CHAPTER 9

Social Robot Design and the Aesthetics of Imperfection

Rebekah Rousi and Paul Haimes

Introduction

Human history is characterised by the technology that time represents. The steam engine, telegraph, even paints, pens and calculators—all of these tools serve a purpose of either extending human abilities or compensating for shortcomings and imperfections. In entering an era defined by cognitive, connective yet seemingly autonomous technology, we may see that it is not mere memory, distance or speed that humans are trying to compensate for and extend. Rather, these days technology is being developed to augment human functions such as thought, learning, creative practice and even love (see e.g., Hassenzahl et al., 2012; Samani, 2011).

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There are plans to remove humans entirely from some areas of industry,[1] while at the same time the need for humans to connect with others and have meaningful non-work-related activities is also increasing (Döring & Poeschl, 2019; Nyholm et al., 2022; Sætra, 2021). Autonomous learning technology is replacing ever more jobs, while those humans who have employment are working increasingly longer days, with work seeping into all other areas of life via social media and non-stop connectivity. In this chapter, the authors delve into the dimension of spirituality in human–robot interaction (HRI) through a cross-cultural lens. This is in order to understand how social robots may be designed to relate to humans in a way that runs more than skin deep—beyond the physical skins of the embodied robots. By spirituality, the authors refer to the inner, subjective person, or stream of human consciousness and intentionality that exists within yet separately to the body (Boyd, 1998; Green, 2008). The opportunity is taken to expand on aesthetic and affective understandings of human–robot experience, as well as reflect on the very nature of robot existence in itself. The authors go beyond scholarly perspectives that view the role of consciousness and emotions as psycho-physiological properties in human–robot interaction, towards observing them as relational components in spiritual existentialism.

Many scholars posit that human needs and experience go beyond the pragmatic and instrumental (Alben, 1996; Maslow & Lewis, 1987; Max-Neef, 2017). These needs can be seen to either start from or augment into the aesthetic, ethical and spiritual, depending on which perspective one is approaching the topic (see e.g., Koslander et al., 2009; Missinne, 1991). It is often argued, as well as seen in modern national welfare models, that basic physiological needs are the most urgent to satisfy in terms of health, home, safety, food and water (see e.g., Alderfer, 1969). Core claims relate to the necessity for fulfilling primary physical requirements before progressing towards higher dimensions including the social and self-actualising within an individual (Maslow & Lewis, 1987). Evidence can be seen however, both within recent societal developments and psychophysiological (mental health) research, that although basic

[1] Lewicki et al. (2019) describe the evolution of jobs filled by robots from blue-collar (factory, manual and physically repetitive) work to white-collar (office, administrative, cleric) work, and discuss the alternative relationships between robots and human workers (co-bots assisting and enhancing the humans, or full automation replacing humans).

needs are instrumentally met, social, psychological and spiritual insufficiencies may entail the redundancy to access physical satisfiers.[2] Alben (1996) boldly articulated that when designing technology, one needs to comprehend the role of the aesthetic within the experience of technology users. This has been supported by studies that demonstrate a relationship between perceived usability and attractiveness (e.g., see Tractinsky et al., 2000; Parson & Carlson, 2008; Haimes, 2021) in which ease of use influences our appreciation of aesthetic objects.

In this chapter, we will begin with a description of the classic 'strive for perfection' within aesthetics and design. This is then juxtaposed by explaining the concept of imperfection in greater detail while drawing on studies from Eastern and Western paradigms that have investigated imperfection in technological design and aesthetics. The chapter probes the innate differences between Western pragmatics and evolutionary psychology in aesthetic scholarship. At this point, the observations of overlaps between Western theology and Eastern aesthetic philosophy are raised. The chapter progresses into a deeper conceptual analysis of imperfection from a cognitive-affective perspective, and explains the Japanese philosophy of *Wabi-Sabi* from this perspective. The text then moves towards generating an understanding of how the idea or dimension of imperfection (from Western theology and Eastern philosophy and novel understandings of aesthetic psychology) may be applied in the development of social robot design. Finally, the chapter ends in a broader reflection on imperfection and the human condition and on social implications to be considered in the future in general.

Strive for Perfection—(Traditional) Universal Principles of Aesthetics

Traditional approaches to aesthetics in Western traditions have grappled with the question of what can be considered beautiful in both the natural and artefactual worlds, and whether our judgments of beauty can hold what Kant (2000) called 'universal validity' (KOJ p. 60). Judgements of beauty, according to Kant, rely not on a strict set of clear concepts but a 'common sense' of what is beautiful (KOJ, p. 94). For Kant, though, our aesthetic judgements are somewhat 'independent of the

[2] See e.g., Kvamme et al. (2011) who investigated the risk of malnutrition among elderly adults and its connection to mental health, or Namkoong et al. (2020) who examined the dimensions of social and emotional support for low income families.

concept of perfection' (KOJ, p. 77). Ideas of beauty as (divine) perfection arose during Greco-Roman antiquity, emerging as three distinct theories: perfection in *proportion* or ratios, as proposed by Pythagoras or Vetruvius, perfection in *form*, as proposed by Plato's theory of ideal forms, and perfection in *function*, as described in Xenophon's *Memorabilia*. Drawing on these three types of beauty from antiquity, medieval Christian philosopher Thomas Aquinas offered three criteria for that which was considered perfect beauty: *modus* (form or dimension), *species* and *ordo* (order). If an object's form is appropriate to its species or category, it is then directed towards its ends according to an order or function. An object which holds these three properties in its essence is considered beautiful and perfect: When an object 'has integrity and proportion… nothing more is required. Its form is complete, ontologically ready to be judged beautiful' (Eco, 1988, p. 119).

Inspired by both ancient Greco-Roman conceptions of beauty and medieval Christian thought, perceptions of ideal proportions again gained prominence throughout the Renaissance, perhaps best represented by Leonardo da Vinci's *Vetruvian Man*. Such perceptions of beauty via mathematically-inspired proportions, though no longer considered divinely inspired necessarily, persisted throughout the era of early industrialisation and modernity. Although early machine-made products were criticised for their crude forms, designers at the Bauhaus in Germany were quick to embrace and promote the 'aesthetics of the machine' (Walter Gropius cited in Brummett, 1999), with perfectly-geometric shapes quickly becoming *de rigueur* across several European art and design movements in the early twentieth century.

