Animé and the Acceptance of Robotics in Japan: A Symbotic Relationship

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(Signature of student)_____

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I'd also like to thank Greg Pak (director of the superb film, *Robot Stories*) for allowing me to interview him [12], and also to Simon Cogan for his unique insight into Irish tourism and its pertinence to this essay.

Contents

Man's insecurity stems from the advance of science. Never once has science, which never ceases to move forward, allowed us to pause...no matter how far we may go, it won't let us take a breath.

—Natsume Sōseki, *The Wayfayer*

[I]t's interesting that stereotypes about Asians parallel stereotypes about robots—both are often negatively depicted as emotionless, faceless technicians, an army of efficient machines destined to take over people's jobs.

—Greg Pak, director of *Robot Stories* [12]

The end of World War II and the subsequent evolution of technology has caused pop culture to become pervasive in every facet of modern-day society; from television to cinema and magazines to the exponentially-growing World Wide Web. Within Japanese pop culture, animé has become progressively more influential and commands true worldwide recognition since the Oscar-winning production, *Spirited Away*.

Similarly, in recent decades, the field of robotics has also been spurred on by technological advances, and is becoming increasingly prevalent within society, industry and our homes. While robotics and animé have originated in very different ways, as both advance they are forming a unique and multi-faceted symbiosis.

This essay will attempt to show the cyclic links between animé 's influence on society's perception of robots, and furthermore how the public's perception of robotics is shaping modern research directions in the field. I will discuss how both animé and robotics have a unique "Japan-ness" about them that distinguishes them from other sciences and pop culture phenomena that are often deemed as Western imports, as well as how World War II, the disillusionment with postwar Japanese society and the *kawaii* culture have affected both areas.

Therefore, in order to fully understand the symbiosis between the two, it is necessary to understand the circumstances and background from which both fields have arisen. This involves analyzing Japan's technological and economic background, animé and its unique perspective on technology, and the inevitable rise of the intelligent machine.

The Rise of the Machine

Intelligent machines and robots are becoming more commonplace within modern-day society with thousands of products now manufactured with little or no human participation and billions of pounds handled by intelligent computers and machines everyday.

Moore's Law & Computability

This inevitable 'rise of the machine' has come about on the back of the digital revolution. Available computing power has been doubling every few years since 1975 and experts predict it will continue to do so for the next 15-20 years [14, 7, 25]. Furthermore, the cost of this technology has reduced dramatically over the last few decades. For example in 1965, a typical computer chip consisted of thirty transistors, each of which cost $5. In 2000, $5 would buy five *million* transistors and the latest Intel Pentium 4 contained a total of 42 million on-chip [7].

This extraordinary increase in computing power and availability has opened up opportunities, allowing institutions to research advanced technology cheaply and permitting private companies to release technologically advanced yet commercially viable products. As a result, the field of robotics has in recent years benefited from these advances more than most.

Excellent examples of this are Sony's two major robotics projects: their commercially available AIBO and technology demonstrator, the SDR-4X.

Sony and the Quest for a "Useless Robot"

Sony started research into an open, modular robot software architecture that could be used for entertainment purposes. This was summarized in an initial research document claiming, "We strongly believe that after the Gold Rush of the Internet and cyberspace, people will eagerly seek real objects to play with and touch. Robot Entertainment provides tangible physical agents and an unquestionable sense of reality" [5]. The initial research proved fruitful and Sony developed the OPEN-R software platform from which to base their entertainment robots [5, 6]. Sony then tested the entertainment robot market by releasing a limited-production product called the ERS-110 AIBO Entertainment Robot, and despite its rather hefty price tag, the robot was an immense success. Subsequently, Sony released a mass-produced version a few months later, and have continued to put new models on the market every year since.[1]

More recently, many of Sony's efforts have focused on its other major robotics project: the SDR-4X, or QRIO.[2] Toshitada Doi, Sony's robotics executive, felt that Sony must develop a

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[1]See www.aibo.com for more information regarding the various models.

