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Public Interest Immersed in the Field of Information Environment: How has Japanese Interest in Energy and Environmental Problems Varied?

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We studied the relevance of the secular variation of Japanese interest in energy and environmental problems to the information primarily released by the news media. From the investigation of the extent of public interest in three matters, *the global warming, the energy saving* and *nature*, all indicated by opinion surveys, the number of newspaper articles and the frequency of Internet retrieval search, we proposed a model such that the public interest along with the acquired public knowledge were given as a function of public memory of the information primarily provided by the news media. The society was assumed here to be immersed in a virtual field of information environment, which induced the collective interest of the public and was proportional in strength to the extent of the public memory with oblivion. Introducing two types of oblivion function, we found the model to well reproduce the real time-variation of the Japanese interest, except for the case of *nature*, almost irrespective to the form of the function. Some comments were made on the attenuation of the public interest that occurred when the field became weakened.

Keywords: Information environment; field; public interest; news media; oblivion; global warming; energy saving; nature; Japanese; model.

1. Introduction

Our society is now filled with so many sorts of information in each of which only a part of us is interested although there also exist many sorts of it to which we all commonly pay attention. Such information, being integrated with each other, surrounds our circumference to result in the formation of an invisible information

environment. Although it varies with time and place, that environment continuously infiltrates into our circumference, becoming a major factor that tacitly affects the formation of our knowledge and cognition regarding various matters, so that such an information environment can be understood as if it is a sort of field.

Thus, the field in the modern society is an atmospheric environment that is compositely formed from all of the reports by various sorts of the news media, the communication between people in the community or the workplace, the school education and diverse activities in the society. In this case, the public's everydaylife being soaked in such a field extending around themselves, their cognition as a whole is influenced by the field depending on their collective sensitivity to lead to the change of macroscopic opinions together with the extent of public interest in some notable matters.

The field defined in the social sciences is the subjective one which is characteristic to each individual.[1,2] It is internally determined by the interaction between the individual traits such as the memory and sensibility, and the outer context of the individual. The individual recognition, being internally exposed by such a field, becomes to be changed. Our field, on the other hand, is a rather objective one that is determined by an external atmosphere, which reminds us a sort of physical force field such as the electro-magnetic field or the gravitational field.

Various types of opinion dynamics models in the social field[3,4] have been proposed on how individualopinion is changed by the interaction with others under the influence of the news media and other information.[5–10] Many of these approaches are the so-called agent-based model whose focuses are to discuss the microscopic feature of the opinion of individual people.[11–13] The opinion is in general the subjective cognition or the view of value to a certain matter, whereas the concern or the interest in the matter is clearly different from the opinion. There exist a few macroscopic models that treat the socially averaged-collective interest or concern of the public.[14–18] Based on the above concept, we investigate, in this paper, a macroscopic model of time-varying public interest in the energy and environmental problems.

In the next section, paying attention to Japanese energy and environmental problems, the secular variation of the extent of the public interest is shown, which is derived by opinion surveys and Internet searches together with the research of reportorial amount by the newspaper. In Sec. 3, the extent of the public interest is pointed out to closely relate to their memory of the matter. It is also pointed out that the extent of the memory is proportional to the strength of the field of information environment, and that a model considered from these viewpoints possibly explains the secular variation of the interest in those problems. In Sec. 4 conclusions are made.

2. Secular Variation of the Interest in the Energy and Environmental Problems in Japan

2.1. *Public interest indicated by opinion surveys*

Although many opinion surveys have been made regarding the interest in various problems in Japan, there does not necessarily exist so many surveys that study the

secular variation of the same theme. In those surveys we show the time variation of three items of public interest in energy and environmental problems.

