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WHO IS AFRAID OF THE HUMANOID? INVESTIGATING CULTURAL DIFFERENCES IN THE ACCEPTANCE OF ROBOTS

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Are robots perceived in the same manner in the West and in Japan? This article presents a preliminary exploration of several aspects of the Japanese culture and a survey of the most important myths and novels involving artificial beings in Western literature. Through this analysis, the article tries to shed light on particular cultural features that may account for contemporary differences in our behavior towards humanoids.

Keywords: Cultural issues; Japanese popular and traditional culture; influence of technology on cultural representations.

1. Introduction

Are there significant cultural differences between the way Westerners and Japanese see robots? Where would these differences come from? Such questions are very difficult to answer. First of all, there is no such thing as a 'Western man' or as a clearly defined 'Japanese culture.' Western attitudes cannot be lumped together as there are important cultural differences between Western countries. In the same way, Japanese culture is not a coherent whole. Moreover, a systematic comparison between the West and Japan is made even more difficult by the fact that Japanese society has developed in relative isolation from the rest of the world.

Given these difficulties, the ambition of this article is not to provide definite answers about possible differences in our attitudes towards robots, but to start a preliminary investigation in order to collect elements for understanding the cultural issues associated with these new kinds of machines. Culture affects the way technology is perceived and, in a reciprocal manner, technological evolution shapes culture in particular ways. One motivation for this work is to show that some of the explanations that are often put forward to account for cultural differences between Japan and the West concerning new technology may actually turn out to be questionable. A very common one views Japanese people as technology fans, who love technology

for the sake of it, whereas Westerners would regard artifacts as less important. In this article, we investigate a hypothesis that suggests that it may be the other way round. We will argue that it is precisely because machines are so central to the way many Westerners view themselves that they are sometimes seen as potentially harmful and that symmetrically, it is because they are not so important for most Japanese people, that they are perhaps more easily accepted.

To study this hypothesis, we will first review some interesting aspects of Japanese popular culture. We will identify in Japan a particular way of dealing with unmastered techniques that we call "technology taming" and show how Japanese culture can absorb new technological innovations without losing its core foundations. At the same time, we will point out how several characteristics of Japanese traditional culture encourage the artificial reproduction of nature and incorporate an aesthetic dimension to the quest for recreating life-like creatures. We will then perform a quick historical survey of the stories associated with artificial creatures in Western myths and novels. This analysis will suggest that the Western man views himself as the sum of the most advanced machines of his time and of a mysterious essence. In the West, technology seems fundamental for defining what humans are. This will be illustrated by a rapid stroll through the history of the metaphors used in medicine and biology. The conclusion will summarize these different preliminary findings.

2. "Technology Taming" in Japanese Popular Culture

2.1. *The robot with the atomic heart and the giant colossus*

When you ask a Japanese robot engineer why he decided to work in this area, he almost always answers that being a kid, he watched the cartoon *Testuwan Atom* on TV. This character was invented in 1951 by the famous cartoonist Tezuka Osamu. It is a small infant-like robot equipped with an "atomic heart" that defends humanity against various threats often coming from outer space. It can be considered as the primary ancestor of most of the friendly artificial autonomous creatures, both imaginary and real, invented in Japan since then. What may seem odd for a western audience is the use of the nuclear energy providing a heart for the robot. It plays the role of a vital force. At the end of the Second World War, one could have expected that nuclear energy would be associated by Japan with death and defeat. But instead of being diabolized, the destructive energy was reintegrated into fiction as a positive life principle. In contrast, Testuwan Atom was exported in the West under the name *AstroBoy*, suppressing the reference to nuclear energy to be better accepted by a western audience.

Another archetype of imaginary robots in Japan was also born in the same period. The first character of this family was *Tetsujin 28 go*, a giant robot remotely controlled by a young boy. It was invented by another manga master in 1958: Mistuteru Yokoyama. It started a long series of giant robots controlled by human

operators, among which the most well-known are *Goldorak* (1975–1977), *Mazinger Z* and more recently *Giant Robo* (1992) or *Neon Genesis Evangelion* (1995–1996).[1,2] These technological colosses, which are still very popular nowadays, are used as armor that transforms young kids into futuristic samurai. These robots are not autonomous; they are used as vehicles, a new body, a second skin.

