Beauty in Interaction: A Framework for Social Robot Aesthetics (Pandemic Edition)

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Social machines have held public fascination in one way or another for a good part of the past centuries. From talking cars to singing clocks, humans have delved into the indulgence of possibilities of creating technology that can not only do our deeds but be our friends. Along with the social distancing and lock-downs of the COVID-19 pandemic, the social needs of human beings have become ever more pronounced. Even hugs seem to be a forbidden luxury these days. Robot form has been the main focus of studies in human preference. This chapter delves beneath the skin to understand social robot aesthetics in terms of the building blocks of social interaction and embodied experience. We focus on explaining the rationale and development of a framework of social robot aesthetics (SoRAEs) that connects deep theory to practical design and development action.

Keywords: social robot aesthetics; social aesthetics; experience; intersubjectivity; social cognition; embodiment; Social Robot Aesthetic (SoRAEs) Framework

Introduction

Throughout history, humans have been fascinated in creating their likeness. Evidence can be seen through centuries' worth of popular culture, philosophy and science alike. Whether it has been a question of creating a friend, lover, child or servant, machine-based human likenesses have never failed to capture the human attention or imagination. Moreover, it is not simply the machines that resemble humans in some way that trigger humans to deal with machine objects as if they were human. For instance, in their book *The Man Who Lied to His Laptop: What We can Learn about Ourselves from our Machines*, Clifford Nass and Corina Yen [1] presented research that demonstrates how people can feel equally as much for machines as they can for other people. Nass and Yen focused on anthropomorphism - the way in which humans treat objects like people (able to experience emotions and feel). In particular, their work highlights how mechanically animated objects and information technology (IT) generate

responses in humans that makes them instinctively feel that these objects have a mind (cognition) and indeed soul (experiential consciousness) of their own.

A range of emotions were shown to arise through social interaction with the computers. In Nass and Yen's reported studies, different types of linguistic responses to study participants generated various types of emotions and attitudes towards the computers. Empathy in particular, was one of the forms of emotional responses that arose in situations where the computer was not behaving (operating) in the way it should have, yet experiment subjects were 'kind' to the computer in order to avoid hurting its feelings. This approach to animated technology can be viewed and explained from a number of ways, none-the-least one in which humans resist insulting the technology in fear that it will get offended and in turn, will malfunction in retaliation. Thus, through anthropomorphism a form of cybernetic (organic combined with non-organic) intersubjectivity, or the sharing of experience [2], can be observed. This intersubjectivity serves to predict and adjust to the behaviours and reactions of the other interactive party [3] and anticipate or expect the behavioural reactions in return [4]. Thus, people modify their behaviour in anticipation of the capabilities and reactive behaviour of the other parties in any interactional situation [5].

Not only does this example give insight into the ways in which humans automatically endow objects with emotions and consciousness, but it also highlights the complexity of social interaction. This social interaction is a dynamic, transactional process in which numerous factors are at play, informing the experience of the interaction itself and its aesthetic qualities [6]. In the realm of human-computer interaction (HCI) much attention has been placed on aesthetics as a means of defining attractiveness or beauty as opposed to unattractiveness or ugliness [7]. Philosophical traditions in aesthetics however, show that aesthetics and these perceptions of the

qualities of aesthetic experience are not so easily classified or opposed to one another [8].

In the year 2021, it is little surprising that ever increasing attention is being drawn towards the design and development of intelligent systems. Coupled with this development of the previously imagined possibility of autonomously functioning and learning machines, is naturally the excitement of the possibilities for our mechanical friends to be realised. By mechanical friends, we refer to artificial companions - robots - who can communicate, think and enable humans to feel as though they were engaged in meaningful social interaction, generating social experiences of a genuine nature [9]. Much of the research to this end has focused on human perceptions and emotional reactions to robot design from a visual perspective (see e.g., [10]).

Why social robots? Basic needs and human social make up

The COVID-19 pandemic has shed light on numerous complex problems - both economic and biological. The social needs of human beings can be seen as closely linked to human biological and psychological make up [11]. Healthy, active social relationships and interactions can be seen to inspire thought and motivate humans towards engaging in action, whether it be learning, creation (from building a house to cooking or designing) [12]. In fact, aesthetic experience can be seen as the act of doing, making sense of the world through the body, its positioning and interactions [13][14][15]. These basic building blocks can be understood as constantly present in social interaction - encouraging or discouraging humans from engaging in interaction.

Social interactions and relationships in themselves are manifold. The variation in these types of interactions and relations also means a diverse range of compositions of how and what we are experiencing. Interactions not only comprise two or more individuals, but also context, purpose, intention, motivation etc. The social isolation

caused by social distancing during the COVID-19 pandemic has placed substantial limits on the range of social interactions people can experience with others. While people have sought alternative avenues for social contact from increased video conferencing to deeper engagement in social media and overall Internet content, the matter of these media being insufficient for compensating real physical contact and proximity is an issue that is constantly raised (see e.g., [16][17]). The limitations of physical social contact raises questions regarding social wellbeing. While the construct of social wellbeing in itself needs to be carefully deconstructed and analysed, the interactional and relational experience involved in contributing to, or deteriorating this social wellbeing should also be understood. For this reason, here we focus on the aesthetics of social robot design to isolate the experiential properties involved in human social robot interaction [18].

In order to approach this topic, we consider five dimensions to begin with: 1) the *why*, 2) the *variables*, 3) the *how*, 4) the *assessment* of resources, and 5) the *what*. Before embarking on the commitment to design social robotics there needs to be an understanding of the *why* - why venture into the topic of social robotic design in the first place? What is there to achieve from the interaction itself? Then, there are the *variables* - what are the factors involved that affect the experience of social interactions in various use contexts? Given the situation much faced by members of the global population during lock-down, the reality of existing in a small apartment without physical human social contact, it is important to understand what from human lived experience remains and what is missing when not engaged in physical social contact. Moreover, and of great importance to this chapter, are the exact factors aesthetically (physically), socially and psychologically that are at play when engaged in social interaction with robots. The composites of these factors can be divided into:

- The environment (where interaction happens)
- The actors/agents (With whom/what? And the factors/associations connected to these actors/agents)
- Mental and physical states of the human(s)
- Material design and logic of the robot

When deliberating on the concrete levels of design, system logic and development, it is also important to understand which variables are somewhat consistent in social aesthetic experience, and what may be dynamic and altering. Thus, the *how* is critical when attempting to match human-robot interactive experience to context. That is, how should the variables change in order to reach the intended end result (desired experiential outcome)? Additionally, from this perspective we may pose the query of the degree to which we, as designers or engineers, can affect and/or control the variables contributing to the aesthetic experience of social interaction with robots.

An assessment of *resources* (both immaterial and materials factors) should be undertaken to know what is at hand in terms of designing for social experience. This leads to the *what*, of determining the technical (functionalities) and aesthetic design choices (physical attributes) that should be made for the systems in relation to their possible use contexts, and the variation between use contexts. Indeed, there should be an evaluation of whether or not the desired end result can be achieved through the assistance of robotics after all, or whether there would be another way of achieving an even better social experiential result (for instance, alternatives may be virtual or augmented reality, multisensory internet or even reading poetry and consuming other cultural products etc.).

Sociological dimensions of social interaction

Social interaction, or social relations, describes the connection or relationship involving two or more people (IGI, 2021). Social interaction often involves speech or written communication, yet not always. Social interaction may involve body language and other communicative or actional cues. Communication in itself can be seen as one of the fundamental bases of society [19]. In interactions or relationships, verbal or natural linguistic communication may or may not take place, yet there is some kind of interaction or processing of the other's presence and features, and what these mean to each perceiver from an individual standpoint [20]. Individual agency is therefore a fundamental component of social interactions as it establishes a platform upon which social structure is formed. In relation to sociologist Max Weber's [21] social action theory, a social act is behaviour that accounts for the behaviour (actions) and reactions (responses) or individuals (agents). Here, actions and behaviour are social if they are aimed towards and considered in relation to other agents. Thus, when subjective meaning is attributed to others and in conjunction with behaviour connected with others, it is considered social.

While the above describes social interaction in a nutshell, this is indeed an oversimplification of Weber's theory of social action. In fact, it seems that Weber [22] likens action to a simple gesture or movement within a specific environment or context [11]. It becomes a social action when it is purposefully and meaningfully aimed towards others [11][22]. Weber organised social actions into three main types: 1) rational - instrumental-rational (calculated and strategic) and value-rational (creation of moral standards); 2) affectual - actions implicated with emotions and feelings; and 3) traditional - social actions that are guided by habit and custom. The types link social actions from micro (individual) levels to macro (community and societal) levels and vice versa.

