpredictable, coherent portraits, based on facial elements (nose, eyes and mouth) with different shapes and skin colours. The merged portraits are collected in a public accessible, growing database.

ASL2 - Touch MY Touch (2021)

- **Context: Complex social technical system.** Streaming online social platforms (with cameras, audio connection, touch screen technologies) for humans, agents, selfies and A.I. generated personas and portraits (with face-identification sensors A.I. merging technologies). gebruik comma's.
- **Intervention, through Disruption of:**
  a) **Sensor Data Collection:** Simultaneous Pattern Recognition, of sensor data of self-caressing movements (participant 1); and synchronous movements of caressing a touch screen (participant 2); enables synchronous visualization (of a self-portrait) on the electronic screen.
  b) **Data Interpretation:** A.I. face-identification and merging technologies are used to merge two portraits into unpredictable, coherent portraits, based on facial elements (nose, eyes, and mouth) with different shapes and skin colors.

ASL3 - Tele_Trust (2009)

- **Context: Complex social technical systems.** Distributed city networks (with electronic screens, cameras, face-identification sensors, and mobile phones (apps) with touch screens); and Haptic body sensors.
- **Intervention, through Disruption of:**
  a) **Sensor Data Collection:**
  - Pattern Recognition of sensor data with which spectators' movements, of caressing a phone's touch screen, enabling synchronous visualization (of portraits) on the phone's screen, can be determined. A mobile phone app has been developed to send auditory messages to a database.
  - Pattern Recognition of sensor data of participants' movements, of caressing haptic body sensors, is used to enable audibility of the auditory messages in headsets, and synchronous visualization (of portraits with transcriptions of the auditory messages) on the electronic screen.

  b**) Shared Data Compositions:** The anonymous audio and visual data (of portraits and (transcriptions of) auditory messages) are collected in a public accessible, growing database. An algorithm *randomly* combines all audio and visual data, of actual and previous participants.

ASL4 - Digital Synaesthetic EEG KISS (2016)

- **Context: Complex social technical system.** Brain-to-brain communication between humans (and robots), (with Brain Computer Interface sensors (BCI)).
- **Intervention, through Disruption of:**
  a) **Sensor Data Collection:** Pattern recognition, of sensors of participants' spontaneous brain activity, of kissing (or caressing), for synchronous data-visualization and -sonification.
  b) **Data Interpretation:** Multiple data sequences are combined into one visualization; and sonified**.** A.I. Technology has been developed to generate sound patterns based on pre-defined combinations and averages (of both participants' brain data signals) and adaption to different performative phases (waiting, approaching, kissing); saved in a publicly accessible, growing database.

ASL5 - Kissing Data Symphony (2018)

- **Context: Complex social technical system.** Brain-to-brain communication between *multiple* humans (and robots), (with *Multi*-brain Computer Interface sensors (Multi-BCI)).
- **Intervention, through Disruption of:**
  a) **Sensor Data Collection:** Simultaneous Pattern recognition, of sensor data of participants' spontaneous brain activity, of kissing (or caressing); *and* spectators brain activity, enables synchronous data-visualization and -sonification.
  b) **Data Interpretation:** Similar to ASL4; but differently, for sensor data of participants *and* spectators.

ASL6 - Intimacy Agents (2020)

- **Context: Complex social technical system.** Streaming online social platforms (with camera, audio connection) and Biofeedback sensors (with Computer Interface sensors (BCI) and Heartbeat sensors).
- **Intervention, through Disruption of:**
  a) **Sensor Data Collection:** Simultaneous Pattern recognition, of sensor data of participants' spontaneous brain activity, of kissing (or caressing); *and* spectators spontaneous heartbeat activity, enables synchronous data visualization and -sonification.
  b) **Data Interpretation:** Similar to ASL5, but differently, for sensor data of brain and heartbeat activity.

APPENDIX (2)
Correlations between Characteristics

The table in this section presents correlations between characteristics of the ASLs presented chapters 5 -9.

TABEL Aspects Interaction Model	ASL1 Saving Face 2012	ASL2 Touch My Touch 2021	ASL3 Tele-Trust 2009	ASL4 EEG KISS 2018	ASL5 Kissing Data 2018	ASL6 Intimacy Agents 2020
Shared Space	Hybrid	Remote/online	Hybrid	Hybrid	Hybrid	Remote/online
Participants Actors *Co-Actors*	One Actor, *Multiple*	One *One*	Multiple *Multiple*	Two *Multiple*	Two Actors *Multiple*	Two Actors *Multiple*
10.1 Shared Embodied Experience						
Mutual Visual Perception	Direct	Direct, remote	Disrupted (Actor veiled)	Disrupted (Actors eyes closed)	Disrupted (Actors eyes closed)	Disrupted (Actors eyes closed)
Haptic Perception Actors *Co-Actors*	Direct, Mediated *Vicarious, Mediated*	Direct, Mediated *Vicarious, Mediated*	Direct, Mediated *Vicarious, Mediated*	Direct, Mediated *Vicarious, Mediated*	Direct, Mediated *Vicarious, Mediated*	Direct, Mediated *Vicarious, Mediated*
Visual Perception Actor *Co-Actors*	Direct, Mediated *Direct, Mediated*	Mediated *Mediated*	Direct, Mediated *Direct, Mediated*	*Direct, Mediated*	*Direct, Mediated*	*Direct, Mediated*
Audio Perception Actor *Co-Actors*	Direct *Direct*	Mediated *Mediated*	Mediated *Mediated*	Mediated *Direct, Mediated*	Mediated *Mediated*	Mediated *Mediated*
Biofeedback data transfers Actors *Co-Actors*	Haptic > Visual	Haptic > Visual	Direct Haptic > Audio-Visual *Direct Audio > Audio-visual*	Direct Haptic > Audio-Visual	Direct Haptic > Audio-Visual *Vicarious Haptic Audio-Visual*	Haptic > Audio-Visual *Heartbeat > Audio*
10.2 Reciprocal Influence						
10.2.1: Touch Performance						
Affective Gestures Actors *Co-Actors* *Vicarious Touch*	Self-touch (Caress)	Self-touch (Caress) *Synchronized Touch Gestures*	Self-touch (Caress) *Phone touch*	Reciprocal Touch (Kiss)	Reciprocal Touch (Kiss, Caress)	Reciprocal Touch (Kiss)
10.2.2: Shared Biofeedbackdata						
Predictable Datafication	Predictable: emerging data visualazition	Shared Data Visualization	*Co-Actor: Data Sonificatic (Audio, spoken Message)*	Predictable = emerging data sonic & visualizition	Predictable = emerging data sonic & visualizition	Predictable := emerging data sonic & visualizition
Unpredicatble Composition of Datafiication	Merging Personal Data Visualization	Merging Personal Data Visualization	Random Revealing Visualization Sonification	Symphonic Personal Data Visualization Sonification	Symphonic *Personal* Data Visualization Sonification	Symphonic *Personal* Data Visualization Sonification
Shared Data Composition (Co-)Actors	Non-simultaneous	**Both: (Non-) Simultaneous**	Partly simultaneous	Non-Simultaneous	**Simultaneous**	**Simultaneous**
2 Shared Reflection						
Dialogue	Staged	Shared	Staged	Staged	Shared	Shared
Hosting Design	(Non-)Human	Non-Human + Participants	Human	Human	Human	Human

APPENDIX (3) Credits, Collaborations

This section includes credits for the six Artistic Social Labs (ASL). Described are: Concepts; Awards, Commsissions; (Technical) Research and Developments; Supports, Sponsorings, Research Groups, Exhibitions. First, combined support and collaborations are described; followed by support and collaborations for each specific ASL, including personal contributions.