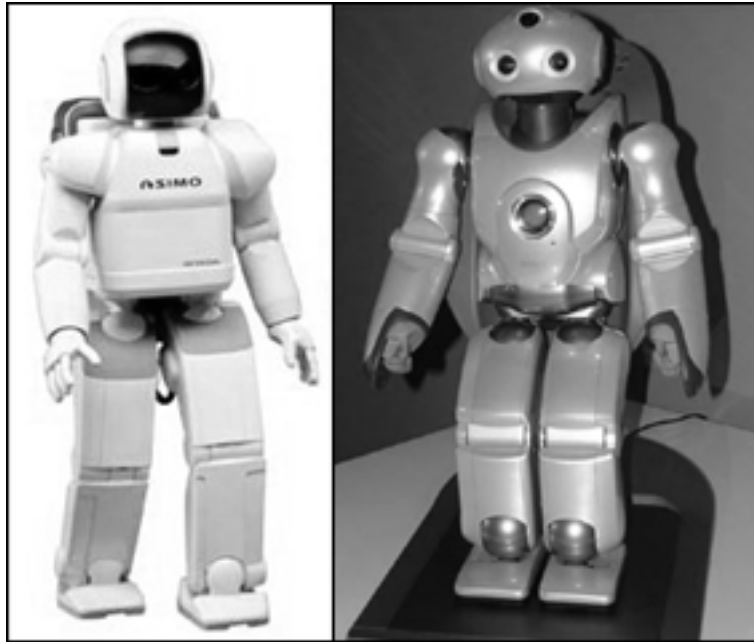[2]Pronounced *curio*, short for Quest for Curiosity [24].

Figure 1: Honda's Asimo (left) and Sony's QRIO (right): The latest bipedal robots

personal entertainment robot to facilitate the creation of a new industry—entertainment robots [1]. QRIO is an absolution state-of-the-art machine, containing three 64-bit processors, 192Mb DRAM, 38 motors, nearly 80 sensors, two 110,000 pixel CCD colour cameras, seven microphones, a speaker and 5 LED displays [24]. Yet while the projected price of QRIO is in the range of a luxury car (QRIO is currently unavailable for commercial sale), Sony's commitment to the QRIO project highlights just how quickly technological and economic changes have affected the robotics industry.

Now with the increasing rise of intelligent machines and robotics, buzzwords, and over-enthusiastic marketing departments, the principle problem when discussing robotics has become one of *definition*.

The Problem of Definition

There are are literally hundreds of definitions as to what constitutes a robot; is it a manipulator, an intelligent system, or an adaptive, anthropomorphic machine? The word 'robot' comes from the Czech *robota* for "servitude or forced labour" [21], but for the purposes of this essay the term 'robot' will be used in the broadest sense to describe anything from an industrial robot, autonomous vacuum cleaner or an animé -style cyborg.[3]

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[3]Schodt [21] expands on these definitions and includes some interesting alternatives from industry leaders, as well as the Japan Industrial Standards' eight formalized definitions.

Definition might not seem important on the surface, but it is intrinsically related to the public's perception of robots. For example, when the first industrial robot was released in 1962, the manufacturer did not want to call it a 'robot' since they felt it held a negative connotation; Universal Transfer Device was used instead [21]. More recently, when the public hears the word 'robot', they often associate it to the bipedal research robots such as Honda's Asimo and Sony's QRIO (shown in Figure 1) that dominate the press. Little consideration is given to the myriad of other robotic 'genotypes'. The resultant effect is that people expect all robots to do the same things equally well—imagine if the definition for a car did not necessitate that it must move an occupant from one destination to another.

Definition has not always been a problem; automata, the mechanical precursors of modern-day robots, have been extremely popular ever since their introduction centuries ago.

Japan's Technological History

The *karakuri*, or tea-carrying automaton, from the seventeenth century is widely recognized to be the first Japanese 'robot.' A cup of tea could be placed upon the doll and once wound up it would move forward until the cup was lifted. When the cup was replaced, the doll would turn around and return to its starting point [21, 3].

Shortly after the *karakuri* was created, Japan fell into its isolationist era, banning all foreign influence and contact, except a small amount of Dutch trading in Dejima. Despite this, the *karakuri* tradition continued. Furthermore, spurred on by developments imported from Western clock manufacturing, the dolls became increasingly complex and performed an ever broader range of tasks and amusements. These advancements eventually froze since the Japanese quest for knowledge seemed driven by the arts. This was in stark contrast to the West, where the development of the automaton was intrinsically related to scientific advancement [21].

The Post-war Importation of Technology

While Japanese research and development (R&D) efforts were extremely active during the early twentieth century and throughout the period between the two world wars [4, 16], Japan's R&D infrastructure was devastated during the World War II bombings. The springs of 1945 saw a rain of fire caused by over 2,000 tonnes of napalm and incendiary bombs dropped from American B-29 bombers, wiping out most of the industrial cities [16].