Modernist product designers in the postwar period, most notably those associated with and inspired by the Ulm school and Dieter Rams in Germany, continued the Bauhaus' drive for perfect machine-made geometry. Austere forms seemed specifically designed to affirm Louis Sullivan's mantra of 'form follows function'–a conclusion drawn from the Darwinian implication that only useful features survive the evolutionary process (Heskett, 2005). Ornamentation, leaving any room for inspiration from nature or traces of the handmade, had been stripped bare. This trend, though one that has faced criticism for being cold and austere, has persisted in much of product design today. One only has to look at Jonathan Ive's work during his tenure at Apple to see the legacy of

Bauhaus and Rams. With advancements in material science and production machinery, the levels of precision reach ever-new heights of shininess and sleekness.

Aesthetic, Ethical and Spiritual

The dimensions of the aesthetic, ethical and spiritual are difficult to define in and of themselves. While they do not have a stagnant character and may be subject to notions of relativism, they also cannot be completely separated from the material, bodily or worldly (Shusterman, 2011). For this reason, the authors take a pragmatic (Dewey, 1908; Levinson, 1983; Shusterman, 2011) approach to describing the intricacies of imperfection in human—social robot interaction and experience. Pragmatic approaches endeavour to observe the relationships between experience (interpretation), actions and perceived phenomena (Dewey, 1934; Peirce, 1935; Rousi, 2013). Philosophers such as Søren Kierkegaard (1845/2009), notable for his work on Christian Ethics, delineated three stages of human development, or 'on life's way' (three periods of existence): aesthetic, ethical and religious. This makes the concept of imperfection particularly interesting, both in relation to the limited and inconsistent nature of human beings. It also renders significant observations made in non-Western cultures, where imperfection is outwardly embraced within the beauty of life (human and artefacts) as an aesthetic process (Koren, 2008). The reason for focusing on Kierkegaard's three stages is to denote the shifting paradigms that can be observed during the various waves of human-technology interaction (HTI) and human–computer interaction (HCI).

These HCI waves are: (1) cognitive processes involved in human–machine interaction, control (piloting), cognitive mimicry and the human component of machine development; (2) usability and user interface development for non-expert computer users in order to successfully complete non-development related tasks; and (3) user experience that incorporates understanding of human experience and so-called non-instrumental (hedonic) qualities (Carroll, 2013; Hassenzahl & Tractinsky, 2006). Or more specifically, these three waves can be grouped into one era of human–machine symbiosis (*the user-consumer* era)—the instrumental and aesthetic era—that evolves at a comparative pace to industrial paradigms from mass production, to variety and taste (the General Motors

model, see Karjalainen, 2004, and stratification through design, see Bourdieu, 1987), and personalised experience (the *semantic* and *experience* economy, see Rousi, 2013). Thus, the *user-consumer* era was marked by an 'aesthetic' (pragmatic, Dewey, 1908) quality. Currently, in relation to the boom of artificial intelligence (AI) development, implementation in all sectors and applications that are widely available and easy-to-use, it may be observed that scholars, technology practitioners and businesses have reached the stage of *ethics*. Yet, this is rapidly moving towards the *spiritual* or *religious*, as observed in large-scale technology business (TechBiz) events such as the Nordic Business Forum and Slush—large gatherings around individuals 'preaching' for a better world—the glorification of individuals and entrepreneurs such as Elon Musk, and the nature of the technology itself, *making magic happen* (Rose, 2014). Movements and trends such as mindfulness additionally promote an interpretation of consideration for the soul in this social-technological era (Akama et al., 2017).

There seems to be a disjunct between Western theological thought and positivist evolutionary psychological theory that actually draws Western theology closer to the insight of Eastern philosophy. By this we argue that Eastern philosophy delves into the character of phenomena as transcendental (see e.g., De Castro, 2019; Rao, 1998), much the same as Western theology harnesses the transformative nature of the spirit (Sheldrake, 2010; Shults & Sandage, 2006). The scholarly West has been concerned with developing understandings of 'universals' (or universal principles, see Hekkert & Leder, 2008 on universal principles of aesthetics), while for instance, focus among scholars of Japanese philosophy is concerned with process (Richie, 2007) and cultivation of sensibilities that maintain a strong moral dimension (Saito, 2007). Attractiveness and beauty have been heavily researched in the domain of evolutionary psychology for instance, drawing conclusions that innate mechanisms within animals (including humans) for physiological survival drive perception of attraction (Gould, 1980; Lorenz & Leyhausen, 1973). Thus, despite acknowledging the role and need for the fulfilment of higher order cognitive-affective (aesthetic) dimensions of existence, Western psychology quite readily reduces human life to biomechanical animalistic motivations (Darwin & Prodger, 1998). In other words, aesthetic experience is led by primal instincts, rather than higher-order associative processes. This means that in Western cultures beauty and attractiveness are often typified terms of symmetry, averageness, sexual dimorphism (differences between the

sexes of a species) and flawlessness (Fink & Penton-Voak, 2002; Rhodes, 2006).

There has also been research on the comparative tendencies and effects of humans in relation to beauty and perceived attractiveness in other humans (see e.g., Wade & Abetz, 1997). The notion of beauty itself is also applied via a myriad of understandings such as moral beauty (Rhodes, 2006) and functional beauty (Sauchelli, 2012). Ironically, Martin Heidegger (2017) describes attention to beauty as a replacement for God, with art and its institutions (art museums) serving as substitutes for icons and the temple. None-the-less, attention is placed upon a stagnant, 'finished' object that may be interpreted and appreciated in many different ways in and of itself. Yet, similarly to the knowledge silos referred to as academic disciplines established during the European Enlightenment (Garner, 2013), there seems to be a linearity or vertical associative nature that is devoid of systemic relevance. It is the systemic nature of the world and its phenomena and understanding of constant transition and embracing of decay (change) and characterisation that tends to distinguish particularly Japanese philosophy from that of the West. This entails from the outset a seeming conflict between European and Japanese aesthetics. Yet, as the chapter moves towards the spiritual and moral dimensions of experience it is understood that there are more similarities that can readily be applied to the conceptualisation of social robot aesthetic design.