Note, that the list of selected ASLs (1-6) in this thesis has been extended to a full list of exhibitions. Included are also two ASLs that have not been analysed in this thesis: 'Agora Phobia (digitalis)' (2000) and 'StalkShow' (2003), both foundational to the development of the ASL concepts.

Universities and Research Groups:

- Delft University of Technology: *Participatory Systems Lab*.
- TU Delft, TU Eindhoven, Royal Institute of Technology Stockholm (KTH): *European EIT ICT lab 'Mediated presence group'*.
- AHK Amsterdam School of the Arts: *ARTI Artistic research, Theory, Interpretation* research group.
- University of Applied Arts Vienna: *Digital Synesthesia* research group.
- Baltan Laboratories Eindhoven: *Hack the body* international art science consortium.
- University Twente: *Dutch Touch* Group, international consortium.
- University of Amsterdam (UvA): *Worlding the Brain & Neurocultures* research group (ASCA).
- University Utrecht: *Urban Interface* research group.
- Tsinghua university Beijing: *TASML Tsinghua Art Science Lab*.
- EMAP European Media Art Platform, Creative Europe Program of the European Union.
- Amsterdam (HvA) Faculty of FDMCI and Lectoraat Civic Interaction Design.
- University Groningen (RUG)/ Minerva Art Academy.

Commissioned ASL research by:
University of Applied Sciences Vienna; Rijksmuseum Amsterdam; MediaFonds@Sandberg; TASML Tsinghua Art Science Lab Beijing; Banff Center Canada *Liminal Screens*; Festival aan de Werf Utrecht; UP Projects London; Lumineus Amersfoort; Kiasma Museum/ *ISEA 2004*; DasArts Graduate School Amsterdam; EMAP European Media Art Platform, Creative Europe Program of the European Union.

With kind support of:
Mondriaanfoundation; Amsterdam Fund for the Arts; Performing Arts Fund NL; Media Fonds; Fund for Creative Industry; Prince Bernhard Culture Fund; SICA NLTR 400; Austrian Science Fund; Berliner Kulturveranstaltungs-GmbH Berlin; AFK Fund for the Arts Amsterdam; Dutch Culture Fund; EMAP European Media Art Platform, Creative Europe Program of the European Union; TNO Netherlands Organisation for Applied Scientific Research; NWO Netherlands Organisation for Scientific Research; DasArts Graduate School Amsterdam; V2_Rotterdam; Canadian Arts Council; Arts Council England; Waag Society Amsterdam**. Dutch Consulates** of Istanbul, Beijing, New York. **Dutch Embassies** in Helsinki, Hong Kong, Moscow, Berlin, Germany, Paris, China.

Sponsoring.
Driebit Amsterdam, www.driebit.nl; Holst Center Eindhoven; Fourtress Eindhoven; BEAM SYSTEMS Amsterdam; Online streaming platform URnowhere; TNO Soesterberg.

ASL1:
Saving Face

www.lancelmaat.nl/work/saving-face.
www.lancelmaat.nl/work/master-touch

Concept.
2011-2012. 'Saving Face': Lancel/Maat, with Mathijs ten Berge; European IET ICT Presence Lab.
2013. 'Master Touch': Lancel/Maat, with Shailoh Phillips.

Artists in Residency.
2012 MediaFonds@Sandberg Masterclass. 'Wireless Stories'.

Commission.
Rijksmuseum Amsterdam: 'Master Touch'.

Award. Best Practice Award 201 Virtueel Platfom / Het Nieuwe Instituut.

(Technical) Research & Development with:
Lancel/Maat; Mart van Bree; Sylvain Vriens; Tim Olden; Jason Saragih's opensource Facetracker library / Kyle McDonald. Video: Daan den Hartoog.
EIC ICT Presence Research group; Delft University of Technology, Participatory Systems Lab.

With kind support of:
Media Fonds; MediaFonds@Sandberg; SICA NLTR 400; Mondriaan Fund;
Festival aan de Werf Utrecht; Dutch Consulate Beijing; Dutch Embassy Berlin;
KTH Stockholm; Rijksmuseum Amsterdam.

ASL1 Exhibitions:
2019 Digital Urbanism Blekinghe Institute, Karslham Sweden
2015-2016 Museum BCAC - Beijing Contemporary Art Foundation BCAF.
Curators: Cui Qiao (BCAC), Susa Pop (Public Art Lab Berlin).
2015 56th Venice Art Biennale: China Pavillion. Curators: Cui Qiao, Susa Pop.
2015 Holland Festival - De Balie Amsterdam, 'Stadsleven.' Curator: Tracy Metz
2015 University Twente 'Tangible User Interaction and Computer Science' Symposium.
Curators: Dr. Gijs Huisman and Prof. Jan van Erp.
2013 Rijksmuseum Amsterdam. Curator: Shailoh Philips.
2013 Connecting Cities Network: Bauhaus Dessau - Ars Electronica.
Curator: Susa Pop, Public Art lab Berlin, Jasmin Grimm.
2015 University Utrecht, Urban Interfaces Group. 'Play Perform Participate'.
Curators: Chiel Kattenbelt, Nanna Verhoeff.
2012 TASIE Beijing 3rd Art and Science Exhibition and Symposium, Science & Technology Museum Beijing. Curator: Zhang Ga, Lu Xiaobo. Art & Design Department, Tsinghua University, China.
2012 European EIC ICT labs: Mediated presence group; by: Prof.dr Frances Brazier,
Prof.dr. Caroline Nevejan, Dr. Charlie Gullström. UT Delft, Eindhoven, Stockholm (KTH).
2012 TEDX Silkroad Istanbul. Curator: Ferhan Cook.
2012 Festival aan de Werf Utrecht. Curator: Rainer Hofmann.
2011 Stedelijk Museum Amsterdam Seminar 'Urban Screens': 'Screening the City'.
Curator: Geert Lovink, Intsitute for Network Cultures.
2011 ISEA Istanbul & Istanbul Art Biennale. Curator: Lanfranco Aceti.
2011 Iaspis Stockholm. Curator: Laura Mott.

