Chapter 6
Weak Robots: Relational-Oriented Approach to Human Well-being

Michio Okada

Abstract Many robotics researchers have attempted to design robots that can move around on their own, believing that autonomous robots should not need help from social others. However, even high-performance robots and their artificial intelligence technologies still have many weaknesses and imperfections. Rather than claiming to be able to do this or that, the robot should recognize its own weaknesses and imperfections and ask others to help it with what it cannot do.

This chapter introduces the concept of "weak robots," i.e., robots that are somewhat imperfect and require the help of other people. For example, the "Sociable Trash Box" robot cannot pick up trash by itself; however, it can pick up trash with the help of children. In addition, the "iBones" robot stands on a street corner and hesitantly attempts to give tissues to passersby. The "Talking-Bones" robot attempts to tell an old story to a child; however, it sometimes forgets important words. All of these robots require assistance and are somewhat inconvenient, however, the weak robots motivated the positive involvement of the children, bringing about the children's strengths and ingenuity. In addition, the expressions of the children were cheerful and somewhat satisfied.

It can be said that these will go beyond the conventional values of providing convenience with highly functional robots and realize a state of well-being for the children, i.e., their abilities are fully utilized in cooperation with the weak robots, and they feel a sense of happiness.

Keywords Weak robot · Human–robot interaction · Social robot · Sociable trash box · Well-being

M. Okada (✉)
Toyohashi University of Technology, Toyohashi, Japan
e-mail: okada@tut.jp

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6.1 Introduction

Robots that once only appeared in cartoons and works of science fiction can now be found on street corners, and cleaning robots are found in many homes. In addition, fully automated, self-driving systems will become a reality in the near future.

However, if we think about it dispassionately, robots and artificial intelligence systems have many weaknesses and imperfections (similar to humans). Why not just expose those weaknesses in moderation without hiding it?

From the perspective of benefits of inconvenience research, this chapter introduces the concept of "weak robots," i.e., robots that are somewhat imperfect and require the help of other people (Okada, 2012, 2017, 2022). For example, the "Sociable Trash Box" robot (Yamaji et al., 2011) cannot pick up trash by itself; however, it can pick up trash with the help of children. In addition, the "iBones" robot stands on a street corner and hesitantly attempts to give tissues to passersby. The "Talking-Bones" robot attempts to tell an old story to a child; however, it sometimes forgets important words. All of these robots are somewhat imperfect and require assistance. The aim of this study is to sort out the social significance of these weak robots.

Until recently, the research and development of autonomous robots have been dominated by the individual capability-based approach, which attempts to make functions and performances self-contained within the body of individual robots. Here, design by addition has been pursued by adding various functions from the viewpoint of how to fill the space in the robot's capabilities and functions. In our research, we have focused on weak robots and how we can design relationships with other people based on the premise that robots are inherently imperfect.

Thus, based on the weak robot concept, we consider peaceful coexistence between humans and robots wherein the strengths and weaknesses of both humans and robots are complemented and supported.

6.2 Weak Robots

6.2.1 Origin of Weak Robots

In our laboratory (ICD-LAB), many types of social robots have been proposed and created as tools for our daily communication research. We were originally working in the spoken language processing and cognitive sciences in communication fields; thus, we were a complete novice when it came to robotics and related technologies. With a lot of hard work, a simple sociable creature called "Muu" (Okada, 2000) was created. With the hope that someday this robot would be able to take care of children, we brought Muu into a kindergarten class.

We attempted to have the children and the Muu robot play with building blocks. The children could play with the building blocks alone or while interacting with the

Fig. 6.1 Sociable creature "Muu" and a child playing with blocks

Muu robot (Fig. 6.1). Once the children became accustomed to this robot, we tried to have Muu give instructions to the children, e.g., "Put in the flat yellow building block next!" Here, we wanted to observe the extent to which the children would manipulate the building blocks in response to requests from the Muu robot.