Figure 1(a) shows the proportion of the public with age groups and with gender during about 20 years in the past, who selected the first choice (1) in the choices composed of (1) very interested, (2) somewhat interested, (3) not so interested and (4) never interested for the question "are you interested in the global warming problem?".[19,20] The interest of the youth in the global warming has been about a half of the aged during 20 years in the past, and female's interest has always been less than that of male by about 10%. With the increase of age, the extent of the interest generally grows high, though the interest for the same age group has not necessarily increased with time.

Figure 1(b) shows the proportion of the public who selected the choice (1) (very interested) for the questionnaire as "by what extent are you interested in the energy saving?",[21] whereas Fig. 1(c) is the same proportion as Fig. 1(b) but for the questionnaire as "by what extent are you interested in nature?".[22] The extent of the public interest given in these figures never shows a simple behavior with time, clearly indicating the participation of some other external variables in these responses.

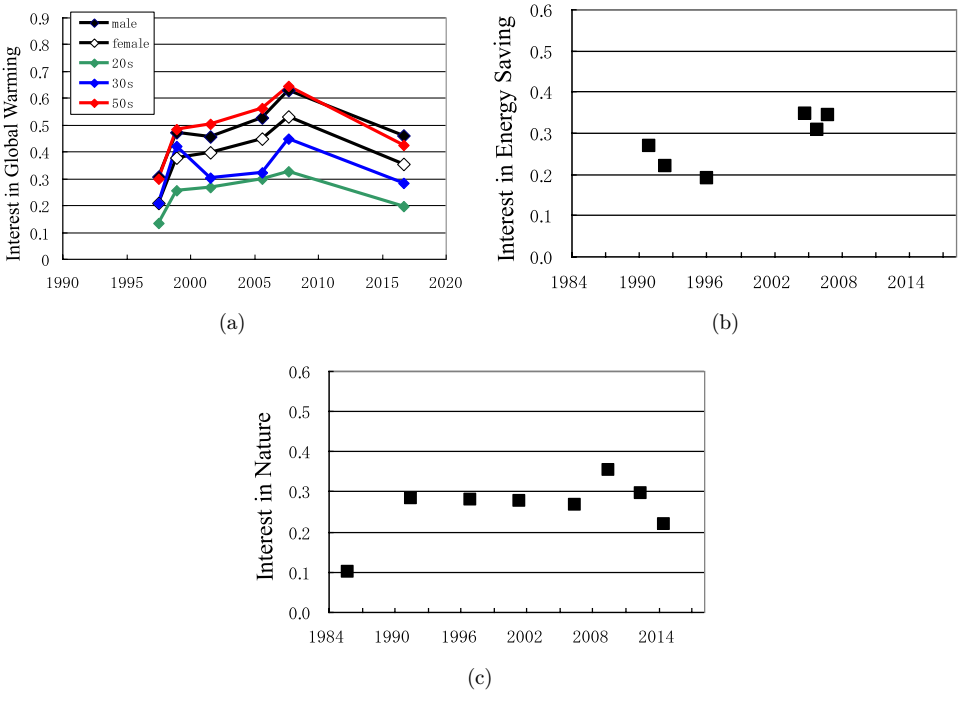


Fig. 1. Time-variation of the proportion of Japanese who are very interested in (a) the global warming, (b) the energy saving and (c) nature. Lines drawn in (a) are just for the guide to eyes. Only the average values for the respondents are shown in (b) and (c).

2.2. *News media's interest: Its reportorial amount*

The information environment that possibly influences on the public interest is just an abstract concept so that we hardly clarify the situation at this point with what physical quantity the environment can be expressed. Such an environment, however, is to be understood as a sum total unifying the quality and quantity of the atmosphere brewed by the media, the school education, the public interaction with surrounding people, along with the social environment of culture and history of their own. Under such a situation the environment around us can be considered as composed of two types of information as (i) the news and reports permeating into a wide range of area provided by the news media and publicity; and (ii) the local information prevailed only in a limited community or a limited place of working or school, or formed by some interaction on the networks as SNS. In this case, the component (ii) is just a local environment formed as a result of mutual interaction between people which takes place following the primary information given by the component (i), so that the (i) is considered to be an essentially important factor for the formation of social atmosphere. We therefore consider only the component (i) as a leading and primary source of information in the society, treating the (ii) as a secondary one, for simplicity.