ASL2:
Touch My Touch

www.lancelmaat.nl/work/touchmytouch

Concept.
2020-2021.Lancel/Maat.
Commission.
UP Projects London (This is Public Space (TIPS)).
(Technical) Research & Development with:
Lili-Maxx Hager; Moira Lascelles;
Eagle Science Software Amsterdam;; Sylvain Vriens;
Jason Saragih's opensource Facetracker library / Kyle McDonald.
Research Group: Dutch Touch - the Society for the Study of Social and Affective Touch in the Netherlands; University Twente;
With kind support of :
Mondriaan Fund; UP Projects London; University Twente;
University of Applied Siences Amsterdam (HvA)
Faculty of FDMCI and Lectoraat Civic Interaction Design;
Arts Council England.
Sponsoring.
Eagle Science.

ASL2 Exhibitions:
2021 UP Projects London TIPS. Touch lab and Discussion panel,
with Nathalie Kane (Digital Art V&A Museum London), Prof. Gabriella Giannacchi.
2021 UP Projects, London, https://upprojects.com/projects/touch-my-touch/.
2022 University Twente, Medtec. Thanks to Jan van Erp;
and the Art Commission for the Public Space of University Twente.
2023 University of Applied Siences Amsterdam (HvA), Jacoba Mulderhuis;
thanks to Martijn de Waal, Marjolijn Ruijg, Frank Kresin.

ASL3:
Tele_Trust

www.lancelmaat.nl/work/tele-trust

Concept. 2008-2010. Lancel/Maat.
Artists in residency.
2010 Artists in Residency: Banff Center Canada 'Liminal Screens'.
Commission. 2009 Lumineus Amersfoort.
Award.
Best Practice Award 2011 Virtueel Platfom / Het Nieuwe Instituut.
(Technical) Research & Development with:
V2_Lab for Unstable Media Rotterdam; Mart van Bree; Banff Center BNMI Canada.
Research group: ARTI 'Artistic research, Theory & Interpretation' & 'Art Practice and Development' by Marijke Hoogenboom and Henk Borgdorff; Amsterdam School of the Arts (AHK).
DataVeil Design Research: AZIZ Amsterdam, the Muslim Women Group 'Jasmijn' Groningen, students of the Sabanci University Istanbul. *Dataveil construction*: AZIZ. *Graphic Design*: Erwin Slegers.
With kind support of: Mondriaan Fund; Lumineus Amersfoort; Banff Center Canada;
Canadian Arts Council; Performing Arts Fund NL; Dutch Consulate of Istanbul; AFK Amsterdam.

ASL3 Exhibitions:
2017 Kulturstiftung des Bundes Frankfurt. 'Fellow-Me, The Sensitive Museum'. Curator: Marie Haff.
2016 TransMediale Berlin. Performance Lecture. Curator: Eric Kluitenberg.
2013 Arti et Amicitiae Amsterdam. Curators: Arjen Lancel, Frans Fransiscus.
2012 Gogbot Enschede. 'Singularity is near!' Curators: Kees de Groot, Viola van Alphen.
2012 Technical University Delft, Participatory Systems Lab.
Curators: Prof.dr. Caroline Nevejan, Prof.dr. Frances Brazier.
2011 Stedelijk Museum Amsterdam. 'Augment IT!'
Curators: Margriet Schavemakers, Hendrik Folkerts.
2011 ISEA Istanbul 2011 & Istanbul Bienale. Curator: Lanfranco Aceti.
2011 Iaspis Stockholm Curator: Laura Mott.
2011 Kasa Gallery 2011. Curator: Lanfranco Aceti.
2011 Festival a/d Werf Utrecht & PSI. Curator: Rainer Hoffmann.
2010 Shanghai World-Expo DCC: The Mobile City & Virtueel Platform.
Curators: Martijn de Waal, Michiel de Lange. Video, Lecture.
2010 De Balie Amsterdam, Banff Center Canada, ADA-network New Zealand.
'Electrosmog'. Curator: Eric Kluitenberg.
2010 Sonic-Acts Xlll Amsterdam, 'On the Poetics of Hybrid Space'. Curator: Eric Kluitenberg.
2010 Banff Center - New Media Institute, Canada. 'Liminal Screens'.
Curators: Nina Czegledy, Marcus Neustetter, Michelle Kasprzak.
2010 Stedelijk Museum Amsterdam: 'Hear IT! Curator: Hein Wils.
2009 Lumineus Amersfoort. Curators: Patricia Deiters, Annelou Evelein.
2009 Tschumi-Pavillion Groningen. Curator: Marinus de Vries.
2009 Exposorium Vrije Universiteit Amsterdam. Curator: Hendriekje Bosma.
2009 Waag Society Amsterdam. Curator: Lucas Evers.
2009 V2_Lab for UnstableMedia Rotterdam 'Intimacy'. Curator: MIchel van Dartel.

ASL4:
EEG KISS,
Digital Synaesthetic EEG KISS

www.lancelmaat.nl/work/e.e.g-kiss

Concept.
2014-2016. Lancel/Maat
Artists in Residencies:
2015-2016 Digital Synesthesia Research Group, University of Applied Arts Vienna / ZKM.
2013-2014 TASML artists in residency Tsinghua University Beijing. Curator: Dr. Zhang Ga.
Neuro Engineering Lab, Prof. Hong Bo.
Awards.
2018 GAAC Global Art & A.I. Competition 2018 China.
2017 Science and Art Gallery Dublin / Waag Society, 'Hack the Brain'. Third Prize.
(Technical) Research & Development with:
Holst Center and Fourtress Eindhoven; HeK Haus der Elektronischen Künste Basel;
European Cultural Program 'Hack the Brain', Waag Society Amsterdam;
University of Technology Delft, Participatory Systems Lab; Institute for Provocation Beijing;
Phillips Eindhoven. *Soundscape Algorithm:* Tijs Ham, STEIM Amsterdam.
Design EEG KISS Digital Portraits: Paulina Matusiak.
Research Group: Baltan Laboratories Eindhoven **'**Hack the body': Olga Mink, Koen Snoeckx, Lorenzo Gerbi. *Video:* Daan Hartoog.
With kind support of:
Mondriaan Fund; TNO Netherlands Organisation for Applied Scientific Research; University of Applied Arts Vienna; NWO Netherlands Organisation for Scientific Research; Austrian Science Fund.
Sponsoring.
Holst Center Eindhoven; Fourtress Eindhoven; TNO Soesterberg;
Eagle Science Amsterdam; BEAM SYSTEMS Amsterdam.

ASL4 Exhibitions:
2018 HeK Haus der Elektronischen Künste Basel. 'Future Love. Desire and Kinship in Hypernature'.
Curators: Sabine Himmelsbach, Boris Magrini.
Premiere: E.E.G. Kiss, collaborative hosting ritual.
2017 Science and Art Gallery Dublin / Waag Society, 'Hack the Brain'.
Curators: Lucas Evers, Mairéad Hurley.
2017 Ars Electronica exhibition at VolksWagen Group Forum Berlin. 'You and I'.
Curator: Manuela Naveau.
2017 Rietveld Academie / Stedelijk Museum Amsterdam. Curator: Jorinde Seijdel.
Studium Generale 'What's happening to our brain?'.
2017 Stedelijk Museum Amsterdam, 'Stedelijk Statements / Worlding the Brain'.
Exhibition and Conference. Curator: Patricia Pisters, and Stephan Besser, Machiel Keestra, Julian Kiverstein, Flora Lysen, Patricia Pisters, Halbe Kuipers.
2017 ThingsCon Salon Intimate Technology Univesrity Twente, Curator: Frank Kresin.
2016 -2018 RIXC Center for New Media Culture, Riga. 'Open Fields', Exhibtion and Conference.
Curators: Rasa Smite and Raitis Smits.

