Proceedings of
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Sponsored by Kyoto University

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Preface

Welcome to the proceedings of the the 1st International Symposium on Liberal Arts and General Education which took place at Clock Tower Centennial Hall in Kyoto University, on March 10, 2011. This was the first International Symposium on Liberal Arts and General Education sponsored by Kyoto University in cooperation with OSAKA GAS CO., LTD and The Scientific Education Exchange.

Since most of the high school students have become able to go to university, universities are required to guarantee the quality of the students who graduate from university, and reform and enhancement of higher education become urgent business. Many Japanese institutes of higher education are adopting the American program, and it is often reported that system work well. As for Kyoto University, we are going to try to adopt this program from this year, and make it better for the future. We expect that our symposium would motivate the students to learn what they want. In addition, we expect that they could become sophisticated and could acquire the international view independently, through this symposium.

This year, we had 106 paper submissions from under graduated students who belong to various faculties in various types of research area. Each of the submitted papers was reviewed anonymously by graduate students. Finally we accepted ten papers and ten posters. And in order for students to continue their research works, the following awards are prepared; Outstanding Poster Award selected by the voting by the audience, Suzuran Awards of the three by OSAKA GAS CO., LTD and The Scientific Education Exchange Award by The Scientific Education Exchange.

We would like to thank our sponsor, corporate partners, and all the members of the Organizing Committee, especially the Symposium Chair, Kiyomichi Sakai, the Advisory Committee, Koji Koyamada, and the Secretary Miki Kioka. Without their invaluable contributions, this event would not have been possible.

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Contents

Contents

Non-wood production in mountains; A case of Japanese Star Anise (Shikimi) in Kyoto

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Abstract: Human consumption from forests has been changing. In Japan, the price of wood has decreased. Japanese forestry is now in decline. However, some non-wood production in Japan still enjoys demand from city markets. Thus new small businesses have emerged. We found one example of such a phenomenon, namely. Japanese star anise, or Shikimi[1] in Kyoto city. Shikimi is used in Buddhist funerals and other events. We interviewed three small shikimi producers near Kyoto city. Additionally, we obtained data on shikimi suppliers in the Kyoto-Seika wholesale market. This research clarifies that shikimi has some unique characteristics and that there are strategy differences between small and large businesses. In conclusion, depending on their scale, shikimi producers have different markets. For example, small producers can survive off of direct sales to temples and individuals. Shikimi is one example of the income potential for non-wood productions.

Key Words: Forestry, Timber productions, Shikimi, Kyoto

1. Introduction

The shortage of labor in forestry is a very large problem in Japan. One of the reasons is that forestry results in a low income. Due to the decline in forestry, there is an aging of the population in many mountain areas. In the face of these circumstances, some areas try to encourage non-wood production businesses. Certain timber production businesses enjoy constant levels of consumption, thus yielding income to the producers. Ogawa (2009) discussed an example of non-wood production in the town of Oguni in Yamagata prefecture. In this area, producers developed “the Forest Owner’s Association (FOA)”, which became a stable business.

One type of non-wood production is Japanese star anise or shikimi Residents in Niyodogawa in Kochi prefecture attempted to start Shikimi businesses. This area also faces an aging problem. Some villages are even nearing at the end of their existence. Given the goal of producing a sustainable income in these mountain villages, timber production has receied much attention. In particular, shikimi is expected to be a stable business because shikimi enjoys constant consumption. It is not difficult for older people. (Center west forestry office, forestry technology center, 2009)

In this paper, we focus on the cases of shikimi production in Kumogahata in Kyoto prefecture. We interviewed three producers in this area. We asked about why they started ashikimi production business. We inquired about the sales outlets for shikimi. Kumogahata is a mountain village with an aging population. A few decades ago, forestry, especially lumber production, was the main industry in this area. However, that is now in decline (Ueda, 2009). Some of the lumber producers are now earning income from shikimi. We believe that shikimi is very unique because it is used for various Buddhist events. Because it is poisonous, shikimi is not eaten by deer. As such there are both biological and cultural reasons why shikimi production has developed.

The economic situation of shikimi production is presently unclear, and there are few studies on shikimi production. Sakamoto (1990) described reasons for changes in shikimi consumption by analyzing. Data from the Kyoto-Seika Corporation (1980-1986). There are many sales outlets for shikimi to which producers can sell directly to consumer. We also inquired of the Kyoto-Seika Corporation as to who sells shikimi at floral wholesale markets.

We researched small and large shikimi production businesses. As such, this paper clarifies the present state and potential future of sikimi production.

[1] After this, we use Shikimi to describe Japanese Star Anise

2. Method

This research is based on interviews. We interviewed three people (A, B, and C) who sell shikimi products. They collect shikimi around Kumogahata area in Kyoto city. Before the interview, we gathered information using questionnaires, that included questions about these items, 1) basic information of questionnaire, 2) the scale of forestry, 3) about scale of shikimi production, and 4) about scale of production for other timber. The results are displayed in Table 1. During the interviews, we asked about five main topics as follows. First, why did the producer start the shikimi business? Second, how does the producer grow and collect shikimi? Third, what other timber businesses was the producer involved in before shikimi? Fourth, how does the producer sell shikimi? What is the Income potential of non-wood business?

We collected data shikimi suppliers in the Kyoto-Seika Corporation, which sells flowers and tree brunches. We inquired about shikimi participants in the wholesale markets in Kyoto and the quality of the shikimi. Quantitative information regarding shikimi is shown in Table 2.

Table 1 Basic date

	Basic			Own forests				income					
No.	Name	gender	age(Xteen)	a1	a2	a3	a4	Total	wood	non-wood	late	shikimi	late
1	A	male	60	21	6	2	50	500,000	0	200,000	0.4	150,000	0.3
2	B	male	70	15	4	1	200	2,000,000	0	200,000	0.1	200,000	0.1
3	C	male	60	65	30	1	100	1,000,000	0	200,000	0.2	200,000	0.2

3. Results

3-1. Interview

We conducted interviews in the village of Kumogahata in Kyoto city. The village was less than 30 minutes by car from the main area of Kyoto city. According to the Kitaku statistics in Kyoto city (2005), population is 218 with 77 families.

Interview 1(took place on 2011/01/15, lasted 3 hours)

The first interviewee was Mr. A1. He did not originally live in Kumogahata. He worked at office of Kyoto prefecture. He subsequently purchased mountain property. Some of this property is in Kumogahata. He found shikimi naturally at his mountains after he purchased it. His friends in Kmogahata told him that the shikimi business was good, so he began harvesting shikimi from mountains to sell. In addition to shikimi, he also grows siitake (mushroom). However, because of the cost of growing siitake, he mainly concentrates on shikimi production. Little is needed to produce shikimi in a mountainous terrain[2]. There are two advantages of shikimi production. One of them is the low cost. Mr. A can harvest natural shikimi from his mountain property without specifically tending. Second, shikimi can be harvested easily. Mr. A collects Shikimi by himself because it is light, contrast to most trees, which require multiple harvesters. He described, "shikimi is like vegetables."

Mr. A also wanted to sell sakaki for Shinto home altars. However, there are few sakaki in his mountains, so this strategy would appear impracticable.

Mr. A sells shikimi from his house; he doesn't use a trader or go to the market. It is difficult for an individual to sell through a trader or at the market, because each requires uniform quality and stable supply. Mr. A said, "the flower market is hursh. We have to be ready with goods in large quantities, and make them uniform. For shikimi, the length is strictly fixed."

Mr. A's shikimi is popular among the people who regularly purchase it. Some people reserve his shikimi a few days beforehand. They say his shikimi keeps longer than which they would buy at a flower shop. The reason may be the short time between its sale, because he does not use a flower market. Additionally, he can hear the complaints of his clients directly, for example, regarding desirable lengths and shapes, and he can improve his goods accordingly. Finally, since Mr. A does not use the market, his price of shikimi is 200 yen-per bundle[1], which is generally cheaper than the price at flower shops in Kyoto. Thus, there are attractive aspects of Mr. A's shikimi business that translate into regular customers.

Mr. A believes that shikimi is an important business in mountain areas. Of course, selling trees is the main source of work, but other types of non-wood production are also important. The price of trees is now very low, and few people cut and sell woods by themselves in Kumogahata. He also sells a few trees, but most of his income comes from forestry subsidies and the sale of shikimi and siitake. The late of shikimi is account for about 30 % of his income.At present, he plans to continue shikimi production while growing trees.

Interviewee 2 (took place on 2011/01/22, lasted 2 hours)

The second interviewee is Mr. B. He harvests and sells natural shikimi on his mountain property, but he does not care for their growth because they do not constitute his main business. When he cuts and sells trees, the mountain areas he own become lighter and many grasses began to grow. At this point, he can collect good shikimi. However, once trees become large seven or eight years after planting, good shikimi decrease.

Mr. B started shikimi production about 10 years ago because a flower shop owner asked him to sell shikimi. Before that, another person supplied shikimi, but that person became too old to collect it, so Mr. B took over the job. At almost the same time, a member of temple also asked him to sell shikimi because the prior supplier had retired. Now, he sells shikimi for a flower shop and a temple. His shikimi is popular among his customers because he devises the way and parts of shikimi when he cuts it.

The price of his shikimi is 500 to 600 yen per kg, the length is about 40 to 50 cm. He mainly sells it for four Buddhist events a year, including spring Higan (May), Bonn (August), autumn Higan (September), Shogatsu (November). A flower shop buys and bundles it. In the winter, Kumogahata has heavy snow, preventing Mr. B from harvesting shikimi. However, this is not a problem because he sells it only Buddhist events. Mr. B also sells sakaki a few times a year to a temple.

He believes that there are reasons why shikimi naturally grows in abundance in the mountains. At first, before selling shikimi, Mr. B harvested it for his own

home use and handled it carefully. Shikimi is an important plant for Buddhism. It is believed to be linked to one's ancestors, and so Mr. B won't cut it down in the mountain. Second, shikimi has strong poison[1] and deer will not eat it. In the mountains, this is a major problem for plants as deer increase and as a result, their consumption of foliage increases as well. Thanks to its poison, shikimi can avoid being eaten by deer.

Although Mr. B believe that his shikimi production is a side income, he thinks that it has potential in comparison with trees. Shikimi grows fast, and Mr. B can harvest it three times a year. Additionally, the market price of tree is low, so whereas that of shikimi is relatively high. He can collect shikimi by himself and cut it at his own personal expenditure. Finally, when he cuts trees, he must also plant new trees in compliance with his forestry practices. However, it is impossible to generate enough sales to plant trees by cutting trees. Mr. B believes cutting trees places a burden on his children. His shikimi business is small now, but expanding shikimi production is one way to increase forestry income. According to Mr. B, "trying to sell everything in mountains is important."

Interviewee 3 (took place on 2011/01/22, lasted 3 hours)

The final interviewee is Mr. C. He lives in Kumogahata. His family has been living in Kumogahata for a long time, and sold raw wood for charcoal[1] and matsutake. He started shikimi production three years ago because a woman asked him to start selling shikimi to a temple. Before that, he gave his shikimi to her, and she worked in his mountains. He had not previously been interested in shikimi. After selling to a temple directly, Mr. C still did not put much effort into shikimi business; he just collected shikimi that was growing naturally. However, the amount of shikimi that the temple needed became larger, forcing him to collect more shikimi; in addition, he began focusing on collecting shikimi in desirable shapes. Thus, he decided to increase his shikimi production. There are two types of propagation; one is cuttage and another is seeding. Mr. C used the former. He studied forestry in college, so he knew the basic method of cuttage. Based on this knowledge, he examined the properties of shikimi and developed a technique for propagation.

Now Mr. C sells shikimi to two temples, and his shikimi is popular among his customers because it keeps longer than usual. One temple often confuses the price of shikimi with that of other Buddhist flowers because shikimi often keeps for a short time. The temple wanted to harvest shikimi itself, so Mr. C helped to successfully plant shikimi in the temple's garden.

In one of his mountains, Mr. C grows shikimi mainly where he cuts natural pines. He wants to increase shikimi production to expand his business. He is also studying how to grow better shikimi. Now that the price of trees is very low, he wants to generate income from other timber products. He plans to expand his timber business only with shikimi but also with selected broad-leaf trees and young hiba[2]. Deer in mountain areas are problem for plants, and people try to kill it recently. However, killed deer was thrown in the mountain, and Mr. C believes deer is also potential of production. He emphasizes, "There are many things that go unnoticed in the mountains. It is important to use everything."

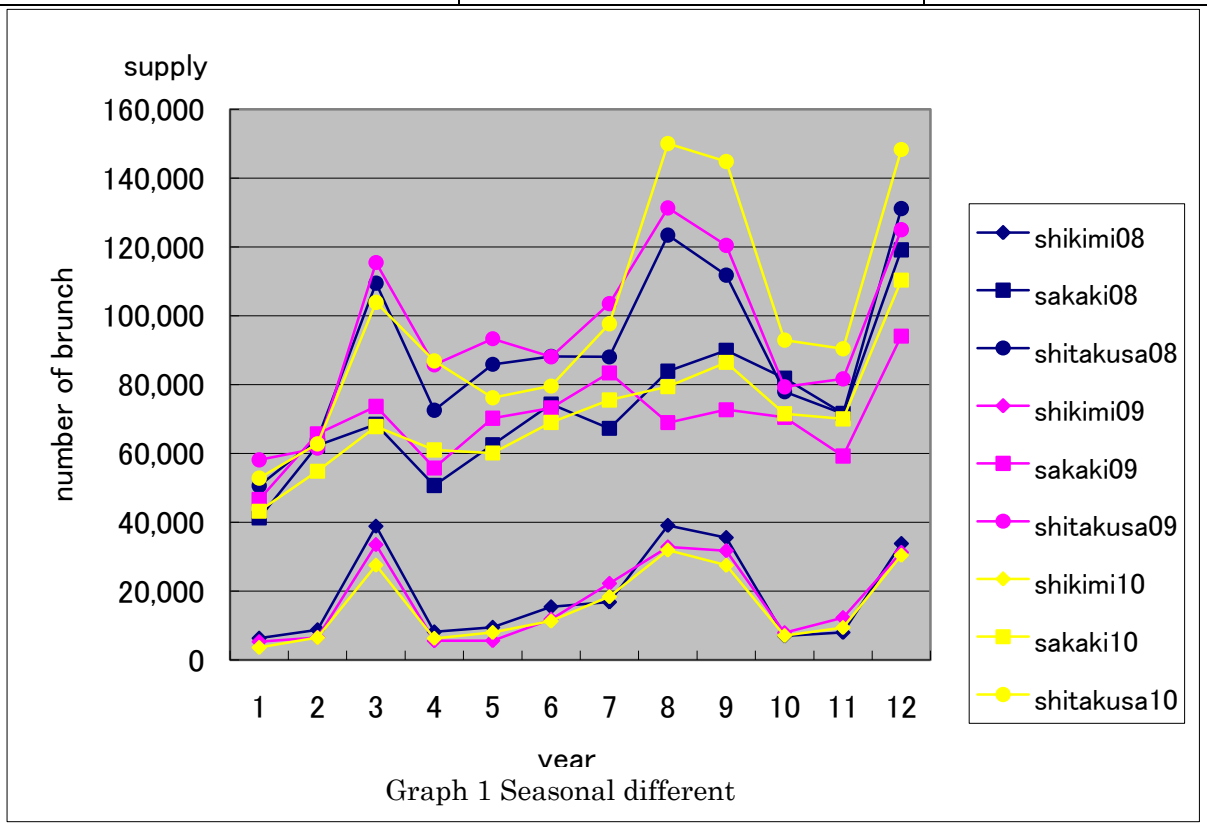
3-2. The Kyoto Seika Corporation

The Kyoto-Seika Corporation is one of the largest floral wholesale markets in Kyoto city. We obtain data on supply over three years. Moreover, we inquired about the recent situation of shikimi on the wholesale market. We found that the shikimi market is smaller than that for other religious plants, namely, sakaki[1] and shitakusa[2], and the seasonal difference is large. (see Table 2, graph 1)

According to these data, the shikimi supply is smaller than that of sakaki and shitakusa. The seasonal changes for shikimi and shitakusa show the same tendency because they are both used in Buddhist events, including spring Higan (March), Bon (August), autumn Higan (September), and Shogatsu (November). We interviewed office worker Mr. D from the Kyoto-Seika Corporation; he told us that the prices of the Buddhist lowers are also highest in the same seasons. Regarding shikimi, differences between seasons are very large, with supply varying four-fold and price varying two-fold. Moreover, in a month, supply and price can change and they get top at middle and last of a month.

Table2　The supply in Kyoto-Seika

year	2008			2009			2010		
name	shikimi	Sakaki	shitakusa	shikimi	sakaki	shitakusa	shikimi3	sakaki	shitakusa
month									
1	6,320	41,251	50,586	5,279	46,642	58,159	3,635	43,211	52,862
2	8,758	62,348	64,168	6,544	65,689	61,516	6,480	54,836	62,778
3	38,872	68,468	109,455	33,519	73,655	115,470	27,563	67,809	103,921
4	8,155	50,670	72,550	5,555	55,777	85,786	6,279	61,004	86,858
5	9,479	62,522	85,888	5,596	70,235	93,328	7,989	60,126	76,172
6	15,436	74,293	88,219	11,840	73,202	88,080	11,310	69,033	79,583
7	16,834	67,294	88,036	22,242	83,398	103,551	18,385	75,503	97,678
8	39,113	83,910	123,427	32,833	68,961	131,328	31,954	79,393	150,025
9	35,579	89,927	111,829	31,759	72,703	120,475	27,503	86,454	144,788
10	6,963	81,866	77,931	7,900	70,501	79,368	7,086	71,542	92,909
11	7,999	71,611	71,487	12,280	59,228	81,670	9,420	70,053	90,392
12	33,848	119,166	131,133	31,254	94,082	125,008	30,434	110,355	148,302
total	227,356	873,326	1,074,709	206,601	834,073	1,143,739	188,038	849,319	1,186,268



Graph 1 Seasonal different

Another large difference between shikimi versus sakaki and shitakusa is importation. There is little importation of shikimi, whereas about 90% of the sakaki and shitakusa in the Kyoto-Seika wholesale market is imported from China. The reason is that shikimi is needed in a smaller amount, and growing it in a field is relatively easy. According to Mr. D, to grow sakaki and shitakusa in a field is difficult; these plants can only be collected in mountainous areas, so they are supplied by individual producers. In contrast, shikimi can be grown on farmland, and its quality and quantity can be coordinated by the agricultural division of each prefecture so that wholesale markets can obtain stable

amounts of shikimi. Kochi, Shizuoka, Kagoshima, Ehime, Miyazaki, Wakayama, and Kyoto are the main prefectures for the sale of shikimi. Thanks to this fact, shikimi production is on the rise while sakaki and satakusa production is declining. In this situation, Japanese sakaki and shitakusa has more on the part of producers for success than shikimi.