Following the atomic bombings of Hiroshima and Nagasaki and the subsequent surrender of Japan, American occupational forces commanded by General Douglas MacArthur and

SCAP[4] arrived to restore order in Japan. The main concern of SCAP was not the restoration of the Japanese economy, but instead the normalization of living conditions within society. Much of this work was delegated to the Economic and Scientific Section (ESS). The chief of ESS' Scientific and Technical Division (ESS/ST), Brigadier John William Alexander O'Brien, soon urged that more attention was paid to technological development in order to aid economic restoration. The ESS/ST was involved in encouraging Japanese scientists to continually innovative and improvise to further their nation's economic circumstances. Numerous initiatives were started to improve productivity through increased technology. US funds paid $125,000 for the importation and translation of scientific and technical publications, and by 1948 ESS/ST was drafting plans to use large portions of EROA[5] funding to import laboratory equipment and supplies to further aid research.

In 1949, $86,000 of EROA funds were used to procure equipment, $75,000 for the following year although this was further supplemented by $200,000 from SCAP's Commercial Account. Furthermore, the ESS/ST initiated actions that led the Japanese government to submit a proposal for a further $11,000,000 for the purposes of technology importation [4].[6]

Upon the completion of the Occupation, the Japanese economy continued to grow using the adopt-and-adapt strategy. This was an interesting period of Japan's technology history, since the bubble economy was booming, and the success was often attributed to the 'uniqueness' of Japanese culture. For example, in his book, *Japanese Technology: Getting the Best for Least* [15], Masanori Moritani discusses with glorious bias the post-war rise and successes of Japanese companies founded by engineers and others with technical backgrounds. Despite this, he also draws interesting parallels between Europe and Japan regarding their concerns with the increasing rise of the microprocessor. While a British House of Commons' survey predicted microprocessors would result in 880,000 lost jobs, a similar report by the Japanese Ministry of International Trade and Industry foresaw no loss in labour jobs but instead expressed concern about a shortfall in software engineering [15].

Acceptance without Ambivalence

Yet what exactly is it about Japanese culture that makes it so open to robotics? Initial theories that centred around society, religion and history seemed to suffice—Japan's religions openly embrace animism in inanimate objects through the concept of *kami*. Furthermore, Japanese art

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[4]Acronym: Supreme Commander Allied Forces Pacific

[5]Acronym: Economic Rehabilitation of Occupied Areas

[6]It should be noted that the term 'Importation of Technology' was an umbrella term that included funds for patent licenses and interchange of personnel as well as equipment and literature. See [4, Chapter 12, Note 7] for a complete breakdown.

supports a tradition of skillful craftsmanship which may now be projected within the robotics research community [22].

Beyond this, it is also necessary to look at how Japan's technological revolution came about. It was not the result of indigenous knowledge like Britain's Industrial Revolution, but instead was imported from the West [17]. Additionally, Japan has undergone two periods of extreme growth both caused by Western influences. First by Perry's 'Black Ships' re-opening Japan to commerce and further technological momentum, and secondly, by the end of World War II which also saw the import of many American technologies and a period of immense economic growth [17, 4].

So how has this affected the Japanese attitudes toward technology? Hajime Nagahama [17] highlights that technological advancement has been enjoyed by Japanese society through modern conveniences not national pride. The result has been highly innovative and advanced technology in every facet of industry and daily life, but this unwavering pursuit of technology has had subtle ramifications. Nagahama continues to stress that while this lack of ambivalence was essential during the post-war era, it is now harming research efforts within Japan [17, also supported by [22] and [26]]. Nagahama cites three key areas to support his argument:

- *Technology as an import.* Since the Meiji-era, technology has been seen as a Western import. Although Japan may have made many discoveries that have garnered worldwide recognition, scientists still receive little national acclaim.

- *Ethics and technology.* Nagahama argues that during the drive to modernize, the Japanese government did little to understand the fundamental relationship between technology and society.

- *Education and technology.* Again due to the rapid modernization process, Nagahama believes that Japan's technological research efforts are solely geared toward economic gain. Due to this, current research efforts in Japan are relatively inflexible and have difficulty responding to changes in the societal system and the period of stable growth that has superseded Japan's economic boom.

These three points are intrinsic to the Japanese attitude toward technology since they highlight the strange relationship between science and culture that is evident within Japan. Japanese religion and spiritualism situates 'humanity' and 'nature' on a continuum from which morality and ethics are derived from. Conversely, the (Judeo-Christian) West holds 'nature' and 'humanity' as a dichotomy, and therefore derive their ethics and morals from God. Western science follows on from this, externalizing 'nature' and subjecting it to analytical query [17].