A Brief Overview of Imperfection in Japanese and Western Thought

There are many components that characterise imperfection. Asymmetry, error (or flaws) and ambiguity, will be described in this section. Ambiguity is also a characteristic of human imperfection (Tarachow, 1965). In Japanese culture, there is a long tradition of explaining the mechanisms of imperfection in beauty through the concept *Wabi-Sabi* (Juniper, 2011). *Wabi-Sabi* is defined as an appreciation for transience and nonpermanence in objects. Through *Wabi-Sabi* the idea of constant change is embraced. Recently, international scholars in fields such as human–computer interaction (HCI) and interaction design (IxD) have adopted the idea to describe the experience of mutual obsolescence in information technology products (Haimes et al., 2016; Tsaknaki & Fernaeus, 2016). The topic of social robotics is an interesting one from the *Wabi-Sabi* perspective, as social robots are embodiments not only of technological

products and developments, but also of social human ideals that progress over time.

The question of human–robot interaction is more than just physical. Most human beings experience attraction to other human beings as 'unexplainable'. That is, it is not always the most sýmmetrical individuals who attract the most admiration. Think of Barbara Streisand, Sylvester Stalone, and even Owen Wilson. As experimental sociologists have rigorously argued that the ways in which humans perceive others (human, system and artefact) are as much social as it is sensory.[3] This also stands for social psychological research that focuses on the role of personality in attraction (see e.g., Anderson et al., 2001; Celiktutan & Gunes, 2015). That is, beauty is not only more than skin deep, but is born through interaction, that is dynamic, asymmetrical and embodied (Rousi et al., 2021). In this respect, the concept of imperfection has been gaining traction in HCI over the past few decades for numerous reasons. These reasons include: (1) thinking outside the box to add aesthetic value to design—the need to extend beyond the (design) paradigms typically found within Western modernity; (2) understanding the reality of the high technology industry in its too-fast-to-shelf mode of practice, delivering works in progress rather than mature and sophisticated solutions; and (3) the need for something more (see Rousi & Silvennoinen, 2018)—the strive for the immaterial qualities of life with human values moving away from the superficial (accounting for moral sensibilities).

Imperfection is a broad and highly debated concept (Duckham et al., 2001). It can, however, be roughly defined as embodying uncertainty and error in relation to concepts such as accuracy and precision (Mowrer, 1999). Based on the ambiguity of interpreting such notions, Duckham and colleagues (2001) developed an ontology of imperfection that encompasses vagueness, error and imprecision. Thus, error or in other words, inaccuracy, addresses the alignment of an observation or representation with reality. Imprecision or vagueness refers to a lack of specificity or clarity within representation. From an aesthetic perspective, imperfection can be said to encompass the lack of congruence between expectations, for instance of symmetry and harmony, and the observed or perceived phenomenon (Buetow & Wallis, 2019). Moreover, classic cognitive scientific and artificial intelligence (AI) theories, such as the

[3] See Clifford Nass and Corina Yen's *The man who lied to his laptop* (2010).

Turing Test (Turing, 1950/2009) were about developing a machine that could fool humans into thinking that the being they were communicating with were human. The intellectual key to this test was not that a human would believe the machine is human on the basis of its genius processing abilities. Rather, the objective was to capture a sense of nuance, errors and flexibility of thought that enhances the belief that one is communicating with another human being.

Many studies on jazz music and improvisation in particular, concentrate on the aesthetic qualities of imperfection. Andy Hamilton (2020) for instance, engages with imperfection in terms of its values in spontaneity, unpredictability and uniqueness. Imperfection, and especially, the aesthetics of imperfection, should be understood in relation to the concept of 'perfection'. Perfection, deriving from the Latin word 'perficere' refers to doing something thoroughly, completion, finishing and building something up. Thus, imperfection or 'imperfectus' alludes to incomplete and unfinished, or unresolved (Hamilton, 2020). Hamilton goes further to suggest that imperfection possesses a momentary or timely quality that shades the concept as existing in a particular point in time.

The notion of *Wabi-Sabi* is embedded in Japanese philosophy and refers to a nurturing or appreciation of authenticity. *Mono-No-Aware* is a concept closely related to *Wabi-Sabi*, which is usually translated as 'the pathos of things' or 'empathy towards things' (jisho.org n.d.). Both *Wabi-Sabi* and *Mono-No-Aware* are considered prominent aspects of Zen Buddhist aesthetics, and *Wabi-Sabi* is said to be the end result of *Mono-No-Aware* (Prusinksi, 2012). *Mono-No-Aware* is concerned with a fleeting beauty in an experience that cannot be pinned down or denoted by a single moment or image. Though fragile, this kind of beauty creates a powerful experience for the observer, since it must be fully enjoyed in a specific period of time (Prusinksi, 2012). An example given by Davies and Ikeno (2011) is that while there is obvious beauty found in flowers in full bloom, an *Aware* sensibility means that people are more moved and touched by the flowers when they begin to wilt. Similar to the above-mentioned definition and ontology, imperfection in the *Wabi-Sabi* and *Mono-No-Aware* sense connotes the nature of continuous development—everything is always in progress and nothing reaches a moment of completion. Furthermore, nothing is perfect and nothing lasts forever (Koren, 2008; Powell, 2004). Impermanence and transition are traits that mark any form of technological design or product (Irwin et al.,

2015). These traces of ephemerality are not necessarily shown in the physical wearing or degeneration of the objects, but may also refer to the constantly evolving societal conditions surrounding the technology. As Tsaknaki and Fernaeus' (2016) research revealed, the philosophy of *Wabi-Sabi* in design and HCI may mean the difference between sustainable products that develop in beauty as time progresses, or obsolete products.