As pointed out by Alessandro Gomarasca, the kind of stories in which these robots are involved follow a rather fixed pattern.[3] An enemy is attacking Japan (or the Earth). These are typically monstrous extraterrestrial creatures coming from space. Their power comes from the mastery of frightening technology with which they have often fused, becoming cyborg-like creatures, half-biological half-machine. To build the giant robot capable of saving the Earth, Japanese scientists must master a new technology. Very often, this technology is not developed from scratch but in some way stolen from the aggressors. This explains why in a lot of stories the "good" robot looks nevertheless frightening. Its appearance shows the signs of its foreign origin.

2.2. *Taming technology*

It seems that at least one particular point distinguishes such stories from their equivalents in the West. In Japanese fiction, new robots are reintegrated into human society most of the time. New bonds appear between men and these artificial creatures. Abandoned by its creator, Atom is soon reintegrated into a new welcoming family. By the same token, giant robots often play both the role of a father and a mother for their young pilots. Around robots a network of new links is built so that none of these creatures is left alone. Integrating such machines is a positive process. But as we will see, integrating machines in society does not imply "merging" with them.

One kind of creature seems to be systematically excluded from these virtuous links. It is the set of hybrid monsters that often play the role of the evil forces in the giant robot sagas. The cyborg, a monster which has fascinated Westerners since the end of the 20th century, is seldom seen as a welcome creature in Japanese fiction. Convergence between technology and biology seems to always be considered in negative terms. The young kid piloting the giant colossus symbolizes this well-defined frontier between the biological body and mechanical armor. In Japan, robots and humans may be living in harmony, but side-by-side. Post-human perspectives are rarely considered as having a positive future.

More generally, it seems that technology can be "tamed" without necessarily melding with it. This approach makes sense when you consider some elements of Japanese history. We may trace back this attitude to the ideological and political program of the Meiji period (1868–1912).[3] Facing its first overseas threats, Japan had to defend itself. It was decided that part of the defense program would consist of learning how to master the threatening technologies of the foreigners. This seemed to be a necessary step towards defending the core of Japanese traditional culture.

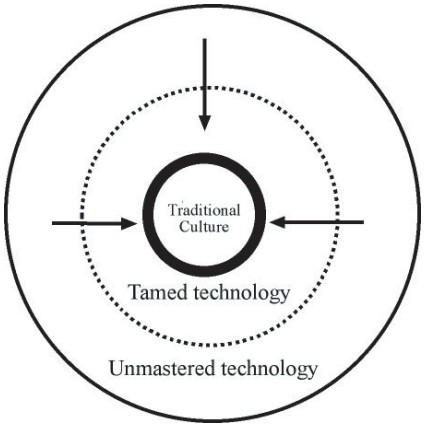

Fig. 1. The Japanese approach to technology as depicted in popular culture: foreign technologies, tamed technologies and traditional culture.

To a certain extent, this political program defined at the end of the 19th century is still present in the way Japanese consider technology. We can summarize this view with the concentric circles in Fig. 1. In the center is a traditional core which is not affected by modernity. At the periphery we find foreign technologies potentially dangerous for Japanese integrity. In between, a set of "tamed" technologies that may one day have been "wild" but that are now well mastered and harmoniously integrated in society.

Beyond this political program, this principle of technology taming appears in diverse forms in popular culture. Besides the imaginary robots already mentioned, the world of the Pokemon, another successful export of Japanese popular culture, is entirely based on this principle.[4] In this imaginary universe, children must capture small creatures. Several kinds of such creatures exist, each one possessing a particular power. Once a Pokemon is captured, it changes from a wild creature to a tamed ally; the child can now use it as a weapon. Having studied the characteristics of the creatures they have tamed, children engage in fights using their creatures as soldiers. It is not difficult to trace back in such a game a miniature version of the Meiji political program.

These different remarks invite us to form a subtler picture of the Japanese approach to technology. In Japanese fiction, technology does not appear as a fundamental quest, but more as a way of preserving what is essential in Japanese culture. There is no dream of fusion with machines. On the contrary, it always seems important to keep a distance. This distance may be an important element to understand why robots seem less problematic in Japan than in the West. Yet, we still have to explain what part of Japanese traditional culture makes machine building a positive activity. To answer this question we need to consider the importance of the natural and the artificial in Japanese society.