Likewise, Talcott Parsons [23] connected the micro to the macro level in his adapted model of social action. Parsons was influenced by intellectual traditions that included positivism, utilitarianism and idealism, and had placed a considerable amount of work into explaining human behaviour in terms of unit acts that are said to be guided by norms, beliefs and various symbols. Parsons argued that humans were limited by their own ideas and material realities [11]. This links the individual level actions defined by both the psycho-biological circumstances of the actor (human) to the ecology of their situation. Quite readily, during the current COVID-19 pandemic, this relationship can be understood through the biology of prevention (social distancing to reduce spread of the viral infection), and psycho-biology of the reality of this social distancing - the conditions individuals live in within their limited face-to-face social contact, and how this in turn affects physical contact when restrictions are lessened.

Also, as is experienced and known in the current global conditions of crisis, social systems and the systems associated with social interactions are complex. In his book, *The Structure of Social Action* Parsons [23] states, “any atomistic system that deals only with the properties identifiable in the unit act . . . will of necessity fail to treat these latter elements adequately and be indeterminate as applied to complex systems" (p. 748-49). This is an important point to remember from the perspective of designing social robots and robotics for social interaction, as the micro, or unit-based perspective, fails to account for the multi-dimensionality, dynamics and variation of social interactions and experiences within these complex systems - the connected world of data, as well as human systems in the world at large. Parsons’ terminology of action refers to orientations that are linked to either motivation or value. *Interaction*, rather than pure action, comes into play when individual actors need to reconcile their orientations - i.e.,

there is a rebound, reflection and/or reciprocation of the actions and their orientations in relation to other actors[1].

Social systems

Thus, social interactions derive when actions are targeted towards other actors, and these in turn are reciprocated and reconciled [11]. This can be understood equally in relation to humans actions towards other humans, as in terms of interactions with technological artefacts, services and systems (IGI, 2021). Social systems emerge and evolve when interactions become formalised and systematically repeated. Parsons [23] argued that social systems could be classified and categorised. These classifications are referred to as pattern variables, also known in the work of Weber as 'social relations' and 'legitimated orders'.

These social systems can be seen to represent macro processes characterised by binaries that entail: universalism versus particularism; achievement versus ascription; neutrality versus affectivity. Moving down Parsons' model towards the micro, we can see these social systems emerging through the institutionalisation of interaction, that in turn are characterised by interaction that form our understanding of actions as instrumental, expressive and moral. According to Parsons, social systems can be deconstructed into units. These units inform modes of orientation that are divided into motivational factors (cognitive, cathectic, evaluative) and value-based factors (cognitive, appreciative, moral). These form the nature of interactions, or indeed actions, derived at the micro level. While widely applied, Parsons' model has received substantial critique. Namely Jonathan Turner criticised Parsons theoretical model for its

[1] We may even think beyond human actors, as in Action Network Theory (ANT), whereby everything - both human and non-human (e.g., technological) can be considered an equal actor, or equally influential within their respective ecosystem. See for instance, [24][25].

inadequacies in analysing micro processes. That is, these micro level, or individual level, factors and processes that are present and activated in interaction were not seen by Turner to be properly accounted for. Moreover, Turner argued that any static typology that aims to explain interaction and its properties will fall short of affording access to factors that contribute to interactions, their circumstances and experiences. There is also contention about the movement between understandings of micro and macro processes, and particularly the attention that is drawn to this movement before enough understanding has been drawn from either [11]. An outcome of this type of treatment of social interactions can be seen in heavily laden metaphorical assertions that macro processes are simply micro processes on different scales [26][27] and/or micro are macro processes at the individual level [28].

Symbolic interactionism

From sociology to psychology (social, behaviourist and phenomenological), including symbolic interactionism [26] crucial attention is claimed to be needed in terms of understanding the interaction between symbolic or outer, expressive elements of interaction and communication, with inner mechanisms. Symbolic interactionism for instance, is claimed by Blumer observes the way in which one's concept of world is shaped in interaction with others - others, including these expressive, symbolic elements. In fact, as a method for symbolically interpreting and analysing social interactions, symbolic interactionism describes how we connect to and navigate our world through series, networks and spaces of symbols [29][30][31]. In fact, symbolic interactionism was one of the main trajectories of semiotics (the science of signs) and pragmatism as we know it today (see e.g., [31][32]) whereby the human mind is in constant symbolic interaction with the world through signs [33][34]. What is more, these signs are relevant for communicating to individuals cognitively and affectively

about the relationship they as humans have regarding the interactive phenomena with which they are encountering.

This process constantly places the self (I, the personal self; or me the ecological contextualised self) in a comparative and evaluative relationship towards the *other* (person, technological design, animal, environment etc.) [26]. Equally, from a cognitive-affective perspective, similar observations are made in evolutionary psychology, particularly in the theories of Appraisal [35][36][37] and Core Affect [38][39] emotions emerge in relation to how people evaluate phenomena against what the phenomena can do in terms of promoting or affecting their primary concern - psycho-physiological wellbeing (of the body).

Thus, social interactions, and being in the world through spaces of symbolic interactions positioning and affecting the *I* or *me* in relation to the *other*, also induce primary emotional reactions (i.e., basic emotions such as fear, disgust, anger) - those which are immediate to humans in reaction to particular circumstances - as well as higher level or higher order emotional reactions that take place cognitively and associatively [40][41]. In Turner's opinion, within social interaction individuals seek the need for trust and self-confirmation. There is also the need for reduction in anxiety - anxiety being generated by the unknown, or likelihood of something posing harm to their wellbeing. Humans are dispositioned to seek group and community inclusion, in addition to the symbolic material gratification of the *I* [11]. There is a direct effect between group inclusion and acceptance by others on gratification and reduction in anxiety. Thus, the role of symbolism in identification, group coherence and interactional synergy cannot be underplayed, as the designs and expressions of these symbols and their application send conscious and subconscious messages in interaction that convey not simply discursive messages, but also emotional ones [42][43]. The experience of

belonging to a group or within a relationship is affected by people's ability to receive symbolic (discursive) and material rewards that are implicated as a continual component of interaction.

Social interaction and assemblages

Everything and everyone exists in contexts, which in turn exist in systems. Thus, when referring to complex systems, it must be remembered that the intelligent technological artifacts themselves are not the only phenomena presenting complexity, but rather, so too do the human systems surrounding them (social, cultural, political, economic etc.). We may think of these systems as networks, and in the same fashion as we turned to sociology for our understanding of social interaction above, we will once more turn to sociology, yet this time in our description of Actor Network Theory (ANT) [44], and particularly assemblages. ANT provides value for explaining the aesthetics of social interaction, and especially social robot design, as it exemplifies the dynamics and characteristics of the layers of our soon to be presented framework for social robot aesthetics in action.

ANT is a theory that strives to explain the natural, synthetic and social world humans exist in [44]. It is a social theory that puts forward the idea that social forces are not self-contained units. Rather, social phenomena and interactions should be dealt with empirically to describe, not explain, how social activity has operated in certain circumstances [44]. This form of argumentation would also to a degree cancel any attempts to construct a firm aesthetic model for social robot design, due to the fact that all social interactional processes are constantly in flux. Yet, from a human-robot social interactional perspective, ANT is ideal for understanding the social activities,

relationships and dynamics between humans and nonhumans, as all actors (people and objects) within the network are equal.

Then, if we move deeper into ANT and in particular observe Assemblage Theory (AT) we can understand that all objects, people and contexts exist in assemblages - systems of other actors (components) that formulate together in particular ways to give meaning, shape experience and formulate action [45]. While one may be tempted to think of these assemblages as clusters, they are rather multidimensional and layered compositions of elements and factors that shape the existence of phenomena. For instance, the design and object of a stirrup means nothing on its own. Rather, the stirrup gains meaning and takes shape through its combination with a horse and its rider [46]. The experience and existence of this assemblage is in turn affected by context and the addition of other objects, i.e., rifle, military uniform, or show grooming etc. The stirrup is but one component in a systemic object, composition - assemblage. The addition of context, its factors (material conditions, objects etc.), actors (onlookers and affectors) changes the coding of the overall assemblage in terms of how it is interpreted and operates. A similar type of logic exists within AT as can be seen in for instance in Daniel Dennett's (2006) 'Framing Problem' in AI programming, whereby each actor or element within a context contributes to a different set of possible events, and every piece of information could result in a different *narrative* or sequence of thoughts.