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So while Japanese science still operates within a Western framework (externalizing Nature), it is only natural for Japanese scientists to react to their Eastern ways of thinking. Does this have an affect upon the Japanese acceptance of robotics and technology? Are robots seen to have a place on the Nature-Humanity Continuum?

No matter the answer, Japan still develops technology quicker than any other industrialized nation. As mentioned though, it is often through the channel of convenience rather than as a part of some ethereal continuum, or the raw pursuit of science.

Counter to this though, Japan also embraces technologies like robotics to national issues such as the "aging society problem" (*kōreika-shakai no mondai*). For example, robots are currently available that allow family members to use audio and visual communication to monitor their elderly relatives using their third-generation mobile phones. Furthermore, research into robots that physically aid elderly people is another extremely active field within Japan.

To summarize, we have seen how Japan's economic and technological history have forged a unique relationship between Japanese culture and the science of convenience that is so pervasive within it. We have seen how changes in availability and cost have changed the face of technological research and paved the way for an influx of commercial robotic products such as Sony's AIBO and possibly QRIO.

Next we must explore the intricacies of Japanese animé , its history, fascination with the apocalypse and iconic characters such as *Astro Boy* and *Doraemon*, and landmark feature films such as *Ghost in the Shell*.

Japanese Animé

Pop culture has always been an incredibly strong force in Japan, carved by the American Occupation, and appealing to an unusually large demographic, from the youngest children to the oldest citizens. With the recent awarding of an Oscar to *Spirited Away*,[7], animé [8] has now entered the 21st century as one of Japan's most successful exports. Within Japan in 2001, animé accounted for over 40% of all revenue from movie showings and generated nearly 200 billion yen from movies, videos and TV productions [27, sourced from *Research on the Information and Media Society*, 2001].

Animé has its roots far back, from narrative scrolls of the twelfth century, *ukiyo-e* (woodblock prints), through to pre-war *manga* (comic books) [23]. Yet, it was not until the post-war emergence of animé like '*Astro Boy* ' that the genre truly became a phenomena of its own.

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[7]Best animated feature film of the year (2003): Spirited Away, Hayao Miyazaki
[8]The word animé comes from a shortening of the English word 'animation'.

Animé has hugely diversified; from fantasy to cyberpunk, romance to pornographic, animé caters to every niché market. Susan Napier [18] outlines the three main types of animé as the apocalyptic, the festival and the elegiac. While all three sub-genres may be pertinent in one form or another, it is the apocalyptic form that most frequently deals with technology and robotics.

Apocalypse Now

Japan's fascination with the apocalypse can be seen in many cyber-punk animé —from the nuclear blast in the opening sequence of *Akira* [20], the massive alien attacks in Neon Genesis Evangelion, or the apocalyptic, world-destroying war sequences in Final Fantasy. The medium of animation is perfectly suited to the apocalyptic genre, since it has no need for special effects or a large budget to effectively wow the audiences with scenes of mass destruction. Yet, *why* are the Japanese so intrigued by this concept?

Many believe the answer lies in the fact Japan is the only nation to witness an apocalyptic event between man and technology; namely the 1945 atomic bombings of Hiroshima and Nagasaki [18, 21, 22, 12]. Interestingly though, the Eastern ideas of the apocalypse are radically different to the wholesale and exaggerated destruction of the world prevalent in Western religious texts. While Christian views of the apocalypse depict the final struggle between good and evil, punishment for the wicked and ascent to heaven for the good, neither traditional Buddhism nor Shintoism share these or any analogous beliefs [18].

Furthermore, factors specific to the present time and Japanese culture have contributed toward the dark nature of many contemporary animé . Napier discusses alienation due to urbanization and the generation gap—two global problems that are particularly acute in Japanese society. The Japanese have also seen a serious economic downturn since the stock market crash in 1989, leading to disillusionment amongst all generations, and a record number of suicide rates since [18].

Yet despite this, many Japanese animé depict life *after* an apocalyptic event: again typified by *Akira* , whose central city, New Tokyo, is built by the A-bomb crater that destroyed Old Tokyo.

Astro Boy

Similarly, it was from the ashes of the real atomic bomb that Japan's most famous robot character emerged. In 1951, Tetsuwan Atomu (*Astro Boy*)[9] was created by Osamu Tezuka, a medical

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[9]Tetsuwan Atomu is actually translated as Mighty Atom, but the character was exported as *Astro Boy* .