2016 Beall Center for Art + Technology, University of Irvine, California L.A. ‘Embodied Encounters’ Exhibition Curator: David Familian. Conference Curator: Simon Penny, ‘A Body of Knowledge: Embodied Cognition and the Arts’.

2016 ISEA2016 Hongkong, and Angewandte Innovation Lab (AIL) Vienna: ‘Digital Synesthesia ‘. Curators: Katharina Gsöllpointner, Ruth Schnell, Romana Schuler, Jeffrey Shaw, Peter Weibel; University of Applied Arts Vienna, ZKM Karlsruhe.

2016 Waag Society for Old and New Media Amsterdam. ‘Hack the Brain’. European Cultural Program.

2016 De Balie Amsterdam. ‘Engaged Art Fair’. Art of Impakt project, Mondriaan Foundation.

2016 UvA University of Amsterdam, Conference. ‘Worlding the Brain: Patterns, Rhythms, Narratives in Neuroscience and the Humanities’. By: Stephan Besser, Machiel Keestra, Julian Kiverstein, Flora Lysen, Patricia Pisters, Halbe Kuipers.

2016 Frascati Theatres Amsterdam. ‘The end of Privacy Festival’. Curators: Marc Timmer, Kiki Rosingh.

2016 Gogbot Media Art Festival Enschede. ‘Internet of things’. Curator: Kees de Groot.

2015 Gallery City University Hong Kong. ‘Contemporary Code – Artistic Research’. Curators: Gerald Bast, Alexander Damianisch and Romana Schuler.

2015 University Twente (Tangible User Interaction, Computer Science). ‘Social and Affective Touch Symposium'. By: Prof. Jan van Erp, Dr. Gijs Huismans, Frank Kresin.

2015 European Science Night, NEMO Amsterdam. Curators: Tanja Koning and Arjen Bangma.

2014 EYE Film Institute Amsterdam and Tolhuistuin Amsterdam. 'Body Hacking'. Curators: Arjen Bangma and Tanja Koning at Discovery Festival, Transnatural.

2015 VPRO Medialab Eindhoven.

2014 Pakhuis de Zwijger Amsterdam. 'Hack the Body' Program. By: Waag Society Amsterdam, Baltan Laboratory Eindhoven, TNO, University Twente, Rathenau Institute.

ASL5:
Kissing Data Symphony

www.lancelmaat.nl/work/kissing-data-symphony

Concept.
2018. Lancel/Maat.
Artists in Residency.
2018 -2022 EMAP European Media Art Platform, Creative Europe Program of the European Union; RIXC Center for New Media Culture, Riga.
Awards.
2019 Golden Calf Interactive, Netherlands Film Festival (NFF) nomination.
2019 TASIE 2019 Award, Art & Science Innovation Wu Guanzhong Prize, Tsinghua University Beijing, National Museum of China.
(Technical) Research & Development with:
Tijs Ham (Soundscape Algorithm) STEIM Amsterdam; Baltan Laboratories Eindhoven;
TU Delft Participatory Systems Lab; European Cultural Program 'Hack the Brain' at Waag Society*;*
Eagle Science Software Amsterdam; *Research Group:* Baltan Laboratories Eindhoven **'**Hack the body': Olga Mink, Koen Snoeckx, Lorenzo Gerbi.
With kind support of:
Mondriaan Fund; Fund for Creative Industry; Dutch Culture;
EMAP European Media Art Platform, Creative Europe Program of the European Union.

ASL5 Exhibitions:
2023 Rotondes Luxembourg, 'Multiplica23 Curators Yves Conrardy Marc Scozzai
2022 IMAL 'Swipe Right! Data, Dating, Desire'. Curators: Valentina Peri, Ania cnowska.
2021 Ars Electronica Festival Linz. 'A new Digital Deal'. In: 'EMAP Garden', Curator Peter Zorn.
2021 Werkleitz Halle, Germany. Curator Peter Zorn (Werkleitz, EMAP Platform).
2020 -2021 LABoral, Gijon Spain. ''When the butterflies of the soul flutter their wings...'
Curator: Karin Ohlenschläger. EMAP Platform, the European ARTificial Intelligence LAB.
2020 IMPAKT Utrecht. 'Cyborg Web Project'. Curator: Arjon Dunnewind.
2019 NFF Netherland Film Festival Interactive Expo, Impakt Utrecht. Curator: Pauline Dresscher
2019 ISEA2019 Gwangju South Korea. 'Lux Aeterna.' Curator: Roh Soh Yeong.
2019 National Museum of China.
TASIE 2019 Beijing, 5th International Art and Science Exhibition and Symposium,
by Art & Design Department, Tsinghua University, China. Curator: Lu Xiaobo.
'AS Helix: The Integration of Art and Science in the Age of Artificial Intelligence'.
2019 OCT Design & Art Gallery Shenzhen China 'The Entelechy of A Hypernatural Generation'.
2019 Ars Electronica Festival Linz. 'Error. The Art of imperfection'.
Curators: Christl Bauer, Veronika Liebl, Gerfried Stocker.
2018 RIXC Center for New Media Culture, Riga and EMAP Platform.
'Open Fields' and 'White Nights'. Curators: Rasa Smite and Raitis Smits.
2018 'RobotLove', at DDW Dutch Design week Eindhoven. Curator: Ine Gevers.

ASL6:
Intimacy Agents

www.lancelmaat.nl/work/intimacy-agents

Concept.
2020. Lancel/Maat.
Commission.
Edgecut performance series @ NEW INC, The New Museum of Contemporary Art, New York.
(Technical) Research & Development with:
Lancel/Maat, University of Technology Delft - Participatory Systems Lab.
With kind support of:
Mondriaan Fund.
Sponsoring.
Eagle Science Software Amsterdam; Online streaming platform URnowhere.

ASL6 Exhibition:
2020 Edgecut performance series. Curators: Heidi Boisvert, Kat Mustatea. Part 3: 'Sanity'.

This ASL has been foundational to the concept of the ASL. It has not been analyzed in this thesis.