3. The Natural and the Artificial in Japanese Traditional Culture

One of the best well-known episodes among Shinto myths is the tale of the vanishing of Amaterasu O-mi Kami, the sun goddess. The goddess, offended by her brother's provocations, decided to withdraw to a cave. As a result, the world was turned into darkness. To convince her to come back, the other deities decided to set up a spectacle with music, theatre and dance. The party was not a real one, but all the guests pretended to have fun, laughed and made a great amount of noise. Driven by curiosity, Amaterasu O-mi Kami decided to take a look at what was going on and came out of her cave. As soon as she was out, the other Gods blocked the entrance: the sun was back for good. The world was saved by a simple masquerade, a fake party and forced laughter, set up to fool a goddess. In the Shinto tradition, artificiality is licit: it saved the world.

3.1. *The artificial reproduction of nature*

Augustin Berque[5] gives several examples showing how Japanese people do not oppose the natural and the artificial but on the contrary very often use the artificial to recreate nature. The difference between Western fountains and small Japanese cascades illustrates this point well. In the west, fountains throw water high in the air. As it is a completely unnatural movement, the Western man hopes to demonstrate his mastery over nature. On the contrary, small Japanese cascades mimic as closely as possible the way water naturally flows. They look much more modest than their Western counterparts but often the hydraulic mechanisms underlying them turn out to be technically superior. The artist-engineer shows his art by transferring the elements that really count from the natural cascade to an artificial one. In this respect, to be able to copy means to understand and to pay homage to nature.

The same idea of artificially simulating nature is illustrated by the anecdote that has opposed two masters of Japanese aesthetics Sen no Rikyu (1522–1591) and Furuta Oribe (1543–1615), his student.[5] The story goes as follows. Every day, a master of ceremony conscientiously orders the removal of all the fallen tree leaves form the paths that lead to the roji (house of tea). Rikyu, who does not like to see such a clean path, explains to him that beauty comes from the kind of disorder that nature spontaneously produces. He advises the master to stop cleaning the path several hours before the ceremony. In this lapse of time, some leaves could fall and this should create a harmonious disorder. But Oribe disagrees with this piece of advice. His aesthetic view of the problem is to go one step further. He recommends cleaning the path very well and then manually positioning some leaves to recreate artificially a natural distribution. Indeed, sometimes nature creates very unnatural patterns; to achieve a perfect aesthetic, it is better to understand the laws of nature and reproduce them artificially.

Building a robot that mimics a dog, a cat or a young infant is a similar process. The more it resembles the real thing, the more gifted the engineer is. There is

no need for further justification. For Japanese, robots are valuable because they reproduce a harmonious form. They can be considered as parts of spiritual and aesthetic research.[6] In that sense, they have something to do with the notion of *kata* used in martial arts.[5] *Kata* is a sequence of gestures of maximum stability where the elements follow one another in a natural manner. In the traditional conception of karate, to master each *kata*, one needs to repeat them over and over to rediscover the natural stability of the form. The *kata* has no finality in itself. In international karate competitions a rather different view prevails: hitting the opponent is permitted. To export this martial art and turn it into an internationally practiced sport, it was necessary to remove the useless aspect of the *kata*. In the same way, it seems that an entertainment robot must be presented as a useful device to be accepted in the Western world.

3.2. *Linking beings instead of distinguishing them*

More generally, from a Japanese point of view, it seems that the difference between the realization of nature and the production of Man tends to become blurred. Tokyo grows like a living organism without any real urbanistic control. Earthquakes regularly destroy parts of it. In that sense, it is not so different from emergent structures built collectively by insects. The city is self-organized like a natural process.

In the Western world, distinguishing between nature and culture is a crucial issue. The idea is to organize the world in a systematic and precise way. Things should be on the natural side or the cultural one. There is no place for hybrids in such classifications.[7] In Japan, gods, men, animals, stones and all the possible intermediary beings seem to be part of a big picture. There is no pressure to make distinctions between them. On the contrary, Japanese create links between them to form a continuous network of beings (Fig. 2).