Figure 2: *Astro Boy* gets into trouble ©Tezuka Productions / Asahi Shinbun

student and artist. The story goes that *Astro Boy* was created by a top scientist at the National Space Agency to replace a son tragically lost. *Astro Boy* was nuclear-powered and endowed with enormous strength, the power of flight and the ability to speak tens of languages. What made *Astro Boy* so popular though, was that he was placed in a normal family environment—he had a mother and father (also robots) and went to school with other human children [21].

Astro Boy quickly became associated with a future where robots and humans lived together effortlessly, and technology and science were embraced by society. Tezuka claims that, as a scientist, many of the characters and central themes of *Astro Boy* were meant to be cynical. Interestingly, it was the publishers, through public opinion, that often made him add a more romanticized aspect to the technology depicted in the series [21].

Although Mighty Atom's influence on the public's perception of technology was something the creator had not envisaged, Tezuka had always seen the story of *Astro Boy* as one of interface—an interface between man and machine. Sena [22] eloquently sums up Tezuka's notions by saying, "*Astro Boy* is neither machine nor human. He is a fosterling to both and a presence that mediates between the two."

In 2003, *Astro Boy* once again became an interface between robots and humans, as a remake of the original series started airing. The new release of *Astro Boy* saw a number of changes introduced—nearly all of which were deliberately introduced to reflect current robotics research. In the first episode, when *Astro Boy* is initially started up, he acts helplessly and

infantile but learns to harbour his emotions over time.[10] This deliberately reflected a popular research field in Japan called 'cognitive robotics' that approaches intelligence from the bottom-up rather than top-down.[11]

Furthermore, the new director of the series, Kazuya Konaka, was very aware his new *Astro Boy* would influence the perception of robots amongst a new generation of children. He had therefore fashioned the new series to take a more practical and less emotional stance [22].

This feeling of responsibility amongst animé directors seems to extend within much of the cyber-punk genre, exploring both the good and bad aspects of technology and robotics.

Acceptance *with* Ambivalence

Like Tezuka's original *Astro Boy* , a lot of Japanese animé portrays robotics in an incredibly strong light, acting as a medium between technology and man. Conversely, like much Western popular culture, many treatments look at the destructive potential technology holds. The distinguishing point though lies in that no matter the perspective within a particular animé , its treatment is always mature and multi-faceted.

For example, Neon Genesis Evangelion (*Shin Seiki Ibangerion*, see Figure 3) centres around a young boy, Shinji, in a time where the world has witnessed an apocalyptic event, the Second Impact. The Second Impact occurs within the Arctic Circle and the force of the explosion causes a massive rise in sea levels. Twenty years on, and Earth is invaded by massive aliens called 'Angels': giant, seemingly indestructible beasts with highly destructive weaponry. The only way Earth can fight back is by using experimental robots called the 'Evangelion'. These robots are powered in part by thought-control and as such require young, teenage minds. Shinji is the second child to be brought into the project to pilot EVA Unit 01, the first operational Evangelion.

As the series progresses, the viewer learns of Shinji's dislike for the technology he pilots counterbalanced by the strong link he feels toward Unit 01 through the mind control. Toward the end of the series, the viewer starts to learn that the Evangelion units are very similar to the aliens they are fighting; organic beings that are harnessed by robotic technology and piloted by humans.

The Neon Genesis Evangelion episodes (and concluding films) make an interesting case-study, since technology is explored through the mind of a young teenage boy—torn apart by an

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[10]It is interesting to note that this is exactly what the Sony AIBO also does. When you first turn your AIBO on, the robot will act like an infant, unable to walk and subject to mood swings. It is only through time and interaction that the robot 'develops' [11].

[11]Please see [10] for a detailed explanation of bottom-up and top-down approaches within artificial intelligence and robotics.

Figure 3: The three main Evangelion Units (from left to right: Unit 03, Unit 01 and Unit 02)

unloving father, and a reluctant hero in an inexplicable war against an unknown enemy. While the Evangelion units are Earth's only hope, the dark and sinister projects behind the technology are portrayed as immoral. Technology as a necessary evil.

Other animé such as *Ghost in the Shell* and *Metropolis* take a more neutral standpoint on advancing technologies, and see it as a snowball effect that humanity has started and must now understand and legislate accordingly. *Ghost in the Shell* [19] is often used as the benchmark cyber-punk animé , and explores technological themes in a philosophical light.