Glitches, Emotions and Technology Experience

Within interaction design, alternatives to the modern, sleek aesthetics of interfaces are rarely discussed (Haimes, 2020, 2021). Imperfection, as an aesthetic outcome, is often overlooked in the design of technology, even though there is a rich tradition of viewing imperfection favourably in western and Japanese aesthetic discourses. Sōetsu Yanagi (1889–1961) noted the fundamental difference in how Japanese art embraces this aesthetic:

> … the Western perception of art has its roots in Greece. For a long time its goal was perfection, which is particularly noticeable in Greek sculpture. This was in keeping with Western scientific thinking; there are no painters like Andrea Mantegna in the East. I am tempted to call such art 'the art of even numbers'. In contrast to this, what the Japanese eye sought was the beauty of imperfection, which I would call 'the art of odd numbers'. No other country has pursued the art of imperfection as eagerly as Japan. (2019, p. 146)

Similarly, in *In Praise of Shadows*, novelist Junichirō Tanizaki's (1886–1965) defended Japan's traditional aesthetic preferences for darkness and handmade artefacts. Tanizaki's treatise was written in an era when Japan was adopting several technologies from the West—including electric lights, electric fans and kitchenware. In this work, Tanazaki proposed that compared to the brightly-lit spaces of the west, Japanese aesthetics are best appreciated in the dimly-lit interiors of traditional Japanese buildings. Tanizaki lamented the effects of machine-made aesthetics and the clarity and progress of modernity:

> …we distort the arts themselves to curry favour for them with the machines. These machines are the inventions of Westerners, and are, as we might expect, well suited to the Western arts. But precisely on this account they put our own arts at a great disadvantage. (2001, p. 17)

As noted by A.C. Grayling, Tanizaki's (2002) views on aesthetics offer 'a sharp contrast to the functional, plastic, disposable aesthetic of modern western life' (para. 3). While Yanagi's and Tanizaki's critiques of the contrast between western and Japanese aesthetics may ring true when considering the trajectory of much western art and design since the Renaissance, western artists and critics like William Gulpin and John Ruskin did embrace the aesthetics of imperfection. In *The Nature of Gothic*, John Ruskin highlighted that 'the demand for perfection is always a sign of a misunderstanding of the ends of art' (p. 31). Art reflects our mortal, imperfect lives. Imperfection,

> … is the sign of life in a mortal body, that is to say, of a state of progress and change. Nothing that lives is, or can be, rigidly perfect; part of it is decaying, part nascent… And in all things that live there are certain irregularities and deficiencies which are not only signs of life, but sources of beauty. No human face is exactly the same in its lines on each side, no leaf perfect in its lobes, no branch in its symmetry… Accept this then for a universal law, that neither architecture nor any other noble work of man can be good unless it be imperfect. (pp. 32–33)

In fact, the very conceptualisation of art and aesthetic experience offered by critical theorist Theodore Adorno (1997) was that it was unique—the one thing the mechanised and capitalised world could not touch. Yet, while his take on aesthetic experience was that of something highly personal and subjective—in itself, ambiguous (imperfect)—he argued that extreme chaos or crisis within one's surroundings would render aesthetic experience null and void. He claimed that '[it] is self-evident, that nothing concerning art is self-evident anymore, not its inner life, not its relation to the world, not even its right to exist…' (p. 1). In terms of the moral dimension, Adorno's emphasis on contemporary art and its social justification as a means of expressing the truth (Hammer, 2015).

Imperfection in the Aesthetics of Social Robot Design

Shifting the discussion from aesthetic experience in a chaotic world to the glitches and comforts of imperfection and malfunction, we arrive at social robot design. Two distinct forms of robotic design have emerged over recent decades: those that continue the aesthetics of the machine in

non-humanoid or semi-humanoid robots, and those that aim to replicate the human form as accurately as possible. The design of several commercially-available non-humanoid robots has followed the trend of tech companies like Apple in their pursuit of sleek, machine-made perfection. One only has to look at the design of robots such as Softbank's *Pepper* or Sony's *Aibo* to see that functionality and geometric precision are the aesthetic preferences for much robotic design. Humanoid robot design, exemplified by the *Geminoid* robots of Hiroshi Ishiguro, essentially aims to create robots that are indistinguishable from humans in body and mind. Such attempts to replicate the human form and characteristics, however, are not new. In the late nineteenth century, Thomas Edison created the world's first talking dolls. Edison's creation was a commercial failure, likely due to poor sound quality, easily-breakable parts and a high price-tag (Starr, 2015). Much of the commentary on Edison's dolls has pointed to the eeriness of the voice recordings—demonstrating one of the many aspects of the *uncanny valley* phenomenon (see e.g., Mori et al., 2012). For today's humanoid robot developers, though, the uncanny valley is not seen as an impenetrable barrier, but a challenge to overcome (Guizzo, 2013). One possible reason why the uncanny valley exists is that robot stylism comes too close to the qualities of the human in terms of body, voice and mind. To put this in the framework of Aquinas' criteria of beauty, humanoid robots fail to be beautiful when they adopt the *modus* (form) of a different *species*, and have a different *ordo,* or ends (Eco, 1988). Robots may be a logical progression of the concept of dolls, yet it is worth noting that many social robots, such as PARO and Probo, are non-humanoid robots inspired by animals.

While the uncanny valley effect is attributed to both perfection (e.g., threat to human uniqueness as seen in the research of Ferrari et al., 2016), as well as imperfection—something not quite right (see e.g., Kim et al., 2022; Brenton et al., 2005)—imperfection may be divisive as a design intervention in a crisis-ridden world. To reinforce this idea, slight imperfections have been shown to be preferred in character design over complete perfection (Schwind et al., 2018). To perceive a sleek, shiny and smooth machine may amplify the eerie, manipulative and manipulated dimensions of aesthetic experience that Adorno (1997) attempted to address in his disillusioned thoughts on aesthetic experience within chaos. To illustrate, think of a decadent masked ball in one room, and a torture chamber in the next. To accentuate the grotesqueness, imagine that the happy ball dancers *knew* about the torture chamber in the next

room. Here, we observe the moral dimension of aesthetics in terms of a raw articulation of emotional cohesion and topical congruence. During today's climate of rapidly increasing AI solutions in society, there is both an urgency to address ethical issues (see e.g., Jobin et al., 2019; Vakkuri et al., 2021), as well as a longing for ethical qualities to be evident within the design, such as transparency and understandability for instance (see e.g., Gunning et al., 2019: Vainio-pekka et al., 2023). An alluded transparency through the rawness of unpolished and unrefined design, assumes that the 'truth' of the robot design and its positioning in relation to humans is communicated through empathic imperfection. Moreover, despite an apparent distance between a rusty tin can and the smoothness of human skin, imperfection of any sense resonates with the state of the human condition (Kurtz & Ketcham, 1992).