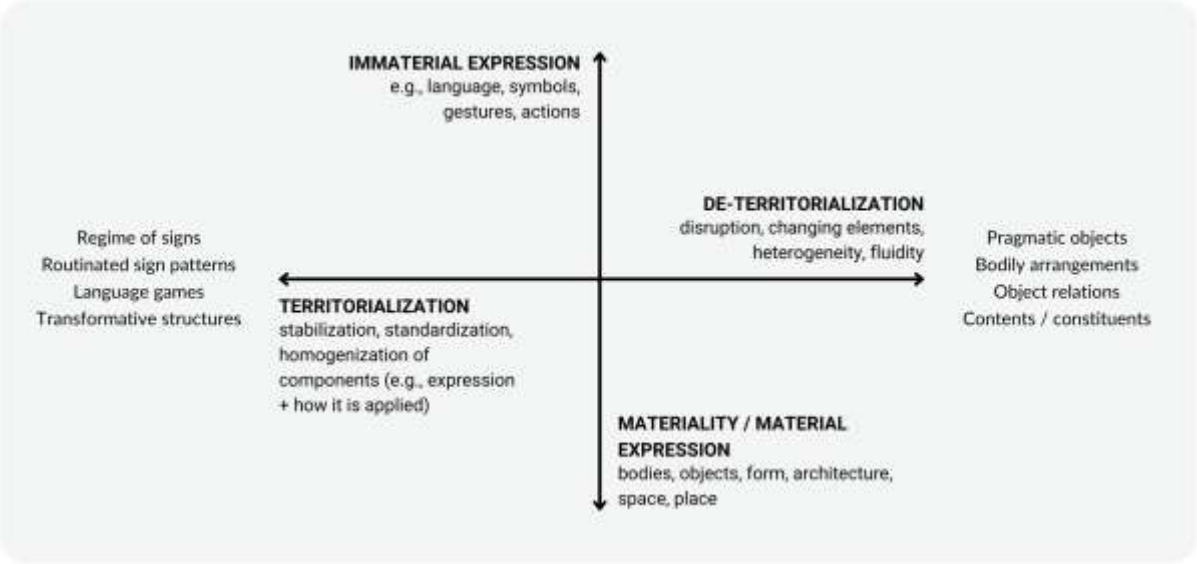

Figure 1: Social assemblages adapted from DeLanda's [46] map of exteriorized relations

This holds for AT from a social actor perspective. Deleuze and Guattari [45] argued that material and linguistic systems self-organized through means of territorialization (stabilization of the components of an assemblage through homogenization of its components or the appropriation of components from a homogenized source, e.g., routines, rituals, gestures specialised vocabulary), stratification or strata (social wholes), and coding (linguistic function of fixing identities of the strata). Manuel DeLanda [46][47] systematically explains AT in a way that has often been referred to in the fields of design. In Delanda's account, there are series of specific functions that are shared among assemblages. Similar to Deleuze and Guattari, these are: the material-expressive; territorialization-deterritorialization; and coding-decoding (see Figure 1). DeLanda explains that there are great variations in assemblage components that play a material-expressive role. Yet, the minimum requirement of these material components is that they feature sets of human bodies that are psychologically and physically oriented in relation to one another. From a semiotic (sign-system)

perspective, this enables the social-interpretive element in which intentionality shapes material expression (coding), and equally, intentionality and cognitive-affective human processing serves to interpret (de-code) the expression [48]. A simple example of this type of assemblage is a face-to-face conversation. Drawing on both Parsons and Weber's models of social action and interaction, we can see similarities in DeLanda's theory as assemblages can just as easily refer to these micro level conversations, as they can to macro level organisational hierarchies and community structures (social systems). These assemblages or social systems entail more than just humans, but also artefacts from food to complex machinery or urban planning for instance.

Zizek [49] titles his analysis of Deleuze as "Organs without bodies" in regards to the attention placed on the mechanics of these complex and dynamic assemblages. Moreover, Zizek invests in explaining the immaterial nature of the expressive dimension of the social world through illustrating content, meaning and signifiers (symbols). Zizek's immaterial approach largely ignores the material components. This is somewhat problematic in that interaction is reduced to a purely social level, without regard for the role that material artefacts have in conveying, facilitating and contributing to the social. In this chapter, we argue that the material dimensions are equally as important as the immaterial - both of which are as expressive as each other. Material form and the actions produced through and in relation to this form are equally as cultural and socially expressive, as the linguistic constructs used to express them.

Here, it is important to return to the notion of territorialization in order to understand that territorialization refers to a stabilization process of an assemblage [47]. This is where an assemblage reinforces its own identity at the same time as it ascertains identity within its components. There is process and progress that can be seen in the stages of an assemblage and its territorialization. For instance, a random meeting with

an acquaintance on a street will start out lightly. It is framed by its context and environment - that of the urban area (spatial) and its timing (temporal) combined with other factors - and then takes on a stronger sense of territory (identity and narrative) through space, place and intensified dialogue. While both actors within the conversation may indeed hold different interpretations or understandings of the conversation in question, which in themselves manifest in differing experiences for each individual, a more standardised or routinised use of language and gestures begin to concretise. The discussion becomes a ceremony or synchronised performance, even if only for a short duration of time. Due to the ephemeral nature of assemblages and territorialisation in itself, the stabilisation that occurs within this interaction is an open one, free to morph, dissolve and re-territorialize when similar conditions and components come together once more. Yet, territorialisation in itself is always an active process [44].

This understanding of social interaction as occurring in actor networks (networks of human and non-human actors) and through assemblages formulations of various actors and components that in a sense, set the stage and frames of the interaction, are highly important when attempting to understand the aesthetic dimensions of interaction with social robots. This is due to the fact that one size does not fit all in terms of these aesthetic layers and how they are experienced, and indeed the interaction space when understanding it through assemblages. The material-expressive elements of the social robot design are one important element of the assemblage and its character. Yet, these material elements are continuously territorialised (stabilised and standardised), then deterritorialized (de-stabilized) depending on the configuration of components, changing of space and altering of time.

Embodiment within assemblages

This understanding can be taken forward towards the cultural and philosophical scholarly fields of embodiment. In particular, Maurice Merleau-Ponty [15] in his phenomenology of perception describes how human lived experience exists in relationships between our body and the outside world. Thus, the body and its proximity to others (agents and objects) provides not simply the vehicle through which the world is perceived, but how it is perceived and made sense of in chains of material and immaterial relations. This close connection between the body and the outside world is termed, "the intentional arc" [15]. The intentional arc explains the way that at all times the human body is undergoing constant and dynamic interactions with the world and its phenomena, and that humans learn the world not simply as mentally bound representations, but information that is stored throughout our entire body [50]. While seemingly dislocated from Weber's social action, in fact, it may be understood that the body, its expressions and relations are actually semantic organisms that *give meaning to action* [51][52]. The body through this light also affects individual agency as both physical factors and limitations guide the way in which actors may affect and be affected by the world, allowing for interpretations of positive (affiliative) or negative (agonistic) interactions [20][22] in accordance to the needs and affordances of the body [56][57]. This may also be seen as inherent within the cognitive-affective theory of Appraisal in which all phenomena encountered in the surrounding world is appraised or evaluated either directly or indirectly through the primal concern of the body [35].

Another concept originated by Merleau-Ponty [15] that is useful for the discussion later on in this chapter is the body's tendency for maximal grip. This notion describes the way in which through the body, actors draw closer to situations via refining responses through practice. That is, when encountering phenomena over and over again, there is a tendency to learn through muscle and sensory memory and to optimise or

refine our responses in a gestalt (or wholelike) way [50]. Once more, in light of Appraisal Theory, this learned and refined way of being in relation to other bodied phenomena will also inform the cognitive-affective processes. These processes generate emotional responses and qualities within social encounters in relation to how the encounters or assemblages and their components connect with fulfilling or potentially damaging wellbeing. Interestingly, this is where embodiment and social interaction meet collective consciousness, as collective consciousness and its manifestation through collective enactments establishes the basis and purpose for the engagement with others to begin with.

Engaging with others through enactment that may be linguistic-based or non-linguistic-based enables a transaction of information that supplements and compliments the already known or existing information of an individual [53][54]. On this note, we may look closer at the definition of social interaction and its components. Social interaction can be defined as an altering and dynamic series of meaning-making or semantic actions between two or more parties [55]. Interaction can be mediated by or transferred via technology (systems and artefacts). This is where we get back to the sociologists. Parsons' [23] conceptualization of social interaction breaks the action down into unit acts. Unit acts define a selection process that engages in alternative means (varied choices) to a specified end (end-goal). Feeding into this process are the idea systems involved within the individual and within their collective consciousness (culture and social beliefs) and the situational conditions (circumstances in which the selection is being made). The level and engagement within this selection process hinges upon both the decision-making capabilities of the individual as well as the goal orientations - what is the desired outcome of interactional engagement?