The film evokes a positive perspective toward advanced technologies such as cyborgs and artificial intelligence, yet remains cautious by depicting the caveats—'hacked' minds, reduced personal privacy and complex ethical and moral issues surrounding these technologies. The basic premise of the film revolves around Kusanagi, a female agent cyborg for a special unit of the Japanese government called 'Section 9'. In the film, Section 9 are tracking a hacker by the name of the 'Puppet Master'. It is revealed that the Puppet Master is in fact an advanced, government-development Artificial Intelligence that became sentient and is now attempting to be recognized as a living being. Kusanagi, as half-human and half-machine, starts to form a unique link with the Puppet Master, who wants to 'merge' with her to become something greater than their parts.

Throughout the film, Kusanagi contemplates her identity, and how her status as a cyborg

changes her identity. In one sequence she discusses the dilemma of trading in the cyborg body which she has become so reliant on, for a wholly organic body to make her human. This is reminiscent of the mental struggle Shinji has toward Unit 01—a mutual, simultaneous feeling of dependence and revulsion.

This treatment of technology as a double-edged sword is prevalent through much of animé , or as Susan Napier eloquently says, "the simultaneous celebration of technology through its privileged presence in the narrative and an excoriation of its destructive and dehumanizing potential" [18].

Friendly & Warrior Robots

Despite this, a 1981 survey found that 20% of all Japanese animé was related to autonomous robots [21]. The most popular of these were in a similar vein to *Astro Boy* , with boy-next-door qualities and an air of humour.

While animé about autonomous robots was popular, one genre outstripped every other by an impressive margin. Out of the remaining 80%, 73% of all robotic animation fell into the warrior-robot genre. Warrior robots were huge, brightly-coloured bipedal robots that fought with similar warrior robots in cities or in space. The robotic shape, now a globally-recognized image, had strong influences from samurai armour and head-wear, as well as strong insect-like features. Stories were simple and repetitive, eventually degenerating to 30-minute advertisements for toy companies [21].

Some productions attempted to break the mold such as *Mobile Suit Gundam* or *Layzner*. *Layzner*'s director, Ryosuke Takashashi, not only stressed highly-realistic robots within his animé, but also saw the genre as particularly important since it had such an influence on the younger generations. Takashashi's father was killed in World War II and therefore until high school he could not watch anything that dealt with the war. Later though, he became a director, creating animé that were, by his own admittance, more violent than most. He felt that robots aided his creativity and said, "The robot world we portray doesn't really exist, but seems as though it could if science keeps progressing. The unknown variables are a stimulus to young people's imagination; we use the robots as a bridge to the fantasy world." [21]

Indeed, Japanese warrior robot productions have had a large impact on children over many generations, both in Japan and in the West. These distinctly Japanese shapes and colours have been associated with robots worldwide since 1983 when the Takara toy company introduced their line of transforming warrior robots to the U.S. under the name, "Transformers". When they hit the market, they became the most successful selling toy ever with $100 million worth of sales within the first year alone [21].

So whether the robots created were cute icons like *Doraemon* or destructive warrior robots like the 'Transformers', it only helped to reinforce the acceptance of machines and technology within Japan. Schodt emphasizes this point with a quote from a personal interview with Eiji Yamaura, vice-president of Nihon Sunrise.[12] "Japan has a long history of robot shows, and the robots themselves sometimes appears as enemies, sometimes as friends. But the basic concept of a robot was formed with Atom—a robot is fundamentally a friend, and, as in Asimov's Laws of Robotics,[13] will not harm us." [21]

So there seems a strange dichotomy between Japanese animé and their approach to technology, especially robotics. Why are the popular animé characters often cute and cuddly machines (such as *Astro Boy* or *Doraemon*), while other successful features treat technology ambivalently (such as *Ghost in the Shell* or *Akira*)? Why do the Japanese hold such an affinity for warrior robot animé , but dislike real battle-robot competitions such as Robot Wars or Battle Bots [22]?

A Symbiotic Relationship

Understanding the cyclic link between pop culture and the acceptance of robotics requires a truly macroscopic view. The reciprocal nature of the two fields has emerged from their respective and wholly unique "Japan-ness" [22]. Animé and robotics are viewed as Japanese on a global scale—animé is seen as a one of the most popular Japanese exports, while Japan is recognized worldwide to be at the forefront of robotics (both academic and commercial).

Furthermore, both these fields have developed irrespective of the strong American influences that permeate modern Japanese society. Japan's entire post-war infrastructure and technological development was geared toward economic reform, and was therefore greatly funded by the ESS/ST and EROA funds. This trend continues as Japan develops many technologies by importing them from the West and merely 'japan-izing' them [17].

Yet due to circumstances unique within Japan, robotics research has developed in a very different way to the West. It has commercialized quicker, and has received much greater private funding as shown by the success of Sonys AIBO and QRIO robots. The Japanese application of robotics to societal problems such as security and the aging society is also in stark contrast to the Western robotics primary application—the military.