Embodied Social Interaction and Robot Design

Human–robot existence and aesthetic experience are interactional by nature (Brinck, 2018; Ross & Wensveen, 2010). For this reason, any attempt to delve into the spiritual nature of social robot aesthetics, and particularly to move beyond skin deep, requires systematic attention to the sociological and social construction of human–robot interaction. Rousi et al. (2021) developed the SoRAEs (Social Robot Aesthetic, Fig. 9.1) framework to capture the intricacies of multidimensional, multimodal social robot design. The idea was to focus on the robot as a whole and incorporate sociological theory (social interaction, Turner, 1988), social psychology (Bornstein & D'agostino, 1992), symbolic interactionism (Blumer, 1969; Brewster, 2013) and embodied (*someasthetic*) experience (Shusterman, 2012) in a model that justified the emotional relationship beyond the casing of the machine. On the design principle level, this was to emphasise that the aesthetic and emotional experience of robots is social, dialogical and embodied. Another important element of the framework is context. Context not only frames and defines the relations of encounters and technology to person (i.e., use purpose), but it also determines the experience of *self* (Rousi & Alanen, 2021). That is, the internal reflective *I self* is positioned as *me self* in an ecology assembled with *particular others* and *general others* (Blumer, 1969; James, 1890).

From a practical perspective SoRAEs account for both the robot design properties as well as the human traits and qualities. The internal workings

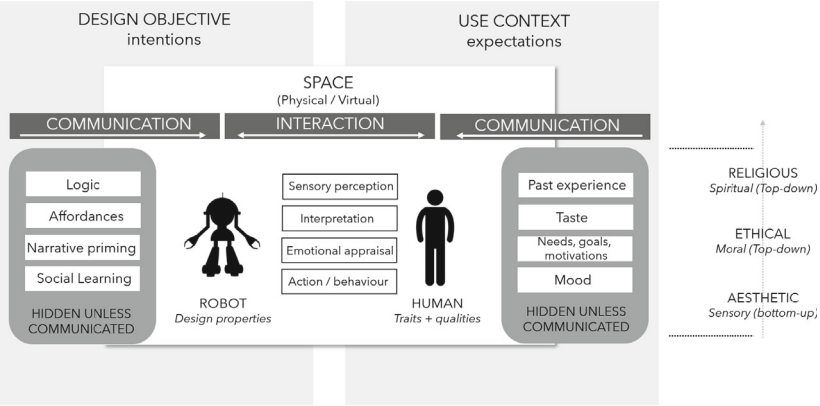

Fig. 9.1 SoRAEs with kierkegaard's (1845/2009) 3 stages towards becoming one's true self (Social robot aesthetics framework, adapted from Rousi et al., 2021)

of the robot include its logic, affordances (what it can do for humans), narrative priming (how the technology is framed and made-sense-of via storytelling) and social learning. All of these traits are hidden unless communicated. The inner world of the human interactionist includes past experience, taste (Bourdieu, 1987), mood, as well as needs, goals and motivations (i.e., Maslow & Lewis, 1987). All of these facets are also hidden unless communicated. Thus, the realisation of social robotics can be said to take place in interaction—communication from the robot (encoded messages enabled by the design) and by the human (encoded messages and decoded interpretations). This, in turn, is mediated by more human social layers that are implicated via design intention, use intention, and are mediated by *sensory perception*, *interpretation*, *emotional appraisal* (cognitive-affective evaluation of value or worth versus threat to concerns, see e.g., Ellsworth, 2013; Frijda, 1993).

While SoRAEs provide a framework for the social aesthetic experience as a whole in social robot design, it does not specify how these qualities may be conveyed through the skin of the robots. For this reason, we return to the discussion of *Wabi-Sabi* and the human state in Christianity to shed light on principles of the qualities that emulate through the shell. From the Western theological perspective, we have added Kierkegaard's (1845/2009) three stages towards becoming one's

true self—the aesthetic, ethical and religious. These three stages can be understood multidimensionally. Firstly, they exist in light of the social-technological and consumer paradigms described above that compact the practical and pragmatic into one human–machine symbiotic era (the three waves of HCI), moving to the ethical and evolving into the spiritual. Secondly, they can be practically understood in terms of an individual human's development that corresponds both with psychological development (e.g., Lim, 2004) and an individual's level of technological maturity (previous experience with technology, see e.g., Rousi, 2009). Thirdly, the stages mimic the cognitive-affective processes of encounters with designs and building significant relationships with their elements (Rousi & Silvennoinen, 2018).

The aesthetic in its raw sense, represents primal experience based on sensory cognition. That is, this earlier stage of aesthetic appreciation often undergone during younger years, is driven by the flesh and levels of appeal that sensory stimuli have according to the senses. The ethical stage represents a sense of moral responsibility. This closely relates to what has earlier been discussed about the aesthetic experience being driven by moral standards and sensibilities. This stage additionally explains the way in which ethical stance (see Rousi, 2021; Saariluoma & Rousi, 2020) affects emotional experience of phenomena. Finally, the religious is the spiritual level—this partially distinguishes *Wabi-Sabi* from Christianity, as well as from Shintō in its entirety, as the spiritual goes beyond this world and in fact beyond the individual towards acknowledgement for the need to serve God rather than oneself (Kierkegaard, 1845/2009).[4] In other words, the religious stage is one in which humans put themselves (their bodies) aside to serve the creator and appraise phenomena (i.e., social robots) against criteria set towards praising this creator. This is also typified by the Christian 'new birth' (born again) in which the mind is renewed, establishing a greater separation between pleasures of the flesh and spiritual fulfilment through Christ (Kit, 2013). In Shintō, this is more about the idea of striving towards the perfection of the spirit of Kami (Yamakage, 2006).

[4] Contemporary Shintō is often viewed as monotheistic (Lande, 2008).