This may explain how Japanese people can be at the same time great lovers of natural things and not so good at developing ecological measures. From a Western point of view, their behavior often appears paradoxical. Being so excited when the cherry-blossom tree starts to be white in the beginning of May, worshipping every river and every mountain as if they were gods seems in perfect contradiction

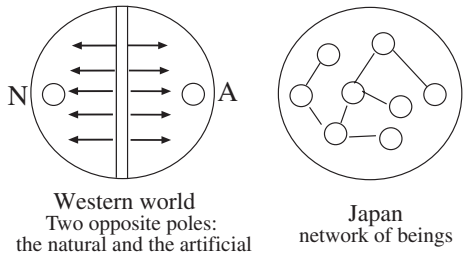

Fig. 2. In the Western world, the distinction between the natural and the artificial is crucial. In contrast, the Japanese create links between them to form a continuous network of beings.

with whale hunting. But given what we have said, these paradoxes are only apparent. To protect nature efficiently, one must see it as something separated, that falls under human responsibility. A clear idea of the frontier between the natural and the artificial is necessary. Japanese people seem to have trouble with this Western view.[8]

3.3. *The apparent unconcern for authenticity*

These two salient characteristics deeply rooted in Japanese tradition can already give us a clearer idea of why robots are perceived differently in Japan compared to the Western world. We should probably add to this picture more contemporary features of the Japanese society. Westerners are often surprised when they walk around Tokyo and see very nice places very close to dull ones, totally new buildings near old houses. It is as if Japanese people regard authenticity as an unimportant matter. Anachronism does not seem to matter in Tokyo, where you can see traditionally dressed ladies buying hamburgers at a fast food restaurant. The city looks like a big entertainment park where it is possible to encounter within a few meters houses of very different architectural style and restaurants serving interpretations of most existing world cuisines. To describe an exuberant patchwork like Tokyo City only one German word seems appropriate: "kitsch." Japan is a place where "kitsch" is acceptable on a large scale. It is not surprising that in such a place, a strange life-like machine seems rather natural.

Behind the "kitsch" layer, one should read the special role played by the artificial in recreating the natural. It seems that the Japanese are able to transcend external appearances of their surroundings to retrieve their own pieces of poetry. A good illustration of this can be found in the small pieces of colored paper that are hung in the streets during autumn to recall the colors of the tree leaves in an urban setting.

Other aspects should surely be mentioned, in particular, the Japanese taste for "Kawai" things (cute, infant-like objects),[9] but this rapid survey of the very particular manner in which the Japanese view the natural and the artificial can already give us relevant insights into understanding the role of robots and robot creation in society. On the way, we have collected some ideas about the issues they can raise in the West. But we should dig somewhat more.

4. Artificial Creatures in Western Myths and Novels: A Brief Historical Survey

There is a long tradition in the West of stories involving artificial human-like creatures. Can they tell us something about the kind of questions raised by robots? We will do a very rapid survey of some important myths and novels that belong to this tradition. To go beyond this simple overview, we encourage the reader to refer to the numerous works done on this aspect of Westernculture.[10–15]

4.1. *Pygmalion, the Golem and the homunculus*

One of the oldest myths telling a story of artificial creation is Pygmalion's tale. Pygmalion was the king of Cyprus. He was also a gifted sculptor. Not attracted by the local girls of the island, who he found vulgar, the young king refused to marry and spent all his time in his workshop. This attitude was a threat for the kingdom, because Pygmalion had no son. One day he created an ivory statue representing an extremely beautiful young virgin. He fell desperately in love with his creation. Faced with this impossible love, he prayed to Aphrodite to create for him a bride that would be as beautiful as his masterpiece. The goddess of love decided to make his wish come true and the statue became a real woman named Galatea. They married and eventually had a son. The royal dynasty was saved.

This story is probably the first instance of the theme of the artificial creature as a companion. It is important to notice that the myth does not present Galatea as an *ersatz*. She was not supposed to replace a real woman. On the contrary, for Pygmalion she was more beautiful and desirable than any of the women he ever knew. Nothing in the myth condemns the creation of this creature. The Greeks gave to the story a happy ending, which differs a lot with the tragic ends of other well-known myths like that of Oedipus.