Eventually, the children became tired of Muu's clumsy physical behaviors and began to care for the robot, asking questions like, "What should we do next?" prior to the robot's instructions. The idea of robots caring for children is an empty theory on our desk. In reality, the children's abilities were overwhelmingly superior to those of the robot, and the children were incredibly excited while caring for the robot.

While observing the children interact with the robot, we began to consider if there is positive meaning and value in the weakness of robots.

6.2.2 Weak Robot Concept

We appear to have developed a culture that believes performing tasks independently is a good thing. Even when raising our children, we sometimes want children to learn to put on their socks by themselves as soon as possible. In response, children may sometimes boast, "I can already do it by myself, isn't that great?" Even in formal education, there is an unwritten rule that tests must be taken independently; we cannot rely on anyone else's help and students support their efforts by believing that "I can solve this problem by myself."

This is similar in the autonomous robotics field. Assuming that an autonomous robot should not rely on the help of others, we attempted to design a robot that can move around by itself. However, there are many weaknesses and imperfections in high-performance robots and artificial intelligence technologies. Rather than claiming to be able to do this or that, why do not robots recognize their own weaknesses and imperfections and ask those around them to help them with what they cannot do?

Based on such thoughts, the concept of a “robot that is not complete by itself, but rather is half-receptive to others, skillfully draws others out, and works together to achieve a goal” has been called a “human-dependent social robot” or a weak robot. Weak robots appear somewhat imperfect, and they are typically perceived as cute and make us want to support them. In the following, we introduce representative weak robots constructed in our laboratory.

6.2.3 Sociable Trash Box

When planning a new robot in our lab, it is easy to think about it in terms of a “robot that does XX.” We hope that useful robots will enrich our lives, however, what would life be like with only such convenient robots around us? Is there any room left for our own participation? What if a robot required a little more work? From such questions emerged the concept of the Sociable Trash Box robot, which is unable to pick up trash by itself and elicits the help of children to perform this task. This concept originated from the casual relationship between infants and their caregivers.

As “weak beings” who are held in their caregivers’ arms and cannot do anything independently, infants can struggle to get the milk they need, and they can move around as they wish while using positive interpretations of those around them. Sometimes, a toddler, unable to do anything on his own, can take away his siblings’ favorite toys while keeping those around him on his side. In that sense, they are also the “strongest being” in the home.

This can also be regarded as the initial emergence of social skills required by infants to survive. In contrast to an action strategy based on individual competences, where individuals attempt to complete all tasks by themselves, this is referred to as a relational-oriented action strategy whereby individuals achieve their objective while eliciting help from social others. In other words, this action strategy is a skill that social robots have yet to obtain.

Therefore, I decided to create the Sociable Trash Box robot, which only involves a small laundry basket and motorized wheels, and I brought this robot to a playground where children were playing (Yamaji et al., 2011).

The children who noticed the somewhat strange-looking trash box immediately gathered around, asking, “What is it?” (Fig. 6.2). Perhaps getting a sense of feelings of the robot, one child threw the paper bag in their hand into the Sociable Trash Box. The robot responded with a bow-like gesture. It is unknown whether this was a gesture of gratitude for helping or a request for more help. Encouraged by this gesture, the nearby children began to search for garbage, and the storage space of the robot was filled with garbage. This somewhat unreliable robot, which cannot pick up trash by itself, was able to achieve its goal of picking up trash by interacting with the children.

Fig. 6.2 Sociable Trash Box picking up trash with children

As another unexpected aspect, the children also began to sort the garbage. Perhaps feeling bad that different types of trash were being thrown into the Sociable Trash Box haphazardly, the children began to assign roles to robots with different colors, e.g., plastic bottles for the red robot and paper for the gray robot.