In other words, the sociological perspectives put forward both by Parsons and developments to Parsons' model seen in Turner [11] understand that the material conditions and positioning of the body interact and intertwine with beliefs, values, norms and other symbol systems. Thus, through this embodied experiential and sociological lens, we may see that social interactions and their experience are constrained and framed through the material and immaterial conditions of bodies (organic and technological) and their connected symbolic systems (communication and representational expression). These in turn are affected by the changing circumstances of the bodies - changing biologies and evolving techno-cultural conditions [11]. In order to understand the aesthetic factors and dimensions of social robotics, it is vital to comprehend how the actors, their orientations and social actions (interactions) exist within these complex systems.

Embodied interaction

The main trajectory of the efforts of this chapter is to argue for an approach to social robot aesthetics that operates on embodied and discursive levels. In order to understand the aesthetic dimensions and components of social robot design, we *really* need to understand the essence and factors of social interaction in the first place. In order to derive the Social Robot Aesthetic Framework we have mapped the core theoretical components in Figure 2. Through considering Shusterman's [56] notion of 'somaesthetics' (bodily aesthetics), and the understanding that the body is both a vessel for perception and bodily sensations, as well as an expressive vehicle that impacts the world around the body, we can model an understanding of embodied social interaction experience that is both affective and effective. The body is not merely a lump of flesh but an assemblage of material and immaterial properties (cultural, symbolic, values and systemic relationships) in its own right.

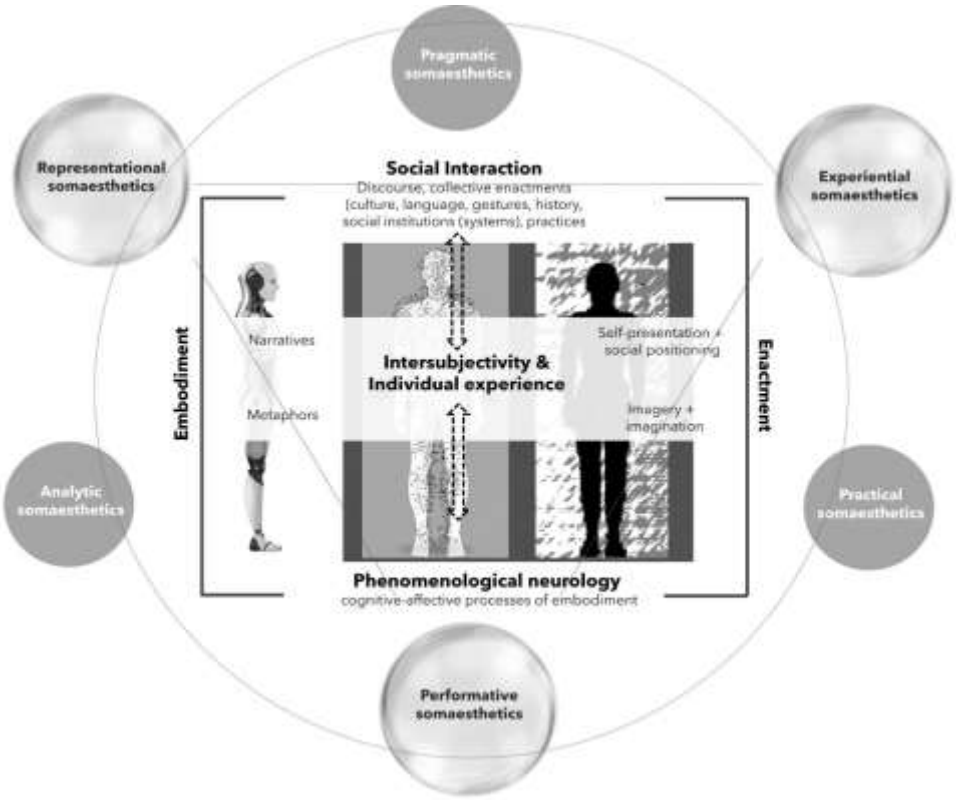

Fig. 2: Embodiment, somaesthetics and social interaction (adapted from [53][57])

Immanuel Kant [58][59] argued that the aesthetic was a type of knowledge. This was in contrast to earlier theories that posited the aesthetic as a particular ability within sensory perception [60]. The Aristotelian [61] view of the aesthetic was that of "unity in manifold". Resonating with the relatively modern theory of the 'mere exposure effect' [62], unity in manifold describes the way in which people recognise beauty in phenomena that they have been much exposed to. This corresponds with modern understandings that consider aesthetics in relation to cognitive-affective processes such as primary emotional reactions versus higher order cognitive emotions [35], as well as preference for the familiar [63]. These processes involve and concern the full body in relationship with the experienced phenomena of any interactional situation.

Social interaction with computers (and robots) and aesthetics

Interestingly, a bridge between robots, AI, aesthetics and art can be seen in recent developments that focus on robots in art creation. Whether the role of the robot is that of a "brush tool" or as a powerful assistant, this creative level of conceptualizing robotic capabilities is equally as fascinating as the development of AI itself. Vast speculation rests in the capacity for robotics and AI to take over the role of humans in creative processes (both from artists to designers). Yet, a firm argument for humans in fulfilling this role continues to exist within intentionality and consciousness - without intentionality, and intention, is any production creative? Subsequently, shifting this discussion into the context of the current chapter we may view the capacity for creativity, and or, the aesthetic experience generated from interaction with a perceived creative being (object, system) as a pivotal point for creating depth and cultural overall in social interactional design. Chen et al. [64] have identified four main ways of viewing robots in creative processes: 1) that of the programmed artist, or main producer of artistic output - still without own intentionality; 2) robots as co-creators - utilizing AI and robotics to go beyond the limits of human cognition and bodily capacity; 3) robots as medium - the robots in themselves serving as the site for art; and 4) robots as human augmentation - creation and representation of the human ideal. Either way, this art-based robot insight provides fruit for thought in relation to the dynamics and discursive contribution robots may play within social interaction. For, aesthetic experience in itself is a creative process [13]. The more humans can see robots as co-creators, or even equal actors within assemblages, the more meaningful interactions with these objects (beings) become.

Moving back towards the building blocks of social interaction, over the years there have been many interesting discoveries relating to the nature of human intentionality and emotions in social interaction with technological objects. In fact from

a research perspective, many scientists have discovered that often researchers can obtain more precise and consistent data about human-to-human interaction, when studying social interaction between humans and computers [65]. This is due to the technologically enabled possibilities of precise interactional (linguistic, expression, gesture) replication from one subject to the next. This means that the same conditions may be presented to human subjectivities repeatedly and indefinitely. Yet, while from the science lab perspective, computers, AI and subsequently robots, may offer advanced opportunities for gaining rich and robust research insight, in actuality and within the context of real life, these systems may fall short of offering a total and fulfilling social interactional experience. This is also so for the belief and utilization of robots as so-called 'creative objects', or systems capable of creativity in themselves. As creativity is a highly complex and debated construct that both relies on conscious thought (intentionality, [66][67]), and depending on the type of creativity in question (divergent versus convergent thinking, Big 'C' versus Little 'c' etc.) human knowledge retrieval, framing and indeed serendipity come into play.

However, endowing AI or robotics with the perceived capacity for creativity can be problematic from a social interaction point of view. In his 1976 paper titled, "Artificial Intelligence Meets Natural Stupidity" Drew McDermott [68] coined the term "wishful mnemonics" to explain the way that people not only have a tendency to believe that the machines are capable of more than they can, but through labelling the machines, their functions and data with human cognitive traits we are also misleading ourselves into believing that they are more human than they are. One of three mistakes McDermott accused AI researchers and developers of was labelling AI identifiers after concepts such as, "understand", "is a" (making a definite or concrete connection) or "theorem". What McDermott argued was that developers should name identifiers

according to what the programs do, rather than what they would like them to do. In other words, back in the 1970s, as we still see today, there is a grandiose estimation of what people (particularly developers) feel computers, AI and robots should and are capable of doing. These do not match reality. They should therefore, not be used as they elevate peoples' expectations through wishful thinking. This results in disappointment as it establishes expectations for the interaction that are simply too high [5]. This is particularly the case for designing human-like android robots for social interaction, as a key goal within this process is to design a machine that is as close to human as possible.

Moreover, developing robotics that can imitate humans physically, and perhaps materially, is one matter, yet, establishing a social robotic system that is capable of not simply symbolically processing natural language, but understanding and interpreting it is another. To create real understanding and interpretation, there must be the capacity to attribute non-symbolic, immaterial and other associative properties and qualities. This would enable flexibility of thought, spontaneity in response and more than anything, creativity in social engagement. The bottom line in this argument that holds strong for this current article is that in order to fully understand and effectively develop the aesthetic properties of social robots, we need to move further than the formalistic material components, and indeed the mechanical capabilities, as particularly at this stage, we cannot place too much hope in the capacity of AI [69].