Similarly, animé is a Japanese phenomenon that has garnered worldwide success and has

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[12]Nihon Sunrise were the production company responsible for many robot-animé such as *Mobile Suit Gundam.*

[13]Fictional laws written by science-fiction author, Isaac Asimov. The three laws are stated as (1) A robot may not injure a human being or, through inaction, allow a human being to come to harm. (2) A robot must obey orders given it by human beings except where such orders would conflict with the First Law. (3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Law. [2]

now transitioned to mainstream media channels. Evolving from ancient Japanese arts such as narrative scrolls and *ukiyo-e*, and absorbing foreign influences such as the early Disney cartoons, animé expanded from bringing existing manga comics to life, to the feature-length, high-budget productions that appear today. Probing every facet of societal culture and every time period of the past, present and future, only one thing has remained constant—it is Japanese.

While this "Japan-ness" seems a plausible explanation to their popularity, it does little to clarify the relationship between robotics and animé although Sena cites this intrinsic "inexplicability" as the essence of their relationship [22].

War and Animé

Looking again at Japan's war experience; the atomic bombings, the Occupation, U.S. technological funding and non-militaristic constitution, it becomes easier to see how the seemingly strange dichotomy converges with robotics and animé .

The atomic bombings have given Japan a deep-rooted interest in apocalyptic events, which has been further augmented in the last 15 years by the downturn in the economy and general disillusionment with postwar society. Furthermore, Japan's postwar constitution renounced any form of aggressive military action while the atomic bombings and humiliation of the Occupation has resulted in an extremely strong sense of pacifism amongst Japanese nationals.

This interest in destruction, especially of society or objects signifying society, coupled with a strong pacifism can only manifest itself truly in one medium—animé . This could explain the popularity of warrior-robot animé , but the reluctance to watch real-life battle robot tournaments.

Japan and the *Kawaii* Culture

The disillusionment with Japanese society has also been clearly substantiated in youth culture through "the ephemeral fashion of the *shōjo* (young girl) and the culture of *kawaii* (cuteness)" [18]. This *kawaii* culture is celebrated through childish fashion, young pop idols and a huge commercial market of 'cute' stationery, fashion accessories and other paraphernalia known as 'fancy goods' [9].

The cute culture started around the 1971 student riots, during a disillusioned calm known as *shirake* (or 'doldrums'), when the consumer boom was just starting. It did not take long for companies to understand the spending power of this new demographic, and by 1990 the 'fancy goods' industry reached an estimated turnover of 10 trillion yen [9].
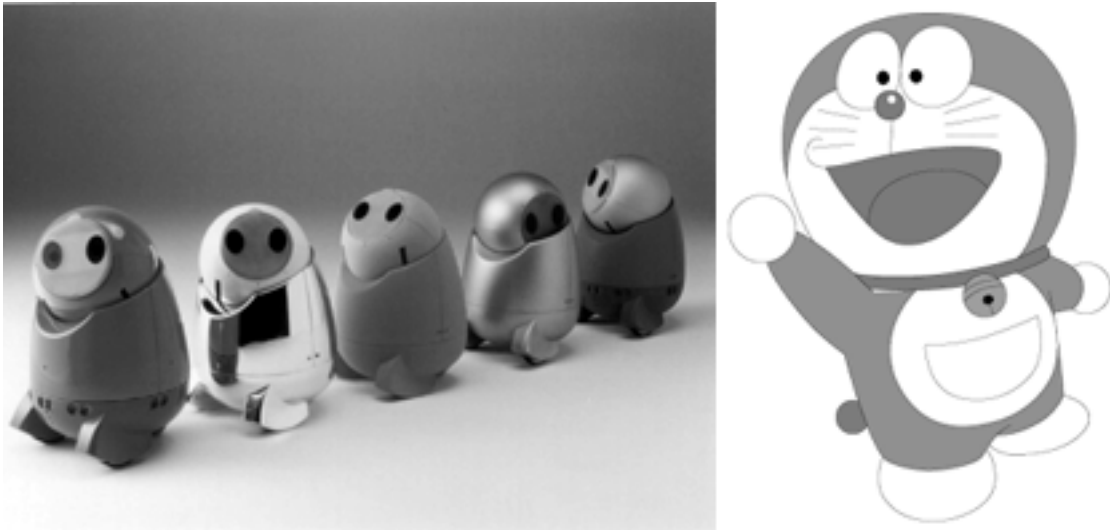
Figure 4: (left) PaPeRo, a state-of-art robotic companion and (right) Doraemon, a animé icon ⓒNEC and Fujiko Pro, respectively