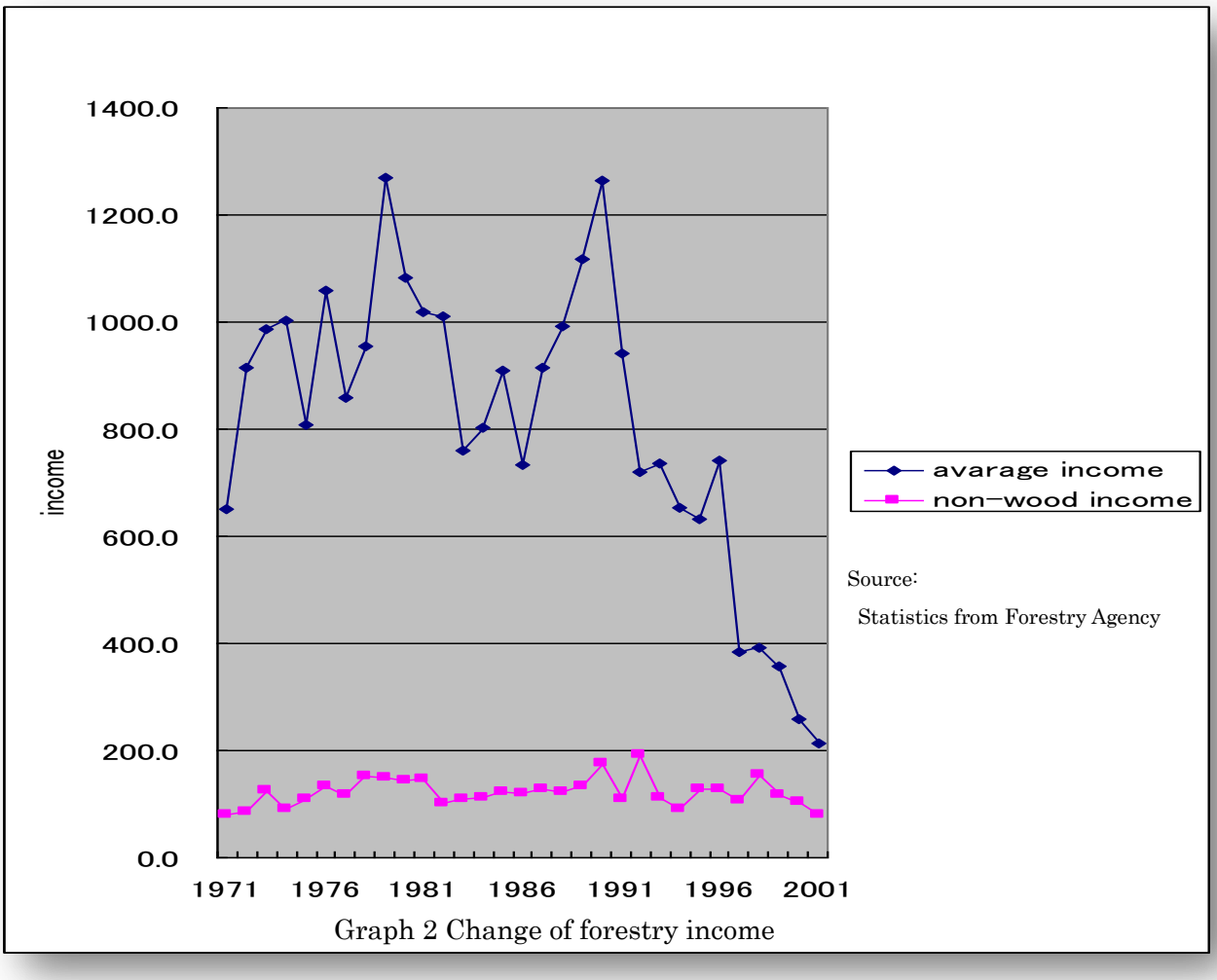
When we look at the quality of shikimi, we note that the Japanese variant is far better than the Chinese one. Because importation from China takes some time, the freshness declines. Although the price of Chinese shikimi is about half that of Japanese shikimi, flower shops still demand the Japanese variant. Because shikimi is used for Buddhist funerals and other events, customers are more particular, preferring the beautiful and durable Japanese shikimi.

Based on this study, we found that the market for Japanese shikimi is sustainable, but it is difficult for small producers to enter the wholesale market.

4. Discussion

Based on interviews with small producers, we recognized the dire situation of Japanese forestry. Two substantial problems are the low price of wood and the aging population in mountainous areas. According to interviewees, their main income depends on government pensions,
their income. Because the pensions do not come from forest production, but rather from the government, this source of income is not sustainable. Income from shikimi is low, but this income is based on forestry and is sustainable.When we look the late of non-wood income, it consistent over the past few decades (graph 2). We found that small producers have direct route customers, and some cases show that these businesses started not from the initiative of the producers but upon the request of temples. This suggests that shikimi supply has continued by individuals and this style still exists now due to individual effort.

Shikimi production suggests another problem of forestry, namely, that mountain plants are often eaten



Graph 2 Change of forestry income

by deer. Because shikimi has poison, its plants are not harmed, and shikimi is abundant in the mountains. Additionally, shikimi is an important Buddhist plant, and so it is not cut to allow for growth of trees. Shikimi thus has many unique biological and cultural characteristics that have helped develop shikimi production.

Sales data from the Kyoto-Seika floral market clarify that shikimi is a relatively small business and seasonal changes are substantial. This change has been described in a study entitled Time Series Analysis of Fluctuation in the Market Prices and in the Supply of Shikimi (Illicium religiosum), Tadashi Sakamoto, 1990. In this paper, Sakamoto analyzed the business records of the Kyoto-Seika Corporation from 1980 to 1986. He noted some characteristics of shikimi. First, there is a chronic imbalance between demand and supply. Second, the pattern in the marketing volume of shikimi is related to seasonal Buddhist events. Third, the currency route to sell shikimi changed drastically during 1980-1990. Fourth, the currency route to sell shikimi that the customercan choose has been remitted. Regarding the third point, the original route ran from mountain harvesters to a local broker to a shikimi or flower wholesale store and then to a shop. However, this route has now become one running from mountain harvesters to the wholesale market to a shop. This change was caused by both consumers and suppliers. In particular, the concentration of the population exercised a significant influence. Moreover, supply from the mountains decreased while supply from the field increased. This is why agricultural corporations have mainly joined the wholesale market. Additionally, producer changes influenced this route. In the past, many people harvested shikimi from the mountains, but that number has decreased. In contrast, some producers have begun to grow shikimi in fl (1000yen) se changes led agricultural corporations to join wholesale floral markets.

In looking at small and large producers in the market, we found that there are in fact different markets. Small producers have a direct route to customers, and these routes are related to their friends or the temples they attend. In a large market, there are many agricultural corporations. These shikimi producers sell in large supermarkets and flower shops. Such a large market is typical for other plants, but the small market is unique to shikimi and its particular characteristics. We believe that this small-scale market will help small foresters who live near Kyoto city generate additional income.

5. Conclusion

In this paper, we focused on how the shikimi business has changed and its income potential. According to three producers, the portion of shikimi income in forestry income has increased. This development has stemmed from the fact that the price of wood has been decreasing, but the price of shikimi has maintained itself at least for a few decades. Both tree as well as non-wood timber production is important. The route of sale for shikimi producers is directly connected to regular customers, which provides favorable conditions for production. In contrast, data from the Kyoto-Seika Corporation shows that agricultural corporations from certain prefectures mainly supply shikimi to the Kyoto-Seika wholesale market, so it is difficult for individuals to join the wholesale market. These facts show that a small shikimi business is easy to start. Moreover, it has become one way to generate money from forests, and larger shikimi businesses are controlled by agricultural corporations. In conclusion, shikimi can become a stable business if small producers have a direct route to consumers. Shikimi is one example of non-wood production, and there are other similar possibilities. Due to declining wood prices, foresters must find other methods to generate income.

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Quantitative Evaluation of Holin on Lysis

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Abstract: Genetically engineered cell death is essential for preventing biohazards in the practical application of biotechnology in areas such as bioremediation. To control cell death, cell lysis of lambda phage may be suitable for various applications. We focused on the quantitative lytic activity and linked the results to the strength of expression of the lysis cassette. We evaluated the expression level in Relative Promoter Units (RPU) to increase reproducibility. In this study, we discovered that the *E. coli* population gradually decreases with the lysis cassette and cell lysis reaches a stable state; at which point, the size of the *E. coli* population depends on the strength of the expression of the lysis cassette.

Keywords: Cell Lysis, Promoter Activity, Biohazard

1. Introduction

Controlling cell death is one of the most needed technologies in many fields, especially in bioengineering [1][2]. A variety of genetically engineered organisms have been constructed as tools for studies. Most of them, however, are strictly kept in laboratories and should not be adopted for practical use because they may pose a biohazard risk.

To overcome this situation, we focused on controlling cell death. This technology may solve the biohazard problem, making bioengineering more adoptable to solving many social problems, such as bioremediation, a way of cleaning environmental pollution with bacteria. The microbes, especially genetically modified organisms with strong resistance, induced to dissolve pollution can disrupt the native ecosystem [3]. Controlling cell death makes these microbes less hazardous by keeping them only in the polluted areas.

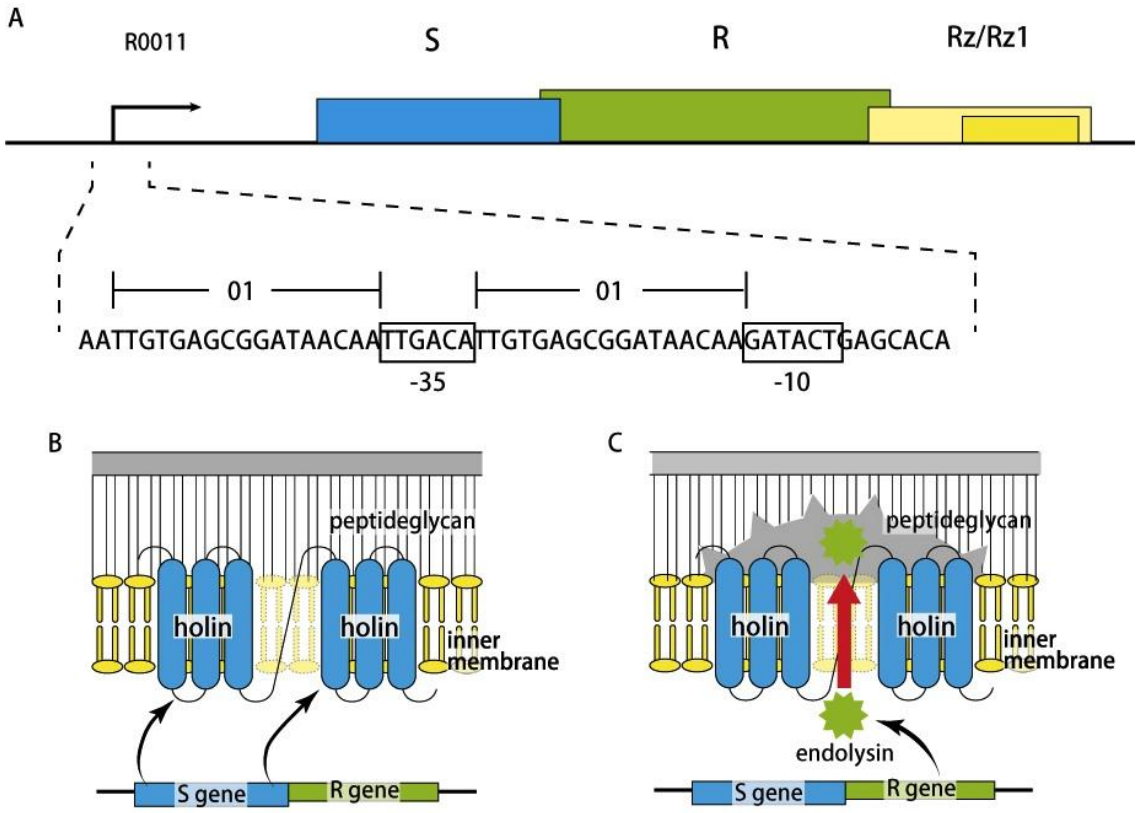

Fig. 1: The sequence of R0011 and the circuit of K358019 including lysis cassette and R0011 (A). The lactose promoter, BBa_R0011, regulates the lysis cassette (SRRz/Rz1). O1 denotes an operator region where lacI binds. LacI is the repressor of the lactose promoter. The inducer of the lactose promoter is lactose and IPTG. They bind lacI and change its conformation so that lacI dissociates from the lactose promoter. The mechanism of cell lysis is shown (B, C). The S gene encodes holin, and the R gene encodes endolysin, a transglycosylase that degrades peptidoglycan. Holin is inserted into the inner membrane where it forms holin rafts. When a holin raft grows large enough, a hole is made within the raft. This hole allows the endolysin to enter the periplasm, which causes cell lysis.

The method for controlling cell death must meet multiple uses and be less expensive, less hazardous to the environment, spontaneous, and not complicated. Using chemical materials to kill the microbes is hazardous and too expensive. Apoptosis can occur spontaneously. However, its mechanism is complicated, and it will not be available for many purposes. However, cell lysis of lambda phage would meet these criteria. Cell lysis of genetically engineered organism requires the lysis cassette, which includes the S and R genes. The S gene encodes holin, an inner membrane protein, and the R gene encodes endolysin, a transglycosylase that degrades peptidoglycan. (Peptidoglycan gives the cell structural strength and maintains the structure of the cell.). Holin is inserted into the inner membrane where it forms holin rafts, which are stable clusters. When a holin raft grows large enough, a hole is made within the raft (Fig. 1B). This hole allows the endolysin to enter the periplasm, which causes cell lysis (Fig. 1C) [4].

The qualitative activity of cell lysis has been well studied. The quantitative activity of cell lysis has also been reported [4], but an evaluation of the timing and the degree of cell lysis is necessary for adopting this technology for practical applications. In this paper, we demonstrate the quantitative lytic activity of the S gene and focus on the relationship between promoter activity and the timing and degree of cell lysis.

2. Materials and Methods

Bacterial strains, plasmids, and medium. All measurement experiments and cloning were performed in *Escherichia coli* TOP10 or KRX. The lysis cassette of lambda phage was retrieved from a λ-*Hin*d III digest (TaKaRa), and the other plasmids were supplied from iGEM (International Genetically Engineered Machines competition) headquarters. The parental plasmid used was pSB4K5, which is a low-copy-number vector. The lactose promoter used to characterize both the lactose promoter and the lysis cassette was BBa_R0011, and the reference promoter used to characterize the lactose promoter was BBa_J23101. The sequences for the two promoters are aattgtgagcggataacaattgacattgtgag cggataacaagatactgagcaca (BBa_R0011) [5] and tttacagctagctcagtcctaggtattatgctagc (BBa_J23101) [6]. Supplemented M9 minimal medium (M9 salts, 1 mM thiamine hydrochloride, 0.2% casamino acids, 0.1 M $MgSO_4$, and 0.5 M $CaCl_2$) [7] was used for all measurement experiments with glucose (0.4%) and kanamycin (50 μg/ml) antibiotic.

Construction. For the measurement of RPU, we constructed two plasmids, BBa_K358000 and BBa_K358001. (Relative Promoter Unit is defined by iGEM in order to share promoter characterization data in compatible units. Details are described in the Discussion section.) The former has the lactose promoter immediately upstream of GFP, and the latter contains the reference promoter. To characterize the lysis cassette, we constructed a plasmid, K358019,

Table 1 RPU for each IPTG concentration

IPTG (mM)	Relative Promoter Unit (RPU)					
	A	B	C	Average	s.d.	CV
0.00	*	0.0122	0.0147	0.0134	0.00821	0.611
0.01	0.0191	0.00963	0.00244	0.0104	0.0084	0.806
0.05	0.177	0.155	0.198	0.174	0.0173	0.0997
0.10	0.205	0.191	0.269	0.221	0.0416	0.188
0.30	0.938	0.955	0.955	0.949	0.00981	0.0103
0.80	1.44	*	1.21	1.37	0.161	0.122
1.00	1.60	1.58	1.65	1.65	0.106	0.064
2.00	1.49	1.83	1.39	1.57	0.233	0.148

* One RPU in IPTG 0 mM and 0.8 mM could not be measured.

Table 2 Symbol Key

Symbol	Description	Symbol	Description
[X]	Concentration of lacI	β	Transcriptional constant for [DX]
[D]	Concentration of lacP	K_1	Equilibrium constant between [D] and [DX]
[DX]	Concentration of lacP binding one lacI molecule	K_2	Equilibrium constant between [DX] and [X]
$[DX_2]$	Concentration of lacP binding two lacI molecules	X_T	Total concentration of lacI
$[S_X]$	Concentration of the inducer	K_X	Equilibrium constant between $[S_X]$ and [X]
α	Transcriptional constant for [D]	n	Number of IPTG molecules binding to one lacI molecule

which has the lactose promoter immediately upstream of the lysis cassette (Fig. 1A).

Measurement of lactose promoter activity. Two types of *E. coli* transformed with BBa_K358000 or BBa_K358001 were used to compare the absolute activity of the lactose promoter with that of the reference promoter. The *E. coli* transformed with pSB4K5 was used for correcting the autofluorescence signal. We did the triplicate measurements all at once for each IPTG concentration.

Measurement of lysis. We used the protocol below to measure the lytic activity either quantitatively or over time.

1) Measurement of lytic activity over time

First, culture a colony at 30°C for 16 hours. Next, dilute 50-fold with fresh medium, and incubate until OD*550 is approximately 0.15. (Measurement of Optical Density (OD) is a standard method to determine the concentration of the cell population.) Then, distribute 3 ml to a test tube, and add the desired amount of IPTG. Last, incubate the culture at 30°C, and measure OD550 every 30 minutes.

2) Quantitative measurement of the lytic activity of the lysis cassette

First, pour 3 ml of medium in a test tube, and add the desired amount of IPTG. Next, pick a colony, add it to the tube, and grow it at 30°C. Then, measure OD550 after incubation for 16, 18, and 20 hours.

3. Results

Lactose promoter activity. We measured the promoter activity of R0011 at various concentrations of IPTG to determine the relationship between the activity of the lysis cassette and its promoter. We measured OD600 and GFP fluorescence to calculate RPUs (Table. 1). Then, we made a model for the activity of R0011 and determined parameters to estimate the RPU of R0011 at every IPTG concentration tested. In our model, we considered that R0011 has two operator regions where lacI binds. Also, we assumed that the promoter activity is completely repressed when two lacI molecules bind to the operator regions and when the total concentration of lacI in a cell does not change in log phase growth; during which, cell growth does not change because the rate of cell growth is constant, and it is compensated by an increase in translated lacI. Thus, the relationship between IPTG and lactose promoter activity is described as follows [8].

$$(\textit{Promoter Activity}) = \frac{aK_1K_2 + \dfrac{bK_2X_T}{1+\left([S_X]/K_X\right)^n}}{K_1K_2 + \dfrac{K_2X_T}{1+\left([S_X]/K_X\right)^n} + \dfrac{X_T^2}{1+\left([S_X]/K_X\right)}}$$

fdetermined the parameters using MATLAB7.10.0 (MathWorks). The result is shown in Figure 2. Error bars represent standard deviation, and points represent an average of three measurements. The line is the expectation from the model.

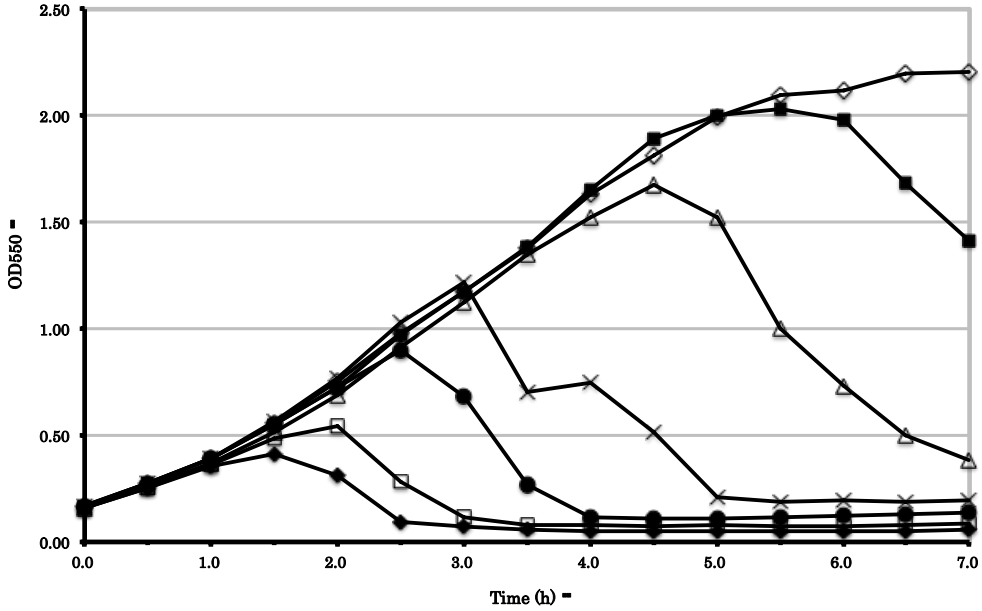

Fig 3: Characterization of the lysis cassette over time. OD550 was measured every 30 minutes after induction of IPTG. IPTG was added at time zero. The concentrations of IPTG are distinguished by the following: 0.00 mM (◇), 0.03 mM (■), 0.05 mM (△), 0.10 mM (×), 0.30 mM (●), 0.50 mM (□), and 1.00 mM (◆). The timing of cell lysis was different with each IPTG concentration.

The timing of lysis depends on its promoter activity. We measured OD550 every 30 minutes and plotted the data (Fig. 3). As shown in Figure 3, we found the timing of lysis was different with each IPTG concentration. The higher the concentration of IPTG, the earlier lysis occurred; as a result, the cell population did not grow any further.