Several newspapers with a national circulation are taken into account as the representative media that forms the component (i). We conveniently take the number of articles regarding energy and environmental problems reported in those newspapers during a unit time span as a quantity for the reportorial amount by the news media. The proportion of Japanese who select TV as a primary information source is about 88% for the case of energy environmental problems, whereas the newspaper and the magazine is selected by about 60% for the information acquisition, the school education by 44%, SNS by 27% and so on.[20] The reason for using only the reportorial amount by the newspaper as our statistical quantity is just the difficulty for grasping the time variation of the amount released by TV and the other means. Hence in the following we investigate to what extent time-varying public interest can be explained by using the statistical quantity only of the newspaper. Namely in this paper the amount of information $F(t)$ released in the society anew at time t is given by

$$F(t) = F_{(\mathrm{i})}(t) + F_{(\mathrm{ii})}(t) \approx C_1 F_{(\mathrm{i})}(t) \approx C_2 F_{\mathrm{NP}}(t), \tag{1}$$

where C_1 and C_2 are constants, the suffixes (i), (ii) and NP indicate the quantities for the components (i) and (ii) and the newspaper, respectively.

Both of the morning and the evening issues of three major newspapers (the Asahi, the Mainichi and the Yomiuri, whose total occupation in Japan being about 80%) prevailing whole of Japan were adopted for the sources from which retrieved was the number of articles on energy and environmental problems with every month by using appropriate keywords (although we investigated the case of the quantity with every 1/3 month, the essential results do not change as the ones with every one month).

Figure 2(a) shows the secular variation of the number of articles per month averaged over the three newspapers regarding the global environment with the keywords ("*global warming*" ∪ "*midsummer day*"). (Researches with keywords in what follows were made in Japanese). The quantity corresponding to the global warming extremely oscillated with time, making sub-peaks at around 1997, 2001, 2005 and 2007–2009. These sub-peaks correspond to United Nations Climate Change Treaty and IPCC Conferences and their related articles, whereas a broad peak appeared in 2007 to the scrum of nuclear power reactors due to Chuetsu-oki earthquake and the recovery of the risky view of global warming which seems to relate to the reactor

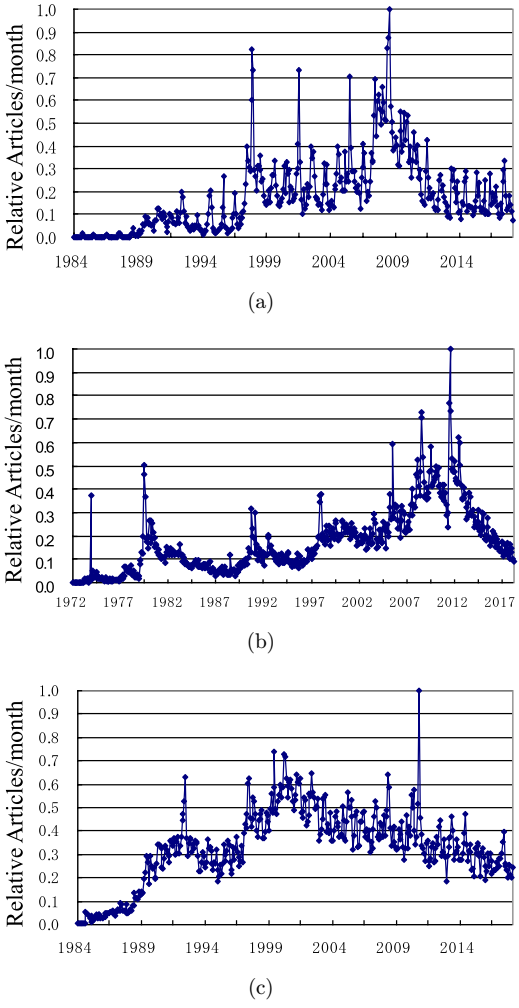


Fig. 2. Secular variation of the number of articles appeared in Japanese newspapers on (a) the global warming, (b) the energy saving and (c) nature. The maximum values of the variable are 349.6, 228.3 and 390.0 articles/month for the cases (a), (b) and (c), respectively, which are all normalized to 1.0 in these figures.