Had the Sociable Trash Box robot picked up the garbage by itself, the children would not have interacted with it. In that sense, the weaknesses and imperfections of the Sociable Trash Box motivated the positive involvement of the children, bringing about their strengths and ingenuity. In addition, the expressions of the children were cheerful and somewhat satisfied. For example, one child said, "I don't feel bad about helping a robot."

According to the cognitive scientist Yutaka Saeki (Saeki, 2017), everyone has the need to care for someone else and this is not striving for a better life for oneself but rather striving for a better life for someone other than oneself and ultimately living a better life.

In this context, the "someone" is not necessarily a person. In our daily lives, we frequently take care of plants, dogs, or cats. In addition, children may care for a wide range of things, from ants or other insects to small animals or even dolls. In the initial phase of our research on weak robots, we were familiar with the concept that everyone has a need to care for someone else. We feel happy when we give or receive help and achieve goals together.

6.2.4 iBones

Another example of a weak robot is our iBones robot, which attempts to hand out pocket tissues to passersby on street corners. Handing out pocket tissues is a common guerrilla marketing method in Japan.

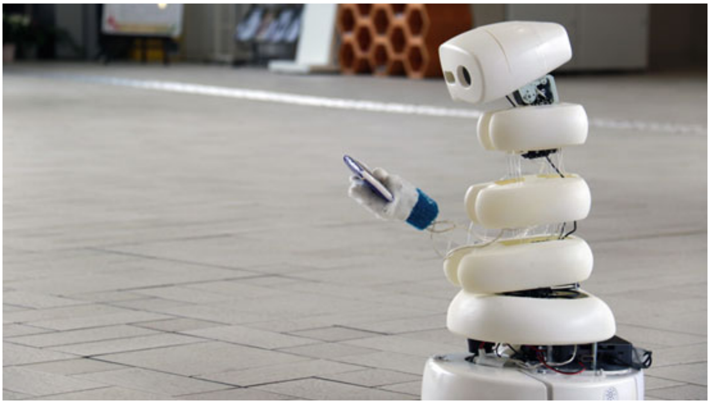

Fig. 6.3 iBones handing out pocket tissues

Here, rather than developing a convenient robot that hands out tissues at street corners, the goal was to develop a robot that allows constructive exploration of social interactions.

We believe that social interactions between humans and robots are extremely interesting. With the iBones robot, pocket tissues are handed to a stranger who happens to be walking by, and the robot is an unknown presence to many people. When attempting to hand out the tissues, if the person does not accept them, the tissue cannot be handed out. Similarly, when attempting to receive the tissue, if the robot does not hand them out properly, the tissue cannot be accepted. Both parties must partially trust the other with an action, and the exchange will fail if both sides do not share the same goal.

Figure 6.3 shows the iBones robot handing out tissues. The iBones robot uses information acquired using a camera to identify individuals and follows their movements. When a person comes near the robot, the robot attempts to hand the person a tissue. However, human movements are unique and agile; thus, it is difficult to match the timing. Each time a person appears in front of the robot, when the robot attempts to hand out the tissue, if it determines that the action will fail, it pulls back in a disappointing manner and repeats the action. This results in the appearance of somewhat fidgety behavior.

Perhaps feeling bad for such a robot, we observed an older woman approach the robot and stop. She happily accepted a tissue while coordinating her timing with the iBones robot's hand movements. Note that this represented a more skillful reception of the tissue by the woman than skillful handing out of the tissue by the robot.

When handing out tissues, there is a brief moment at which the two sides share the same mindset and share a common goal, and they adjust the timing of their movements to realize that goal. One reason why the older woman appeared to be happy may have been a combination of the sense of accomplishment for achieving the successful exchange and a sense of connection with the robot. As demonstrated by the relationship between the Sociable Trash Box and the children, there appears to be a state of well-being (Calvo & Peters, 2014) in which one's abilities are utilized to achieve an active and happy state.

At first glance, the hesitation and awkwardness of iBones may seem inefficient; however, these characteristics appear to motivate the cooperative nature of social others.