ASL
Agora Phobia (digitalis) www.lancelmaat.nl/work/agora-phobia-digitalis

Concept.
1999-2000. Lancel/Maat, in conversation with Jellichje Reijnders, Inez Sauer, Robert Steijn.
Award.
Digital Art Canon of the Netherlands (1960–2000), LIMA Media Art Platform Amsterdam.
(Technical) Research & Development with:
Website: Waag Society Amsterdam; Driebit Amsterdam, www.driebit.nl.
Inflatable design: Rens Bouma / imaginAiR. Inflatable construction: maginAiR.
Graphic design: Erwin Slegers.
With kind support of:
Mondriaanfoundation, Amsterdam Fund for the Arts, Fund for Art, Design and Architecture, Performing Arts Fund NL, Prince Bernhard Culture Fund, Berliner Kulturveranstaltungs-GmbH Berlin, [NES]theaters, the Dutch Ambassy in Germany and Paris; Dutch consulat in New York (USA), Foundation DasArts/ DasArts Graduate School Amsterdam.
Sponsoring.
Website hosting: Driebit Amsterdam, www.driebit.nl

Exhibitions
2023. Het Nieuwe Instituut Rotterdam. Exhibition: 'REBOOT': The 'Digital Canon (1960-2000)'. Curators: Gaby Wijers, Sanneke Huisman, Klaas Kuitenbrouwer, LIMA Amsterdam.
2007 CBK Amsterdam in the frame work of: Herdenking moord-aanslag op Theo van Gogh.
2007 www.Volkskrant.nl/oog Curator: Nannette Hoogslag.
2004 Villette Numerique Paris. Curator: Benjamin Weil.
2004 MUU Galleria Helsinki, Finland. Exhibition: 'Direct exposure'.
2003 SKOR / City of Utrecht Leidse Rijn. Exhibition: 'Parasite Paradise'. Curator:
2003 Eyebeam New York. Curator: Benjamin Weil. In collaboration with Alice Smits.
2002 Foundation DasArts.
2001 Artfair and Podewil Berlin. Curator: Wilhelm Grosz.
2000 De Appel, Amsterdam. Exhibition: 'Unlimited.nl#3'. Curator: Zdenka Badovinac.
2000 Stedelijk Museum Amsterdam Exhibition: 'Municipal Acquisitions'.

This ASL has been foundational to the concept of the ASL. It has not been analyzed in this thesis.

ASL
StalkShow

www.lancelmaat.nl/work/stalkshow

Concept.
2002-2003. Lancel/Maat, in conversation with Josephine Bosma, Mart van Bree, Günther Heeg, Steven Kovats, Anne Nigten, Jellichje Reijnders, Alice Smits, Robert Steijn.
(Technical) Research & Development with:
V2_Lab for Unstable Media.
With kind support of: Fund for Visual Art, design and Architecture (NL), Mondriaan Foundation, Amsterdam Fund for the Art (AFK), Performing Arts Fund NL, Kiasma Museum, [Nes]theaters Amsterdam, Foundation DasArts, SSAS, Dutch Embassies in Helsinki, Hong Kong, Moscow and China.

Exhibitions:
2008. Urbanscreens 08, Melbourne Australia Curator: Mirjam Struppek.
2008 Ceac Xiamen China 2008. Curators: Ineke Gudmunssun, Jos Houweling.
2007 ArtCenter Nabi Seoul, Korea P.Art.Y Festival Seoul 2007.
Curators: Roh Soh-Yeong, Dooeung Choi.
2007 TASIE Millenium Museum Beijing and Tsinghua University,
2nd New Media Art Science Exhibition/Symposium Beijing, China.
Curators: Alex Adriaansens, Zhang Ga.
2007 Science and Art Expo Shanghai, China
2006 'Outvideo 06' ArtInPro Moscow & Yekaterinburg, Russia. Curator: Arseny Sergeyev
2006 Hong Kong Arts Center IVFA Film Festival/ Videotage 06 Hong Kong.
Curators: Connie Lam, Teresa Kwong, Isaac Leung.
2005 Urban Screens 05 Symposium, Stedelijk Museum Amsterdam
Curators: Geert Lovink, Mirjam Struppek, Jeroen Boomgaard.
2004 ISEA 04, Kiasma Museum Helsinki. Curator: Pertu Rastas.
2003 Smart Project Space Amsterdam, Netherlands 'Tresholding' 03. Curator: Alice Smits.
2003 E culture-Fair 03 Amsterdam. Curators: Virtual Platform & V2_LAB for Unstable Media.
2003 Festival 'Stad als Film/ City As Movie' Schiedam.
Curators: Adriaan de Regt, Martijn Verhoeven.
2002 Master of Arts DAS Academy for Theatre and Dance Amsterdam.

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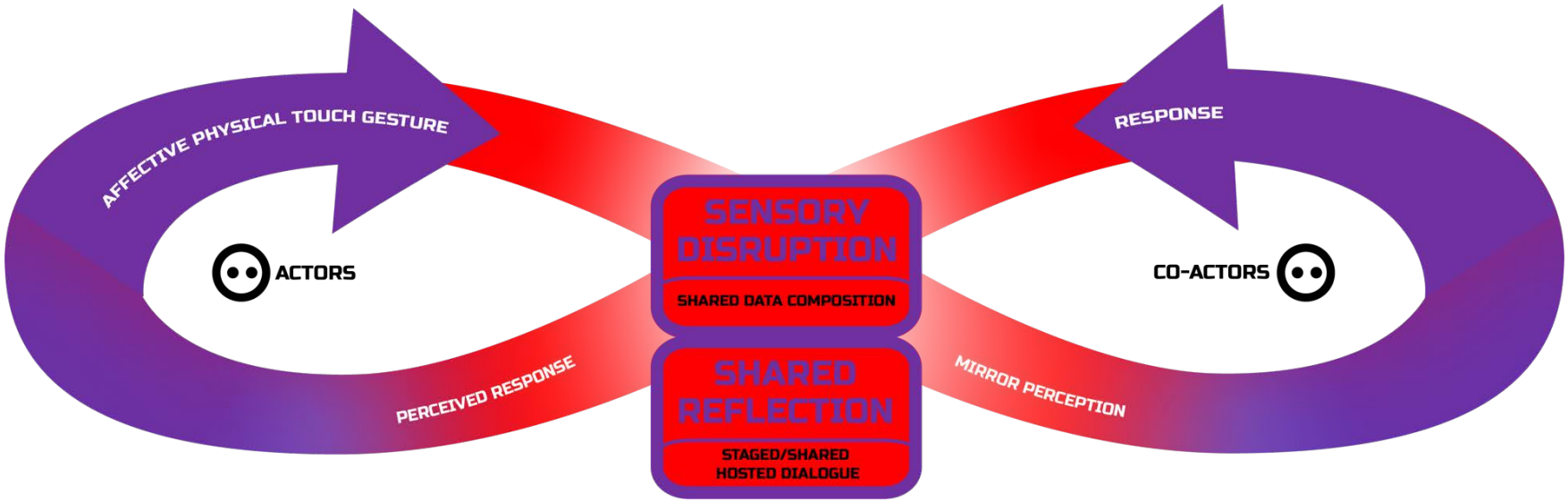

Fig. 53: CITYO Interaction Model for Shared Social Touch, extended by insights into the use of the model.

Summary

Experience of touching and feeling touched is fundamental to human well-being, of safety and trust. Being in touch with others can be emotional and spiritual, it enables space for movement and transformation: to touch, kiss, play, dance, make love, tune and breath together.