In a very different context, the Golem is another interesting archetype of an artificial creature created by Man. The creation of golems was first mentioned in the commentary of the *Sefer Jezira*, the book of creation. This book, probably written during the Third Century, plays an important role in the Jewish Cabbala. To build a Golem, a rabbi must imitate the way God made Adam in Genesis. He has to take some red clay and form a human shape out of it. Once the model is finished, the rabbi can animate the creature by writing the word meaning truth in Hebrew: "Emeth." The creature starts to breath, walk and can become a useful servant for the rabbi. If the creature becomes too big or dangerous, the rabbi just has to suppress the first letter written on the Golem. The word "Meth" means death in Hebrew and the creature is turned back to a stack of inanimate clay.

The Golem illustrates how Man can imitate divine creation through research and science. In the Jewish tradition, such an imitation is not a bad thing in itself. God created the world by combining letters. Exploring the art of letter combination is an act of wisdom. It can be seen as an act of devotion to God. This conception of artificial creation has some similarity with the Japanese tradition.

We find in alchemistic practices the equivalent of the Golem creature. The Swiss alchemist Paracelsus describes in *De generationibus rerum naturalium* what one should do to create an artificial being. The recipe is different from the one of the Jewish tradition, but it has a similar structure. If one follows it consciously, it creates a homunculus.

Thus, at the root of this genealogy of artificial creatures, we see a least two archetypes. The first (Greek myths) introduces the idea of an artificially created companion creature. The second (Jewish tradition and alchemy) views artificial

creation as an exercise to understand God's know-how. In both cases, to create such creatures is not seen as a transgressive act.

4.2. *Rousseau, romantism and the turn of the 18th century*

The 18th Century marks an important turn in this rapid history. As the first automata appeared, in particular with the work of French and Swiss engineers like Vaucanson or Jacquet-Droz, the art of the artificial fascinated people.[13] The machines shown in exhibitions were very popular. They were seen both as a way to understand human beings and as important devices for future industrial applications.

But the winds were changing. With the spreading of Rousseau's philosophy in particular, machine creation has started to be seen as an act of corruption. Rousseau tried to show how culture, science and even language corrupt Man more each day.[16] To live in civilized societies drives Man far from nature, where he once lived happily. Rousseau pictured a primitive state where the first human beings did not know about good and evil, lived in perfect communion with nature, and expressed their desires in a transparent way. But as they started to build tools and weapons, they began to master their environment. Man believed rapidly that he was superior to animals and felt pride and vanity. For Rousseau, this evolution was the original sin of our species. From this point, self-esteem had replaced the innocent love of our origins and the artificial had taken the lead on the natural.

According to Rousseau, we must try to return to this golden age. He tried to make his own life an example of abnegation. In his last books, he recalled with emphasis nice walks in the mountains or in the forest. By rejecting the artifice of civilization, he tried to cultivate a kind of immediate feeling of life and hoped others would follow in such a quest against the artificial.

Initiated by Rousseau's thoughts, a new cultural stream emerged in England and Germany: Romantism. A growing number of authors started to share the idea that technical innovations and scientific progress take Man away from his real nature. Greek myths and even the Jewish tradition of the Golem got reinterpreted in a very different way. Goethe revived an old Greek tale appropriate for this romantic view of the world: The Sorcerer's Apprentice.

Initially, this story by Lucien de Samosate (120–180 BC) told how a young magician decided to use a magic spell he had seen his master use. When he was alone, he commanded a broom to fetch water to clean the house. It worked and all went well until the apprentice found out that he did not know how to command the broom to stop. The basin begun to overflow, soon filling the room with water. The moral: if you are not competent, just don't do it.