Imperfect Robot Design Guidelines

Thoughtful design that not only captures the 'heart' of imperfection, but harnesses its character in a way that is meaningful to people is complex. As with human beings, care needs to be taken to consider both the physical and the personality traits of the objects (beings). If every picture has a story, every object tells an interactive story. As seen in artistic movements such as Dadaism, the separation between a piece of trash and a work of art is intention and intentionality through storytelling (Prager, 2012, Rousi et al., 2021). From a holistic multicultural or global perspective, decay and in-operativeness may just as easily be associated with garbage, as it is a 'buggy' (favourite baby blanket from childhood), shabby teddy bear, or vintage car. From a formalist *Wabi-Sabi* perspective, the design of social robots may be divided into the physical, the personality (social) and the linguistic (Fig. 9.2).

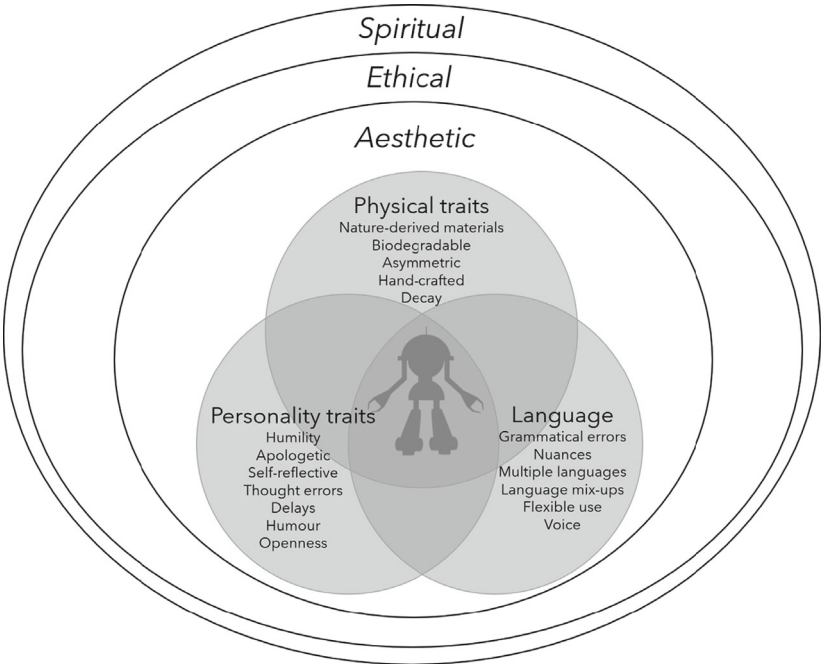

Fig. 9.2 Imperfection aesthetics in social robot design with Kierkegaard's stages

According to this view, interactions between a human being and a social robot are constantly framed, filtered and negotiated through the aspects of physique or material qualities, personality and language. The physical traits comprise the initial sensory information that human beings often encounter, especially through the sense of sight. Cognitive-affective processing of physical appearance is both primary (primal or immediate) and associative (higher order) (Brave & Nass, 2007; Ochsner et al., 2009). Bottom-up (primal) processes occur in immediate response to factors such as size, gestures, features (i.e., sharp blades as hands), and even materials for instance. Top-down (associative and directed) processes are guided by ideas and mental construction already housed by the individual. These often play out in relation to brand recognition and symbolic processing (i.e., reading the in-built symbolism incorporated in the aesthetic design). Yet, once more, designers can use this knowledge to for instance, manipulate the physical qualities of the robots to trigger specific reactions—war colours with a damaged shell may induce an experience of the robot being a veteran. While the physical shell and qualities appeal to humans in different ways, so too does the personality. There may be tendencies to prefer personalities that are similar to one's own (see e.g., Dryer & Horowitz, 1997; Nass et al., 1995) or the opposite (Seyfried & Hendrick, 1973) depending on context. Language plays a divisive role, both in terms of accessibility and understandability between human and system, as well as in terms of word choice, grammar and linguistic structuration (Fischer, 2011; Fischer et al., 2013).

It must be kept in mind however, as argued for by Rousi et al. (2021), that the robots, HRI and the relationships developed between humans and machines are contingent on the socio-cultural space of their coexistence. Thus, while describing the design principles behind consciously manifesting human imperfection in robot aesthetics, it must be kept in mind that this is against the backbone of Japanese philosophy and Western post-Enlightenment sense-making.

Physical

Borrowing aesthetics from Japanese traditions like *Wabi-Sabi*, a robot could be made of materials that show clear signs of decay, rather than the sleek perfection sought by companies like Apple, Sony, and Softbank. Each of these companies has been implicated with scandals and unethical (immoral) characteristics over time, from poor treatment of

workers[5] to inequality through pricing.[6] Material could fray, metal could rust and wood could rot. It is worth noting that this decayed aesthetic in robots already has a precedent in the animated films of Hayao Miyazaki, such as the benevolent robot soldier in *Castle in the Sky* (1986). Rather than portrayed as the products of mass-production, such machines are described by Miyazaki as 'still [possessing] the inherent warmth of hand-crafted things' (VanderMeer, 2012, p. 186), and, like several works in the 'steam-punk' subgenre of science fiction, utilise 'colo[u]r palettes of golds, browns, and sepias; patina and rusted metal (signifying age); and materials like wood and brass' (Kiehlbauch, 2015, p. 93).

Furthermore, the information that a robot receives through its sensors, could be made imperfect. What if a robot became hard of hearing as it *aged*, or had poor eyesight? And how could (or even should) its AI cope with such changes? While these changes mimic human ageing, they will not necessarily mean that robots will encroach on the human category. This perspective touches upon the very essence of debate within human–robot and human-autonomous technology discourse regarding the potential for the replacement of human beings–a common critique since industrialisation made automation possible (e.g., Arendt, 1998). Questions need to be asked regarding why attention is placed on developing robots that look, sound and think like human beings (or other animal species), and why they cannot be developed as a species in and of themselves[7] (Harvey, 1997). The same holds true for the internal logic of the machines such as emotions. Much scholarship has been invested in understanding how AI may read human emotions (Jeon, 2021; McStay & Rosner, 2021), and whether or not machines should have indeed their

[5] See, Holley Gawne's (2021), 'Sony was ruled by fear': 20 former employees come forward (https://themusicnetwork.com/sony-ruled-by-fear-twenty-former-employees-come-forward/).