shutdown. The midsummer day was included in the keywords because the high temperature in summer successively continued in recent years which reminds Japanese of the progress of global warming.

Figure 2(b) shows the time variation of the articles with the keyword "*energy saving*". The articles before 1972 are quite scarce, indicating the non-existence of that concept itself in those days. After the year 1972 there exist sub-peaks at around 1979–1980 (energy crisis), ∼1990 (enhancement of the awareness of energy saving due to the Middle East crisis), ∼2000 (enhancement of the global warming problems), ∼2005 (light clothing movement in summer), ∼2009 (beginning of eco-point system) and ∼2011 (enhancement of electricity saving movement).

Figure 2(c) shows the secular variation of the articles regarding nature whose keyword's are ("*nature protection*" ∪ "*natural environment*" ∪ "*environmental protection*" ∪ "*biodiversity*" ∪ "*nature destruction*" ∪ "*endangered species*"). There appeared broad peaks of the articles at around ∼1992 and 2000–2001, but the number of the articles gradually decreases with time after 2002. Such time-varying distributions of the number of articles are considered not to correspond necessarily to the strength of the field of information environment itself.

2.3. *Public interest derived from the Internet retrieval search*

The topics prevailing on the widely spreading SNS (such as twitters, blogs or facebooks) at present are apt to be popular matters following the fashion at that instant, so that it is pointed out that many people just pay attention to those popular matters as momentary followers.[23–26] If this really is the case also for the global warming, the energy saving and nature, the extent of the public interest in those matters can be judged from the number of instantaneous Internet retrieval search on those matters. In this case we expect the time-behavioral trend of the Internet search quite similar to that of the reportorial number by the news media at that instant because the news is the primary source that excites the public straightaway. To see the appropriateness of this hypothesis, we show the secular variation of the number of Internet search per one month that was carried out with the keywords (a) "*global warming*", (b) "*energy saving*" and (c) "*nature*", in Figs. 3(a)–3(c), respectively,[27] together with the number of articles by the newspaper for comparison.

So far as the range of time ($t > 2004$) when the Google Insight is available, the public interest in "*global warming*" seems approximately to follow the reportorial trend of the newspaper that changes from time to time. Although such a tendency roughly holds also for "*nature*", its public interest shows a cyclic time-behavior superposed on that tendency where it increases in summer and decreases in winter. The increase of the search in summer may be due to the search for the nature-oriented leisure and sightseeing in this season. For the case of "*energy saving*"; however, the time-behavior of the search does not show any similarity to those two cases. Namely although its time-behavior barely resembles to that of the newspaper before around 2011 and after around 2015, the frequency of the search relatively