In *Der Zauberlehrling*, Goethe gives a larger scope to this tale by assimilating the young apprentice with Man and the master with God.[12] This short story attained a discrete but very important influence on Western culture. Golem stories were reinterpreted from this perspective, describing how the artificial servant becomes

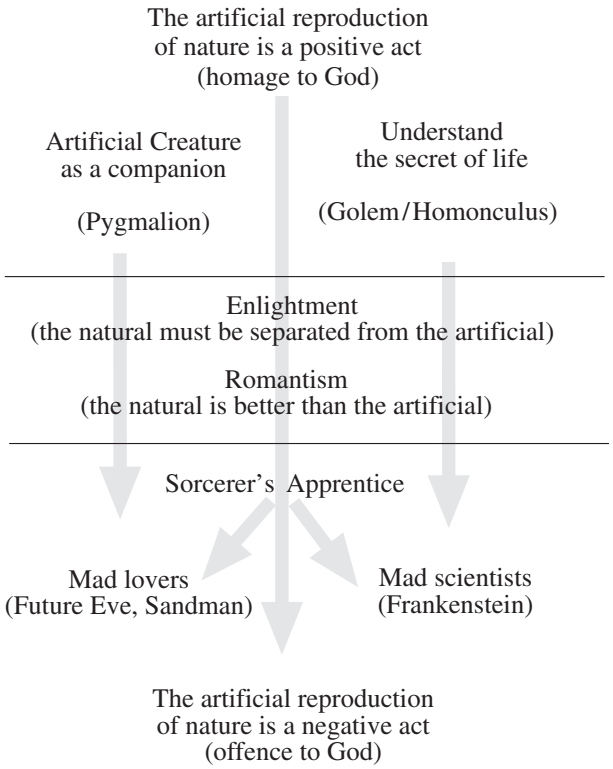

Fig. 3. Evolution of the image of artificial creatures in Western myths and novels.

an uncontrollable creature that destroys everything along the way. Greeks myths, like Prometheus, were revived to support the romantic idea that Man's ambition goes too far when he wants to play God. Everything is in place for the emergence of the Frankenstein syndrome.

4.3. *The Frankenstein syndrome*

In the summer of 1816, on a stormy night, Lord Byron decided to challenge his guests to write a horror story. Among the participants, the young Mary Shelley started to write the story of a doctor and his artificial creature. The manuscript she begun that night became one of the world's most famous novels: *Frankenstein.*

Victor Frankenstein was a young Swiss doctor, initiated to the arcane world of alchemy and to the new science of electricity. He pursued a Holy Grail: understanding the secret of life. His project was to recreate a human being from scratch. He spent his nights in cemeteries to collect parts of dead bodies useful for his creation. It was an arduous task and Frankenstein was a bad surgeon. His lack of dexterity leads him to build a tall and ugly creature. During a storm, he saw his artificial infant move for the first time. The doctor got scared and tried to flee. Because of

its ugliness, the creature got rejected everywhere it went. It was not an evil being in itself but it felt alone. The monster turned back to the doctor to ask for a female counterpart. But after some hesitation, the doctor refused and the creature got mad at him.

Popular culture progressively filtered out all the complexity of this story to only recall the transgression of the scientist. A single rule was remembered and constituted the "Frankenstein syndrome": any artificially created humanoid will necessarily turn against his creator at some point.

During the 19th century many novels explored the Sorcerer's Apprentice theme, in particular by adapting the Pygmalion myth (*Sandman* in *Tales of Hoffman*, *Future Eve* by Villiers de L' Isle-Adam). With the interesting exception of Carlo Collodi's *Pinocchio* (1883), the idea that to create a human-like machine is a transgressive act became common sense.

The word robot was coined in a play by Karel Capek named *R.U.R.* (Rossum Universal Robots). In this play, humans started to build human-like machines, treating them as slaves. The Frankenstein syndrome was applicable more than ever. To create an artificial being was a transgressive act in itself, to enslave it, worse still. In such a context, the robots' revolt was almost legitimized.

In the twenties, German expressionist films put these romantic fears in images with *Metropolis* (1921), *Der Golem* (1914, 1917, 1920) or *Faust* (1926). By the Second World War, the robot was closely associated with fear.

When Isaac Asimov started his "Robots" short stories, he wanted to differ from the common science fiction novels, where robots systematically revolt against their master, by suggesting that some security measures could be taken. He imagined the "Three Laws of Robotics" that should prevent robots from running amok. It has been argued that the popularity of the robot series lead to a very positive attitude towards humanoid robots, provided they stay "under control." But with his laws, Asimov legitimized the Frankenstein syndrome yet further by viewing it as a fate that humans must try to avoid.