This celebration of *kawaii* continued with animé icons such as *Doraemon* . *Doraemon* was *kawaii* is every aspect—from his appearance to his back-story, Doraemon was engineered in 1970 to endear the nation. Doraemon's appearance followed the stereotypical *kawaii* formula, being a small, soft, mammalian and extremely round [9] robot. *Doraemon* lived in a normal family environment with Nobita, a young and clumsy boy who performed poorly at school. Nobita's shortcomings cause problems for his descendants in the future, so they send a protector back in time—*Doraemon* . This robotic cat is highly intelligent and always looking after Nobita's best interests. *Doraemon* is not perfect though, prone to error and mechanical failure as well as a paralyzing fear of mice [21]—*Doraemon* embodies *kawaii* by being cute in appearance and helpless in personality.

Cute animé robots have had an effect on commercial robots: AIBO, Asimo, QRIO (see Figure 1) and PaPeRo (see Figure 4) all exhibit the trademarks of *kawaii* objects. Furthermore, the robots are often exhibited performing similarly cute actions. For example, Sony demonstrates the remarkable servo and actuator technology behind QRIO through a series of coordinated and synchronous dance sequences [13]. In fact, Sena [22] explores the possibility that animé and pop-culture may be diluting the pursuit of science, by appealing to the Japanese's affinity with cuteness.

Although the *kawaii* culture might be diluting the pursuit of science behind robotics, there is no doubt it is greatly promoting the acceptance of robotics at a superficial level.

It is also the *kawaii* culture that helps explain the strange bipolar attitude toward robotics and technology. Both the cute icons epitomized by *Doraemon* and the dystopian, apocalyptic

worlds of Akira have their roots in the disillusionment of postwar Japanese society.

Great Expectations

As seen by the '*kawaii* culture', not all of these intricate relationships are wholly positive. One further link between the two is that animé tends to give the public an exaggerated view of robotics. The public grows to expect technology equivalent to that of *Astro Boy* or *Doraemon*, leaving no room for the intermediary or even the most advanced robotics of today. If *Astro Boy* was born on April 7th, 2003, where is he now [22]?

This echoes the problems of definition previously discussed. With the concept of a robot being so broad, ranging from an automaton (like the *karakuri*) to industrial robotic arms, entertainment-orientated robots like QRIO to cyborg animé characters like *Ghost in the Shell*'s Kusanagi, the public's perception of a robot is extremely vague. Additionally, as robotics is a high-technology field, the public often explores the interesting aspects of robotics through much more accessible means—popular culture.

Conclusion

The process of understanding why animé and robotics are fundamentally linked involves looking at a variety of elements; some immediately apparent while others are seemingly disconnected. Both fields have experienced a rapid expansion in recent years, due to technical advances and popular demand, and both have a unique, globally-accepted "Japan-ness" associated with them.

In Japan, robotics has progressed further than any other nation, through the postwar mentality of 'technology through convenience' and also in part due to societal problems such as the aging population. The rapid advancement of microprocessor technology and plummeting costs have allowed companies like Sony to experiment with new industries, such as 'entertainment robotics.' Similarly, animé has seen increasingly larger exposure, both within Japan and more recently on the global stage. Japanese robotics artistry has been globally accepted as the norm since the mid-1980s, when the "Transformers" were popularized.

More fundamentally though, animé and robotics are intrinsically linked by the disillusionment of Japanese postwar society. The same disenchantment has manifested itself in two almost polar fashions—the dark, apocalyptic views of many cyberpunk *anime* and the '*kawaii* culture' of the youth generation.

Similar dichotomies have been presented and clarified: the popularity of warrior robots in a pacifistic nation and the pursuit of science using Western methodologies but an Eastern

mindset. All these factors affect the Japanese public's opinion of robots, through their lack of ambivalence toward technology.

The symbiosis between robotics research and animé has been demonstrated principally through *Astro Boy* , whose post-war introduction inspired generations of robotics researchers that continue to advance and influence modern-day research. Furthermore, with the advent of the updated *Astro Boy* series, the new production team has made special note of infusing certain underlying philosophies and ideas that they hope will further inspire a new generation of robotics research for the twenty-first century.

It is undeniable that animé is having a tangible and positive effect on the Japanese public's acceptance of robotics. Whether the robots are saving the Earth, battling through crumpled cities or making jokes—they are here, and here to stay.

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