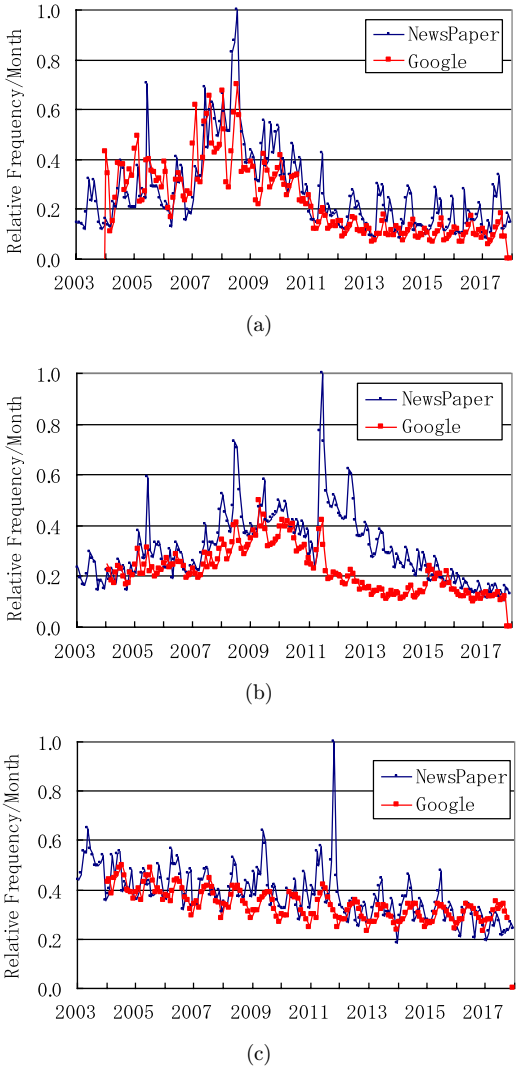


Fig. 3. Frequency distribution of Internet retrieval search using Google Insights (given by red lines) for (a) the global warming, (b) the energy saving and (c) nature. The maximum frequency of each search after the year 2004 is conveniently normalized to 0.5 for the comparison to the newspaper values (given by black lines).

decreased in 2011–2015 by about a half a value expected from the frequency on both sides, indicating that the public weakened their interest in this matter and changed it to some other matters during this period. The electricity crisis caused by the nuclear accident had occurred and the awareness of energy saving had been raised after March 2011 over the whole country in Japan. After 2015 the power liberalization had been pushed by the Government and, associated with its energy policy, the raising of

the awareness along with the movement for the energy saving had been brought. The Internet search seems to have some relation to those social conditions.

In the case of a matter which is not a great urgency and scarcely becomes a talk of communities such as the problem of health care, the secular variation of the Internet search behaves like the variation of the reportorial number of the newspaper.[28] Such a resemblance; however, does not necessarily hold for any matter. For the risky matter that threaten the every day safety for oneself, one's family or for one's society such as the terrorism, it attracts public attention during a long time after its occurrence so that the number of search only gradually decreases with time even if the matter occurs for just a small and limited time duration. In this case the information environment is imagined to hold or to expand via the above cited secondary component of information source (ii) to result in the maintenance of the public interest. On the other hand, when the report on the same subject monotonously continues; for instance on the energy saving, for a long time, the public interest will shift to the other topics such as the case of general fashion phenomenon so that its number of search decreases despite of the amount of information provided by the news media.[28–30] The depressed phenomenon seen in 2011–2014 in Fig. 3(b) probably corresponds to this case.

Then does the information in the past not influence on the present interest at all? If it does, to what extent does the collective memory of the information accumulated in a society influence on the extent of public interest at present? When the public is immersed in an information environment of one color for a long time, the public interest and even the everyday habit for a certain matter will be changed and their view of value for the matter is strengthened toward the color. Hence the memory of information in the public interior seems to play an essential role for forming the public interest at present. A model which takes such things into account will be investigated in the next section.

3. A Model of Public Interest that Changes with Time

3.1. *Memory of information*

The topics adopted on the widely diffused SNS are apt to be fleeting matters prevailing at the point in time in the society so that many users only temporarily follow such a fashion. If this really is the case, the public interest appeared on SNS roughly follows the popular information provided by the news media at that time, and hence it is scarcely influenced by the memory in the past. On the other hand, the response to the questionnaires as "do you know the matter A" or "how are you interested in A" considerably depends on the amount of the memory or the knowledge on that matter the respondent has, that is; the extent by what amount he/she has the knowledge about A, by what amount he/she acquired the information on A in the past and how strong he/she memorizes the information. The respondent usually makes a reaction according to his/her memory on A.