From a social aesthetic sense, the over-estimation of technological abilities and mistaking of database analytics as skills can be seen as a major drawback when designing these systems for social interaction. In fact, through a better understanding of humans and adjustment of the expressive communication around social robotic systems (i.e., the language and labels that describe these systems to people), a richer, more fulfilling experience can be established through deflating estimations in order to lower

expectations. Moreover, it is often forgotten that some of the characteristics that contribute to fulfilment, satisfaction and positive experience in social interactions are actually the randomness and unpredictability of human imperfection [70][71].

To really understand this from the perspective of aesthetics, we must first define what we mean by aesthetics. Aesthetics in itself is a broad field of philosophical study that is often connected with artwork and notions of beauty. Yet, there are many more understandings that incorporate anything from the qualities of experience, judgment and values to object-based understandings, expressions of culture and taste [72]. Here, the term 'aesthetics' links to notions of immediacy in experience. This immediacy has been described by Davide Panagia [73] as:

> *"...the temporality of an aesthetics of politics. When an appearance advenes, it strikes an impression on a sensorial apparatus, variously conceived. In doing so, it disarticulates our senses of constancy, continuity, and commonality. The immediacy of an aesthetics of politics is thus rooted in an ontology of discontinuity."*

In HCI terminology, we may easily refer to research on presence and immersion through the 'experience of being there' [74]. This is an all engaging experience in which artificially constructed or not, the interaction and events themselves become merged with our embodied realities. Philosopher David Hume [75] described the concept of *taste* (as in preference) as a form of internal sense. If, on a simplistic level, we understand that there are five external (direct) senses - sight, taste (tongue-based), olfactory, touch, sound - then an 'internal' sense relies on mentally stored information (i.e., knowledge and associations from previous experiences, and other representational contents such as sense data [76][77] in order to function. That is, an aesthetic experience

combines sensory information from the external and internal (reflex or secondary) senses to form an embodied impression, sensations and meaning within encounters. Thomas Reid [78] argued that:

> *Beauty or deformity in an object, results from its nature or structure. To perceive the beauty therefore, we must perceive the nature or structure from which it results. In this the internal sense differs from the external. Our external senses may discover qualities which do not depend upon any antecedent perception… But it is impossible to perceive the beauty of an object, without perceiving the object, or at least conceiving it.*

It is precisely this point in the nature of aesthetics that rely on the human perceiver and experiencer, that we emphasise in this chapter. For, in a certain moment at a given time, more people within a study sample may respond positively to a certain social robot design than others. Yet, at another moment, and potentially with another group of people these preferences, and tastes, may have changed. For this reason it is important to understand the combination of sensory information and mentally bound antecedents to establish a formula, or framework, that describes how humans experience the aesthetics of social robot design.

In reflection of these aesthetic discussions, beauty itself is a highly complex construct, both in terms of its understanding, as well as in terms of the way it presents itself through artefacts, systems, beings and other phenomena. While the ability to perceive and/or conceive the nature and structure of artefacts presents one part of aesthetic engagement, it does not explain beauty and the experience of beauty fully in itself. This is due to the fact that the combination of internal and external senses in aesthetic experience is highly dynamic, contextually, socially and psychologically

dependent and the qualities (qualia) of these experiences are in turn, pertinently subjective. Aesthetics emerged through discourse over 200 years ago along with major societal shifts regarding the institutionalisation of art [79]. These discussions were used as a vehicle through which to intellectualise creative expression, distinguish between artistic or intentionally creative efforts and other domains (e.g., handicraft and mechanical manual labour), and to create distinctions on cultural and societal levels - coupling sophistication of creative expression with discussions on *taste* and the ability to appreciate the structures and mechanics of these pieces (higher order cognition and emotions).

3.4. Structuring interaction and discursive aesthetics

Engagement with robots, and even AI when looking at the role of the body in enabling the human mind and cognitive function, is a fully embodied process. This includes engagement in interaction. Returning back to McDermott [68] we can see that from the perspective of human experience, and indeed, the experience of socially interacting with other humans, there is a fine line between intellectual sophistication and stimulation, and imperfection within human discourse. Prominent characteristics of AI and traditional computational technology holds in their symmetry and accuracy of calculation and semantic analysis. Whereas, human beings are prone to asymmetry (both physically and cognitively as seen in biases for instance). These are often perceived in terms of quirkiness or the often referred to 'common sense' [69]. Interestingly, in Nass and Yen's [1] sociological research on human-to-human interaction, their team discovered that the perfect confederate to study was a computer. This is due to the fact that computers do not alter. Rather, computers remain consistent in content, state and demographic characteristics. Computers are valuable from the social interaction perspective as they can evoke diverse social reactions and responses that may be repeated in exactly the same action continuously (24/7). Furthermore,

computers are not affected by their subconscious responses, and have the capacity to avoid unconscious biases presented by users (humans). Finally, no matter what the communicational output, computers operate via rules. From a programming perspective, there is no ambiguity within the machine's logic, and while humans and humans as users, may not be able to see this logic, transparency through knowledge of the stability of machine behaviour should create an underlying sense of safety through consistency. For, as Nass [65] stated, "Rules are incredibly powerful!"

Computers can however, be programmed to give 'asymmetric' or quirky questions and responses, making their interaction seem realistic, as has been discovered in relation to the Turing Test, whereby human errors and oddities have been incorporated in the computer responses to give its communication an air of human authenticity [80][81]. If we think of interaction from the perspective of learning, and the potential of learning something new occurring through abnormalities in discussion such as mistakes, new details to older stories, misunderstandings, poor grammar etc. then it can be assumed that aesthetically, these imperfections have multiple aesthetic qualities. These qualities range from this excitement of anticipation of discovering more (see e.g., [63]), stimulating higher order cognitive-affective processes similar to those associative processes that occur during art appreciation. There are also primary emotional reactions (or close to primary) by the human recognising the AI as imperfect, thus, not posing a threat to the human's existence. To break this down into the main points of connection between human cognition and aesthetic experience, we can see that some of the key components of human understanding contributing to interactional and aesthetic experience are [65]:

- Intuitive physics, biology and psychology
- Mental models of cause and effect

- Vast world-knowledge
- Abstraction and analogy

These main points can be seen throughout this chapter's descriptions on social interaction and aesthetics to varying degrees. Yet, to understand how they operate in the context of social robot aesthetics, we can look closer at preferences and human emotional responses to certain types of interactions, and interactional structures. To illustrate this, Nass highlighted the underlying structures and rules for what we may understand as the *aesthetic qualities of interaction*. These rules are as follows:

- Humans evaluate machine intelligence as intelligence (similar to "Artificial intelligence versus natural stupidity") regardless of whether or not they feel it is authentic, sincere or random
- There is something smart about negativity - cruel equals brilliance and when the computer blames the human, the computer is the genius
- People are willing to pay more for computers that praise them
- Negativity stays in the brain[2] - when people are criticised their memory of the event(s) increase
- People's emotions and emotional disposition should be matched - e.g., happy people like happy people (machines) and vice versa.

These types of scientific findings should be drawn upon when designing social robots for desirable aesthetic social interactional experiences. Human science-based

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[2] This was observed by Rousi (2014) in relation to elevator travel, where negative phenomena and events trigger primal cognitive-affective responses such as fear, disgust and anxiety, that in turn release adrenaline charging humans [82]to respond (freeze, flight, fight), strengthening us, sharpening attention and activating information storage that leads to long-term memory recall (Cahill & McGaugh, 1998).

traditions and theories such as Social Cognition Theory that argue that people see reflections of the self in others, should be carefully considered. This additionally leads to more concrete and practical questions such as, what words, register and approach should be used when designing robot communication? And, indeed, should social robots look like and mimic people, or should they have an identity of their own? Interestingly, the matter of human tendency to see themselves in others and objects, and moreover to be attracted to this *self* in others has been discussed in terms of the *self as an aesthetic effect* [82]. There is a human need for self-validation, which is one of the drives for embodied social interaction [83].

Social Robot Aesthetic Framework (SoRAes)

As seen so far in this chapter, literature and theory in the fields of social interaction, embodiment and aesthetics is rich and varied. While in fact, more of this classical literature should be brought into contemporary discussion, particularly when considering the vital role of the human mind in the development of emerging intelligent technologies, there should be a way of synthesising it in order to achieve practical outcomes. For this very practical reason, we see it necessary to break down the human social and embodied components of interaction with robots into biteable chunks that may form a scaffolding for making more precise design decisions in social robot development. In fact, we have developed the Social Robot Aesthetic Framework (SoRAes - pronounced, '*So Raise*') in order to isolate the factors contributing to the complex, multilayered and varied understanding of aesthetic experience in social robot interaction that accounts for more than just 'skin deep' design elements.