Cell lysis ends up in the stable state. We also measured OD550 after incubation for 16, 18, and 20 hours. It seems that there are minor differences between the values at each time, 16, 18, and 20 hours, and cell lysis seemed to be at a stable state at every

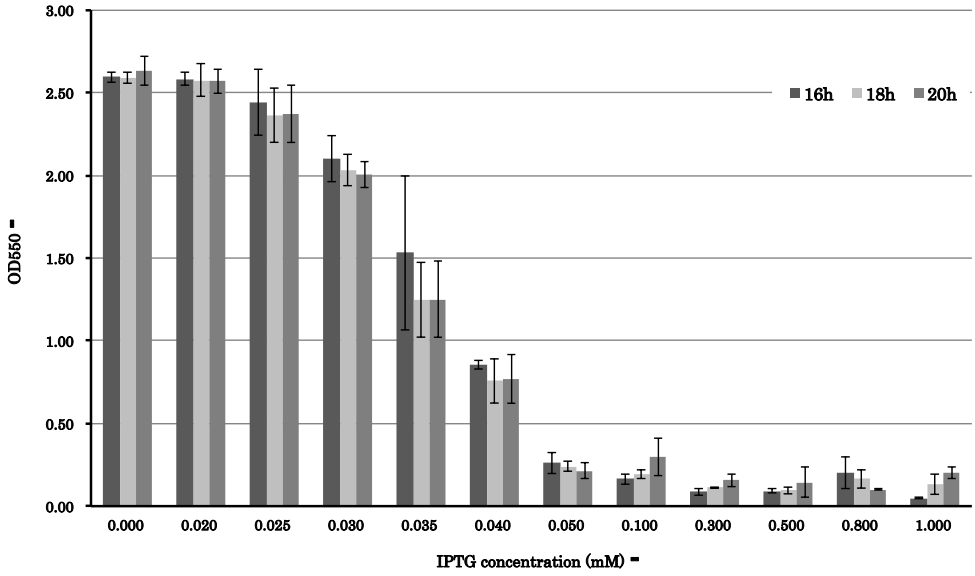

Fig. 4: OD550 was measured after incubation for 16, 18, and 20 hours at several concentrations of IPTG. IPTG was added at time zero. Error bars represent standard deviation, and bars represent averages obtained in triplicate experiments. There are minor differences between the values at each time, 16, 18, and 20 hours, and cell lysis seemed to be in a stable state.

IPTG concentration tested (Fig. 4). Error bars represent standard deviations, and bars represent averages obtained in triplicate experiments.

Therefore, we plotted the data showing the relationship between the degree of cell lysis and the RPU we predicted based on the result in Figure 2 (Fig. 5). Error bars represent standard deviation and points represent averages obtained in triplicate experiments.

From this result we determined that the degree of cell lysis is dependent on the promoter activity, and cell lysis can be evaluated quantitatively by measuring the expression level of the lysis cassette. Figure 4 represents the relationship between the lytic activity of the lysis cassette and its expression level. The lysis cassette effectively induced cell lysis even if its promoter was repressed.

Moreover, cell lysis activity had a distinct threshold at approximately 0.1 RPUs. In the case were RPU was greater than 0.2 under higher induction, the cell population approached zero, although it did not reach zero.

4. Discussion

Lactose promoter activity. We characterized R0011 by RPU [7] because absolute promoter activity depends on test conditions and instrumentation. RPU can reduce the coefficient of variation (CV) from 39.1% to 17.5% [7]. Therefore, RPU can make it easier to express the promoter activity data.

The results indicate that the maximum activity of R0011 is about 1.6 RPU, and the minimum is less than 0.01 RPU. R0011 has a wide range of activity, so it can change the effect of the lysis cassette, making it useful for characterizing the lysis cassette.

In addition, lactose concentration in the supplemented M9 medium was measured using a Lactose Assay Kit (BioVision) [9]. We found that the medium was contaminated by approximately 0.01 mM lactose. This lactose may have come from casamino acids, which can induce R0011. Therefore, we tried to culture *E. coli* and measure RPU without casamino acids. However, the growth rate of *E. coli* declined and RPU could not be measured. Accordingly, the RPU data were measured in the presence of casamino acids, and the real value of RPU at low IPTG concentrations may be lower than the data gained from this experiment. The CV in 0 mM IPTG is high, 0.611, and CV in 0.01 mM IPTG is also high, 0.806 (Table. 1). These two RPU data cannot be trusted too

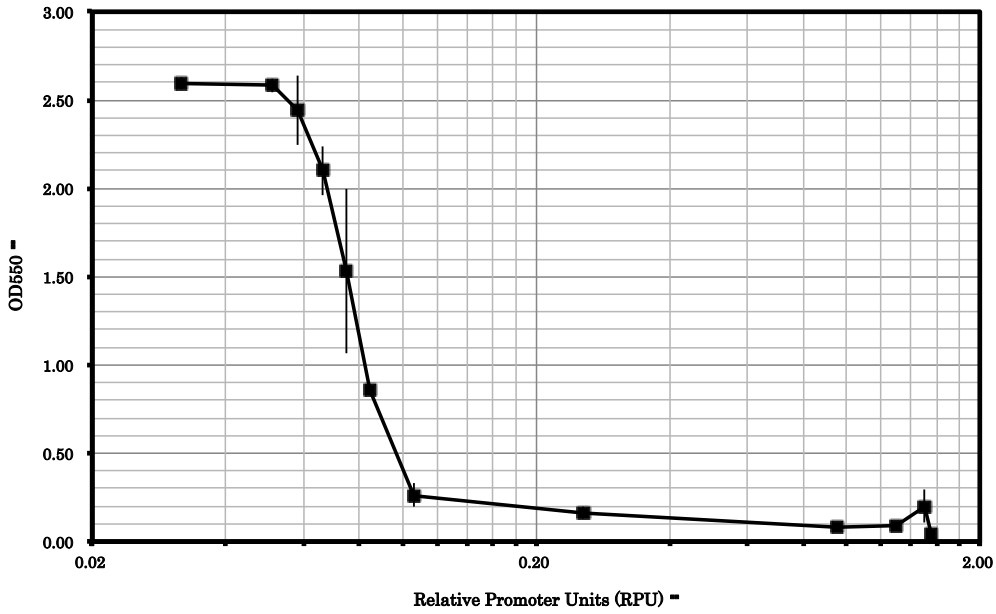

Fig. 5: The lytic activity and RPU at 16 hours were related, according to Figures 2 and 5. Error bars represent standard deviation, and points represent averages obtained in triplicate experiments. The cell lysis activity is dependent on the promoter activity, and it has a distinct threshold at approximately 0.1 RPUs. Some cells survived in the case of higher induction with 0.2 RPUs.

much. Additional measurements may be required.

Experimental methods for measuring the lytic activity. Before characterizing the lytic activity quantitatively, we established a standard method to measure cell lysis. We first considered characterizing the activity by measuring OD550 of the cultures after induction with IPTG. However, after preliminary experiments for determination of the measurement condition, we learned the following. First, cultures induced to express the lysis cassette reach a stable state of cell lysis. Second, R0011 regulates the expression of a toxic gene and is frequently mutated at 37°C under natural selection. Third, the probability of mutation is low at 30°C, although it is still possible. Based on this information, we followed the protocol described in the Materials and Methods section.

Cell lysis may occur stochastically. In the quantitative characterization of the lysis cassette, we made two predictions. First, OD550 is measured at the steady state at 16, 18, and 20 hours. Second, the more IPTG added, the more the value of OD550 in steady state decreases until reaching zero. Based on the results, however, OD550 was a fixed value — approximately 0.3, and the *E. coli* were not completely lysed even in 1.0 mM IPTG. At first, we considered the possibility that this result was caused by a mutation. Even though the DNA sequence is correct at the beginning of the experiment, the accumulation of mutations could cause loss of the original function. As a result, the OD550 does not reach zero. However, this model should not support the result because, according to this model, the value of OD550 must increase exponentially.

We considered another model where the transcription of holin and endolysin decreases because a portion of the cell population becomes dormant [10][11]. At any concentration of IPTG, a part of the cell population is always dormant and survives (Fig. 6).

5. Conclusion

The lytic activity was characterized quantitatively and the relationship between the degree of lysis and the expression level was observed. From our experiments, new facts were revealed; cell lysis reaches a stable state when it is not completely induced, thus allowing some cells to survive. In terms of adopting cell lysis for practical applications, however, these caveats need to be addressed and the mechanisms need to be revealed.

In constructing a simple circuit consisting of an inducible promoter and the lambda lysis cassette, the combinations are limited by the promoter's basal expression, the strength of the killer-function, and many other factors. To remove this disadvantage,

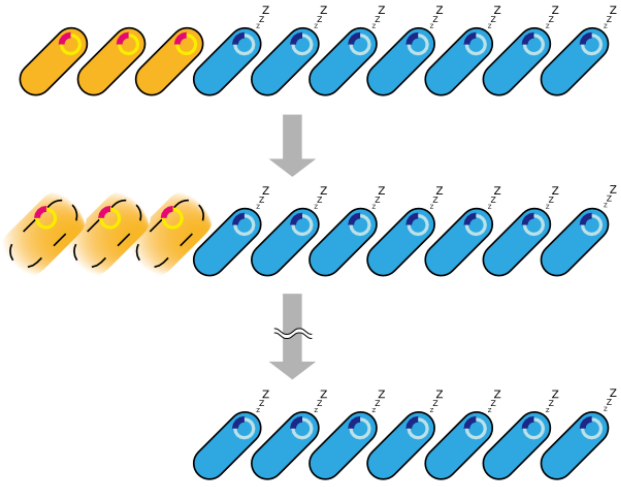

Fig. 6: A model for the steady state of lytic activity. A stochastic model may be considered; a part of the cell population is always dormant and survives.

both the lysis cassette and its anti-killer gene may be used. $S_{\Delta TMD1}$ may be an appropriate anti-killer gene. It lacks the code for transmembrane domain 1 of holin, and it is known that $S_{\Delta TMD1}$ strongly inhibits hole formation [12]. By using two types of promoters, a constitutive promoter and an inducible promoter, regulating the timing and degree of cell lysis may be possible. Thus, quantitative characterization of the anti-killer gene, $S_{\Delta TMD1}$, is also necessary, and the lytic activity when S and $S_{\Delta TMD1}$ are both expressed should be studied in detail.

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Fortran Program for Estimating CO_2 Emissions Associated with Taking a Bath

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Abstract: **Global warming currently threatens many forms of life on earth, including human beings. One of the causes of global warming is said to be excessive CO_2 emissions by human beings; therefore, many of us are trying to reduce CO_2 emissions. I have focused on the CO_2 emissions associated with taking a bath, which are thought to account for a large portion of most people's daily CO_2 emissions; however, it is difficult to find any easy, reliable means of estimating these emissions, and this lack of knowledge may be a source of inefficiency in reducing CO_2 emissions. Hence, I have created a Fortran program to easily estimate the CO_2 emissions associated with taking a bath. This program allows us to determine not only how much CO_2 we emit currently but also how we should change our way of taking a bath to emit less CO_2. If many people were able to use this program, CO_2 emissions would be massively reduced as a whole. This program could also be used in other ways, e. g., conducting "control estimation" of CO_2 emissions associated with taking a bath.**

Key Words: CO_2 emission, estimate, Fortran program

1. Introduction

Global warming currently threatens many forms of life on earth, including human beings. One of the causes of global warming is said to be excessive CO_2 emissions by human beings; therefore, we are trying to cut CO_2 emissions.

Energy consumption causes CO_2 emissions; we produce most of the energy we use by burning fuel, which emits CO_2. Using tap water also causes CO_2 emissions because we must use energy to purify water. With these facts in mind, there are many cases in which we emit CO_2 in our daily lives. However, we can hardly find any easy, reliable means to calculate our CO_2 emissions; therefore, most of us do not even know how much CO_2 we currently emit or how we can change our way of life to reduce our CO_2 emissions. This lack of knowledge may be a source of inefficiency in reducing CO_2 emissions.

Most of us take a bath every day and presumably use relatively large amounts of energy and water in our daily lives. Therefore, we emit a considerable amount of CO_2 when we take a bath. If we were = able to easily calculate the CO_2 emissions associated with taking a bath and determine how much CO_2 emissions would be reduced by changing our way of taking a bath, e.g., using a lower temperature to heat water or not using the bathtub but the shower, we could take a more efficient approach to massively reducing our total CO_2 emissions. In this paper, I present a new Fortran program with which we can easily estimate the amount of CO_2 we emit while taking a bath during a given period of time.

2. Research Methods

To create a Fortran program that can calculate the amount of CO_2 we emit, the appropriate formulae must be prepared. First, I considered how many formulae were necessary in the program. In most cases, when we take a bath, ①we take a shower, bathe in the bathtub, or do both, and ②we use water and ③city gas, LPG, or electricity to heat the water. Hence, when we take a bath, we emit CO_2 because of the emissions associated with these utilities. Therefore, I needed to prepare eight formulae to calculate CO_2 emissions: CGs: CO_2 emission caused by using city gas to heat water for a shower; CGb: CO_2 emission caused by using city gas to heat water in a bathtub; Ws: CO_2 emission caused by using water for a shower; Wb: CO_2 emissions associated with using water in a bathtub; LGs: CO_2 emissions caused by using LPG to heat water for a shower; LGb: CO_2 emission caused by using LPG to heat water in a bathtub; Es: CO_2 emission caused by using electricity to heat water for a shower; and Eb: CO_2 emission caused by using electricity to heat water in a bathtub.

Second, I defined variables and created formulae to calculate these CO_2 emissions over a given time period. In these formulae, d represents the number of days constituting the given period of time, Ts the setting temperature required for a bath, Tn the average temperature of tap water during the given time period, and t the length of time over which water is running during a shower. V represents the volume of water placed in the bathtub. The amount of city gas, LPG, or electricity used for heating water is calculated by calculating the amount of heat necessary to heat a given amount of tap water to the setting temperature for a bath, assuming that all of the heat generated is used only to heat the water. The formulae are as follows:

$CGs = 2.29 \times d \times (Ts\text{-}Tn) \times 12 \times 10^3 \times t \times 4.18/(45 \times 10^6)$
$CGb = 2.29 \times d \times (Ts\text{-}Tn) \times V \times 4.18/(45 \times 10^6)$
$Ws = 0.36 \times d \times 12 \times 10^3 \times t/10^6$
$Wb = 0.36 \times d \times V/10^6$
$CGsb = CGs + CGb + Ws + Wb$
$LGs = 6.5 \times d \times (Ts\text{-}Tn) \times 12 \times 10^3 \times t \times 4.18/(108 \times 10^6)$
$LGb = 6.5 \times d \times (Ts\text{-}Tn) \times V \times 4.18/(108 \times 10^6)$
$LGsb = LGs + LGb + Ws + Wb$
$Es = 0.294 \times d \times (Ts\text{-}Tn) \times 12 \times 10^3 \times t \times 4.18/(60^2 \times 10^3)$
$Eb = 0.294 \times d \times (Ts\text{-}Tn) \times V \times 4.18/(60^2 \times 10^3)$
$Esb = Es + Eb + Ws + Wb$

Emission factors (kg-CO_2): electricity: 0.294 /kWh; city gas: 2.29 /m^3; LPG: 6.5 /m^3; tap water: 0.36 /m^3[1],1 cal = 4.18 J, disregarding three or fewer decimal places [2]; the amount of heat produced when burned, city gas: 45 MJ/m^3N,LPG: 108 MJ/m^3N[3]; the flow rate of running shower: 12 l/min[4]; the density of water: 1 g/cm^3

Third, I separated the cases in which city gas, LPG, or electricity is used to heat water by making three subroutines to calculate the value of CGsb: the sum of CGs, CGb, Ws, and Wb; to calculate LGsb: the sum of LGs, LGb, Ws, and Wb; or to calculate the value of Esb: the sum of Es, Eb, Ws, and Wb. The CO_2 emissions in every case①, ②, and ③ could be calculated using one of these three subroutines.

3. Results

I managed to create a computer program in Fortran named CO2_bath to calculate the CO_2 emissions associated with taking a bath over a given period of time. The program is shown below.

```
module subprog
  implicit none
  contains
    subroutine CO2_CG(d, Ts, Tn, t, V, CGsb)
      integer :: d
      real :: Ts, Tn, t, V, CGs, CGb, CGsb, Ws, Wb
      CGs = 2.29*d*(Ts-Tn)*12*10**3*t*4.18/(45*10**6)
      CGb = 2.29*d*(Ts-Tn)*V*4.18/(45*10**6)
      Ws = 0.36*d*12*10**3*t/(10**6)
      Wb = 0.36*d*V/(10**6)
      CGsb = CGs + CGb + Ws + Wb
    end subroutine CO2_CG

    subroutine CO2_LG(d, Ts, Tn, t, V, LGsb)
      integer :: d
      real :: Ts, Tn, t, V, LGs, LGb, LGsb, Ws, Wb
      LGs = 6.5*d*(Ts-Tn)*12*10**3*t*4.18/(108*10**6)
      LGb = 6.5*d*(Ts-Tn)*V*4.18/(108*10**6)
      Ws = 0.36*d*12*10**3*t/(10**6)
      Wb = 0.36*d*V/(10**6)
      LGsb = LGs + LGb + Ws + Wb
    end subroutine CO2_LG

    subroutine CO2_E(d, Ts, Tn, t, V, Esb)
      integer :: d
```

```
        real :: Ts, Tn, t, V, Es, Eb, Esb, Ws, Wb
      Es = 0.294*d*(Ts-Tn)*12*10**3*t*4.18/(60**2*10**3)
        Eb = 0.294*d*(Ts-Tn)*V*4.18/(60**2*10**3)
        Ws = 0.36*d*12*10**3*t/(10**6)
        Wb = 0.36*d*V/(10**6)
        Esb = Es + Eb + Ws + Wb
      end subroutine CO2_E
end module subprog


program CO2_bath
  use subprog
  implicit none
  integer :: m, d, hw, GorE
  real :: Ts, Tn, t, V, CGsb, LGsb, Esb

  write(*,*)'month→1-12, total→0'
  read(*,*)m
  if (m==0) then
    d = 365
  else if (m==2) then
    d = 28
  else if (m==4 .or. m==6 .or. m==9 .or. m==11) then
    d = 30
  else
    d = 31
  endif

  write(*,*)'heat water? yes→1, no→0'
  read(*,*)hw
  if (hw==0) then
    Ts = Tn
    goto 1
  endif

  write(*,*)'setting temperature(℃)?'
  read(*,*)Ts

  if (m==0) then
    Tn = 16.6
  else if (m==1) then
    Tn = 8.1
  else if (m==2) then
    Tn = 8.5
  else if (m==3) then
    Tn = 11.9
  else if (m==4) then
    Tn = 15.3
  else if (m==5) then
    Tn = 18.3
  else if (m==6) then
    Tn = 19.3
  else if (m==7) then
    Tn = 22.9
  else if (m==8) then
    Tn = 25.1
  else if (m==9) then
    Tn = 24.0
  else if (m==10) then
    Tn = 20.0
  else if (m==11) then
    Tn = 14.5
  else
    Tn = 11.4
  endif

  if (Ts<Tn) then
    stop'error'
  endif

  1 continue
  write(*,*)'shower: how long(min)?'
  read(*,*)t

  write(*,*)'bathtub: volume of water(cm^3)?'
  read(*,*)V

  write(*,*)'city gas→0, LPG→1 electricity→2'
  read(*,*)GorE
  if (GorE==0) then
    call CO2_CG(d, Ts, Tn, t, V, CGsb)
    write(*,*)'Your CO2 emissions are', CGsb, 'kg.'
  else if (GorE==1) then
    call CO2_LG(d, Ts, Tn, t, V, LGsb)
    write(*,*)'Your CO2 emissions are', LGsb, 'kg.'
  else
    call CO2_E(d, Ts, Tn, t, V, Esb)
    write(*,*)'Your CO2 emissions are', Esb, 'kg.'
  endif
end program CO2_bath
```

This program contains six questions, and all that is required for the program to run is to input six numbers as the answers to the questions it asks. The following is a

guide on how to use the program. It should be noted that I used g95 as a compiler.

The first question
month→1-12, total→0

This asks what period of time is going to be used. The program will calculate the amount of CO_2 emitted during the chosen period of time. Any integer between 0 and 12, inclusively, can be entered. The number 1 stands for January, 2 for February, 3 for March, 4 for April, 5 for May, 6 For June, 7 for July, 8 for August, 9 for September, 10 for October, 11 for November, 12 for December, and 0 for one year. The number of days constituting the chosen period is substituted for d. February contains 28 days, and one year contains 365 days in this program.