In contemporary fiction, the Frankenstein syndrome is still commonly present. It has been integrated as an aspect of technology that seems unavoidable. Nevertheless, it is a relatively recent evolution in Western culture.

4.4. *We are robots plus "something else"*

We have argued for the existence of a Frankenstein syndrome and trace its history back to Romantism. But this is not sufficient to explain the important success of this kind of story. Philippe Breton has studied the same corpus of texts about artificial creatures (including the scientific discourses about them) and discovered a similar structure that seemed to be followed by all the stories.[11] Behind the style diversity, it appears that all these texts are actually formed using the same archetypical organization. First, the creator chooses a raw material: ivory, clay, magic wood, parts of dead bodies, artificial neurons. In most cases it is a material with remarkable

properties. Then this raw matter is modeled, sculpted, organized using the most advanced technologies of the time: hammer, mathematics, electricity, computer science, genetic algorithms. The creator aims at artificially reproducing what makes the essence of human beings: the fundamental difference to animals. This goal changes depending on time and place: beauty for the Greeks, movement and speech during the age of Enlightment, intelligence for computer scientists during the cybernetics era, emotion or consciousness today. But despite all his efforts, the creator is unable to reach his goal. External intervention is necessary to give the final and necessary touches to the creation: magic, divine intervention, lucky circumstances. Artificial creation is impossible without a *deus ex machina*.

We can trace back the origins of such a structure to the Bible. In Genesis, God creates Adam with two distinct techniques. First, God acts as a ceramist to make the first humanoid form. This involves a know-how that humans can master. Then, this form is animated with a magic breath. Only God can master this pneumatic technique that gives life to matter. This kind of creation in two steps can be found in a large number of mythologies. In Egypt, China and in some African cultures, gods also model a clay figure like the God of the Old Testament and then bring it to life with a magic gesture or word. In Northern mythology, sculpted wood is prefered to clay. Other legends describe how stone figures magically become alive. However, there is no trace of such technical creation in Japanese mythology. In Japan, no gods created human beings.

All these technical myths, tales and novels consider a human as the most advanced machinery of his time plus "something else," a mysterious *delta* that remains to be explained. The Western man puts all his pride in this *delta* which is supposed to be specifically human, a testimony of its divine origins. Understanding how this delta changes over time will give us an important insight into the causes underlying our fear of machines and robots.

5. Machines as Models of the Human Self

5.1. *Technical schemes as metaphors*

In the previous section, we showed that the Western man defines himself as an advanced machine plus some mysterious human specificity. He does not want to consider himself as a machine but he has no other way to understand himself than by building machines.

Before going any further, we need to clarify what we mean by "machine." We must distinguish the physical machines that we use daily and the underlying mechanisms that make them work. Behind each real machine there is a set of abstract processes understood and mastered. Let's call "technical schemes" these technological elements that underlie the realization of physical machines.

For each technical evolution, it is possible to draw a genealogy of associated technical schemes. Technical schemes can be considered as a particular example

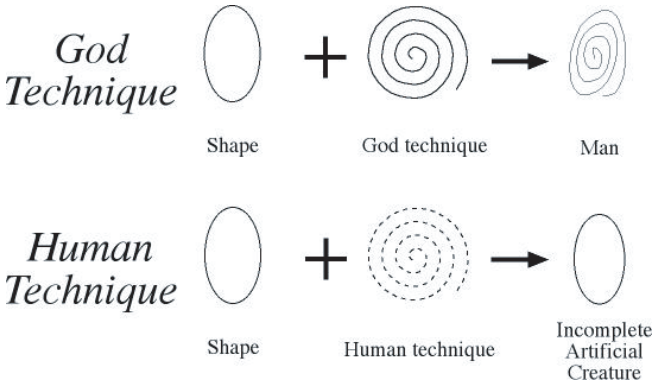

Fig. 4. The two steps of creation in Western culture.

of cultural replicators, like Richard Dawkins' memes.[17] They arise, propagate, are altered and sometimes die out along with the success and failures of the machines they permit to build. A machine is often built for a particular purpose but a technical scheme is neutral. It just describes the understanding of a process.