6.3 Weak Robot Concept in the Field of Communications

Here, I introduce the benefits and values of spoken utterances with ambiguous or incomplete meanings in our communication with robots.

The Sociable Trash Box attempts to bend its upper body when it detects that a child has thrown trash into the storage space. This gesture can be interpreted in various ways, e.g., "thank you for throwing away trash here!" or "pick up more trash!" Some may think this alone sends an ambiguous message, which may be perceived by some as an inconvenient communication style. However, leaving room for such interpretations is considered an important design element when drawing out positive interpretations of the surrounding people or their participation.

For example, we could implement a synthetic voice system in the Sociable Trash Box and make it speak in Japanese. If the words spoken were "thank you very much," it could be clearly interpreted as a gesture of gratitude. However, a repeated call of "I found trash. I found trash. Please pick up this trash!" would likely be somewhat annoying. In addition, it would feel like the robot is unilaterally giving instructions or commands, which is likely to make people uncomfortable.

According to the literary critic Mikhail Bakhtin (Bakhtin, 1996), an utterance with a self-contained meaning is referred to as authoritative discourse and tends to impose its meaning unilaterally without room for coordination with the listener. The utterance from the robot "Please pick up this trash!" somehow sounds harsh and strong.

In addition, the interpretation of incomplete phrases whose meaning is not self-contained is partially entrusted to the listener, and meaning is formed in a mutual manner. Here, there is room for adjustment with and acceptance from the listener, ultimately resulting in persuasive power.

6.3.1 Moco Language with Sociable Trash Box

With the recent Sociable Trash Box, we are attempting to use semi-syllabic sounds (i.e., a "Moco language") that are not yet articulated sufficiently, e.g., "Moco" or "Mocomon!" Assume a scenario where the Sociable Trash Box walks around a plaza endlessly humming, "Mocomon, Mocomon!"

Occasionally, when the robot sees scraps of paper, it will stop there and utter "Moco!" It will then scan for people nearby while also saying "Moco!"

Fig. 6.4 A new Sociable Trash Box humming "Mocomon"

When someone picks up the trash, it will bend its upper body slightly while saying "Mocomonmon!" The robot will then begin walking again while humming "Mocomon, Mocomon!" (Fig. 6.4).

Thus, the meaning of "Moco!" and "Mocomon!" are not self-contained and are open to interpretation by the surrounding people relative to the circumstances of the specific moment.

For example, "Moco, monmon!" can be interpreted as "thank you," or as words of gratitude. It can also be interpreted as begging, as in "more, more!" or "one more, one more!" People will then pick up the trash while agreeing with their own interpretation. In response to the light bow, people will simply interpret it as a sign of gratitude and feel satisfied at that moment.

Thus, ambiguity is required to allow people to form their own original interpretation to facilitate positive participation and a sense of acceptance, which can also be considered kindness toward the listener.

6.3.2 Rich Communication Created by Incomplete Utterances

Rather than utterances that carry self-contained meaning, incomplete utterances create meaning together by partially opening up the interpretation of the meaning to the listener. This can be considered a relational-oriented action strategy that is common in many weak robots, e.g., Sociable Trash Box or/and iBones robots.

A representative example of the development of the weak robot concept in the communications field includes the Talking-Ally robot, which is characterized by adjusting and organizing the content and timing of utterances using "hearership" that indicate that they are currently listening (Matsushita et al., 2015). In addition, the Talking-Bones robot attempts to tell children old stories; however, it occasionally forgets important words (Onoda et al., 2019).

Conventionally, when communicating with others, there is a need to use only the right amount of fluent spoken language, which indicates the need to properly organize one's thoughts and speak calmly. However, when applying this to communication with a robot, it feels somewhat distant and as though the hearer has been left behind, similar to the utterances generated by a smart speaker system.

The model we used is one in which a child who has just returned from elementary school attempts to tell their mother about the events of their day.