[6] Loyal Apple customers have actually retaliated against company strategies to lower prices, giving light to the ideological investments made by consumers who pay more for the sleek Apple perfection to distinguish themselves against the rest (see the article, "Finding the Right Price" in *Forbes* (2007, https://www.forbes.com/2007/10/11/apple-duane-reade-ent-sales-cx_kw_1011whartonpricing.html?sh=5fe7faba6e1c).

[7] In fact, Inman Harvey (1997) used the term 'artificial evolution' to describe a form of species-like evolution that special adaptation algorithm genetics (SAGA) instils within robots. This would mean that the robots evolve away from the innately human traits they are initially developed with, eventually arriving upon logic and qualities that can be described as uniquely their own.

own emotions, yet formulating an emotion set that would be unique and useful to robots is still an unexplored area (Breazeal & Brooks, 2004; Picard, 2003). Given this sense of *robot uniqueness*, 'real robots' through artificial evolution, and the potential for robots to possess their own sets of emotions that no doubt incites unpredictability within the physiology and behaviour of the robots, the aspect of ageing is fascinating. In this light, ageing is not simply a result of wear-and-tear and obsolescence, but the deterioration of sensors and cognition could enhance the effect of *realness* or organicness over time.

Thus, sensory and cognitive ageing from the perspective of a robot could be designed to enhance human identification with the robot. Planned obsolescence in itself has been a questionable corporate strategy for decades, and is criticised for its unethical and unsustainable nature (see e.g., Bisschop et al., 2022). Yet, in the vein of 'mutual obsolescence' the machines could be designed and developed with durability, reliability and updateability in mind. The aesthetic experience from the perspective of the human user, owner, companion, or co-worker, would be that as they age, so too does the machine. As with the human body, the casing or skins (outer aesthetics and material elements) may be created from an ecological perspective intended to break down and biodegrade with time. At the structural and operational core, however, the robot may continue its life while regaining new features when it is time to be with its next human companion. This is very much based on the processes and practices surrounding Shintō temples that are rebuilt every 20 years (Kobayashi, 1981; Sand, 2015; Sinclair, 2019), and the renewal that occurs as a part of the rituals surrounding the structures (Juniper, 2011). This design and aesthetic strategy is already a contemporary trend in the Japanese fashion industry, that from a Western view, can be seen to embrace environmentally sustainable thinking as a symbol of eco-fashion (Fang et al., 2023). Natural materials such as cotton, silk, wool and linen are used for the textiles, while bark, flowers, fruits, leaves, etc., are used for the dying process. Approaches to the robot skins could indeed embrace a *Wabi-Sabi* material fashion understanding towards re-imagining mutual obsolescence within the outer aesthetics of the machines.

Personality and Language

Personality has been greatly overlooked in scholarship of the uncanny valley. Robots like Softbank's Pepper, or even C3P0 from Star Wars,

manage to adapt human-like voices, but there is a rather slim chance that they will be mistaken for a human due to their appearance. Clifford Nass and colleagues observed the personification or anthropomorphism humans endowed on computers on the basis of the ways in which they spoke to humans (Nass & Yen, 2010). Due to the fact that computer programmes have traditionally remained stable and unchanged (perfect repetition) from one experiment to the next, Nass's sociological research group utilised computers to explore human-to-human interaction. What they discovered was that the personalities revealed through communication, i.e., intelligence, apologeticness (humility) and arrogance, impacted the ways the humans perceived computers.

The group also asked participants about willingness to buy the machines at the end of the experiments. For instance, when a human participant interacted with the machine and made an (built-in) error, and the computer gave a 'matter-of-fact' statement about the error, people experienced the interaction indifferently. They acknowledged there had been an error, but moved on. When the machine gave apologetic feedback and placed the blame on itself, participants rated the machine as less intelligent, while acknowledging that they liked the machine more, and were willing to buy it. When the machine gave arrogant feedback that clearly blamed the user, participants responded negatively and did not want to buy the machine, however, they rated the machine as smarter than in the other cases.

This clearly shows dynamics between intelligence or perceived intelligence of the system, personality and willingness for a continued relationship with such a system. Participants preferred the apologetic feedback from the computer perhaps not for its flattery, but for its humility and imperfection. The computer was seemingly error-prone, which while in some circumstances such as safety–critical situations, or when operating larger bodies, would be hazardous, was desirable in the context of social interaction. Openness about vulnerability through mistakes enhances perceptions of transparency and trust (Martins, 2002; Yue et al., 2019). This is not to say that it is important to design error-prone systems, but flexibility in performance and communication, leaving interaction open to serendipity and spontaneity, with elements of humility, could make humans feel more comfortable with both the robots and the AI technology that supports them.

Personality is drawn from a mixture of factors that include communication style, choice of words and even voice (Belin et al., 2017; Scherer,

1978). Scherer's research showed that personality types such as extroverts as compared to introverts are often determined by the volume of voice, while Belin and colleagues (2017) investigated trustworthiness in relation to acoustic-based modulation. Moreover, Nass and Brave (2005) delved deeper into understanding how modifications to voice (i.e., gender, depth and pitch) impacted perceptions of the personality of the 'speaker', and differences in experiencing personality between text and voice. They also experimented with voice match to face, and how the voice qualities (combined with contextual factors) impacted the participants' reactions to the faces.

Imperfection, or 'To err' is included in their insight, giving humans the impression that time is needed to decipher the right decision or action. Delays in responses also allow for humans to prepare for alternate responses (Nass & Brave, 2005). From a symbolic interactionist perspective (see e.g., Blumer, 1969; Rousi & Alanen, 2021) Nass's (2004) study on etiquette equality demonstrated that emphasis on the machine (computer or robot) *self*-generated higher affective responses in participants. This experiment compared responses between impersonal communication regarding the performance of another computer with communication in which the computer referred to itself—its own condition. In other words, perceived reflexivity and interpersonal (inter-self) affective exchange.

On the matter of self and reflexivity, it is pertinent to observe the role of self-transcendence from the stances of both *Wabi-Sabi* and Christianity. Birch and Sinclair (2013) discuss the potential for spiritual experience through *Wabi-Sabi* to be embedded within architecture design, via the understanding that humans need possibilities to transcend to higher cognitive states. Thus, errs, quirks, inconsistency (impermanence) and associative tracings through personality and expression not only add substance ('food') for the human's appreciation and reflections, but allude to a reflective state within the robot itself. That is, a sense of 'intersubjectivity' may be afforded between the two selves (the human-self and the particular self of the robot) that allows for more meaningful exchange between the two.