The second question
heat water? yes→1, no→0

This asks whether the water is heated during bathing. If water is heated, 1 is inputted; otherwise, 0 is inputted. If 1 is entered, the program will proceed to the next question; otherwise, it will proceed to the fourth question.

The third question
setting temperature(℃)?

This asks about the temperature of the bath. The value should be answered in units of ℃. Any real number higher than Tn, the average temperature during the given period of time[5], can be inputted and will be substituted for Ts; otherwise, the program will stop running and show the message "error." If 0 is inputted for the second question, the same value as Tn will be substituted for Ts to allow the amount of heat used to heat the water be 0.

The fourth question
shower: how long(min)?

This asks how long water is running during a shower in minutes. Any real number can be inputted.

The fifth question
bathtub: volume of water(cm^3)?

This asks how much water is placed in the bathtub. The answer should be inputted in units of cm^3. Any real number can be entered.

The sixth question
city gas→0, LPG→1 electricity→2

This asks which kind of energy is used to heat the water. The values 0, 1, and 2 are used to designate city gas, LPG, and electricity, respectively. If 0 was entered as a response to the second question, any of the three aforementioned values can be entered without affecting the results. This is the last question, and the results immediately appear. The following is a sample result:

The result
Your CO2 emissions are 287.37833 kg.

4. Discussion

Anyone who can compile Fortran code can use this program to estimate theCO_2 emissions associated with his or her bath. This is already a remarkable merit of this program; additionally, anyone can estimate how changes in his or her way of taking a bath will affect CO_2 emissions in the future. In other words, anyone can simulate their CO_2 emissions in the future according to his or her bathing habits. Here is an example. Suppose that there is a man who lives with his wife, has no children, and wants to know how he could produce less CO_2 emissions. Two cases can be considered: he and his wife take only showers throughout one year or both bathe in a bathtub and take few showers throughout one year. Suppose that in the former case the man takes 10-minute showers and his wife takes 15-minute showers, and in the latter case, they maintain 63000 cm^3 of water in the bathtub and each take 5-minute showers; moreover, in both cases, they set the water temperature to 45 degrees centigrade and use city gas. This program calculates that during one year they would emit 700.9228 kg of CO_2 in the former case and 427.5629 kg of CO_2 in the latter case. Accordingly, in the latter case, they would emit about 273 kg less CO_2 than in the former over one year. The subject would probably suggest to his wife that they bathe in the latter way. Most of us take a bath every day and presumably emit a large portion of CO_2 daily. This program enables us to adopt bathing behaviors that produce less CO_2. Therefore, the more people who use this program, the less CO_2 would be emitted, and eventually, massive reductions in CO_2

emissions would be possible.

We could also make other uses of this program. By adjusting certain input values, we could conduct "control estimation" of CO_2 emissions and even make a graph relating the variable factors and the resulting data by plotting them, e. g., the relationships between temperature and CO_2 emissions, length of time to take a shower and CO_2 emissions, and so on. The program could also be used in other ways.

There are some free compilers for Fortran available on the Internet; therefore, I would like people who cannot compile Fortran program to install these free compilers on their computers and run this program.

5. Conclusion

The Fortran program I have created enables us to estimate how much CO_2 we currently emit and allows us to determine how we should adjust our bathing behavior to emit less CO_2 individually. If many people start to use this program, it would be possible to massively reduce CO_2 emissions as a whole.

An aspect of this program that can be improved is the error between the calculated amount of CO_2 emitted and the real amount of CO_2 emitted. This is because in this program 100% of the amount of heat produced by burning gas or using electricity is assumed to be used only to heat water for a shower or water in a bathtub; however, there is always some amount of heat that is not used to raise the temperature of water. Therefore, the calculated amount of energy produced to heat water in this program is smaller than the real amount. Accordingly, the calculated CO_2 emissions are also smaller than the real CO_2 emissions. Making these errors smaller is a current issue.

This program estimates the CO_2 emissions associated with taking a bath only in Japan. Therefore, I would like to make as many versions of this program for other regions as possible and, accordingly, provide as many people in the world as possible with this program to massively reduce CO_2 emissions. I would also like to develop other uses of this program such as those mentioned in the discussion section.

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The Culture of Waste: Relations between Waste and Human

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Abstract: **Waste products cause many serious problems today. Part of the reason for these problems is that people misunderstand waste products, because they are closely related to the daily lives of ordinary people. I therefore conducted research on the topic of waste culture, defined as the view of waste taken in each age of human history, because waste culture is likely to exert a great influence on people's action. I discovered that waste products had once been regarded as useful, but as time passed, such views disappeared, and waste began to be regarded in a negative light. I also used questionnaire to conduct research on students' attitudes toward waste. The results of my study shows that many people are concerned about waste problems today, but not many people take practical measures to resolve these problems.**

Key words: waste, culture

1. Introduction

Currently, it is widely accepted that dealing with waste products is one of the biggest problems of the 21st century. Serious anxiety has arisen because dumping grounds -places for disposing of waste products- and natural resources are running short. However, my opinion is that waste problems seem to receive less attention in people's daily lives than do the problems of energy or greenhouse gases.

Most people seem to do little to deal with the problems connected with waste products. People have no hesitation about purchasing disposable goods, about choosing merchandise that has too much packaging, about accepting plastic shopping bags, and so on. These sources all produce surplus waste products. This situation means that people can potentially avoid generating these types of waste products. However, few people dare to take action to end the practices that produce more waste products.

We must decrease the amount of waste products that accompany daily life. Therefore, it is important to know why people do not act to reduce waste products, despite their concern about the environment. Many reasons are likely to be responsible, but cultural factors are potentially one of the most important factors because culture has a strong influence on human's daily activities. In this report, I will consider waste cultures-how waste was seen- in different historical periods, and I will explain what we should do now.

2. Research Method

To achieve the aim of my study, I consulted books about waste, culture, hygiene, and history. In addition, I administered a questionnaire to investigate the views of contemporary people on the topic of my research.

For convenience, in this report the term "waste" will be used to describe things that require disposal in each era.

3. Results

(1)Prehistory

In the eras of prehistory, no waste problem existed. In those days, the number of humans and the amount of waste products that they generated were both small. Human activity was a part of the ecosystem, and human "waste" was not waste. These materials were returned naturally to the environment.

With the beginning of larger-scale of social organization came the production of the first true "waste". As human beings concentrated in groups, the amount of inessential things that they produced increased. Therefore the leaders of the groups established systems for collecting and dumping waste products.

Today we can observe evidence for this custom in the form of shell mounds. Shell mounds are heaps of discarded shells. These mounds are considered to be the first form of dumping ground.

Here, however, it must be recognized that shell mounds differ in well-defined ways from today's dumping grounds. Shell mounds were located near the houses of the people who discarded the shells. (Tozawa, M. ,1989 [5])

Today, however, dumping grounds are located at a distance from where people live. This difference reflects a great difference in people's views of waste over time. In the era under discussion, people seemed not to dislike waste. The products of their daily lives were all natural, and the waste products that they generated did not exceed the capacity of the natural environment. Thus people regarded these wastes as a part of life that remained close to themselves.

This view, it may be said, represents the waste culture of the prehistoric era: people did not dislike waste. Rather they viewed waste as a part of life.

(2)Development of cities

Waste became a much more serious problem with the onset of urbanization. The concentration of populations led to an increase in the amount of waste products. It is interesting that this change led to changes in people's thoughts and actions concerning waste.

The history of Paris furnishes an example of this process. During the Middle Ages, waste products were discarded by throwing it away from windows into the street. Today this custom seems unacceptable, but it was the usual practice during that era. This practice was common in the urban centers of Europe.

The custom of throwing waste products from windows into the street continued until the 1800s. The background for this practice must have been related to the existing waste culture.

During the Middle Ages, waste apparently continued to be regarded as a part of life, too. There were cultural nuances that differed from those of the prehistoric era, however. During the prehistoric era, waste had been part of the natural environment, and they had disappeared as the result of natural process. Human beings had not needed to be concerned about waste, as I argued in the previous section.

This factor, namely the context for waste, was evidently modified during the Middle Ages. As I discussed at the beginning of this section, the concentration of populations led to an increase in the amount of waste products. That change made it impossible for the natural environment to manage waste. Therefore waste no longer disappeared naturally.

In the view of these conditions, I suggest that people were rather "lazy" about waste. The suggestion is based on the history of waste administration in Paris. Many laws were enacted during the Middle Ages with the purpose of cleaning the city, but none of these laws were effective. And the chief reason for this situation was that the public was not cooperative.

For example, the French king Louis XII decided that the royal authority would control the collection and disposal of waste products in Paris. He also decided to impose a new tax on the public to meet the expenses of waste disposal. However, this tax encountered wide opposition, and the work of cleaning the city became impossible.

I consider this point important. By accepting the tax, the people might have been able to live in a clean city. However, they did not accept the tax. Catherine de Silguy, a French agronomist, characterizes this attitude as "indifference" [4]. People were not interested in how waste products were disposed of, so they opposed the new tax.

Other views of waste existed as well. In those days, most of the waste products were organic. To the peasants, therefore, waste products were important source of fertilizer for their crops. Moreover, some people made their living by collecting useful things that they found by searching through waste. These people were called "ragmen". For these people, waste products had value. Waste made it possible for them to make a living.

However, the nobility disliked wastes, just as we do today. Louis XIV said, "Today the street is as dirty as possible, and so was in the past."(Catherine de Silguy, 1999 [4]). Many people belonging to the upper classes of society expressed similar complaints about waste and about the dirty city.

(3)Radical changes in the waste culture

During the Middle Ages, three types of views about waste prevailed: that waste was worthy, that waste was unpleasant, and that waste was unrelated. During the 19th century, however, the establishment of hygiene

greatly influenced prevailing views about waste.

Louis Pasteur discovered bacteria and revealed how infectious disease was transmitted. Flies and rats were found to spread bacteria, the cause of pandemics. These harmful disease vectors were able to survive and reproduce easily because waste products in the city sustained their life cycles.

People in Europe had been suffering from infectious diseases like the plague or whooping cough for a long time. Therefore, they were very aware of pandemic diseases. As Pasteur's discovery was publicized through newspaper coverage, the views of waste changed radically: wastes got regarded as hotbeds of disease and harmful.

This development caused a very important change in waste culture. The public image of waste as unsanitary and harmful remains the same today. At that point in history, cleanliness became moral precept. (Hoy, S. ,1999 [3])

Following this development, waste was no longer considered to be valuable or viewed with indifference. People at all levels of society began to regard waste as a genuine "problem". Public concern about waste mounted. In Paris for example, the tax for cleaning the city was accepted by the public in 1883.

It is important to note in this context that waste disposal became the responsibility of local government, not of the public. People recognized the importance of waste disposal. However, they were unwilling to shoulder the burden of cleaning. In this sense, the public was still "lazy" and did not cooperate directly to clean the city.

People left the works of waste collection and disposal to government. They did not do the work themselves.

This attitude seems to have persisted. It appears to represent the chief cause of today's waste problems.

(4)Modern era

Pasteur's discovery of bacteria had a great influence on the waste culture. People began to see waste as cause of disease and as a harmful presence.

This type of view persisted into the modern era and became more and more pervasive. Pasteur's supporters insisted that waste products must be moved away from cities, to achieve greater cleanliness. With the onset of these "hysterical" insistences originating from the field of hygiene, people became desperate and began moving waste products away from areas of habitation. This era saw the beginning of the use of modern technology to separate waste products from society.

It is important to note that as waste products became more distant from the public, people became less concerned about waste. Therefore, from this time, most people again became indifferent to waste because waste seemed unrelated to their lives.

The thorough separation of waste from the public made people less concerned about waste.

4. Discussion

This paper has considered the waste culture in different eras of human society. During the prehistoric era, humans did not have waste problem. Waste products were involved in the natural systems. However, as populations increased and became concentrated, people produced many more waste products. At first, the public was indifferent to waste. With the establishment of hygiene, however, waste began to be regarded as harmful. This change in attitude led to thorough separation of waste and produced another form of unconcern.

What do people think about waste today? I formulated the hypothesis that indifference to wastes has continued, and this hypothesis furnishes the chief motivation for this research. To research the current waste culture, I administered a questionnaire that addressed people's consciousness about waste, compared with their consciousness about other environmental problems. The respondents were almost all students aged 15 through 25.

The questions included in the questionnaire were as follows:

・Question 1. "Which do you think is most serious among 1~3 below?"

1.global warming

2.energy problem

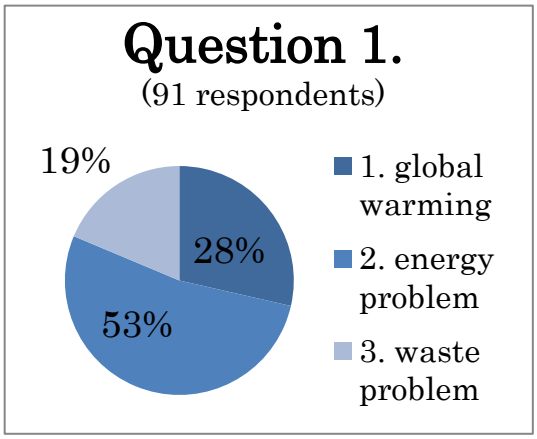
3.waste problem

・Question 2. "Which do you think is most possible to solve with technology, among 1~3 above?"

・Question 3. "Which do you think is most possible to solve with the efforts of ordinary people, among 1~3 above?"

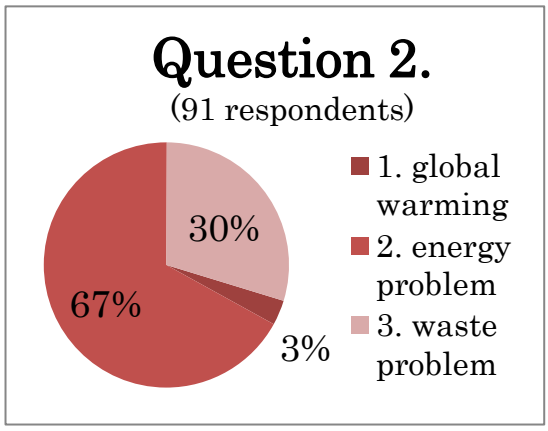
・Question 4. "Do you do in daily lives something to solve the problems 1~3 above? Please answer with A(Yes) to E(No) for each of 1~3.

The following figures present the results.



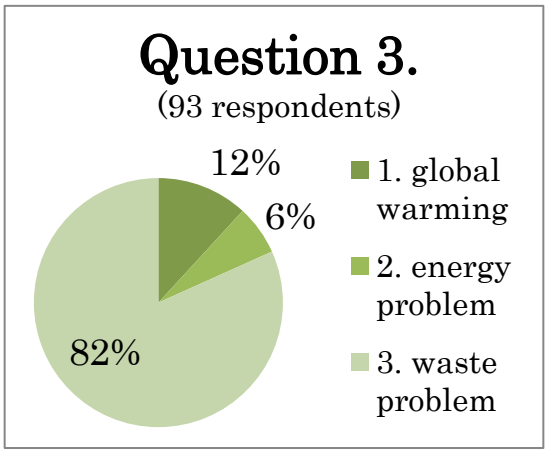
(percentages)

Figure 1. Responses to Question 1.



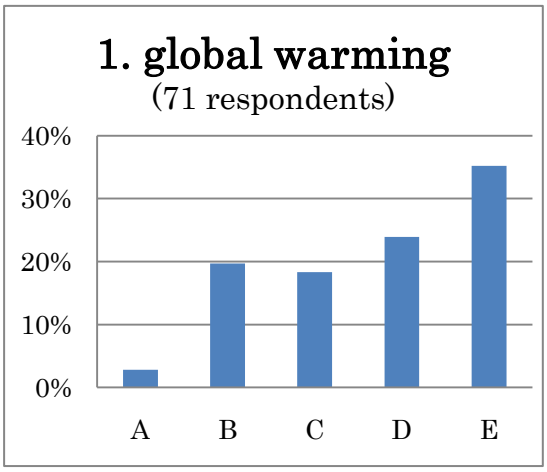
(percentages)

Figure 2. Responses to Question 2.



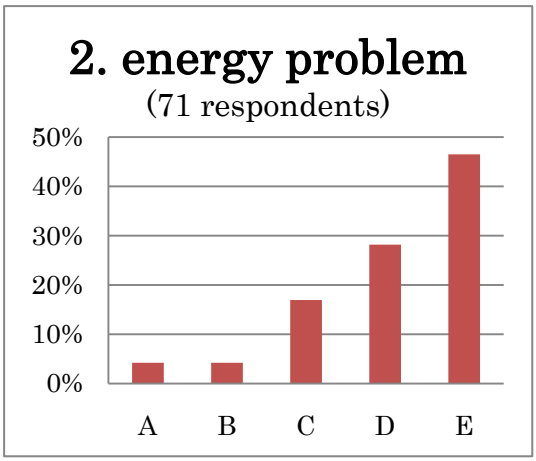
(percentages)

Figure 3. Responses to Question 3.



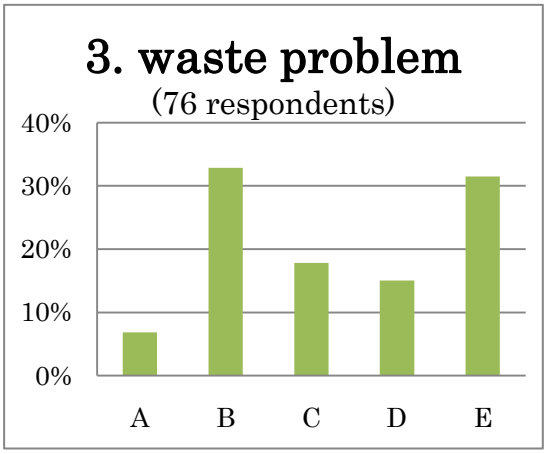
(percentages)

Figure 4. Responses to Question 4-1.



(percentages)

Figure 5. Responses to Question 4-2.



(percentages)

Figure 6. Responses to Question 4-3.

Figure3 seems to indicate a very important fact. Over 80% of the respondents answered that the efforts of the public are effective for solving waste problems.

This result suggests that today waste is perceived as being close to ordinary people.

In other words, indifference to waste seems to have started to decrease. Young people relate waste problems to themselves. This attitude represents one type of waste culture today.

Today, concern about waste is beginning to recover its importance. People recognize their involvement with the problem of waste.

Figure6 seems to reinforce this view. The figure shows a large number of responses to choice B, make a relatively large amount of effort. This result indicates that people's efforts in their daily lives reflect the realization seen in Figure3, that people perceive the waste problems as something close to themselves.

This result does not support my original hypothesis that people would do little to deal with the problems of waste. Eventually young people take practical action to solve the problems of waste.

However, Figure6 suggests a different view. Choice E, don't do anything in daily life, also shows a large number of responses. In this case, Figure6 seems to give partial support to my hypothesis. This result suggests that a fairly large number of people make no concrete efforts, considering the public's awareness of waste problems.

The results obtained from this questionnaire show a bipolar distribution of people's action/inaction in solving waste problems. This effort or lack of effort occurs in the context in which almost all respondents are interested in waste. Some people act practically to solve the problems about waste, whereas other people do not. Thus, it is important to urge the latter group of people to act practically to solve waste problems.

5. Conclusion

Various types of waste cultures have existed in past and present human societies. It is interesting to recognize that waste was seen in past times as useful or natural things. Only during a relatively recent era did waste begin to be seen unsanitary.

Today we are surrounded by unprecedented amounts of waste products. If people today were not concerned to waste as was the case in the Middle Ages and Modern Ages, the consequences of such an attitude would be disastrous.

In the future, we will need to recognize the fact-concern about waste, to face the fact directly, and to take practical action. To achieve these goals, the cultural attitude that waste problem is closely related to each of us needs to grow to lead all people to take practical steps to solve the waste problems.

I believe that education has an important role to play in involving waste culture. The culture to which one becomes accustomed during childhood should be a major influence on the way the person acts during his or her entire life. However, the concrete ways to improve education about waste problems needs to much more consideration. The remaining problem is the problem of changing waste culture.

The current situation regarding waste products is unprecedented. To cope with this situation, it is necessary for each of us to take practical action and not to rely on technology. Waste culture in the future must lead to outcomes involving practical action by everyone.

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The Effects of Changes in Science on the Values of Japanese Society

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Abstract

Science has contributed many findings greatly and has greatly changed society. Science is usually evaluated positively based on the value that more wealth is better. Despite this contribution and the progress of science, some people today cannot be satisfied and find their philosophies. This problem would be caused by society, which is greatly changed by science. This report analyzes these values with some unique thinking and research to find the effect of science on the values shared by people. This report is focused on Japanese society.