Until recently, research into Human Computer Interaction has concentrated on the performative potential of technology, on physiological and technological aspects of social touch; and less on human experience as a starting point.

Recent research, however, shows that ethical aspects of vulnerability, inclusiveness, agency, autonomy, trust are core to human experience of technically mediated social touch. Recent neuroscience research focuses on mirror neuron and cognitive activity in empathic processes through touch; and on perception of one's own body in visuo-haptic motor data interaction. Media Performance Art has started to explore digital systems for shared experience of sensory, intercorporal connections and emphatic spectatorship with human and non-human others, in various hybrid social and spatial configurations.

This thesis expands these new research foci from an interdisciplinary Art, HCI, Design and Computer and Neuro-Science perspectives, for discussions on ethics, empathy, body ownership, responsibility and responsiveness, in (neural) multi-actor networks.

It explores forms of embodied awareness of touch in technically mediated interaction and the emergence of a new sense of bodily togetherness, with multiple bodies worldwide, between lovers, friends, family, and strangers.

It shows the importance for new performance scripts for 'shared embodied intimate experience of technically mediated social touch, for multiple participants', defined in this thesis as **Shared Social Touch**.

The central research question in this thesis is: **Can shared embodied intimate experience of technically mediated social touch be orchestrated for multiple participants, in empathic interplay?** The question is answered on the basis of a novel prescriptive and descriptive **interaction model**, for distributed, hybrid, XR, online, human-agent and robot interaction; in private and public digital domains. The model has been designed on the basis of characteristics discussed in the literature; and that has been tested and evaluated in six case-studies.

The Literature brings together fragmented knowledge from Design, Art, HCI, Social and Neuroscience, with a focus on characteristics for empathic interaction through social touch. Theoretical perspectives have been combined with insights from Media Performance Art research into social touch, to explore essential aesthetic principles for intimate interaction between humans, technology and biofeedback data; and for socially and for the design of

technically hosting multiple participants in a shared space.
The literature shows that co-creation of intimate experience and meaning making are crucial to the orchestration of Shared Social Touch, combining shared experience of a) **Sensory Disruption** (of reciprocal, physical touching and being touched, in shared empathic vulnerable interplay) combined with b) **Shared Reflection** *on* the experience. The knowledge gap this thesis addresses concerns the combined orchestration of these two elements.

Sensory Disruption and Shared Reflection are at the heart of the **interaction model 'Can I Touch You Online?' (CITYO)** in this thesis. The model facilitates sensory, technological and social interaction, on the basis of affective touch gestures, in ambiguous, multisensory synaesthetic synthesized motor data interaction, for mirror-perception by multiple participants, with agency of potential or actual participation, and (non-)simultaneous and (un-)predictable response , in socially and technically hosted interaction.

The research method combines Artistic Research (AR) and Research through Design (RtD). From an AR approach, this thesis presents subjective perspectives and observations of the artists Lancel and Maat, on shared embodied intimate experience of technically mediated social touch, for multiple participants.

The systemic approach to develop the design guide lignes derives from a RtD perspective.

Both research methods make use of photography and video documentation; and thick description, reflective participatory notes and dialogues. Shared reflection with ASL participants supports the iterative design process.

The interaction model has been evaluated and analysed for six participatory artistic orchestrations and performance scripts as case-studies.

These orchestrations, **'Artistic Social Labs' (ASL)** have been presented internationally in different social cultures and geographical contexts and technological configurations, in hybrid and online interaction, in Europe, USA and Asia. The ASLs introduce a new design approach for Shared Social Touch in which participants are invited as 'co-researchers', to meet each other. The technologies used in the ASLs (outside, on and inside the body) include smart city facial technologies (ASL1,2); smart haptic textiles (ASL3); online streaming platforms (ASL2,6); phone apps (ASL3); and brain-to-brain computer interfaces (multi-BCI) (ASL4,5,6)). These technologies have been used by participants for performativity of different affective (self-)touch gestures (caressing, kissing, embracing).

The ASL's technical A.I. systems collect sensor data of the participants' touch gestures, and of mirror-perception and responses; and recognize patterns. The design of data-interpretation leads to uniquely composed data compositions (shared 'Reflective Datascapes'). These data-composities are used to incite hosted, shared reflection.

Analyses of ASLs, to evaluate the interaction model, show that disruption, as an aesthetic principle, can be used to orchestrate new forms of bodily awareness and Shared Social Touch interaction. Performance scripts must facilitate both *immersive* perception, *and cognitive* empathic awareness.

Data interaction by participants must lead to **Shared Data Compositions** with a) individual data feedback signalling; and b) shared synaesthetic sensory connections that partly replace each other, in preferably, c) simultaneous reciprocal influence. Performativity by participants must be characterized by autonomous participation; and shared social and physical vulnerability.

Shared Reflection, on the shared embodied experience, must be part of the performance script, and must take place in **Hosted**, **Shared Dialogue** or **Staged Dialogue.** It can be based on memory, imagination, and storytelling; and on personal data-appropriation and interpretation.

The CITYO interaction model, and the new insights, support new perspectives for Art, Design, HCI and Science, and Education, on emotional well-being (including social connection, disconnection, and isolation (e.g. through trauma, dementia, depression); neurodiversity and autism) design of e-learning and presence design; in hybrid, A.I. XR mixed and merging realities.

Samenvatting

De ervaring van aanraken en geraakt voelen is fundamenteel voor het menselijk welzijn, voor veiligheid en vertrouwen. Aanraking, en *being in touch* met anderen kan emotioneel en spiritueel zijn, het biedt ruimte voor beweging en transformatie: voor samen aanraken, kussen, spelen, afstemmen, ademen, vrijen en dansen.

Tot voor kort concentreerde het onderzoek naar Human Computer Interactie voor sociale aanraking zich op de performatieve mogelijkheden van technologie en op fysiologische aspecten. De menselijke ervaring vormde hierbij in mindere mate het uitgangpunt.

Recent onderzoek toont echter aan dat in de menselijke ervaring van technisch gemedieerde sociale aanraking ethische aspecten van kwetsbaarheid, inclusiviteit, agency, autonomie en vertrouwen centraal staan. Recent neurowetenschappelijk onderzoek richt zich op activiteit van spiegelneuronen voor *mirror perception* en cognitieve activiteit in empathische processen via aanraking; en op de perceptie van het eigen lichaam in visuo-haptische motor-data interactie. Media Performance Art verkent digitale systemen voor de ervaring van sociale aanraking in zintuiglijke, intercorporale verbindingen, en *empathic spectatorship,* met *human and non-human others*, in verschillende hybride sociale en ruimtelijke configuraties.

Dit proefschrift breidt deze nieuwe aandachtsgebieden voor de sociale aanraking uit vanuit een interdisciplinair perspectief: Kunst, HCI, Design en Computer- en Neurowetenschap, voor discussies over ethiek, empathie, lichamelijk bewustzijn, verantwoordelijkheid en responsiviteit, in (neurale) multi-actor netwerken.