In this framework we chart the dimensions related to intersubjective interaction in human-robot-interaction. The created framework derives from previous works in product and interaction design, aesthetics, and social psychology. The purpose of the

framework is to map the aesthetic and interactional properties we need to take in account when designing social robots. In this sub-chapter we explain the significance of each dimension, using examples to clarify what the different aspects might mean and how to use them in practice.

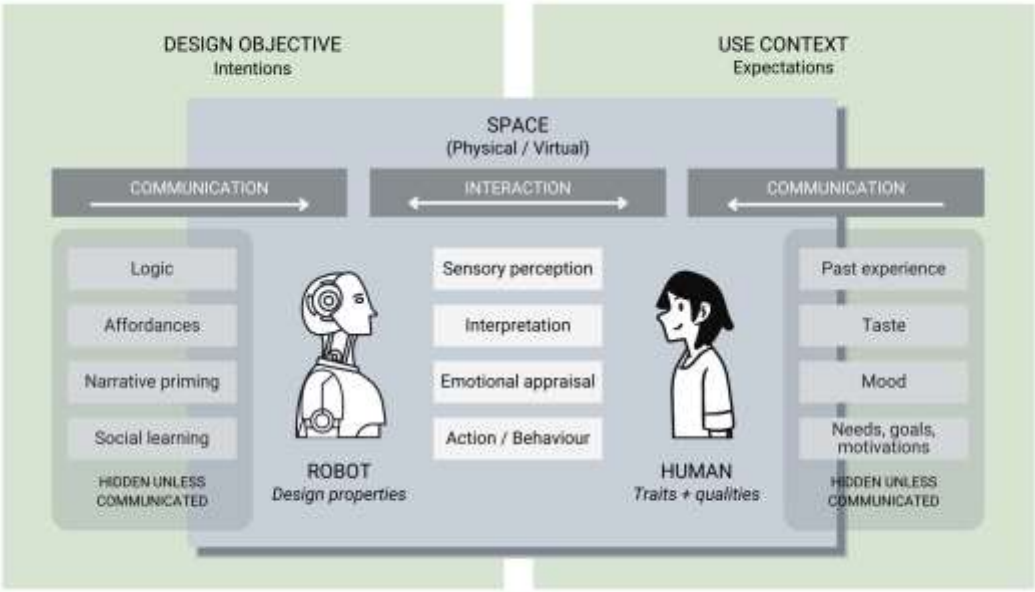

Fig. 3: Social Robot Aesthetic (SoRAEs) Framework

SoRAEes represents assemblages of human-robot social interaction from a somaesthetic perspective. The main components of the SoRAes Framework are: use context - expectations (intention and motivation of use); design objectives - intentions (design intentions); space - physical/virtual; robot design properties; human traits and qualities; and the sensory aesthetic dimensions. The following sections describe these components. This is achieved through providing examples specific to the current COVID-19 pandemic in order to highlight the potential of the framework for designing more effective and affective social interaction with robots for these challenging circumstances. Guiding this framework in practice is an ontology realised through sets

of questions that correspond with each component of the framework. These are presented in conjunction with the descriptions below.

Use context – Expectations (use intention and motivation)

We need to start from charting the user needs. For example, given the current pandemic, we want to ease the loneliness of elderly people and others living alone who cannot leave their home or have visitors during the lockdown. The main design goal is to create a robot that can be used by people who might have differing abilities (deteriorating mobility, hearing and/or sight), cognitive decline (memory disorders), and/or even people with interpersonal challenges and inabilities to recognise social and emotional cues (e.g., autism spectrum disorder). The robot might be used as a substitute for other human companions, or it may indeed be a link between the isolated individuals and their families and friends. A part of charting the user needs involves posing questions that affect the ways in which the robots should be designed in light of use. These questions include:

- What does the user want to accomplish by using the robot (what problem will it solve)?
- Where will the robot be used (hospital, own home etc.)?
- Will other people be using the same robot? Is it public (hospitals, schools), private (own home, private events) or shared (private but can be used by several people, e.g. family members)?
- Should the robot be specialized in one task only, or be able to cater to multiple needs (e.g. companion + physical assistance)?

These are just a few questions among many that may be posed to decipher the physical and contextual boundaries of the embodied social interactional experience expected to be encountered during use.

Design objective – Intentions (designer expectations of use and user experience)

The design objective or design (designer) intention is one of the most common discussed factors in cognitive science. Design intention has been researched from the perspectives of communication in design and user experience (see e.g., [84]) to intentionality in AI (see e.g., [85]). To establish a practical basis for the design objective we need to ask the following questions:

- What are we trying to accomplish - what problem needs to be solved? (in the COVID-19 case, very likely loneliness induced by social distancing)
- Are we intending to develop a commercial or non-profit product? → who is the customer and who is the end user (revenue model)?
- What is the minimum viable product that we can aspire towards? → the simplest solution to build that solves one part of the problem?
- What is the design and development budget/resources/funding? → what can be achieved with the resources available?

After we know what we are designing to whom, why, and what the available resources are, we can proceed to analyze factors that can affect (positively or negatively) the desired result. This also sets up the scene for understanding the assemblage at hand, affording certain types of understandings of the factors involved in the social interactions. This aids in ascertaining insight into the *framing* of both the social interaction itself as well as some levels of the conscious experience occurring

within the human user. For, the more information we have about the humans engaged in these interactions, the more we can know what, how and why the person experiences the interaction in the way that they do.

Space (Physical/Virtual)

Interaction happens always in space and place, be it fully physical or partly virtual. Partly virtual is referred to here, due to the user's body always being in some physical space, of which properties have an effect on the success and effects of communication and interaction. If the communication takes place partly virtually (e.g. through VR glasses), we need to take into account the properties of both the physical and virtual space. For this, designers and developers should answer the following questions:

- Where does the interaction take place?
    - Physical: own home, office, hospital, open air, one room or several, one kind of environment or in several different ones
- Is this virtual? → what kind of virtual space/environment?
- What kinds of objects and phenomena can be perceived in the use environment? Artefacts, other people, spacious or crowded, temperature, quiet or noisy etc.
- How/where does the user get into the space? Travel time, check in, opening computer/software, logging in etc.
- How does the robot relate to the space? Does it move or stay in one place? Does it need to interact with/react to other objects in the space?

When we are talking about human-robot-interaction, the dimensions that affect reaching the desired result can be divided into three parts. On the right-hand side we have the robot agent, with its built-in properties. On the left-hand side we have the human agent, with their personal traits and accumulated experiences. These remain

unknown to the other agent until they are being communicated in some way, whether we are aware of the information exchanged or not. Pictured in the middle of the framework is the interaction, or exchange of information, which takes place between the agents. The interaction in the middle means all information that is received via perceiving the other agent in some way, conscious or unconscious for the human and via perceptual (sound, visual, even possibly temperature and vibration etc.) sensors and processors for the robot. On the basic, sensory perception and symbolic processing and behavioural levels, the process can be modelled in roughly the same way for each of the participants. First, sensory input is received, then the received data is interpreted (attached to semantic meaning and alternate options for behavioural response), which in turn is coupled with emotional-aesthetic reaction within the human. Finally, we make an assessment of the situation using the emotional reaction as a cue, and act accordingly.

For the human agent, sensory data is received multi-modally, and the emotional reaction is formed either immediately or through associative processes depending on the type of encounter, design and actions. This is as the result of the automatic interpretation of this complicated, intricate data, unconsciously performed by our brain. Depending on the person's level of self-awareness (refer to symbolic interactionism, i.e., [26]), it is possible to make conscious effort to intercept this process before acting on the impulse roused by the initial emotional reaction (primary response triggering basic emotions) and use logical thinking to come up with other possible interpretations (associative higher order thinking seen in traditional aesthetics).

For the robotic agent, the data is collected via electronic sensors. The kind of data that is possible to collect is dependent on the technical properties of the robot. After collecting data, the robot needs to be able to make a real time interpretation of what the data means in the context of this particular interaction. Instead of the emotional

appraisal happening automatically in the human counterpart, the robot needs to make an assessment of what kind of actions it needs to perform in order to appropriately react to the state of the human agent. This is what we call *social-emotional awareness* within the social robot aesthetic design. This links to the social learning component that will soon be discussed.

Interpretation and the appraisal process that leads to the actions that form the communication between the agents, happens by sensorily perceiving physical attributes and connecting these attributes to meanings and alternative action possibilities. Here, we come to the importance of aesthetics, as aesthetic experience can be seen as having a positive emotional reaction to the things perceived in our environment which our brain interprets as beneficial to our survival or well-being (e.g., [35]). When designing robots, we should consider how we can best communicate the functionality of the robot to the user, to make the user experience as intuitive and pleasant as possible. The best design can be intuitively understood in much the same way as social situations that feel predictable and familiar to us. These types of interactions are perceived as the most pleasant [63].