Key Word Science, Sense of Value, Society

1. Introduction

To clarify the position of science in Japanese society, a questionnaire was administered. In addition to the questionnaire, the author investigated the history and the transition of relationship with Western society. These factors could be some possible reasons for the great influence on society. A change in people's sense of values also be hypothesized. More concretely, science, which often provide people with money and power, has been developed primarily in Western countries. As a result, Western countries have obtained more power than other countries to export their culture, political systems, and thinking and ideologies, such as freedom, human rights, and democracy. However, certain traditional values could be incompatible with Japanese society to disappear. Imported ways seldom suggest what is the best important for people's lives.

2. Research Method

The questionnaire included 4 –questions: A, B, C, and D. The responses were assigned to a five point Likert scale:5,4,3,2,1

A Learning science is meaningful in life for more reasons than getting money.

B Science contributes to human beings.

C Academic studies should be promoted for the advancement of society.

D Academic studies should be promoted to address the intellectual interests of individuals.

All participants were asked to record information about themselves on paper including heads, sex, age, names of faculty, and answers to the four questions. All of the participants were university students.

Ages	Numbers	Numbers of people who belong to scientific faculty
18	4	2
19	14	13
20	19	16
21	16	8
22	1	1

3. Results

The average points for each question are shown in following figure.

A	B	C	D
2.9	4.6	3.8	3.2

Based on the higher points given to B and C, it is possible to determine that science today is expected to contribute to society and human beings and less thought of as an intellectual activity based on lower score for A and D. Of the people who chose the highest scores for B, 68% chose the highest for C. The percentage of scientific student who scored on this tendency was about three times larger than that of literature students. Of people who chose the highest scores on C. 74% chose scores less than 3 for D.

4. Discussion

The position of science has been clarified by this research. In general, people think of science as a method for contributing to society; the results effectively showed tendency this. This suggests that both society and science share the common value that human desire has the highest priority. The following discussion would will illustrate the relationship and the reasons behind it, with a brief investigation of the history of science.

Traditionally people's values have been based on a variety of culture. However, today, they are primarily based on Western values especially those of the United States and the United Kingdom. The more influential U.S puts a high value on freedom and human rights and basically treat individuals as independent with rights to pursue their own desires. These basic concepts have been spread widely into the world because the U.S. has been powerful in terms of politics and military strength. These have been supported by material they then demanded this enrichment. Science has produced a new driving force, and this new force has become an ideology, or the main aim of this intellectual activity. This is the common view for the relationship between science and society. At this stage, science without meaning and values has been adopted as science by society. Through this process, science developed a new relationship with our lives.

Western this form of science basically share the same concept that desire should be respected. As a result, this concept has spread throughout the world changing people's value to some extent.

And such values seldom reveals what is most important, but, these values often drive people to demand material fulfillment. This situation produced by science causes some problems in Japanese society. Traditional values have less influence and Westernized values could become dominant. Science has played a very large role in changing values.

5. Conclusion

The strong influence of Western countries supported by science has changed Japanese traditional values. Values guide people's actions and science and Western society share a common concept that individual people should be materially satisfied.

This way of thinking about science could be seen in the answers to the four questions on the questionnaire. powerful influence, more concretely, scientific power including technology and academic studies. Science might have indirectly changed values.

To consider this point in detail, it would be important to investigate the reasons why science and Western society have come to share the same values.

The origin of science lies in the philosophy of the ancient Greeks. Philosophers investigated general logic to explain everything in world. In addition, they wanted to know how to live well.

Their meaningful intellectual activities were closely related to their lives and had meanings in and of themselves. Studying science was the aim.

Science has been practiced by very conflicted people since then. However, after the Industrial Revolution, it has played a very important role in people's lives. The difference between science and technology has been reduced. People came to realize that they could enrich their lives, and

The number of subjects was small, and their backgrounds are not known little. These are points of weakness with this study, however, the results and the discussion still be valid. The averaged points and the observed tendencies support the discussion and the conclusion.

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Education with ICT (Information and Communication Technology) in developing countries

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ABSTRACT Today, some children in developing countries, such as those in Asia and Africa, do not receive enough education. There are still many people who are neither able to read nor write. How can they receive an education equal to that provided to children in advanced countries? Using ICT (Information and Communication Technology), for example, digital media and the Internet is one possible way to accomplish this task,

Although many children in developing countries do not have textbooks, notebooks and pencils, by using digital media teaching materials, no paper or pencils are necessary. Various kinds of information, such as characters and phenomena, can be more efficiently understood if they are taught with images and movies. Furthermore, satellite classes will enable them to receive the same education as advanced countries.

However, this will not be an easy challenge. There are some important problems to overcome, such as electricity requirements and students' tendency to be passive.

Considering these problems, I propose maintaining interactivity with low electricity use by using cell phones. In the following paper, I would like to describe a method that would allow all children in the world to study in the same manner.

1. THE PRESENT SITUATION OF EDUCATION IN DEVELOPING COUNTRIES

Today in Japan, children receive compulsory education, and most students go to high school. Furthermore, the number of students who graduate from university is increasing.

However, there are many people in the world who cannot read or write their own character. Actually, the regional adult literacy in Africa from 2005 to 2008 was 63.8%. We should note that although the male literacy rate reaches 72.6%, the female rate is still only 54.5%. In Chad, the literacy rate is only 32%, and the female rate is 21.9%. (UNESCO Institute for Statics, http://stats.uis.unesco.org/unesco/) That is, in some developing counties, there are more illiterate people than literate people. There are several reasons why many children do not receive an education in developing countries.

First, in these countries, children are also part of the workforce. Some children must go to wells that are far away to draw water every day, while others stay home and take care of their family.

Second, gender roles are strict in some countries because of religion and the native culture. In these cultures, it is thought that women should always be in their home and that they should not go out in public. This is why women have a problem going to school. However, if women are educated, they have more opportunities to take part in social development, so promoting education for women is beneficial for their country as a whole.

Third, the infrastructure is not advanced. Because many roads are not adequately maintained it is difficult to build public transportation, and children cannot go to school far away. Fundamentally, the school itself is not substantial. Classrooms are not cleaned, and some schools have no toilets. In addition, the lack of teaching materials is serious. For example, in Papua New Guinea, there are many students who do not have textbooks and a text is shared with some children They are not domestic textbooks but rather are made in Australia. It is a problem that students cannot study their regional circumstances. Moreover, even teachers are not educated enough.

Finally, people are not aware of the need for education. If one receives higher education, he may not be able to get a job in his country. In the end, they may come to think that working at home for life is better than going to school. That is, social and economic conditions are deeply related to the incentive to study.

2. SATELLITE BROADCASTING CLASSES AND DIGITAL TEXTBOOKS

At present, numerous projects that broadcast classes from advanced countries by satellite to developing countries have been tried. For example, a pilot project was conducted by the Hua Hin Remote Education Station, Thailand. In this project, classes in a model school—a school that broadcasts their classes—are recorded on video and edited, then broadcast through a private TV station. Next, pilot schools—schools that receive these classes—receive these broadcasts directly and utilize them for their classes. The purposes of the project are to make up for the lack of teachers in the country and to maintain a high quality in the classes. In addition, here at Kyoto University, OCW (OpenCourseWare) has started. It is challenging to upload certain classes in the university. To promote OCW, an iPod touch rental system for students was tentatively started. With OCW, we can review classes anytime and anywhere.

This has some advantages. First, if electricity and the necessary equipment are available, many people in a wide-ranging area can receive classes at the same time. Therefore, it would enable people in remote areas, such as those in the mountains and on islands, to join classes easily. OCW has a mass communicative character. Second, schools in developing countries can teach

students as the same level as advanced countries.

However, there are some problems with this approach. One problem is that it is difficult for satellite classes to secure interactivity. For instance, if a question comes to a student, he cannot have it answered quickly. In addition, in a science experiment, it is very difficult to conduct the class with the pace of broadcasting. Furthermore, satellite classes broadcast in English by advanced countries have the potential to weaken languages that do not have many speakers.

In terms of teaching materials, "digital textbooks" have been primarily investigated in advanced countries. Digital textbooks are tools of study using computers. They enable students to study more efficiently with the Internet, photographs, videos, animations and sound. It is said that children can cultivate thinking power, creativity and expressive ability with them.

I wonder if it is possible to use digital textbooks for education in developing countries. Literacy teaching would be easier with animation and graphics, and children can learn about what is happening in the world in places they would have difficulty visiting. Even better, no paper or pencils are necessary; this contributes to environmental protection and cost reduction.

The challenge to solve is that people in these countries do not know how to use computers and electrical equipment. The fact that sufficient and stable electricity is not available is also an important problem.

3. MAINTAINING INTERACTIVITY WITH ICT

Next, I will describe how we can maintain interactivity. In Japan, there is a good example of interactive ICT education. "Oyako de Science" was carried out by the graduate school of Tokyo University in 2005. It was a project in which parents and children tried science experiments together with a mobile phone as a digital textbook for three weeks. In the project, a mobile phone and the equipment for the experiment were distributed to participants, and children experiment with consulting the mobile phones. They input their expectations for the experiment on the Internet. After the experiment, via the mobile phones, they can watch explanatory videos and try quizzes to check whether they understood the lesson. Because their results were sent to their parents in an e-mail, the parents were able to know the study condition of their children and to take an interest in their education. This information facilitated communication between parent and child.

I feel that it would be possible to keep interactivity in the OCW educational process by utilizing mobile phones because if cell phones were used in satellite classes, the children could ask questions at any time. Another reason that mobile phones would be feasible is that they use less electricity than computers and other electrical equipment. Even if in the area in question is not supplied with enough electricity, mobile phones can be easily charged by compact batteries. It would be possible for students in developing countries to attend classes broadcast by satellite and to send their questions and opinions to the instructor via mobile phones by using lighter data-use technologies, such as text.

Of course, it would also be necessary for advanced countries to provide instructions on how to use this equipment and to cooperate with developing countries in the building of infrastructure and other fields.

4. CONCLUSION

Although improving infrastructure, health and the economy are the top priorities in developing countries, it is necessary to educate the citizens for development to occur. Even in these areas, ICT, such as the Internet and multimedia, will contribute to interactive study and making the available education better. It will not be easy to introduce ICT education to developing countries, but I think it is necessary for them to adapt to the information-oriented society step by step. Advanced countries should support them by respecting their traditional lifestyles and religious beliefs. Everyone in the world has the right to receive education. My hope is that someday, all women and children in developing countries will have access to education and will be able to take part in the social development of their country.

Application of the Ottawa Process to the Problem of Depleted Uranium Weapons

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Abstract: **Depleted Uranium (DU) is low-level nuclear waste that is used in militeary weapons. Because the DU is radioactive, it can affect both soldiers and civilians. Although DU weapons can be restricted by international humanitarian law, DU weapons themselves are outlawed. This paper seeks to estimate the effectiveness of the application of the Ottawa process to DU weapons.**

Keywords: Depleted Uranium, Ottawa process

1. Introduction[1],[2]

Depleted Uranium (DU) is low-level nuclear waste that is generated by the uranium enrichment process for use in nuclear power, in weapons, or for other purposes. DU possesses both radioactive toxicity and chemical toxicity. Specific information about the radioactive toxicity of DU includes the following: DU contains less uranium-235 (active fissile material) and more uranium-238 (non fissile material) compared with natural uranium. The external radiation dose produced by DU is approximately 60% of that resulting from the same mass of natural uranium. Uranium emits alpha radiation. These emissions are harmful to living cells and increase the possibility of cancer. The chemical toxicity of DU results from the fact that uranium is a heavy metal. The harmful consequences of its strong chemical toxicity are seen primarily in its effects on the liver.

DU becomes an aerosol when it is burned in high temperatures. If aerosol DU particles are absorbed into the human body, some of the aerosol DU goes into cells and remains there, continuing to emit alpha radiation. These emissions destroy DNA. This form of exposure to radiation is called "internal exposure," which increases the possibility of cancer.

DU is used in armor-piercing munitions as a penetrator because of its very high density. It is 1.7 times denser than lead. This property of DU, gives DU weapons increased range and penetrative power. In addition to its use in armor-piercing penetrators, DU is used as armor in US M1A1 and M1A2 battle tanks and in small amounts in some types of land mines. Its high density gives the combat tanks high durability under shelling by the enemy.

DU weapons were used on a real battle field for the first time during the Gulf War. It is estimated that the US and the UK military dropped more than 300 tons of uranium during the war. Subsequently, DU weapons were used in Bosnia, Serbia and Kosovo, and Afghanistan. They were used again in the war in Iraq by the US and the UK during 2003. After those wars, combat veterans suffered from various symptoms known as the "Gulf War syndrome", and the "Balkans syndrome." Among civilians and former soldiers, the incidence of cancer and leukemia has increased in Iraq following the Gulf War.

Dr. Jawad Al-Ali[3] has stated that the incidence of cancer increased from 44.7 per 100 thousand to 84.4 per 100 thousand people in Basra, almost a twofold increase from 1990 to 2005.

Dr. Al-Ani[4] has also conducted a survey of Iraqi men aged between 19 and 50 who participated in the war in the southern part of Iraq. He counted the number of people who contracted cancer after the Gulf War. A total of 1425 subjects in this survey had been exposed to the explosions of DU weapons. Another 315 people had not exposed. Table 1 shows the number of cancer patients who participated in the Gulf War and were exposed to the explosions of DU weapons (Al-Ani, 1998, Table 1[5])

Table 1

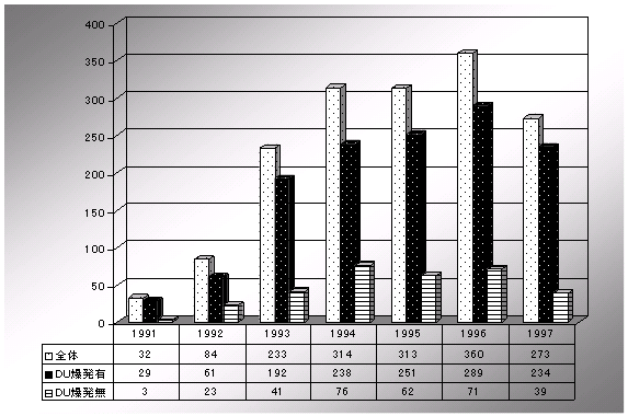
病名＼年	1991	1992	1993	1994	1995	1996	1997	総計
リンパ腫	10	16	70	85	80	106	82	449
白血病	10	28	45	53	65	70	40	311
肺ガン	4	6	39	40	41	40	40	210
脳ガン	1	2	20	30	35	40	34	162
胃ガン	2	6	13	15	10	10	10	66
骨ガン	2	3	5	10	10	12	15	57
膵臓ガン	·	·	·	3	10	12	15	40
肝臓ガン	·	·	·	5	10	11	13	39
唾液腺ガン	·	·	·	·	7	11	15	33
睾丸ガン	·	1	5	10	12	15	15	58
1,425	1,425	1,425	1,425	1,425	1,425	1,425	1,425	1,425

Table 2 shows the number of cancer patients who participated in the Gulf War and were not exposed to the explosions of DU weapons (Al-Ani, 1998, Table 1[5])

Table 2

病名＼年	1991	1992	1993	1994	1995	1996	1997	総計
肺ガン	2	6	7	15	11	23	14	78
胃ガン	·	10	11	17	14	13	·	65
白血病	1	4	7	11	7	12	6	48
リンパ腫	·	2	8	11	9	8	6	44
肝臓ガン	·	1	6	8	10	5	·	30
骨ガン	·	·	2	12	7	3	3	27
脳ガン	·	·	·	2	4	7	10	23
総計	3	23	41	76	62	71	39	315

The graph below, based on the Tables 1 and 2, shows the annual incidence of cancer in the southern Iraq[3].



The graph shows that the incidences of cancer increased for 7 years following the Gulf War. The number of cancer patients increased 9.97 times from 1991 trough 1996. This result indicates that exposure to DU weapons is relates to the incidence of cancer.

No existing rule or treaty applies explicitly to DU weapons. ICBUW, the NGO seeking to ban DU weapons, says the following. "In particular the treaties on biological and chemical weapons as well as the 1925 Geneva Gas Protocol cannot be seen as relevant here. The toxic effect of DU weaponry is of secondary character and therefore cannot be subsumed under the aforesaid provisions as those assume the respective harming effect as a primary one. The Convention on Certain Conventional Weapons Convention's (CCW) legal regime does not include DU weapons either" [1] .The DU weapons must be outlawed.

However, international humanitarian law (IHL) addressing the means and methods of warfare applies fully to the use of DU weapons and to their effects. The Additional Protocol I to the Geneva Convention, which is binding on 168 States, requires them to ensure that any new weapon, means or method of warfare does not contravene existing rules of international law (Article 56): "General principles of the laws of war/IHL prohibit weapons and means or methods of warfare that cause superfluous injury or unnecessary suffering, have indiscriminate effects or cause widespread, long-term and severe damage to the natural environment."[1]

In connection with the applicability of the existing humanitarian law to DU weapons, Dt. Hideaki Shinoda[2] has stated that the law addresses only the use of DU weapons, not the DU weapons themselves. However the US and UK do not recognize that any such breach of IHL has occurred. ICBUW and some other NGOs as well as some nations, claim that a new convention is needed to ban DU weapons comprehensively.

2 ways are taken for banning certain weapons in the international law. One method is to establish a convention at the Conference on Disarmament (CD) in Geneva. This method represents the traditional approach to making disarmament treaties. The conference has 65 members including the US, the UK, Russia and China. The other method is to make a convention involving only the nations who approve of prohibiting a certain weapon. This approach has recently been developed in the Ottawa process, which ultimately succeeded in passing a strict treaty banning land mines, the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction [4].

In this paper, I will discuss which process might be preferable for achieving a convention banning DU weapons.

2. Research Method

In this chapter, I will first define what it means to say that a convention banning DU weapons is a good convention. The best sort of convention is one that has strict rules and allows no exceptions to the ban on possession, transfers or use and that has many countries, including the countries possessing DU weapons, as participants.

Then, in the next chapter, I will compare the characteristics of anti-personnel mines and DU weapons. These two kinds of weapons differ in many aspects, and these differences in their characteristics must be considered in connection with the process of making a convention to prohibit such weapons.

Finally, I will discuss the relative merits of the CD in Geneva and the Ottawa process in the context of making a good convention to ban DU weapons.

3. Results

Anti-personnel mines and DU weapons are similar in that they produce indiscriminate and semi permanent effects. Land mines are active semi permanently because they are triggered only if someone steps on them. They cannot discriminate between soldiers and civilians. Consequently, land mines can injure civilians even after an actual war has ended. According to IHL, civilian injuries from this source should be prevented. DU weapons have a similar secondary character. When a DU weapon hit in a tank, the weapon explodes. In the explosion, the DU becomes an aerosol. Tiny radioactive particles are released and remains at the site. They continue to be radioactive for more than hundreds of millions of years. If this tiny particle is absorbed into the human body, the particle then enters a cell, remains there and continues to emit alpha rays for many years. Radiation from DU sources endangers civilians indiscriminately and semi permanently.

It is also informative to note some important differences between land mines and DU weapons.

First, the number of countries possessing land mines and the number of countries possessing DU weapons are very different. Before the Mine Ban Treaty (Ottawa Treaty) went into effect, almost all of the nations in the world possessed anti-personnel land mines. In contrast, approximately 20 countries possessed DU weapons. These countries are the UK, the US, France, Russia, Belarus, Greece, Turkey, Israel, Saudi Arabia, Bahrain, Oman, Egypt, Kuwait, Pakistan, Thailand, China, India, Belarus and Taiwan[1].

Second, the number of countries in which victims of DU weapons are present is also very different from the number of countries in which anti-personnel mines posed risks to the population. Before the Ottawa Treaty went into effects, the number of countries whose territory was contaminated by anti-personnel mines was 88[7]. In contrast, the number of countries whose territory is contaminated by DU weapon are limited. These countries currently include Iraq, Somalia, Bosnia, Serbia, Kosovo and Afghanistan. However, the accidents associated with the production of DU weapons or with military exercises have occurred in several countries. Moreover, the soldiers who participated in the Gulf War came from many countries. Large numbers of these soldiers are estimated to have been affected by uranium. Therefore the potential numbers of victims is large.

Third the military importance of land mines and DU weapons is different. Land mines were no longer needed after the Cold War ended. In contrast, DU weapons are highly important, because these weapons enable the army to minimize combat casualties. To the US, these weapons are important because they are seen as minimizing the duration of the war and the amount of human casualties on the battle field.