> "Today, I played a lot!" (Oh, with who?)
> "Rei-chan!" (Oh wow, what did you do to play?)
> "I drew!" (Ah, I see.)
> "Cha-chan did too!" (Oh wow, was it fun?)
> "Yup!" . . .

Why do children use incomplete utterances in such circumstances? This could be attributed to the children's low language skills. Initially, children cannot organize what they want to say in their heads. They might simply say what they want to convey as they think them.

However, in response to such incomplete utterances, people often ask, "What does that mean?" One strategy is likely to draw out sympathetic engagements (i.e., care) from the surrounding people. It is also thought that the speaker wants to share their happy memories of the day and needs a place where utterances can complement each other.

In the process of investigating such incomplete utterance patterns, we created the Talking-Bones robot, which attempts to tell an old story to children but sometimes forgets important words (Fig. 6.5).

> "A long, long time ago, in a certain place there was a grandpa and grandma." "The grandpa went to the mountains to gather firewood, and the grandmother was at the river . . . "
> "Uhh, what was it again? What did she go and what did she do . . . ," "Uhh . . . " . . .

It is somewhat strange for a robot to forget important words; however, the child becomes instantly enthusiastic when the robot makes a troubled gesture, e.g., "Hmm?..." or "Uhh, what was it again?"

The child helps out, saying, "didn't she go do the laundry?" In response, the robot states, "Oh, yes! That's it!" "She went to do the laundry."

> "And then the grandma went to do the laundry at the river."
> "Then from the river comes a bobbing and bobbing . . . "
> "Uh, uhm, what came bobbing down?"
> "Not a watermelon . . . uhh . . . " . . .

Faced with this unreliable storytelling, the children jump in and attempt to help the robot. By wondering, "what is the robot struggling with" or "what is the robot trying to remember," the child thinks, "it's not this, it's not that." This is essentially putting oneself in the shoes of the other, which is a communication strategy where one attempts to understand the other's situation using one's own thoughts and feelings as clues. The robot and children explore each other's thoughts and feelings about the forgotten word and adjust to each other. In this so-called triadic relationship, there

Fig. 6.5 Talking-Bones robot occasionally forgets important words while telling an old story

is a place for being in each other's shoes, where the participants mutually identify themselves with each other.

This triadic relationship can be formed between children and robots and between children alone. The following example presents a disagreement between children in response to the forgetfulness of the Talking-Bones robot relative to the statement, "From the peach . . . uh, what comes out again?" "Ba . . . "

> "Isn't it Momotaro?" "Hmm, isn't it a babe?"
> "Babe," "N, No . . . ," "Momotaro!"
> "Uhmm . . . ," "Babe . . . ," "Oh, baby!"
> "Baby! That's it!" (The children laugh.)

The children go back and forth several times over the object that comes out of the peach, and they finally decide to say "Baby!" Thus, here, everyone feels a sense of relief, and laughter occurs.

If the Talking-Bones robot simply read old stories, the children would quickly become bored. Thus, the incompleteness of the robot's utterances (i.e., imperfection in memory and recall) draws out the children's positive involvement and strengths. In addition, even children cannot recite the old story of "Momotaro" to the very end. It can be said that a mutual relationship is formed between the children and Talking-Bones, where each party complements the weaknesses of the others and draws out their strengths.

As a result, compared to when Talking-Bones speaks unilaterally, the communication between the children and the robot would be an enriching activity. This is also expected to lead to a protégé effect, where children ultimately learn things themselves while taking care of a robot.

Here, what is interesting is the satisfied expression on the children's faces when dealing with a clumsy robot. While taking care of robots that require some work, they appear to be somewhat happy. This is similar to the interactions observed between children and our other robots, e.g., the Muu and Sociable Trash Box robots.

It can be said that these will go beyond the conventional values of providing convenience with highly functional robots and realize a state of well-being for the children, i.e., their abilities are fully utilized, and they feel a sense of happiness.