Robot design properties

We have divided the robot design properties into several components that contribute to aesthetic experience in interaction. These are logic, affordances, narrative priming, and social learning. Their associated ontological questions are as follows:

- Logic
    - How does robot "intelligence" work?
    - How does the design and functionalities operate in relation to human thought?

    - What are the patterns, traits and protocol of the robot's operations?
- Affordances
    - How is the robot constructed?
    - What kind of tasks is it able to perform?
    - What does it *give* the human user, and *enable* them to do?
- Narrative priming
    - Do we give the user some background information on the robot, like details of its personality and its origins (cultural, make-believe, history of form)?
    - Does the user know something about the designer or company who made the robot?
    - Can brand identity play a role in social robotics?
- Social learning
    - Does the robot remember the users or their preferences if they have met before?
    - Can the robot form preconceptions? (e.g., after meeting three girls who like playing with dolls, does it suggest playing with dolls to the fourth girl also?)
    - What types of words and language can the robot pick up to assimilate communication with the human?

Thus, the logic is about understanding the cognitive logic or rules of information flow, understanding, processing and behavior of the social robot design from both holistic and material cultural expressive perspectives [11][23]. By holistic we mean, the overall behaviour - movement, speech, language, gestures etc.. In terms of material cultural expressive perspectives we refer to the particular details of the robot's form and

design, i.e., materials, shapes, psychological principles of form (e.g., symmetry and facial features, appealing to paedomorphosis [baby face bias] and Kawaii [Japanese cute] etc.).

Affordances derives both through James Gibson's [86] Ecological Theory, as well as Donald Norman's [87][88] discussions on the role of affordances in design, in which humans perceive phenomena in terms of what they afford, or offer them. This may be in terms of use value or social-expressive value. As Gibson stresses, we identify phenomena based on what we can do with it, and subsequently what it does for us. Thereby, a chair is perceived and interpreted often primarily in terms of whether or not we can sit on it. Immaterial qualities, values and affordances implicated in the chair's design may be seen in anything from the material used to create the chair, trademark form (e.g., the iconic Eames chair, or the James Bond-like Eero Aarnio fabric bubble chair), or even novelty in the functionality and use of the chair. Similarly, social robots - their form, and even capabilities of cognition, emotion and discussion - will be interpreted in terms of what they afford the human user. Particularly in the COVID-19 pandemic period and from a social perspective, the robot may be seen as fulfilling (affording) social needs in terms of providing companionship through meaningful discussion and/or affording the possibility for individuals to express their feelings about the situation. From this social aesthetic perspective, we may understand that oftentimes social fulfilment comes through the ability to reveal our inner selves and talk through our problems without judgment[3]. For this reason, psychologists are increasingly in demand.

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[3] Think of verbal catharsis and the role of the psychologist as a listener and mirror for psychological (and social) cleansing [89].

Narrative priming in itself constantly occurs through people's exposure to media and social interaction with other humans. We are continuously primed through stories and anecdotes on the nature of robots. Yet, narrative priming may also be used strategically to shape the way in which people attach meaning to and make sense of the social robots at hand. If looking at the doll industry for instance, the iconic Cabbage Patch kids were sold with a birth certificate that established date of birth and name. Looking back further in history, little Russian nesting dolls (Matryoshka) with their many layers provided multidimensional and multi-character build up to the identity and experience of the dolls. Narrative is also a strong aesthetic factor in human-robot fields such as sex robots in which humans form deeper relationships with the robots based on either a previously established narrative, or the narrative the individual themselves create in interaction with the robot (see, e.g., [90]). During times of the COVID-19 and the inability to escape the physical living conditions of one's home, the possibility to escape through narrative and imagination is all the more appealing.

Human traits and qualities

Past experiences

The past experiences of a person highly affect the way one interprets sensory information involved in encounters with various phenomena. Our aesthetic preferences are influenced by the kinds of environments we have been in when experiencing strong positive or negative emotions. The elderly person in our example might find the earthly colors and scents from their childhood farmhouse as safe and pleasant. Yet, the presence of shiny surfaces and bright lighting may be associated with unpleasant hospital visits. An urban youth might associate these same attributes of earthly smells and agricultural buildings as old-fashioned, unrefined or unclean versus modern, reliable and high-class.

Likewise, the ways in which an individual approaches a social robot and then engages in longitudinal interactions with the robot also relies heavily at first on these previous experiences. Biases and prejudices against the technology held from prior experience (either first-hand or second-hand through news and social discussion) may be overwritten with continued exposure, use and also the conditions. Social isolation causes anxiety [11] for which people may be actively seeking solutions, making them more willing to engage in social robot interaction despite prior opinions.

Culture

The cultural background of the individual affects the way that they interpret different social and visual cues, for example body language, color preferences, even the amount of perfume someone wears. This is due to the fact that many of our readings of material and behavior, in addition to the way that we behave ourselves, are based on social conventions, routines, rituals and consensus [91]. This too, informs the 'framing' of the social interactional assemblage at hand. Perception and experience of materials, shapes (e.g., facial form and ethnically or culturally specific features etc.) and colours is not simply about preference, but the ways in which we as humans are culturally programmed to attribute meaning to these specific forms. This occurs through the rituals, behavior and beliefs that are mentioned above [92][93]. This is in addition to having a firmer evolutionary psychological basis that both consciously and subconsciously tells an individual as to whether or not they are encountering friend, family, foe or even a potential mate [94]. Likewise, depending on context, readings of the materials, forms and their values may drastically change. Furthermore, in terms of the current COVID-19 social robot discussion, it needs to be acknowledged that some cultures are more prepared for the eventuality of robots fulfilling human social needs than others. For instance, we can see this in Chinese and Japanese cultures to name two,

where there are already long traditions in engaging in robot interaction for social purposes [95][96].

Taste (preferences)

Taste is one of the main aspects of classical discussions on aesthetics [72]. On a basic and practical level, taste is formed or cultivated in the context of the person's surrounding cultural and social environments. Taste has been discussed equally as much in relation to art [75] as it has in relation to social class [97]. While past experiences contribute to the underlying emotional landscape from which our aesthetic emotions spring, our social environment dictates the boundaries of desirable and acceptable phenomena as well as its expression, and how we may (should) react to these. These social environments additionally regulate the types of emotions that are considered acceptable to reveal or show to others around us. The youth from the previous example might associate a bold flower pattern with his grandmother's musty old-fashioned curtains but start finding it fresh and exciting after seeing similar patterns worn by their favorite social media influencer. Thus, we already see the overlaps and interrelations between cultural levels such as narrative priming, culture itself and the factors that contribute to taste formation.

Mood

Our perceptions are affected by our current internal state. If someone had a stressful and challenging day of work behind them, they might long for a quiet relaxing evening at home. But at times when their life feels dull and uneventful, they navigate towards more exciting and stimulating experiences. The concept of mood is constantly confused with that of emotion [98]. Yet, one way of explaining the difference is through the great semiotician, Charles Sanders Peirce's [99] explanation of shades of color. Peirce

described moods at states of mind that are similar to colors, for instance the shade of blue. For instance, if someone wakes up in the morning experiencing the shade of blue - perhaps from a dream, or perhaps from occurrences of the day before - this shade will taint the perception of the phenomena and events to follow within the day. This influences the ways in which we emotionally experience our encounters with phenomena.

Needs, goals, motivations

People always have a reason for engaging with technology, and particularly for using a robot. This affects the way the suitability of the robot is evaluated. People vary greatly in their expectations towards robots. Whether they want to use one as a social companion or a teaching assistant, there are dynamic and altering sets of criteria that humans anticipate within the design and interaction circumstances. This hinges upon the match of what the robot and its design affords in regards to needs, goals and motivations of the individual. The evaluation of the appropriateness to needs, goals and motivations ties in with Appraisal and the perceiving of affordances. Someone may need conversation to feel closeness to others. Others might want to play games or do some other activities to achieve that same feeling. For others owning a certain kind of robot might signal social or financial status or personal taste. In reflection of an example given earlier, a social robot may fulfil the purpose of enabling the human user to feel heard during the times of the pandemic crisis. Another engaging in more intimate actions with robots may be fulfilling the need to feel wanted, and to belong. Thus, a form of responsiveness within the robot's design, or responsiveness within the design and development team to truly understand the target groups for whom they are developing is crucial.

Aesthetic dimension (and multisensory experience)

When discussing aesthetic dimensions we refer to the multisensory experiences in interaction situations that can have either positive or negative effects on the outcomes exchange. These are the dimensions that one should consider when designing social robots, and additionally, the spaces and environments in which they are used. Thus, we should not think of the aesthetics of social robot design in a vacuum, rather than from the *assemblage* perspective in which environment, context, people and other objects are all equal actors in forming the interactional experience.