4. Discussion

The similarity of the indiscriminate and semi permanent effects of anti-personnel land mines and DU weapons suggests that a convention banning DU weapons can be achieved successfully using an Ottawa-type process. However, these considerations are not sufficient to determine that a process of the Ottawa-type is better for achieving a ban on DU weapons. To make this determination, it is necessary to focus on the differences between the situations involving two weapons and the differences between the two convention-making processes.

In the Conference on Disarmament in Geneva, the 65 member countries, including the DU-possessing countries like the US and the UK, all participate in treaty making and in the discussions involved in this process. Thus the resulting treaties tend to be rough. They can even be meaningless in some places.

In contrast, in the Ottawa process, some NGOs and Canada took the initiative in formulating the international convention that banned the anti-personnel mines[6]. They included some other nations that fully supported the prohibition of land mines. This process enabled the adoption of a convention that included strict rules. Owing to strict rules included in the Ottawa Treaty, the US, Russia and China, the “big three” countries that possesses land mines are not parties to this treaty. However, these nonparticipants respect the concepts underlying the Ottawa Treaty. In fact, most of the nonparticipants no

longer transfer and use anti-personnel mines[8]. As more and more countries participated in the convention, it became increasingly necessary for nonparticipants to refrain from violating the concepts underlying the convention.

The foregoing considerations suggest that if the number of participants in the process is large, it is better to use a process of the Ottawa type in making a good convention banning DU weapons.

Because the number of countries possessing DU weapons is limited, the possibility of making a good convention will increase even if one or two nations participated in the treaty-making process.

5. Conclusion

The indiscriminate and semi permanent effects of anti-personnel land mines and DU weapons are similar. Only 20 nations including the big countries possess Depleted Uranium weapons. The number of countries whose populations include victims of DU weapons is also limited. DU weapons have more importance in military perspective than the land mines when the Mine Ban Treaty, Ottawa Treaty was made.

Thus, to achieve a convention that abolishes DU weapons, a process of the Ottawa-type can be more effective than the Conference on Disarmament in Geneva, provided that the number of participants in the process is large and provided that some of the DU-possessing nations participate.

In my future research, I would like to estimate how large this number should actually be.

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The relation between the presentation and perception of time

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Abstract: **In this report, I conducted a study measuring the qualitative effect of a timer, which visualizes time on the perceived time. The timer resembles a progress bar, which is one of the widgets of the Graphical User Interface. The timer resembling a progress bar has an ability to divide time into some parts. I focused on this feature. I had test subjects watch the timers, which are paid attention on the feature, and subsequently obtained feedback. As a result, it was revealed that there is a relation between the timer's appearance and perceived time; specifically, the fact that the timer resembled as progress bar had an effect on shortening the perception of time.**

Key Words: perceived time, subjective time, visualized time, frequency

1. Introduction

1-1 Reason for the Study

When we move or download files on a personal computer, a progress bar often appears on the screen. The progress bar tells us how far along the process is and how much time we have to wait

Figure 1-1 Example of a progress bar

In this report, I took notice of the way remaining time is presented in progress bars. This information is displayed via a frame and rectangles. The number of rectangles increases according to the progress of the process. The progress of the process is, in turn, proportional to the time left in the process. Thus, the progress bar has the appearance of a timer that visualizes time. Because the number of rectangles is fixed, the time between the appearances of each rectangle is dependent on the total time that the process will take. It is possible to say that the progress bar divides time into the same number of parts as the number of rectangles. The remaining time is displayed as a gray area in figure 1-1. I studied the effect of progress bars on the perceived time by varying the number of rectangles.

The aim of this study is to examine how to shorten subjective time. If successful, this study could tell us how to shorten subjective waiting times for other things such as traffic lights, railway crossings, and elevators.

It is important to seek a way to display time that will shorten subjective time.

1-2 Related Works

Tayama[1][2] proved that the stimulation of a sense of speed becomes larger as the perceived length of time increases. However, Tayama also proved that the perceived length of time is larger when there is no stimulation of the velocity than when there is a small stimulation of the velocity.

Tayama proved that both visual stimulation and mental condition, personality brain damage, and bodily heat affect the perceived time.

1-3 Purpose

The main purpose of this report is to clarify the relation between how time is presented and how it is perceived

The focuses of this study are the perceived time, the time standard, and the expression of time.

Do you know why a minute consists of 60 seconds? According to one explanation, the reason goes back about 4000 years. At that time, the Babylonian Dynasty was flourishing around what is now called Egypt. The Babylonian system of mathematics was a base 60 numeral system. Because of this, a minute consists of 60 seconds. A minute is thus divided into 60 seconds for historical reasons rather than necessity. Now most of us use a base 10 numeral system, so the division of a minute into 100

parts might be more useful today. Thus, the division of time is only a rule. I generalized this time standard as frequency.

Frequency is defined as how many times a timer tells us the remaining time during a passage of a fixed interval. The time between each announcement of the remaining time remains constant.

I expressed time in a visual manner in order to emulate the sort of progress bars that inspired this study.

To examine the effect of the visual expression of time ordered by frequency, I formulated the following hypothesis: As the frequency of the timer's updates increases, the perceived time becomes shorter. I made several models of timers that each resembled a progress bar. I had test subjects watch them and subsequently obtained their feedback.

2. Research Method

2-1 The Test Subjects in the Experiment

The test subjects are thirty two people. Twelve of them were students in "Introduction to Research A," 10 of them were students in "Introduction to Research B," and 10 of them were people who participated via the Internet. The students of "Introduction to Research A" and "Introduction to Research B" were freshmen, sophomores, or juniors. The individual information of those who participated via the Internet is completely unknown.

2-2 Experimental Device

I made 5 models of the timer. Each timer lasted a total of 20 seconds. The configuration of each timer is detailed below. The numbers (No. 0, No. 1, etc.) are the names of each timer.

No. 0・・・The timer displays a blank page for 20 seconds.

No. 1・・・The timer has a frequency of 4. It displays a square divided into 4 parts, with one part disappearing every 5 seconds.

No. 2・・・・The timer has a frequency of 8. It displays a square divided into 8 parts, with one part disappearing every 2.5 seconds.

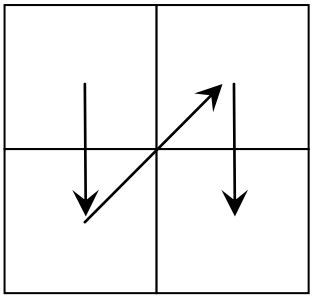
No. 3・・・The timer has a frequency of 32. It displays a square divided into 32 parts, with one part disappearing every 0.625 seconds.

No. 4・・・The timer constantly tells the test subjects how much time has passed, such that the square appears to disappear smoothly. The frequency approaches infinity.

All squares have the same area. The arrows in the following figures show the order in which the parts of the square disappear.

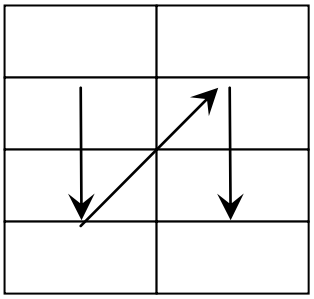
The division of timer No. 1 is indicated in the figure below.

Figure 2-1 Division of timer No. 1



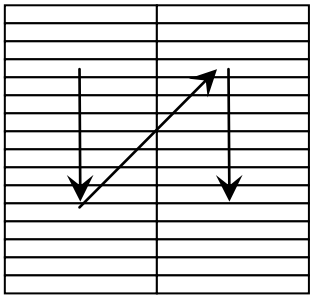
The division of timer No. 2 is indicated in the figure below.

Figure 2-2 Division of timer No. 2



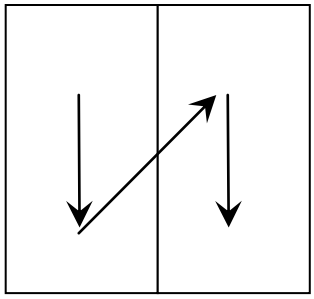
The division of timer No. 3 is indicated in the figure below.

Figure 2-3 Division of timer No. 3



The division of timer No. 4 is indicated in the figure below.

Figure 2-4 Division of timer No. 4



I made a movie of these timers with PowerPoint. The movie was uploaded to a video sharing site. The page with the movie linked to a page with an online questionnaire.

2-3 Research Method

I first had the test subjects watch the movie. The movie shows each model in numerical order. After they watched the movie, I asked them to rank the models in order of the feelings of time passed fast in front of the timer. Wording of the question is that "which timer did make you feel the time passed fastest? Please write the rank as follow example; 42031. This sequence of numbers means that the leftmost number is ranked as fastest and that the rightmost number is ranked as fifth fastest."

3. Results

3-1 Outline of the Results

In this section, I first discuss the relevant data and the validity of the data. Next, I explain the reason that I made table 3-1 and the way I made it. Then, table 3-1 is displayed. Table 3-1 is based on the experimental data, which are presented in more detail in section 5-4. In table 3-1, I present the clarity of the comparison between two arbitrary models. This is related to the validity of the data, which is discussed in more detail in section 4-2.

Next, I explain the reason that I made table 3-2 and the way I made it. I calculate the dispersion of the evaluation for the ranking of each model and discuss their features as well as the correlation between the models and the ranking.

3-2 Relevant Data and Validity of the Data

The data from 3 subjects out of 32 were excluded because those subjects all stated that they did not feel the effect of the timer. The appropriateness of this exclusion is discussed in section 4-2.

This table is needed to examine the validity of the experiment. In this study, the test subjects were forced to compare 5 models at the same time. Thus, it is necessary to examine whether the comparisons between two arbitrary models are relevant.

Table 3-1, presented below, displays how many people evaluated any given model higher than any other given model. The numbers in parentheses indicate the percentage of subjects who ranked one model higher than another.

Table 3-1 Comparisons among the models by their ranks

	No. 0	No. 1	No. 2	No. 3	No. 4
No. 0		17(100)	17(100)	17(100)	17(100)
No. 1	0(0)		13(76)	10(58)	10(58)
No. 2	0(0)	4(24)		12(71)	7(41)
No. 3	0(0)	7(41)	5(29)		4(24)
No. 4	0(0)	7(41)	10(58)	13(76)	

The elements of the first row of table 3-1 are the model numbers that were ranked higher than the elements of the leftmost column of the table. For example, the element of table 3-1 in the 3rd row, and 4th column is the number of people who ranked timer No. 1 higher than timer No. 2 (4 subjects). Likewise, the element of table 3-1 in the 4th row and 3rd column is the number of people who ranked timer No. 2 higher than timer No. 1 (13 subjects).

I now turn to the clarity of the comparisons between two arbitrary models.

Clarity is defined as the percentage of people who ranked one model higher than another one. If the rate is near 50 per cent, the clarity is low; if not, the clarity is high.

First, the comparisons between timer No. 0 and the others have very high clarity. Second, the comparisons between timer No. 1 and timer No. 2, timer No. 2 and timer No. 3, and timer No. 3 and timer No. 4 also have a high clarity, but they are less clear than the former comparisons. The clarities of all the other comparisons are low. These results are discussed in more detail in section 4-2.

3-3 Dispersion of the Evaluation of Each Model

The questionnaire contains one question concerning ranking, but this question contains 5 items. The first item asks which timer the subject felt was the fastest, the second item asks which timer the subject felt was second fastest, and so on. In table 3-2, the rankings are listed in the leftmost column, and timers are listed in the first row.

Table 3-2 contains the total combinations of each model number and rank. The numbers in the lowest row of table 3-2 are the dispersions of the evaluation for each model.

Table 3-2 Evaluation of Each Model and its Dispersion

	No. 0	No. 1	No. 2	No. 3	No. 4
1st	0	4	6	12	7
2nd	1	4	4	9	11
3th	0	0	18	8	3
4th	2	18	1	0	8
5th	26	3	0	0	0
Dispersion	128.2	49.2	52.2	30.2	18.7

Table 3-2 reveals the following trend: the larger the frequency becomes, the smaller the dispersion. A large dispersion means that the evaluations are concentrated in a specific rank, and a small dispersion means the evaluations are not as concentrated. The table shows that the dispersion of timer No. 0 is significantly large.

In addition, there is a positive correlation between timer No. 0, No. 1, No. 2, and No. 3 and the rank. However, timers No. 3 and No. 4 are negatively correlated with rank.

4. Discussion

4-1 Outline of the Discussion

First, I discuss the validity of the data. Second, I discuss the experimental method. Third, I discuss the dispersion of table 3-2. Forth, I examine the hypothesis. Finally, I discuss a singular result.

4-2 Validity of the Data

To begin with, I return to the appropriateness of the exclusions from the data and the validity of the comparison between two arbitrary models.

As explained above, data from 3 subjects were excluded because they stated that they did not feel that the subjective time was affected by the different timers. In this report, I excluded them because their answers went against my format that I told them to hold by. These 3 answers are nevertheless important to keep in mind because they might indicate a limitation of the effect of the timers.

Next, I discuss the validity of the comparison between two arbitrary models. As the results show, 26 out of 29 test subjects gave timer No. 0 the lowest rank. This result shows that the subjective time is the longest when subjects view timer No. 0, and the feeling that the subjective time is long has a very high level of clarity. In addition, the comparisons between timer No. 1 and timer No. 2, timer No. 2 and the timer No. 3, as well as timer No. 3 and timer No. 4 are clear, though the clarity is less than the comparisons between the timer No. 0 and the others. I do not think that the comparisons between the other combinations are relevant. The clarity of the evaluations depends on the experimental method. In this experiment, I showed the models of the timer in the same order. Using this method, there are two types of comparisons. One is a direct comparison. This is applied to comparisons between consecutively numbered timers. In this case, it is easier to compare the models. The other is an indirect comparison. In this case, it is more difficult to compare them using an indirect comparison than a direct comparison. Thus, the direct comparisons are relevant.

4-3 Dispersion

Table 3-2 revealed the following tendency: the larger the frequency number becomes, the smaller the dispersion. The effects of the timers on shortening the subjective time become similar as the frequency number increases. The time between a timer's updates makes almost no

difference to perceived time when the frequency is large. Thus, I think that the dispersions of the large frequency models are vague.

4-4 Examination of the Hypothesis

In this section, I examine the hypothesis. According to section 3-3, there is a positive correlation between the models and the ranks. This result confirms the hypothesis. However, the rank of timer No. 4 is less than that of timer No. 3. This result is at odds with the hypothesis. In section 3-3, I presented the dispersions, and in section 4-3, I discussed that data. From this discussion, it is possible to conclude that, as the frequency becomes larger, the effect of the timer on the perceived time becomes stronger but also vaguer. I think that the effect of timer No. 4 has the widest range among the 5 models. The wide range is the reason for the lower rank of timer No. 4. Thus, the hypothesis of this study is confirmed when the wide range of the effect of large-frequency timers is taken into consideration.

4-5 Singular Data

Now, I discuss timer No. 0 due to its singular data. Twenty-six out of twenty-nine test subjects (90%) answered that timer No. 0 was the longest. According to section 3-3, the larger the frequency becomes, the smaller the dispersion becomes. According to sections 3-3 and 4-3, the small dispersion indicates that the effect of the timer is similar. Thus, the existence of information concerning the progression of time plays an important role in the perceived time. This study confirms the effect Tayama observed of a blank model on the perception of time. In this study, the blank model is timer No. 0.

5. Conclusion

The purpose of this report is to examine the hypothesis that the larger the frequency of telling the remaining time is, the shorter the subjective time is.

In this study, to examine this hypothesis, I made 5 models, with 1 blank and 4 resembling a progress bar. I had the test subjects watch the timers and then asked them to rank the models. One limitation of this study is that all test subjects saw all the timers in the same order. The order in which the timers are viewed might, however, have affected the results; further studies will be needed to see if the results can be replicated when the order of the patterns is varied.

This study has shown that the larger the frequency is, the shorter the subjective time is. However, among the timers that have a high frequency, the evaluations are diversified. This is because timers that have a high frequency have similar effects on the perception of time.

This study has also revealed that there is a clear difference between cases in which test subjects wait in front of a blank page and cases in which they wait in front of a timer.

In this study, the only variable was frequency. In future studies, I would like to examine the effect of varying both the frequency of timers along with the total time which elapses. This study has demonstrated the qualitative nature of the perceived time, so I would like to clarify its quantitative nature.

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Department of Psychology, Hokkaido University, Tayama Laboratory

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7. Data

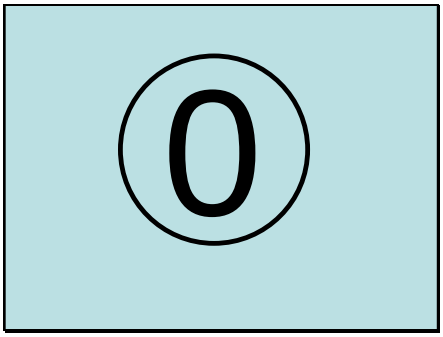
7-1　Slides of PowerPoint

slide 1

時間間隔と感覚

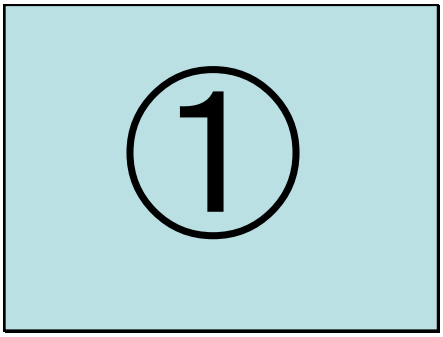
- 始めに何もないパターンを見せます。
- その後に、4つのパターンを見せます。
- 最も長く感じたものと最も短く感じたものを選んでください。
- 白い背景の画面の出ている時間が感じる時間になります。青い背景と青い背景の間です。

slide 2



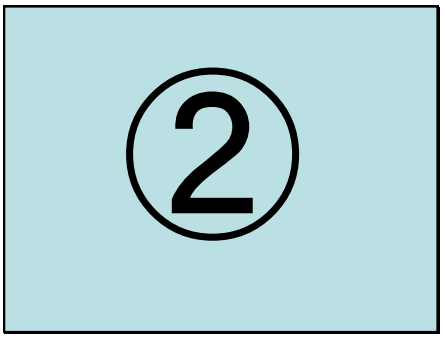
slide 3

slide 4



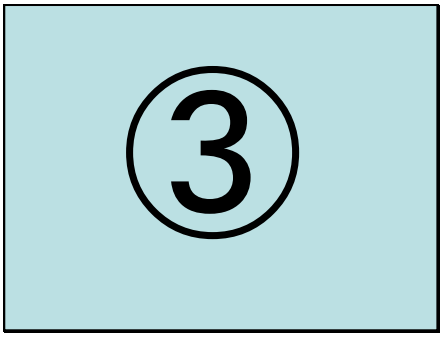
slide 5

slide 6



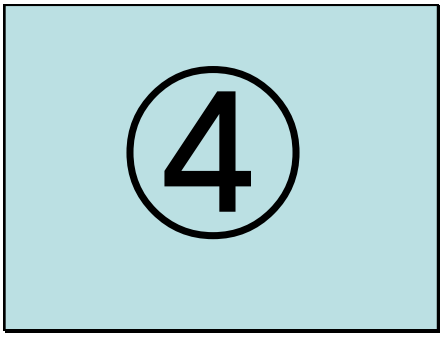
slide 7

slide 8

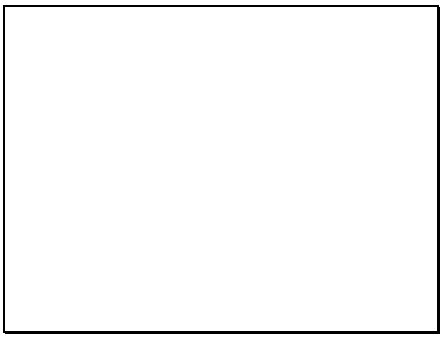


slide 9

slide 10

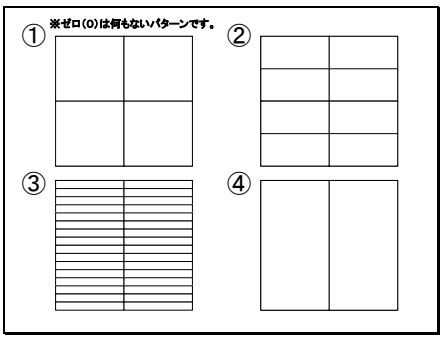


slide 11



slide 12

slide 13



In the seemingly blank slides 5, 7, 9, and 11, the timers are hidden.