The consequences of the creation of new technical schemes are not limited to the construction of new machines. The history of medicine can be interpreted along with the history of technical processes. To understand how the heart beats, the invention of the pump was a crucial step (the pump itself has been at the center of a cultural and political debate[18]). Without this invention, the movement of this muscle would have remained totally mysterious. The pump is indeed a wonderful metaphor. To explain how our body worked Descartes mainly used complex pneumatic mechanisms.

But the pump metaphor had its limits. Several researchers discovered a network of "tubes" that seemed to play a role in motor commands. It was the nervous system. Under the pneumatic model, these wires should have a liquid or a gas moving inside.[19] New optical devices were designed to see this internal cavity. This quest would have continued a long time were it is not for a new idea coming from the first characterization of electrical phenomena by Volta and Galvani, who suggested another way of looking at muscle control. The nerves were supporting electrical messages. A new technical scheme had arrived and our vision of ourselves changed.

The invention of the computer can be viewed as a third revolution. This machine introduced the crucial notions of software and hardware. The computer was a universal machine which could run an infinite number of possible programs. A few years later, Watson and Crick discovered that heredity is coded in the form of a genetic program. The DNA supposedly contained information to drive the construction of a full living being. Once again, biology had directly used an engineering metaphor. This latter one has been so successful that we have almost forgotten that it is not the real thing, only a metaphor.

5.2. *The upsetting machine*

We see ourselves in the mirror of the machines that we build. Given that, one could think that each new machine is happily welcomed because it enables us to have a clearer idea about ourselves. But this is far from being the case. Because new machines can potentially force us to redefine ourselves, challenging what was thought to be our specificity, we are sometimes afraid of them. Science fiction novels describe armies of robots taking over the earth but in fact what we really fear is that they make us change our view of ourselves.

We like the way we are and we do not want it to change. Peter Sloterdijk has examined closely the mechanism that we use to prevent machines from upsetting us.[20] He explains how machines challenge our "narcissistic shields" and how we painfully resist in this fight. But in the end, the new metaphors of humans introduced by new machines inevitably win, forcing the Western man to redefine himself. For a long time, playing chess was a definite sign of intelligent behavior. When a machine was able to beat the chess world champion, it was soon suggested that in fact, playing chess is not a good challenge and that human intelligence had other distinct characteristics. The same kind of redefinition is currently happening around emotions. New robots capable of expression emotional responses force us to define exactly what is meant by having emotions. This is maybe why some people from the Western world are not so happy to welcome them.

The same kind of process goes on with discoveries in animal behavior. Human beings are thought to have specific features that animals lack. When biologists show that we are underestimating the complexity or the richness of some aspects of animal life, the specificity of human beings is again challenged and "narcissistic shields" get activated. But in most of cases, we are not faced with these clever animals in our daily life. The situation is different with machines and in particular with mass-market robots. New humanoid robots currently under development and progress in artificial intelligence may significantly change what we thought were features unique to humans.

6. Conclusion

Making definitive statements about the West and the East is always a dangerous game. The investigations presented in this paper are only preliminary but they lead us to formulate the following tentative hypothesis (Table 1). Several cultural elements suggest that in the Western world machines are very important for understanding what we are. We think of ourselves by analogy with the way machines work. But at the same time, technological progress challenges our specificity. That is why we can at the same time be fascinated and afraid when confronted with new machines. In Japan, in contrast, machines do not seem to affect human specificity. The difference between the natural and the artificial is not so crucial and building machines is a positive activity in the search of the natural laws that govern

Table 1. Hypotheses about the differences in cultural acceptance of robots.

The West	Technology is central for defining what humans are	The possible convergence of humans and machines is a central topic, both fascinating and frightening	New robots can be upsetting
Japan	Technology has a more external role and can be part of an aesthetic quest	A distance is always maintained between the human body and technological prothesis	New robots rarely raise difficult issues

the world. We view this hypothesis as a thought stimulating idea that should be challenged with possible counter examples.

In any case, possible cultural differences do not mean that robots cannot find a market in the West. Several recent examples have clearly shown how the typical products of Japanese popular culture can be successfully exported. This tendency towards a "neo-orientalism" seems to be growing over time suggesting that Westerners continue to find in Japanese culture some sources of interest. Westerners may not start to think in the Japanese way, but they may definitely change their view of the world when confronted with Japanese artifacts.

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