Het onderzoekt vormen van lichamelijk bewustzijn van aanraking in technisch gemedieerde interactie; en het ontstaan van een nieuw gevoel van lichamelijk samenzijn, met meerdere lichamen wereldwijd, tussen geliefden, vrienden, familie en vreemden.

Het toont het belang aan van nieuwe performatieve scripts, voor "gezamenlijke lichamelijke intieme ervaring van technisch gemedieerde sociale aanraking, voor meerdere deelnemers", in dit proefschrift gedefinieerd als **Shared Social Touch**.

De centrale onderzoeksvraag in dit proefschrift is: **Kan gezamenlijke lichamelijke intieme ervaring van technisch gemedieerde sociale aanraking worden georchestreerd, voor meerdere deelnemers, in empathisch samenspel?**

De vraag wordt beantwoord op basis van een nieuw prescriptief en descriptief **interactiemodel,** voor hybride, gedistribueerde, online, XR en human-agent interactie, en interactie met robots; in private en publieke digitale domeinen. Dit model is ontworpen op basis van in de literatuur besproken karakteristieken; en is getest en geëvalueerd in zes case-studies.

De literatuur brengt gefragmenteerde kennis samen uit Kunst, Design, HCI, Sociale en Neuro-wetenschappen, met een focus op kenmerken voor empathische interactie via sociale aanraking. Theoretische perspectieven zijn gecombineerd met inzichten uit Media Performance Art onderzoek, om essentiële esthetische principes te verkennen voor intieme interactie tussen mensen, technologie en biofeedback data; en voor het ontwerp van het sociaal en technisch *hosten* van meerdere deelnemers in een gedeelde ruimte.

De literatuur laat zien dat co-creatie van intieme ervaring en betekenisgeving cruciaal zijn voor de orchestratie van Shared Social Touch. Centraal daarbij staat de gezamenlijke ervaring van twee elementen, namelijk a) ***Sensory Disruption*** (van wederzijdse, fysieke aanraking en aangeraakt worden, in gezamenlijk, empathisch kwetsbaar samenspel) en b) ***Shared Reflection*** op de ervaring. Het kennis hiaat dat dit proefschrift adresseert betreft de gecombineerde orchestratie van deze twee elementen.

Sensory Disruption en Shared Reflection vormen de kern van **het interactiemodel 'Can I Touch You Online?' (CITYO)** in dit proefschrift.

Het model faciliteert zintuiglijke, technologische en sociale interactie, op basis van: affectieve gebaren van aanraken, in ambigue, multi-sensorische syntheses van motor-data interactie, voor *mirror-perception* van meerdere deelnemers; met *agency* van potentiële of actuele deelname, en (niet-)gelijktijdige en (on-)voorspelbare respons; waarbij de interactie sociaal en technisch wordt gehost.

De onderzoeksmethode combineert Artistic Research (AR) en Research through Design (RtD). Vanuit een AR benadering worden de subjectieve perspectieven en observaties van de kunstenaars Lancel en Maat, over gedeelde lichamelijke intieme ervaring van technisch gemedieerde sociale aanraking, voor meerdere deelnemers, gepresenteerd.

Vanuit een RtD-perspectief ontstond de systemische benadering op basis waarvan richtlijnen voor het ontwerp zijn ontwikkeld.

Beide onderzoeksmethoden maken gebruik van fotografie en video-documentatie; en *thick description*, notities over de gezamenlijke (*participatory*) reflectie en dialogen. De gezamenlijke reflectie met ASL-deelnemers ondersteunt het iteratieve ontwerpproces.

Het interactiemodel is geëvalueerd en geanalyseerd voor zes participatieve, artistieke orchestraties en performatieve scripts als case-studies.

Deze orchestraties, **'Artistic Social Labs' (ASL)** zijn internationaal gepresenteerd in verschillende sociale culturen, geografische contexten en technologische configuraties, in hybride en online interactie, in Europa, de VS en Azië. De ASLs introduceren een nieuwe ontwerpbenadering voor **Shared Social Touch**, waarbij deelnemers worden uitgenodigd als 'medeonderzoekers' (*'co-researchers'*).

De technologieën die in de ASL's worden gebruikt (buiten, op en in het lichaam) zijn onder meer *smart city* gezichtsherkennings-technologie (ASL1,2); *smart haptic textiles* (ASL3); *online streaming platforms* (ASL2,6); *phone apps* (ASL3); *brain-tot-brain computer interfaces* (multi-BCI) (ASL4,5,6)). Deelnemers gebruikten deze technologieën voor performativiteit van verschillende affectieve gebaren van (zelf-)aanraking (strelen, kussen, omhelzen).

In de technische A.I.-systemen van de ASLs verzamelen sensoren data van de gebaren van aanraken, en van de *mirror-perception* en reacties van deelnemers; en herkennen patronen. Het ontwerp van data-interpretatie leidt tot unieke data-composities (gezamenlijke 'Reflective Datascapes'). Deze data-composities worden gebruikt om aan te zetten tot gezamenlijke reflectie, die wordt gehost.

Analyses van de ASLs, om het interactiemodel te evalueren, tonen aan dat ontwerp van *disruption*, als esthetisch principe, kan worden gebruikt om nieuwe vormen van lichamelijk bewustzijn en Shared Social Touch interactie te orchestreren. Hiervoor moeten de performatieve scripts zowel immersieve perceptie als cognitief empathisch bewustzijn faciliteren.

Data-interactie door deelnemers moet leiden tot gezamenlijke data-composities, met a) individuele data-feedback; en b) gedeelde synesthetische zintuiglijke connecties die elkaar gedeeltelijk vervangen, met bij voorkeur c) gelijktijdige wederzijdse beïnvloeding.

Performativiteit door de deelnemers moet worden gekenmerkt door autonome deelname; en gezamenlijke sociale en fysieke kwetsbaarheid.

Gezamenlijke reflectie, op de gedeelde lichamelijke ervaring, moet onderdeel zijn van het performance script, in Hosted, *Shared Dialogue* or *Staged Dialogue*. Het kan worden gebaseerd op herinnering, verbeelding en verhalen vertellen; en op persoonlijke data-toe-eigening en data interpretatie.

Het CITYO-interactiemodel, en de nieuwe inzichten, ondersteunen nieuwe perspectieven voor kunst, ontwerp, HCI en wetenschap, en onderwijs, over emotioneel welzijn (inclusief sociale verbondenheid, samenzijn, disconnectie en isolement (bv. door trauma, dementie, depressie); neurodiversiteit en autisme; ontwerp van e-learning en presence design) in hybride, A.I,. XR, mixed en *merging realities.*

About the Author

Karen Lancel works at the intersection of art, science, technology. Her work is inspired by the changing experience of physicality, privacy, empathy, intimacy and togetherness, in our digitally networked societies.