7-2 Result of Questionnaire 1

Table 7-2 Experimental Data 1 (N=17)

1st	2	1	3	3	4	2	1
2nd	1	3	2	4	3	3	2
3rd	3	2	4	2	2	4	3
4th	4	4	1	1	1	1	4
5th	0	0	0	0	0	0	0

Number of test subjects	3	3	2	3	4	1	1

(conducted from 2010/11/29 to 2011/1/15)

These are the results of the questionnaire conducted on the website "Dounano.net". The URL of the questionnaire page is below.

URL (http://www.dounano.net/answer/JOH0z2927.html)

The test subjects in this study include the students of "Introduction to Research B" as well as people who participated via the Internet. The set of the numbers in each row contains the answer of one test subject. The numbers in the lowest row indicate the number of people who gave the same answer.

7-3 Results of Questionnaire 2

Table 7-3 Experiential Data 2 (N=12)

	No. 0	No. 1	No. 2	No. 3	No. 4
1st	0	0	2	7	3
2nd	1	1	1	1	8
3rd	0	0	8	4	0
4th	2	8	1	0	1
5th	9	3	0	0	0

(conducted on 2010/05/24)

Table 7-3 is made by using the method of section 3-3.

Iran's Nuclear Program and U.S. Security Policy

Faculty of Science

Uchino Yoshinari

Abstract: **The United States should deter Iran's aggressions by limiting Iran's influence in the Middle East, and engage with Iran to dissuade it from acquiring nuclear weapons. To understand Iran's military power and foreign relations in the Middle East, I have studied media reports, theses, and U.S. official reports, which suggested the dangers of a nuclear-armed Iran, the challenges of deterring Iran, and the necessity of engaging with Iran. Washington should dialogue with Tehran while providing its allies with credible and extended deterrence.**

Key Words: Iran, Middle East, nuclear weapon, deterrence

1. Introduction

Iran has enriched uranium defying UN Security Council resolutions. "World powers have made no progress in persuading Iran to halt its nuclear program".[1] If Iran continues to increase its stockpile of enriched uranium, Iran might produce high-enriched uranium for a nuclear bomb in a centrifuge facility under IAEA safeguards.[2]

If Iran acquires nuclear weapons, the Middle East would destabilize, and nuclear proliferation might occur in the volatile region. The next section of the paper explores the options available to the United States for stabilizing the region.

Israeli officials appear to be planning for a military strike on Iran's nuclear facilities, having examined the courses of flights for the military action. Jeffrey Goldberg has stated, "the [Netanyahu] administration knows it is a near-certainty that Israel will act against Iran soon if nothing or no one else stops the nuclear program."[3]

Robert E. Hunter argues that military action "is certainly unacceptable in terms of US interests," and that containment and deterrence "would come at high and perhaps unacceptable costs," referring to the foreign relation challenges facing the United States. Hunter has argued that Washington should offer security guarantee to Iran if it abandons its nuclear weapons program and stops other unacceptable behavior.[4]

Eric S. Edelman, Andrew F. Krepinevich, and Evan Braden Montgomery have argued that a nuclear-armed Iran would destabilize the Middle East, pointing out difficult problems facing deterrence of a nuclear-armed Iran by the United States.[5]

This paper argues that the United States should refrain from a strike on Iran, deter Iran's aggressions, and engage with Iran to dissuade it from acquiring nuclear weapons.

The credibility of the willingness of the United States to offer extended deterrence, and its capability to deter a nuclear Iran would be questioned, as noted by Edelman, Krepinevich, and Montgomery. To deter China, North Korea, and Iran, the United States needs to show strong willpower and deploy troops in the Middle East and in East Asia. Appropriate deployment of U.S. forces and easing the tensions in the Middle East are necessary for the success of extended deterrence by the United States in East Asia, as well.

In this paper, I examine Iran's military power and the foreign relations situation in the Middle East, and consider U.S. security policy for deterrence of and engagement with Iran.

2. Research Method

The information about Iran used here is based on expert analyses and media reports. Sources are noted below.

3. Results

3.1 Iran's Military Power

First, this section of this paper examines Iran's military power. According to an unclassified report to

the U.S. Congress on the current and future military strategy of Iran, "Since the [Iranian] revolution, Iran's first priority has consistently remained the survival of the regime. Iran also seeks to become the strongest and most influential country in the Middle East and influence world affairs…To ensure regime survival, Iran's security strategy is based first on deterring an attack."[6]

Iran's armed forces have impressive manpower and varied assets, "but they are widely considered relatively combat ineffective in a head-on confrontation against a well-trained, sophisticated military such as that of the United States or even a major regional power such as Turkey. Iran is believed to largely lack the logistical ability to project power much beyond its borders."[7]

However, "Iran continues to develop ballistic missiles that can range regional adversaries, Israel, and central Europe."[8] Iran has deployed Shahab-3 ballistic missiles (800-mile range, about 1280-km range). "U.S. officials believe Iran might be capable of developing an intercontinental ballistic missile (3,000 mile range [about 4830km range]) by 2015."[9]

Iran's armed forces are also seeking to improve the country's air defense system. Iran "seems to prefer a point defense strategy, with its strongest defenses located around key strategic centers... Tehran continues to invest heavily in advanced air defenses… Iran acquired modern TOR-M1 short range surface-to-air missiles in 2007."[10] In addition, Iran has developed a new air defense system, although its reported performance is dubious.[11]

At the same time, Iran has supported dissident groups and terrorists in the Middle East. For example, Iran provided Hezbollah, a Lebanese Shiite militia group, and Hamas, a Palestinian militant group, with weapons, such as rockets. "Hezbollah fired Iranian-supplied rockets on Israel's northern towns during the fighting [the July-August 2006 war between Israel and Hezbollah]…Iran has since resupplied Hezbollah with at least 25,000 new rockets."[12] Iran also has provided Hamas with Fajr-3 rockets, which have a range 60 to 70km and can attack Tel Aviv or Jerusalem from Gaza.[13] In addition, Iran has provided weapons for Taliban and other militants in Afghanistan, although its assistance to Afghan militants is at a relatively low level. Tehran also supports economic development in Afghanistan and has close ties to Kabul.[14]

Iran has avoided direct conflict with the United States and Israel, while it has supported terrorist groups and incited proxy warfare with Israel.

3.2 Iran's Nuclear Program and Economic Sanctions against Iran

The next section of the paper examines the status of Iran's nuclear program. Iran claims that its nuclear program is for peaceful purposes, enriching uranium against UN Security Council resolutions.

Iran's nuclear program has been hindered by several factors: UN sanctions, U.S.-led sanctions, computer viruses targeting Iran's centrifuge system, and assassinations and kidnappings of Iranian nuclear scientists. The sanctions against Iran deny the country access to finances and nuclear-related materials. For example, Iran has trouble acquiring carbon fiber necessary to produce centrifuges. "Meir Dagan [a former director of Mossad, Israel's intelligence service] said he believed that the Iranians would not be able to make a bomb until 2015, at the earliest, 'because of measures that have been deployed against them. '"[15]

Despite sanctions and international efforts to prevent Iran from going nuclear, Iran will produce nuclear weapons sooner or later, and it might decide to do so despite international resistance to the nuclear program. "Dagan was contradicted by Israel's chief of military intelligence, Major-General Aviv Kochavi," and Kochavi said, "sanctions had not held up Iran's nuclear program, and it could produce bombs within two years."[16]

Director of National Intelligence James Clapper said, on February 16, 2011, that "Iran is technically capable of producing enough highly enriched uranium for a weapon in the next few years, if it chooses to do so." "Whether such a decision had been made, he said, remains unclear."[17] "A comprehensive new U.S. intelligence report concludes that Iran has resumed research on key components for a nuclear weapon, but that the slow and scattered nature of the effort reflects renewed debate within the regime over whether to build a bomb, U.S. officials said."[18] According to Clapper, Iran's decision on nuclear development will be based on cost-benefit calculations, and thus, the international community can affect Iran's decision.[19]

In fact, Iran has increased its stockpile of 20%-enriched uranium[20] and could realize the breakout scenario. In addition, Iran has procured

products for enrichment facilities, such as maraging steel from China.[21]

Some hope for regime change in Iran, but regime change would not make a drastic change in the Iranian posture regarding its nuclear program. The Ahmadinejad administration might be undone because of Iran's bad economy.[22] However, 50% of the Iranian people rate the work of the government as excellent or good, and 59% support the government's crackdown on the Green Movement opposition after the presidential election in 2009. Moreover, 71% support Iran developing and possessing nuclear weapons. Most Iranians are not interested in making deals over the nuclear program.[23]

3.3 Military Action against Iran

Military action against Iran will cause catastrophic consequences. "Some experts express greater concern over the potential for a strategic strike on Iran by Israel as compared to strikes by the United States."[24] Regardless of whether Israel or the United States carries out a military strike on Iran, military action would bring unacceptable consequences: Iran closing the Strait of Hormuz, retaliation by Iran's proxies, such as Hezbollah and Hamas, Iran supporting anti-U.S. insurgents, and so on. "Iran's military leaders have, in mid-2010, stressed its willingness and ability to retaliate in the Gulf and cause the West economic difficulty."[25] "More than 40% of the world's oil traded goes through the Strait of Hormuz, a channel along Iran's border."[26] According to an estimate in 2007, if the Strait of Hormuz is closed, the price of oil will reach up to 175 U.S. dollars per barrel.[27] Moreover, Iranian officials think that if Israel attacks Iran by missiles, Hezbollah and Hamas will retaliate Israel.[28] In addition, "Iran could also try to direct anti-U.S. militias in Iraq and Afghanistan to attack U.S. troops."[29]

There are also military challenges in conducting strikes on Iran. Targets are interspersed in Iran, including enrichment facilities at Natanz and near the city of Qom, research facilities at Isfahan, and the heavy water reactor at Arak.[30] The facility at Natanz is buried for defense against military strike by U.S. forces or Israeli forces.[31] In addition, Iran has military resources that include MiG-29s, F-14s, and more.[32]

3.4 International Relations concerning Iran[33]

(See Figure 1 at the end of this paper.)

Although the dialogue between world powers and Iran continue, conversations have not yet progressed. "The United States is open to diplomacy with Iran on its nuclear program and sanctions are intended to cause Iran to bargain in good faith in those negotiations."[34] However, that approach seems, thus far, to have been unsuccessful.

If Iran goes nuclear, the relationship between Iran and Israel will grow tenser, because of the incentive for preemptive strike. In addition, the arms race in the Middle East might escalate, and emerging nuclear-armed states might cause nuclear warfare because of the incentive for preventive strikes, loose command and control, and miscalculations.[35]

If Iran gets nuclear weapons, nuclear proliferation might occur in the Middle East. Several countries in the region have announced or initiated nuclear energy programs, for example, Egypt, Saudi Arabia, Turkey, and the United Arab Emirates. "These moves have been widely interpreted as hedges against nuclear-armed Iran."[36]

Iran is believed to interfere and conduct subversive activities toward its neighbors. (See Table 1 and Table 2 at the end of this paper.)

"Iranian politicians … advocate for and support actors that have opposed Saudi policy and disrupted regional security in recent years, such as Hamas and Hezbollah." According to Yemeni and Saudi sources, Iran has provided material support to the Shiite Al Houthi rebel group in northern Yemen.[37] Bahrain has a large Shiite population, and its ruling Sunnites are concerned about Iranian-supported unrest.[38]

Although it is unclear whether Iran instigated the political turmoil in the Gulf States early in 2011, Iran will continue to be a major concern for the Gulf States. In Yemen, the Shiite rebel group purportedly linked to Iran is not conducting noticeable actions for now, though it may resume terrorism activities and attacks against Saudi Arabia beyond the border.[39] In Bahrain, groups of Shiites have held demonstrations against the regime, which can stimulate Shiite action in Saudi Arabia. Moreover, the headquarters of the U.S. fifth fleet is located in Bahrain, which is a very important strategic foothold for the United States.[40] In Saudi Arabia, the Shiite share of the population is 15%, and many Shiites work for Saudi Aramco, the national oil company, which could lead to disruption of its oil production.[41]

4. Discussion

The influence of a nuclear-armed Iran and U.S. security policy toward non-nuclear/nuclear Iran are discussed here.

4.1 After Iran Goes Nuclear

What if Iran gets nuclear weapons? This section of the paper explores the consequences of Iran going nuclear.

First, some of Iran's neighbors might follow suit and go nuclear. Several Arab states have nuclear energy programs as hedges against nuclear-armed Iran, as mentioned above. If Iran acquires a nuclear bomb, these states might decide to produce nuclear weapons, although it might be too late. Moreover, Pakistan might provide Saudi Arabia with nuclear weapons, nuclear technology, and a delivery system. Emerging nuclear-armed states might use nuclear weapons, as noted above.[42]

Second, some of the Gulf States might appease Tehran. In such a country, Iran might engage in illicit activities, including transferring weapons of mass destruction, support for terrorism, and money laundering.

Third, a nuclear war between Israel and Iran might occur. Indeed, Iran might refrain from preemptive strike on Israel because of Israel's second-strike capabilities, such as Dolphin-class submarines and SLCMs.[43] Israel might refrain from a first strike for fear of Iran's attack by ballistic missiles and proxy warfare with Hezbollah. However, Israel might want to carry out preventive strike before Iran increases its nuclear arsenal. Iran might also launch the first strike before it loses its nuclear weapons, as discussed by Edelman, Krepinevich, and Montgomery.[44]

Fourth, Iran would conduct frequent provocative actions, including support for terrorist groups, such as Hezbollah and Hamas, subversive activities in Sunni Arab states, and deliberate near-misses toward the U.S. ships in the Persian Gulf.

Fifth, allies of the United States, as well as Iran, China, and North Korea, would question the extended deterrence policy. Would Washington risk the homeland to protect Israel, Saudi Arabia, and the UAE?

The best way to solve these conundrums is to prevent Iran from crossing the nuclear threshold.

4.2 How to Prevent Iran from Crossing Nuclear Threshold and Deter Iran's Aggressions

The Obama administration has tried to dissuade Iran from crossing the nuclear threshold, but it has not achieved a compromise with Iran. Thus, the United States should take measures to deter Iran while engaging it. The next section of the paper discusses several points about how the United States should prevent Iran from going nuclear and deter Iran's aggressions in the below.

First, the United States should refrain from preventive attack on Iran and dissuade its allies from attacking. Tehran has various kinds of retaliatory options: retaliatory attacks on Israeli and U.S. bases in the region with ballistic missiles, proxy warfare by Hezbollah and Hamas, support for anti-U.S. insurgents in Iraq and Afghan, subversive activities in Sunni Arab states, the closing of Hormuz, and so more.

The United States should remind its allies that a strike on Iran's nuclear facilities might fail and that a strike is unacceptably risky. Israel's F-15s or F-16s might be shot down by Iran's air defense, and Israeli pilots might be captured by Iran. Bunker-Busters might not destroy nuclear facilities under the ground. Iran might aggressively initiate retaliation.

Moreover, preventive strikes believed to be successful might be undone. Such a strike might lead Tehran to cling to the development of nuclear weapons. Iran might rebuild nuclear facilities and accelerate its nuclear program, procuring nuclear-related materials from China and North Korea.

Second, the United States should impose effective sanctions on the Iranian government's activities to delay Iran's nuclear program. The United States should deny Iran access to nuclear-related materials, such as maraging steel and carbon fiber with continued international and U.S. sanction. The United States should also prevent Iran from acquiring uranium enriched at North Korea's centrifuge facility.

In addition, Washington should promote and strengthen international and U.S. economic sanctions on Iran. The U.S. needs to mandate foreign companies that invest in Iran's energy sector to withdraw investments. Such a sanction would restrict Iran's finance and might lead to a compromise from Tehran on nuclear issues, although it is difficult to get cooperation from China. Because Iran's nuclear program is based on cost-benefit calculations, it is important for the United States and the international community to increase the

cost of Iran's nuclear development by effectively implementing economic sanctions.

Third, to deter Iran's various aggressions, the United States should ensure the security of its allies. The United States should reassure its allies by showing credible commitment and strong capabilities. In addition, the United States should provide the Gulf States with weapons, such as missile defense systems and combat warships, so that they will not appease Tehran and support Iran's activities.[45]

However, reinforcement of U.S. troops might bring about anti-American sentiment in the Muslim World and a security dilemma for Tehran. Washington should pay attention to the influence of its policies.

The various costs for the United States should be also considered. The reinforcement of U.S. troops will impose financial costs on the United States. Moreover, operations in the region have already laid heavy burdens on Americans in uniform. Washington should lower these costs by cooperating with its allies and partners.

Fourth, the United State should make diplomatic efforts to limit Tehran's influence and defuse anti-American sentiment. James M. Lindsay and Ray Takeyh noted, "A concerted push, diplomatic and economic, to improve the lives of the Palestinians would limit Iran's appeal among them." They also noted, "Drawing Syria into a comprehensive Israeli-Palestinian peace process could not only attenuate Tehran's links with Damascus but also stem Iran's ability to supply weapons to Hezbollah."[46]

Washington should also help each of the Gulf States integrate and establish dissidents into one nation. Domestic tensions, such as sectarian conflicts between Shiites and Sunnites, are vulnerabile to Tehran's subversive activities. Washington should help the Sunni establishments resolve the dissatisfaction of the Shiites, especially in Bahrain, Yemen, and Saudi Arabia.

Fifth, Washington should make every effort to enhance the proliferation security regime, calling on every state that does not participate in the Proliferation Security Initiative (PSI) to join.[47] The United States should call on Asian-Pacific states to participate in PSI. The United States should also ensure that both Northern Sudan and Southern Sudan do not support terrorists, such as Hamas.

Moreover, the United States should help every state that is lacking in laws and law-enforcement agencies to prevent the proliferation of WMDs. Pyongyang and Tehran have agreed to a secret nuclear deal, and Iran has arranged to receive enriched uranium from North Korea in return for capital support to the North.[48] Washington should help Japan enhance laws and capabilities for proliferation security and monitor North Korea's nuclear-related activities.

Sixth, the United States should strengthen its intelligence efficiency. It needs to continuously cooperate with intelligence communities in the Middle East and East Asia, and observe Iran's clandestine activities such as procurement of nuclear-related materials and support for terrorism. The U.S. intelligence on Iran is said to depend on Egypt's intelligence community, so the United States should maintain close ties with that country.

In addition, the United States should detect Iran's covert enrichment activities. For Iran, secret enrichment activities will take a long time and involve detection risks.[49]

However, such an international effort to contain Iran has limits. Despite Israel's efforts to prevent Hamas from acquiring Fajr-3, Hamas still seems to acquire weapons.[50] After all, it will be very difficult to stabilize the volatile region unless U.S. engagement with Iran softens the stubbornness of Tehran.

Lastly, Washington should make every effort to dialogue with Tehran. It might be easy for Tehran to start with the areas of common interest between the United States and Iran. As Robert E. Hunter suggested, if Iran meets key U.S. requirements, as well as the requirements of regional countries, the United States should offer credible security guarantees to Iran.[51]

Washington should show Iran that it does not intend to topple the regime. Building confidence should facilitate bilateral dialogue between the United States and Iran.

In nuclear talks, Iran should accept the ratification of the Additional Protocol of IAEA safeguard agreements, restriction of the stockpile of low enriched uranium, and so on. Iran does not yet meet those requirements. The United States should collect information on the requirements posed by Iran and possible face-saving compromises for Tehran.

The United States should help Tehran achieve future prospects. After Iran gets the bomb, it would confront

the United States, Israel, Turkey, and Sunni Arab States. Although some of the Muslim World might support Tehran, the consistency of Supreme Leader Khamene'i's statements would be questioned. Sunni Arab states would strengthen ties with the United States, and Iranian activities might be much more restricted. Divestment in Iran would accelerate.

There are common interests between the United States and Iran, such as issues on Afghanistan and counter-narcotics.[52] Although Tehran's purpose is different from that of the United States, stability of the Karzai administration in Afghanistan seems to be beneficial to both the United States and Iran. Washington should promote confidence-building during multilateral talks with Tehran as well.

4.3 What to Do After Iran Acquires Nuclear Weapons

Despite incentives and sanctions to prevent Iran from going nuclear, Iran might have nuclear weapons within a few years. What should the United States do? It should offer extended deterrence to its allies while engaging with Iran. Some of those tasks would be the same as mentioned above. However, the United States should carry out additional actions.

First, the United States should enhance the capability and credibility of extended deterrence. Deployment of BMD and reinforcement of U.S. troops in the region would strengthen the capability and credibility of the United States. In addition, the United States should provide its allies with a nuclear umbrella, if necessary.