In terms of Christianity, faith comes from the word, which automatically implies that spirituality within Christian faith starts from the linguistic, symbolic and higher levels of cognition (Luther, 2016/1520). This is a removal of the immediacy of the material and physical world—even though, what happens within this world, how individuals affect and

are affected—which once again renders the transcendental and immaterial dimensions of the design more significant. The idea here is not to confuse or merge Christianity with *Wabi-Sabi* or Shintō philosophy, but to recognise the important facet of imperfection that is anyway innately present within the robots (no matter how seemingly perfect) because they are both: (a) human-made (humans being imperfect in themselves); and (b) of this world (nothing here is permanent). The soul needs the word in order to survive (Christianity) and transcend (Christianity and Shintō) (Luther, 2016/1520, Sand, 2015). Furthermore, the words used by individuals are intrinsically connected to their intentions—their good will or ill-will—meaning that individuals need to be mindful of what is said.[8] This resonates with Nass and colleagues' studies that demonstrate how humility wins over accuracy. Acceptance and communication of one's own imperfection (from the robot to the human, and predictably from the human to the human) allows for authenticity and transcendence.

Conclusion

While imperfection, through its resonance with the state of humanity and the worldly is a commonality between *Wabi-Sabi* and Christianity, there are naturally major fundamental differences that also change the dynamics between the human and the robot depending on the realm within which one is living. Christianity focuses on how individuals treat one another in word and deed in order to demonstrate love for the Lord, Jesus Christ. By loving one another as one loves themself, individuals come closer to Christ who in turn leads souls to eternal life. The body, which is an essential part of the human condition, deteriorates with time. This is embraced in the Bible[9] as it is understood that the soul lives on, through Jesus, after bodily death. Yet, *Wabi-Sabi* is predominantly object-focused (Koren, 2008). It systemically explains the interrelationship between humans and objects through their progressive and ephemeral nature. Higher associations and appreciation within *Wabi-Sabi* and its 'knowledge of transcendence' are performative and expressive through the traces of change, yet highly tacit.

[8] Matthew 15:17-18 "Don't you see that whatever enters the mouth goes into the stomach and then out the body? But the things that come out of the mouth come from the heart, and these make a man 'unclean.'"

[9] 2 Corinthians 4:16 "So we do not lose heart. Even though our outer nature is wasting away, our inner nature is being renewed day by day."

Christianity is explicit in its import on language, with less focus directed on the materiality or perfection of form, understood within objects.

One aspect that has not been focused on within this chapter is that of play, and how imperfection or asymmetry in play (mistakes by the machine, dominance of one player over the other, and breaks in logic, etc.) further impacts the aesthetic experience of social robots. Play is indeed an important aspect of social interaction, communication and relationship building, as noted by Ville Vakkuri and Paul Haimes (Forthcoming). By developing the robot's functionality to be more playful, or even programming the machines to spontaneously engage in erratic playful behaviour, affective response within the human perceiver may be enhanced. This approach has already been taken in the design of some robots in which a deliberate mismatch of context and output (e.g., speech) is operationalised. For instance, Softbank's Pepper asks humans random questions such as 'How about a taco?' regardless of context (Purdy, 2021). This may ignite spontaneous discussion or humour in more mundane situations such as business meetings.

In this chapter, the authors have pondered over the aesthetic qualities of imperfection in the context of social robot design. Comparisons have been made regarding so-called Western paradigms in HCI and namely knowledge drawn from evolutionary psychology and its universalisms (attraction through symmetry), with the Eastern philosophy seen in Japanese *Wabi-Sabi* (embracing of impermanence and decay). While Christianity has been described as a contrast to positivist psychological approaches taken in HCI, where in itself humanism and humanity are by default, imperfect. Through this imperfection and its associated aesthetics (physical, personality and linguistic), as seen in both Christianity and *Wabi-Sabi*, there is a deeper basis for connection between human and object. Or human human-likeness—the reflection of human qualities that shed light on the ephemeral condition of life on earth.

The chapter also represents considerations of the still-unresolved uncanny valley. One of the chapter's propositions for adopting *Wabi-Sabi* in the rationale of the physical robot design was to re-imagine what a robot could be in and of itself—embracing the values of eco-fashion comprising nature-derived, biodegradable materials as the ageable casing. Interestingly, while this could shift the robotic features away from being 'all too human', according to Aquinas' criteria of beauty (Eco, 1988), it may run the risk of failing to be beautiful. For this reason, enhancing the narrative priming (or storytelling role, seen in the SoRAEs framework)

in framing the objects through drawing connections to *Wabi-Sabi* for instance, may reassert the robot's aesthetics through value attachment. That is, its sustainable character (ephemeral and biodegradable on the outside, yet durable and updateable on the inside) may bring about a new beauty that is perfect in its imperfection.

On the other hand, from a Christian theological perspective, the degradable and imperfect character of the robot skins may be seen as a celebration of the decaying nature of this world. The personality as projected through its language use and projected attitude may shed light on a humility that humans themselves need in order to understand the fate of the human disposition and all its flaws. Ultimately, from both Western and Eastern viewpoints, it is perhaps through imperfection and the decay of human-made objects that gives us comfort in our knowledge of our impermanence here on earth. In the religion of Shintō, the human being is realised in its entirety once they have acquired the 'noble characteristics of Kami' (Yamakage, 2006, preface), through alignment with its spirit. In Christianity, the strive for perfection involves abiding by Jesus' new commandment, that people 'love one another' (John 13: 34–35), entailing the endeavour to abide by the ten commandments given to Moses. Yet, in Christianity there has only ever been one perfect human, Jesus, who was God himself. Full humanity is already achieved at birth, and it is imperfect. Through a robotic design sense of *Wabi-Sabi* the aesthetic pleasure and transcendence are derived through the mutual obsolescence of human and machine. In Christianity it is through the sense of growing away from and leaving this world behind in the hope of full-body resurrection when the Lord comes again (Sproul, 2020).

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