Within the artist-duo with Hermen Maat (Lancel/Maat, www.lancelmaat.nl) she orchestrates participatory performances, installations and innovative meeting spaces. Central in this research is technically mediated intimacy as a form co-creation. She explores agency to co-create intimate connections, of touching and feeling touched, among multiple participants - crossing boundaries between public and private spaces, in hybrid, online, XR and merging realities.

These orchestrations make use of new, emergent and imaginary technologies. In multi-disciplinary partnerships Lancel and Maat research and develop haptic interfaces including smart wearables, online platforms and brain computer interfaces, from an ethical and bodily performative design approach.

Lancel/Maat's innovative art and design concepts have led to new perspectives on the design of emotional well-being (including social connection, disconnection, and isolation (e.g. through trauma, dementia, depression), neurodiversity and autism), e-learning and presence design. Their research has been presented in lectures, academic journals and book publications (CHI, InderScience, Springer Verlag, Leonardo).

Exhibitions of their internationally awarded interdisciplinary artworks (supported by Mondriaanfonds, Stimuleringsfonds, NWO, EIT) include Venice Biennale 2015, Ars Electronica Festival Linz, Stedelijk Museum Amsterdam, Waag Society, Rijksmuseum Amsterdam, ISEA2016 Hong Kong, National Museum of China, Beijing; EMAP European Cultural Program.

During the many international collaborations and teaching appointments, Lancel discovered the need for an interaction model that would support discussion and concepts for the design of technically mediated *shared social touch* interaction, and feeling touched. Crucial in this model are social, technical, ethical and esthetical aspects. This interaction model, 'Can I Touch You Online?' (CITYO), is at the heart of this thesis.

This novel interaction model, that combines the two key elements Sensory Disruption and Shared Reflection, is the first interaction model for shared experience of social touch and feeling touched in hybrid connections.

List of publications

PEER REVIEWED PUBLICATIONS of scientific articles related to this thesis:

(1) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2020). 'Saving face: shared experience and dialogue on social touch, in playful smart public space.' In: Nijholt, Anton (ed.) *Making Smart Cities More Playable: Exploring Playable Cities*, 179-203.
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PEER REVIEWED PUBLICATIONS: ONGOING WORK

(1) Lancel, Karen, Hermen Maat and Frances M. Brazier.'Touch My Touch: Sharing Intimate Experience of Social Touch in Remote Interaction, through artistic design'. *(Under Review)*

(2) Lancel, Karen, Hermen Maat and Frances M. Brazier. 'How Close Can We Get? Artistic Design for Shared Empathy in Intimate Connections, through Online Multi-Brain Computer Interfaces'. *(Under Review)*

(3) Lancel, Karen, Hermen Maat and Frances M. Brazier. 'From Tele_Trust to Touch My Touch' *(In preparation)*

OTHER ART, SCIENCE, DESIGN AND TECHNOLOGY ARTICLES

(1) Lancel, Karen, Hermen Maat and Frances M. Brazier (2022) 'Empathy Ecologies': New Connections between humans and plants in Techno-Ecological Sensoriums'**.** *RIXC Art Science Renewable Futures Conference 2022 'Splintered Realities'*. RIXC New Media Culture Riga. *Online Conference Lecture.:* https://www.youtube.com/watch?v=Q0N4PBzBb-w (20:00/1.02.04 - 44:08/1.02.04).

(2) Blanton, Andrew, Lancel/Maat (2022) 'Sounds of Feeling'. In: Malinowska A, Valentina P (eds.) Data Dating. Edition Galerie Charlot Paris/ Intellect Books UK.

(3) Lancel, Karen, Hermen Maat (2020) 'Viral Intimacy'. IN Lene ter Haar, Valérie-Anne Houppermans, Astrid Kaminski, Beate Gerlings (Eds.) *Recipes for the Future*. Dutch Embassy Berlin, Onomatopee 196.

(4) Lancel, Karen, Hermen Maat, and Frances M. Brazier (2018) 'Can I touch you online?' In: Price, Sara, Kerstin Leder Mackley, Carey Jewitt, et al. (eds.) *Reshaping Touch Communication: An Interdisciplinary Research Agenda*. CHI 2018 Montreal. https://dl.acm.org/doi/10.1145/3170427.3170603; https://intouchchi.wordpress.com Conference Article

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(6) Lancel, Karen, Hermen Maat H (2012) 'Tele_Trust'. In: Nevejan, Caroline (ed.) *Witnessing You, artistic research into being and bearing witness*. Publisher: Participatory Systems Initiative, Technical University Delft, pp 245-260

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Propositions

accompanying the dissertation

Can I Touch you Online?
Embodied, Empathic Intimate Experience of Shared Social Touch in Hybrid Connections

by

Karen Lancel

1) Shared Social Touch requires the design of Sensory Disruption and Shared Reflection.
   (this thesis.)

2) Shared Social Touch need sensory connections that partly replace each other.
   (this thesis)

3) Visuo-haptic motor data interaction of affective touch gestures provides new potential for the design of Shared Social Touch.
   (this thesis)

4) Design of Shared Social Touch must focus on shared performativity in social interdependence.

5) Shared intimate experience is always the result of co-creation.

6) Performance scripts for Shared Social Touch must include perception of touch on the body, in the brain, and in the imagination.

7) Design for empathy in digital interaction can learn from shared physical social touch experience.

8) Online my body is not only mine.

9) If in Chinese language animals are defined as moving objects,
   then social robots are animals.

10) Kisses are unique – they cannot be exactly repeated and validated.

These propositions are regarded as opposable and defendable, and have been approved as such by the promotor Prof. dr. F. M. Brazier.

Stellingen

behorend bij het proefschrift

Can I Touch you Online?
Embodied, Empathic Intimate Experience of
Shared Social Touch in Hybrid Connections

door

Karen Lancel

1) Shared Social Touch vereist ontwerp van Sensory Disruption en Shared Reflection. (dit proefschrift)

2) Shared Social Touch heeft zintuiglijke verbindingen nodig die elkaar gedeeltelijk vervangen. (dit proefschrift)

3) Visuo-haptische motorische data-interactie, van affectieve gebaren van aanraken, biedt nieuwe mogelijkheden voor het ontwerp van Shared Social Touch. (dit proefschrift)

4) Het ontwerp van Shared Social Touch moet gericht zijn op gezamenlijke performativiteit in sociale onderlinge afhankelijkheid.

5) Een gezamenlijke intieme ervaring is altijd het resultaat van co-creatie.

6) Performance scripts voor Shared Social Touch moeten waarneming van aanraking mogelijk maken op het lichaam, in het brein en in de verbeelding.

7) Ontwerp voor empathie in digitale interactie kan leren van de gezamenlijke ervaring van fysiek sociaal aanraken.

8) Online is mijn lichaam niet alleen van mij.

9) Als in het Chinees dieren worden gedefinieerd als bewegende objecten, dan zijn sociale robots dieren.

10) Iedere kus is uniek - een kus kan niet precies herhaald en gevalideerd worden.

Deze stellingen worden opponeerbaar en verdedigbaar geacht en zijn als zodanig goedgekeurd door de promotor Prof. dr. F. M. Brazier.