However, given those actions, some of the problems about U.S. extended deterrence, such as a question about its credibility would not be solved. What if Iran gets ICBMs and thermonuclear warheads? Would Washington risk the homeland for extended deterrence?

Second, the United States needs to monitor its allies. Israel might carry out preemptive attacks on Iran. Saudi Arabia might make a nuclear deal with Pakistan. These actions would confuse the situation. The United States should eliminate recipes for disaster.

Third, Washington should set up a hot line with Tehran. Because of Tehran's brinkmanship, the United States and its allies might put out a nuclear alert. Because of Tehran's misunderstandings and miscalculations, Iran might call a nuclear alert. Washington should have a tool for risk management.

Lastly, Washington should have diplomatic channels for regional stability and arms control. Washington needs to prevent Iran from suffering security dilemmas. Washington should dialogue with Tehran, but also restrict Iran's nuclear arsenal for the sake of regional stability.

5. Conclusion

After Iran crosses the nuclear threshold, the credibility of U.S. extended deterrence will be questioned. Moreover, nuclear warfare might occur in the region. The best thing for the United States is to dissuade Iran from acquiring nuclear weapons.

Therefore, the United State should make every effort to engage with Iran and deter its production of nuclear weapons. The United States should delay Iran's nuclear program by denying access to finances and nuclear-related materials. To hamper Iran's nuclear program, Washington should enhance the cooperation of intelligence communities between the United States and its allies. At the same time, Washington should promote confidence-building and dissuade Iran from going nuclear.

In contract, the United States should deter Iran's aggressions by providing U.S. allies with credible commitments and weapons, such as air defense systems. In addition, Washington should help the Sunni Arab States solve domestic problems, such as Israeli-Palestinian peace process and sectarian conflicts.

If Iran acquires a nuclear bomb, the United States should enhance its extended deterrence with the deployment of BMD systems and with the reinforcement of U.S. forces. In addition, Washington should continue to dialogue with Tehran for the sake of regional stability and arms control.

Nuclear talks are continuing, and whether world powers and Iran achieve an agreement for the nuclear program matters greatly. The global security policy of the United States will depend on the result.

Furthermore, recent revolutions in the Middle East are disrupting regional stability, which could dramatically change the game. Tehran may expand its influence in the Gulf States through revolutions in the Sunni Arab states. Tehran may be even democratized. However, it is difficult to be certain of prospects in the Middle East. More research on domestic politics in the region is required to restructure the U.S. policies.

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Table 1. Shiite and Sunni Share of the Population in the Region

Nation	Sunni	Shia
Afghanistan[53]	Sunni Muslim 80%, Shia Muslim 19%, other 1%	
Bahrain[54]	24%	56%
Egypt[55]	90%	
Iran[56]	9%	89%
Iraq[57]	Muslim 97% (Sunni 32%-37%, Shia 60%-65%)	
Kuwait[58]	Muslim 85% (Sunni 70%, Shia 30%)	
Oman[59]	Ibadhi Muslim 75%, other (includes Sunni Muslim, Shia Muslim, Hindu) 25%	
Qatar[60]	90%	
Saudi Arabia[61]	85%	15%
United Arab Emirates[62]	mostly	16%
Yemen[63]	"The population of Yemen is almost entirely Muslim, divided between Zaydis, found in much of the north (and a majority in the northwest), and Shafi'is, found mainly in the south and east. Zaydis belong to a branch of Shi'a Islam, while Shafi'is follow one of several Sunni Muslim legal schools."	

Table 2. Selected States in the Middle East and Confrontations with Iran

Saudi Arabia	Saudi Arabia competes with Iran on Islamic ideology, oil supply, the Iraq issue, the Palestine issue, the Lebanon issue, etc. According to Wikileaks, "Saudi Arabian leaders expressed their growing concern over Iran's nuclear ambitions and the threat that it poses to the region. Most strikingly, at an April 2008 meeting, Saudi King Abdullah himself reportedly urged the US to 'cut off the head of the snake' by launching military strikes to destroy Iran's nuclear program."[64] Riyadh is concerned about Iranian influence on Shiite people in the region. "In August 2010, an individual affiliated with Asaiab Ahl Al-Haqq group (affiliated with Iran) was arrested and found with documents and maps of high level security areas."[65] Moreover, "Iran's ballistic and cruise missile forces, the unconventional capabilities of Iranian naval forces, and Iran's relationships with non-state actors like Hezbollah are thought by many experts to pose a credible and dangerous threat in the minds of Saudi security officials."[66]
Kuwait	Kuwait is concerned about Tehran's interference in its Shiite population. "Kuwait has aligned itself with the US in order to protect itself from threats emanating both from Iran itself, and from Iran's growing influence in neighboring Iraq."[67] Indeed, "Kuwait provides basing facilities for both the US Army and Air Force, and is their key supply and staging route to Iraq."[68] "In keeping with Kuwait's overall perceptions and strategy, Iran-Kuwait relations are relatively normal… Kuwaiti refineries supply gasoline to Iran, which must import about 30% of its gasoline needs."[69] "Some believe Iran is looking for opportunities to strengthen Shiites in Kuwait to ensure that Kuwait maintains a relatively friendly posture towards Iran. Others say that Iran has no opportunity to support Shiites in Kuwait as an opposition movement because Kuwaiti Shiites are relatively well integrated into Kuwait's society and economy, and have fewer grievances than do Shiites in other states of the Gulf."[70]
Bahrain	In Bahrain, the Sunni elite has controlled the Shiite majority. Tehran has periodically referred to Bahrain as Iran's 14th province.[71] Thus, Bahrainis are worried about Iranian interference in Bahrain. According to Marissa Allison, "there is considerable evidence of some level of Iranian interference in support of Shi'ite opposition groups, particularly Al-Haq. The Shi'ite popular upbringings are more concerned about domestic political conditions rather than coordinating with Iran…"[72] As of February 22, 2011, anti-government demonstrators demanded the release of political prisoners, resignation of the cabinet, and political reforms for limited monarchy. Some of the Shiite protesters demanded the abolition of the monarchy, but others required the resignation of the prime minister.[73] "As a result of its small size, and lack of economic resources, Bahrain tends to play an accommodating role towards Iran, in order to not incite its aggression… Bahrain is in a particularly vulnerable position and depends on both the US and Saudi Arabia for protection and security support."[74] "Bahrain hosts the headquarters of the US 5th Fleet, and provides the US with port and air basing facilities. Its forces are equipped with US arms and train with US forces."[75]

The United Arab Emirates	"The UAE is a divided state composed of seven emirates, and the two major emirates-Abu Dhabi and Dubai- do not always share the same priorities. Abu Dhabi sees Iran as more of a threat, and focuses more on Iran's occupation of the three islands, Abu Musa and the Tunbs. Dubai sees Iran as a major trading partner."[76] "Dubai has a sizable and powerful Iranian expatriate community, numbering around 400,000. Because Dubai is the trade and financial center of the UAE, this community has significant influence."[77] "Iran and other nuclear proliferation customers and suppliers have used the UAE as a transit, shipping, and financial hub."[78] "The UAE's economic potential and planned growth depends on security and regional stability, and UAE leaders accordingly promote peaceful resolutions to regional disputes…"[79] "From a broader security perspective, the UAE has cooperated extensively with the US… More recently, the Emirates have taken part in deals for major defense systems, indicating that they are also seeking to deter Iran."[80]
Yemen	"Yemen is largely a broken state, and the security situation there has been steadily deteriorating. The lack of development and economic growth has contributed to a number of rebellions, not least the Houthi rebellion in the North, and instability throughout the country has created a safe haven for Al-Qaeda and like-minded Sunni extremists." [81] "While the Yemeni government claims that Iran has been militarily, economically, and politically supporting the Houthi rebels, there is only evidence of Iranian political support. Such support is largely rhetorical and falls in line with Iran's larger program of undermining Arab regimes through populist appeals to the "Arab street."[82]

Figure 1. Iran and Its Neighbors

Source: CRS Report R40849, *Iran: Regional Perspectives and U.S. Policy*, by Casey L. Addis, Coordinator, January 13, 2010, p. 4.

The Correlation Between the Decline in Names with the Suffix "ko(子) " and the Prevalence of Television

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Abstract: **The decrease in the number of names with the conventionally girls suffix "~ko" (such as Kazuko, Akiko, and Yoko.) is strongly influenced by the spread of television. The data shows that those who watch television are influenced by the profusion of images and names disseminated on television. This trend has created various kinds of names and eventually led to a decrease in names with the suffix "ko".**

Key Words: decrease in names with suffix "ko", girl's name by rank, prevalence of television names.

1. Introduction

1-1. Changes in the prevalence of names with the suffix "ko"

Names with the suffix "ko" have existed for over one thousand years and have undergone many changes.

In the Nara period (A.D.710 ~ 794), this suffix was used both for men and women. In the Heian period (A.D.794 ~ 1192), the suffix began to be used in personal names for women born of high rank. After a long period, the Family Registration Law that was enforced during Meiji period enabled common people to use names with the suffix "ko". At this time, these names became popular among new-born girls. As a result, "ko" name made a clean sweep of the top 10 girl's names for several decades, starting in 1921.

However, since1957, ~ko" names started decreasing, and now they are ranked below the top10 most popular girls' names with some exceptions. The reason behind is explained as follows. As information from medium flooded society due to rapid economic growth after World War II, preference over women's name has changed, resulting in greater diversity in naming.

This study shows how the prevalence of televisions, which is the most influential medium in terms of information dispersal, impacted preference toward girls'

1-2. Associated Research

In his degree thesis, Hanrai(潘蕾) discussed how "ko" names came into existence and how they have changed[1]. Katsunori Kanehara explains how the media affects preferences. [2]

2. Research method

Four hypotheses are formulated regarding the effect of television on name preferences.

1. The number of "ko" names has decreased.
2. People consider the phonetic qualities of a name, as well as the image that is associated with a particular name; as a result, proper kanji (Japanese writing using Chinese characters) are chosen that are most suited to people's preferred phonetic qualities and image associations selected in advance.
3. The types of names in circulation have become more diverse since 1957.
4. More and more people choose the name of a celebrity or a public figure when naming a child since 1957.

These changes are the results of the emergence of various kinds of names into circulation that satisfy parents' preference in naming their newborn girls. These

hypotheses thus suggest that the names "~ko" names have become unpopular because such names are considered uniform and boring.

This study clarifies that televisions indirectly dissuades parents from naming newborn girls "ko" names.

Each hypothesis was demonstrated using the following surveys (1) ~ (5).

Survey (1): The top 10 most popular girls' names by rank according to the Meiji Yasuda Life Insurance Company from 1945 to 2010 was used to graphically represent the change in the number of "ko" out of the top ten. The ranking are based on members of the Meiji Yasuda Life Insurance Company (about 10,510,000 families) .[3] This graphical representation (the yellow line in Figure 1) is laid over other graph[4] that shows the rate of the spread of black and white televisions (the pink line in Figure 1) and color televisions (the violet line in Figure 1). This survey is used to prove hypothesis1.

Survey (2): The subjects within the rankings can be divided into three groups according to the number of "ko" names in Figure 1: first, those who were born between 1921 and1956, when "ko" names monopolized the ranking(group 1), ; second, those who were born between 1957 and 1985, when the "ko" names began their decline(group 2), ; and finally, those who are born after 1986, when the "ko" names were almost entirely missing from the ranking, with some exception(group 3). In each group, I counted the number of each kind of name. In addition, the periods are defined in terms of decades (i.e. 1950s, 1960s and so on) in order to count the number of each type of name. This approach is used to prove hypothesis3.

Survey (3): The beginning of a given name makes the largest impression and it is also representative of the general ethos of the name[5]. Therefore, I developed a point-based method to evaluate which types of sounds are preferred by three groups.

The first letter of each name is tallied, with each name earning up to two points. If the name has a consonant sound (i.e., all letters except -A, E, I, O, U, M, N, W, and Y), the name receives two points. In addition, if the name includes N, W, or Y in any position, the name receives one point. Furthermore, if the beginning of the name includes either E or U, the name receives one point.

Survey (4): The top 10 most popular images associated with different names from 2005 to 2009 are available on the Tama-Hiyo website run by the Benesse Corporation[6]. The data were used to investigate which kinds of images are popular with respect to names. These ranking data are based on members of the Benesse Corporation (about 37,340 families). These data are used to prove hypothesis2.

Survey (5): For each group mentioned in survey (2), I investigated whether the name of a celebrity or a public figure is featured in. This approach is used to prove hypothesis4.

3. Results

The result of survey (1) shows that the years in which the number of "ko" names starts to decline coincides with the remarkable spread of black and white televisions. Moreover, around 1985, when color televisions became pervasive, "ko" names were almost entirely excluded from the rankings.

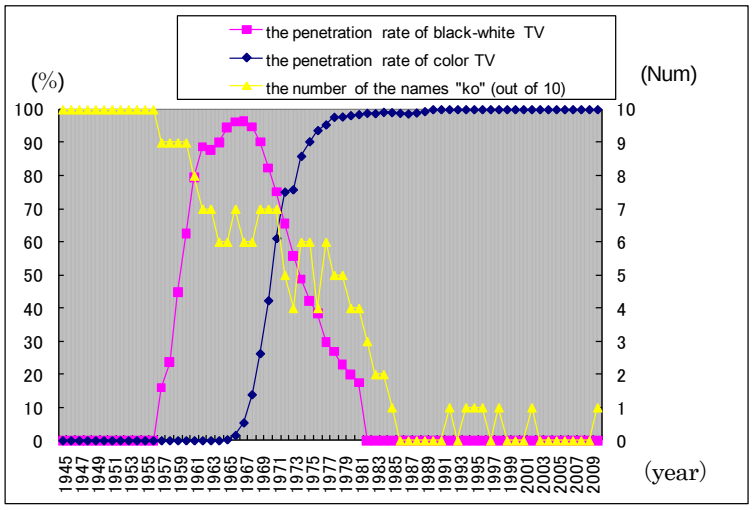

Fig1. The number of "ko" names and the prevalence of television.
Source: Adapted by Yuka Sasagawa from Meiji Yasuda Life Insurance Company, Top 10 (most popular names for newborn girls (2010) [3] and the data on television prevalence per household[4]

Survey (2) returns the results below. The same sounds across different kanji (Japanese writing using Chinese characters), hiragana (a set of symbol used in Japanese writing), and katakana (a set of symbol used in Japanese

writing, used especially to write foreign words or to represent noise) are also counted.

Period	Number	P/N
1921～1956(for 36 years)	44	1.22
1957～1985(for 29 years)	42	1.45
After 1986(for 25 years)	64	2.56

Period	Number
1950s	15
1960s	16
1970s	23
1980s	24
1990s	32
2000s	32

Table1. Total "ko" names in each period .
Source: Adapted by Yuka Sasagawa from Meiji Yasuda Life Insurance Company's, top 10 most popular names for newborn girls (2010). [3)]

Survey (3) results in the findings presented below. Note that the same kanji names with different variations are counted separately. The results from survey (3) show that group 2 and group 3 have more names with vowel sounds.

	group1	group2	group3
A	2	6	16
E	2	3	0
ET	1	0	0
M	4	11	16
N	2	3	5
Y	5	9	7
H	7	1	2
HN	1	0	2
JN	1	1	0
K	6	5	2
KN	0	0	3
KY	3	0	0
R	1	1	1
RN	0	0	3
S	3	1	4
T	3	1	2
TN	0	0	1
TY	3	0	0
SUM	44	42	64
V/S*2	0.44	0.77	0.76

Table2. Counts for letters at the beginning of names and the proportion of the vowel sounds, with V = vowel sound and S = sum.
Source: Adapted by Yuka Sasagawa from Meiji Yasuda Life Insurance Company's top 10 most popular names for newborn girls (2010) [3)]

The result from survey (4) shown below indicate that he first through fourth ranking of the most desirable meanings associated with names did not change from 2005 to 2009.

ranking	The kind of popular image or meaning
1 place	Kindness and consideration
2 place	Love
3 place	Flowers, plants or fruit
4 place	Luck

Table2. The top four popular images associated with different names from 2005 to 2009.
Source: Adapted by Yuka Sasagawa from the top ten popular images of girls' names from the Tama-Hiyo website run by the Benesse Corporation[6)]

Survey (5) resulted in the following findings. I raise some famous person with each name in the top 10 most popular names for newborn girls.

・Michiko(ranked in the top 10 from 1931 to 1982)
Michiko Oe worked as an actress mainly from 1930 to 1939.
Empress Michiko married in 1959 and gave birth to the Crown Prince in 1960.

・Akemi(ranked in the top 10 from 1957 to 1968)
Akemi Negishi appeared as an actress in the movies *"A Stormy Man*" (嵐の男), and " *Rainbows Never Fade Away from My Mind*"(わが胸に虹は消えず). Since 1966, she has made appearances on television dramas.

・Yoko(ranked in the top 10 from 1966 to 1982)
Yoko Tsujiguchi is one of the main character in the novel "*The Freezing Point*" (氷点). The novel was dramatized and broadcasted on television in 1966.

・Emi(ranked first in 1980 came top)
Emi Watanabe was a figure skater from 1972 to 1980.

・Ai (ranked in the top 10 from 1983 to 2002)

Ai Fukuhara became a professional table tennis player at age 10. She has been popular since she made first appearance, when she is four years old.

・Mao(ranked in the top 10 in 2006)
Mao Asada began her career as a figure skater since 2003. She won a silver medal at the Beijing Olympics in 2008.

4. Discussion

The results from survey (1) show that the decrease in "ko" names is correlated with the increased prevalence of television.

The results from survey (2) shows that as the the number of "ko" names decreased, names became more diverse.

Every sound conveys a certain image or connotation when it is pronounced. Our brains are sophisticated processors of the many sounds we receive.[7] Hence, televisions, which disperse various kinds of information on many topics, make our brains more sensitive to sounds. Moreover, it is widely recognized that sounds are translated into images or meanings by our brains. (For example, if we hear the sound effect "WOOOO-HOOOOO", we will realize ghost appears soon and imagine it.) Therefore, as we receive various kinds of sounds including sound effect, the richer the image becomes. realize

In addition, unlike speakers of other language, Japanese people process sound data such as laughter, animal noise, humming, natural sounds, and so on through the left part of their brain and attach meanings to these sounds.[8]

These theories suggest that the many sounds and images covered by television may promote the function of the left brain. Along these lines, the frequent use of vowel sounds in girls' name shown in survey (3) is believed to be closely connected with enhanced activities in the left brain.

The results from survey (4) show that the top four popular images or meanings are conveyed through vowel sounds, which often implies feminine grace, natural beauty and maternal images. This is thought to explain the increase use of vowels in names, as revealed in survey (3).

The results from survey (5) show the effect of celebrity or a public figure names on the top 10 most popular girls' names before 1957. In addition, celebrities or public figures with a "ko" name may explain why these names appeared in the rankings after 1957, during which time "ko" names decreased steadily.

It is often said that n increasing number of people choose the name of a celebrity or a public figure whose name suffix is not "ko" due to the spread of television. This is because people have much more of an opportunity to know the names of celebrities or public figures due to television. However, survey (3) reveals that this opinion is not necessarily supported by data.

Names such as "Momoko" and "Riko", which appeared after 1990, are considered exceptions. Because "ko" names have lost popularity and are now uncommon, some parents may feel that there is something new and unique about "ko" names and thus prefer them. As such, this dynamic provides a possibility for future research.

Note that "ko" names are believed to be considered uniform and borring particularly because the names with four syllables or four letters and above are never seen on the top 10 ranking of newborn girls' names.(for example, the name "Kaoruko", 4 syllable name have never ranked in this top ten ranking)[2] The research presented here reveals that more and more people place an emphasis on images and sounds when they choose the name of a newborn girl. That means that they often choose to use proper kanji or hiragana within 2 or 3 syllables and 2 or 3 letters. The suffix "ko(子)" does not fulfill these preferences and thus has gradually dropped out of circulation.

5. Conclusion

This research clarifies that the prevalence of television exposes us to large amount of information, which has changed our preference toward girls' names, especially with respect to sounds and the image they evoke. As a result, various kinds of names have emerged, while the number of "ko" names has decreased due to the uniformity of these names. Future research should study what kind of impact televisions has on boys' names, how the prevalence of the Internet has influenced girls' names, how the influence of hiragana and Katakana names has affect naming and whether the popularity of the Japanese

Imperial Family is partially related the decline in “ko” names.

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