6.4 Conclusion

This chapter has introduced the weak robot concept and discussed ways for humans to interact with social robots.

This concept can also be applied to various simple tools, e.g., scissors. When cutting a thread or string, the hard steel of the scissors compensates for our soft (i.e., weak) human hands. The weakness in our hands requires the help of the scissors and draws out the strength of the scissors.

However, what about the scissors? When simply left on a table, their essential function cannot be realized. It is only in our hands that their function, e.g., cutting a thread, can be exhibited. Thus, the weakness of the scissors is complemented by our freely moving hands. Here, our soft human hands become a strength by using the scissors. The weakness of the scissors changes the weakness of our hands into a strength and draws it out. As a result, tools draw out the strengths of the users while complementing their weaknesses.

Recently, various robots and information devices have been developed in line with the trend of pursuing increasingly convenient objects. As smart entities achieving perfect work, we have sought a high degree of autonomy that allows us to complete work independently. What kind of relationship do we form with such highly convenient systems? Similar to the relationship between an automated driving system and passengers, as soon as we draw a line between a "system that does XX for me" and a "person who gets xx done for me," we become susceptible to falling into a situation of "it just does something without me doing anything!" Here, a disconnect is created between the two entities, empathy for the subject is lost, and we continually escalate our demands, "Quieter! More accurately! More efficiently!"

This pursuit of convenience tends to draw out our arrogance and encourages intolerance. What can we elicit from the previously mentioned well-being perspective? The spread of automated driving systems will be good news for many users, e.g., the elderly and those with disabilities. However, similar to baggage, we will be at the mercy of the decisions of a self-centered automated driving system, including where we are transported. Many of the controls will be entrusted to the system, which therefore does not reach the level of operating freely as desired. In addition, it is difficult to obtain a sense of accomplishment and competence that comes with proficiency, and no sense of unity or connection with the car that has been present to date can be expected. Thus, it appears that we are going backward from a well-being perspective.

We hope that the discussion presented in this chapter will be of some help when considering the symbiosis between advanced robots and humans in the future.

References

Bakhtin, M. (1996). *Слово в романе (translated in Japanese)*. HeibonSha.

Calvo, R. A., & Peters, D. (2014). *Positive computing: Technology for Wellbeing and Human Potential*. The MIT Press.

Matsushita, H., Kurata, Y., De Silva, P.R., and Okada, M. (2015). Talking-Ally: What is the future of Robot's utterance generation? Proceedings of the 24th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN 2015), 291–296.

Okada, M. (2000). Muu: Artificial creatures as an embodied interface, Proceedings of the 27th International Conference on Computer Graphics and Interactive Techniques (SIGGRAPH 2000).

Okada, M. (2012). *Weak Robot (in Japanese)*. Igaku-Shoin.

Okada, M. (2017). *Thought of weak robot (in Japanese)*. Kodansha.

Okada, M. (2022). *Robot: For symbiotic relationship with humans (in Japanese)*. University of Tokyo Press.

Onoda, S., Nishiwaki, Y., and Okada, M. (2019). Interaction design and field study of a forgetful social robot talking-bones, Proceedings of 7th International Conference on Human-Agent Interaction (HAI '19), 259–261.

Saeki, Y. (Ed.). (2017). *Education as caring about the world children care (in Japanese)*. Minerva Shobo.

Yamaji, Y., Miyake, T., Yoshiike, Y., De Silva, P. R., & Okada, M. (2011). STB: Child-dependent sociable trash box. *International Journal of Social Robotics, 3*(4), 359–370.

Michio Okada Professor, Interaction and Communication Design Lab. Department of Computer Science and Engineering, Toyohashi University of Technology.

Professor Okada obtained a PhD in Computer Science at Tohoku University. From 1987 to 2005, he was a senior researcher at NTT Basic Research Labs and ATR International. His research interests include human–robot interaction, social robotics, and cognitive science.