Not only do people attribute meaning to the robot designs, but materials, forms and linguistic expressions of the machines operate in relation to and against the formal properties of the surroundings. For instance, while being cute, a large fluffy teddy bear robot may be off putting within the context of intensive care. The smell of heated electrics and warm plastic generated by the robot body may not be appetising in a restaurant setting etc. In order to address this we list the basic five external senses - sight, sound, touch, smell and taste - and the types of information that may be collected through them. In relation to these we outline the types of emotional responses that multisensory inputs can evoke in the person perceiving them. Finally, we take a look at the meaning and significance of multimodality in the human-social robot interaction process, and how the sensory experience is perceived across the different modalities.

Sight

The sense of sight is often considered the dominant human sense, and earlier research has proven so in many contexts (see e.g., [100][101][102]). This is what is referred to as sensory dominance [103]. Sight enables the ability to gain a total picture, or collection of various parts and wholes with one glance. In fact, as most sighted individuals have

experienced (e.g., in virtual reality interactions), when engaged in the act of viewing, it is easy to become consciously immersed in the visual sensory information. Other sensory input may remain on the levels of either subconscious or unconscious experience. Visual sensory design factors that should be considered from the human perspective include:

- color psychology of spaces and objects
- visually perceived materials
- social cues of colors
- spatial perception (is the space crowded or roomy)
- social distance (cultural differences)
- body language, mirroring
- time lag
- uncanny valley

This visual information prepares the human and their body for particular types of behavior when engaging in social robot interaction. In turn, as in the theory of somaesthetics, this preparation, behavior and expression of the body shapes the way in which the interaction is experienced [57].

Hearing

Sound also plays a major role in human perception, and often goes relatively unnoticed in encounters and situations that are focused on or framed by the visual sense [103]. Think of the way in which music is used as a narrative experiential device in film and theatre. Beyond the subconscious role of sound as a sensory enhancer, sound also plays an important interactional role in human communication. Audio factors that should be carefully accounted for in the robot design include:

- speaking voice: tone and color, gender, age, accent, language, volume
- mechanical sounds from the robot body
- use of other sounds: music, nature sounds, alarms and signals
- use environment soundscape (background noises): quiet or loud, echoing, can you hear chatter, traffic etc.

These all play crucial roles in the experience of the social robotic experience assemblage, and may mean the difference between for instance trust, or lack thereof, in the object based on the gender and age of the voice. Mechanical sounds may be off-putting or even eerie, contributing to a heightened sense of the uncanny when combined with human-like visuals.

Touch

Touch is one of the integral senses in terms of relationship forming. Through touch, for instance, handshakes, taps on the shoulder, or even hugs, the hormone called oxytocin is released [104]. This is a hormone that plays a role in childbirth as well as breastfeeding. It induces a sense of bond between the two individuals engaged in touch and additionally creates a sense of emotional bond between humans and objects [105]. Touch is known as the sense that pre-determines purchase of goods [106]. Gentle touch is also associated with decreasing stress [107]. There are also crossmodal correspondences [108] - interactions between the senses - that induce experiences of perceived touch, or perceived visual information through touch, that are interesting to observe in material design. Some aesthetic factors to consider in relation to touch are:

- visual perception of a material can produce a physical sensation
- temperature has an impact on emotions
- psychology, and the psycho-physiology of touch

- social touch: aggression, pressure, safety etc.

While touch is traditionally categorized as one sense within the basic external five sense understanding of the senses, indeed, in more sophisticated sensory models, the tactile sense comprises several composites (or senses). There is the vestibular sense, or sense of balance and movement [109], and the sense of temperature (thermoception, [110]) to name some.

Smell

Smell is a chemical sense - one that relies on sensory receptors that react with molecules in the substances humans inhale [111]. Smell plays a highly important yet greatly overlooked role in emotional experience, and particularly interaction with others, due to the fact that olfactory information is processed in an area of the brain that rests closest to the limbic system [112]. The limbic system is the area of the brain that processes emotional information, making associations between input and attributed emotional experience. What is more, the sense of smell is the most direct channel between the outside world and the limbic system. Given the cognitive role of emotions in for instance, attention, memory and recall, this means that smell, which is closely connected to emotion in the brain (emotional associations taking place through smell), also heightens recall and cognitive associations [113]. Many may have experienced times in which the smell of a particular perfume may take us back to a particular childhood memory of our mother and the emotions attached to this memory [114]. Smells can usually only be perceived when people are in closer contact with the perceived phenomena. Olfactory factors that should be considered from the SoRAEs perspective are:

- materials - plastic, metal, wood, perfume, human-like?

- possibilities with aromatherapy etc.
- use environment: fresh or stuffy air (ventilation)
- psychology of smell (bakery, new car smell etc.)

Taste

There is an old saying, “The way to a man’s heart is through his stomach”. The sense of taste is the most intimate sense when related to social interaction [115]. It may usually only be reserved for very intimate situations on the one hand, or can be seen as a social connector i.e., through the cultural practice of food (cooking and joint dining) on the other [116]. However, because of the multimodality of senses, we can evoke the sensations associated with different tastes also through visual and olfactory cues. In fact, taste and flavour are two concepts regularly mistaken for one another. Yet, flavour in contrast to taste, is the combination of taste and smell [117]. Additionally, connections to emotions and personalities have also been made to taste [118]. Think about, for example, how a person or an emotion could be sweet, bitter or sour. The assemblage of social interactions may boost in memorability and meaning if taste is combined with smell to produce flavour in interaction, perhaps through thinking of robots in context - restaurants, parties, home chefs - or even as flavored love companion (sex) robots.

Discussion

Aesthetic considerations involved in designing robots for social interaction with humans is expansive and complex on many levels, from the human psycho-biological make up itself, to social levels, technological and contextual levels. If considering an underlying design objective for the development of social robots as being that of improving the social wellbeing of humans, aesthetic experience and its relationship to emotions is one

of the main starting points for concretely endeavouring this feat. Through using our knowledge of emotional responses created by design choices, we can create different kinds of user experiences that can have various positive impacts on an individual's mental state and overall physiological well-being. This is achieved through the impact of social interaction, sense of belongingness and intellectual engagement in conversation as well as that of situated multisensory experience on the body. Through the current knowledge presented in this article we can also prevent making mistakes in the robot design that might accidentally work against the desired effect.

The purpose of this chapter was to merge insight from sociological, philosophical, cognitive scientific and cultural studies traditions to explain the aesthetic dimensions of social interaction between humans and robots. In this particular chapter, the emphasis is on understanding these dimensions in the context of the COVID-19 pandemic crisis. This chapter has linked traditions of human thought and theory to the practical development of a framework for aesthetic design in social robot interaction. The goal of this chapter was to go beyond prominent research into surface level design issues such as external form and even voice, to concentrate on the logical and semantic dimensions of social interaction. The framework we present here, SoRAEs, aids in designing for social interactional and aesthetic framing. SoRAEs incorporates factors of linguistics, culture, social components (ANT - the assemblage of given situations in which all actors/factors equally influence the composition), and indeed, embodied multisensory experience itself.

In an academic setting as in the practical field of technological development, it may be understandable to gravitate towards seemingly simpler solutions that are easier to control when there is a need for measurable results. However, overlooking the vague and shifting nature of design and aesthetic experience, we might inadvertently close our

eyes to the more serious issues that, when taken into consideration, might compromise the relevance and accuracy of the achieved results and inferences. When researching the human reactions to social robots, especially when it comes to the negative effects and associations that keep coming up over and over again like in the case of uncanny valley, to be able to correct the problem we must first have a complete understanding of what the problem actually is. That will only be possible after having some kind of comprehension about all the possible variables that might affect the outcome (human experience) in the real world usage and research situations. The SoRAEs framework is an attempt to map these dimensions in a way that would make it easier for engineers, designers and researchers to plan and design human-robot interaction scenarios and make aesthetic decisions that effectively work towards achieving the intended goal.

In this chapter, we gave a brief introduction to the different modalities related to the aesthetic experience and the complex sociological, psychological and philosophical theories surrounding them. There is a plethora of research available considering the psychology of modalities, like color and material psychology, but connecting and understanding the vast multimodal elements in the context relevant to social robot design remains largely unexplored. One worthy direction to approach the exploration of the design process further, could be the utilization of character design and narrative techniques combined with product design principles. When designing and building a robot with affective qualities, we are in fact creating a fictitious character, using aesthetic means to evoke feelings in the user. From another practical perspective this means that we should not shy from using the expertise of artists, writers and directors to guide us in making the most important design decisions. For designing social interactional aesthetic experience with robots, is like creating a meaningful, engaging and emotional chapter of life.

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