When compared to the fading-away of that type of memory with time, once definitely acquired knowledge and the resultant habit that has become part of one's nature hardly disappears after that, though they may be forced to allow gradual oblivion without any stimulation from their environment. Thus the difference in the public's response to the information environment is depicted as given in Table 1 depending on the rapidity of oblivion of the memory.

In the opinion dynamics hitherto we have introduced a continuous variable X_ξ within [0, 1] for a certain person ξ to express the extent of his/her interest in a matter ω (energy and environmental problem in our case), where $X_\xi = 0$ and 1, respectively which correspond to the states "not interested in ω at all" and "very interested in ω". In many opinion surveys that put questions for the extent of interest in a certain matter, their choices are usually something like (a) very interested, (b) somewhat interested, (c) not so interested and (d) not interested at all, which we referred to in what follows. Since in this paper we pay attention to the collective interest of the public, we treat a quantity $X \in [0, 1]$ which is an average value of X_ξ with respect to ξ and derive the time-behavior of $X(t)$ by introducing the collective memory which corresponds to an average memory of information in the past accumulated in the population.

The way that the public reacts to the information released anew on a given matter at a given time may depend on the extent by which the public has the memory of that information in the past. Namely even if cognition is changed and an action is induced in the public due to the stimulation from a new information, the extent of the cognitive change must be owed to the memory on that matter, and the action must be determined based on the memory together with the information provided at that time. Hence the independent variable of our case is

$$\Psi_\omega(t) = \int_\tau^t I_\omega(t')\Omega(t:t')dt', \tag{2}$$

where $I_\omega(t')dt'$ is the amount of information released during $[t', t' + dt']$, τ is an initial time, and $\Omega(t{:}t')$ is the oblivion function representing a proportion of the memory survived even at a time t $(\geq t')$, whose information was released at a time t'. Although the memory in this case corresponds to the long-term one, we are not sure at present how it decreases with time. According to some indirect indications; however, inconsistency does not appear when a power-law type[31–35] or an exponential type[36] functions with respect to time are taken for the form of the oblivion

Table 1. Spectrum for the various phenomena relating to memory.

Rapidity of oblivion	Slow——————————→ Fast		
Phenomenon	Acquired knowledge Acquired habit	General knowledge General interest	Following fashion Follower's reaction on SNS

function. Hence we adopt the following formulae for $\Omega(t{:}t')$:

$$\Omega(t:t') = g\left(\frac{t_0}{t_0 + t - t'}\right)^k + (1-g), \tag{3}$$

$$\Omega(t:t') = g \cdot \exp\left\{-\frac{(t-t')}{t_0}\right\} + (1-g), \tag{4}$$

where g is the proportion of the memory forgot when $t \to \infty$ and hence $(1-g)$ the proportion survived forever, and k and t_0 are constant parameters.

The amount of knowledge acquired from the environment is expected to grow large and the extent of interest is also expected to become strong with the duration for the public tolive in the information environment because of the accumulation of memory in the public. In reality in the opinion survey to ask the extent of interest in the global warming, the interest grows strong as the age of the subject becomes high, namely as the duration of living in the information environment on that matter becomes long, as seen in Fig. 1(a).

3.2. *model for the change of public interest*

When the public live in the field of information environment, its atmosphere acts on the feeling, the mentality and the cognition of the public, influencing on the formation and growth of public interest. In such a case, the state of the feeling or the cognition held in the public finally becomes to equilibrate to the surrounding atmosphere, that is, the field of information environment, after the elapse of a sufficiently long time for sensing information. Hence under the equilibrium condition between the public feeling and the atmosphere, the strength of the field of information environment at time t, $Y_\omega(t)$, becomes proportional to the public memory as in Eq. (2). Thus

$$Y_\omega(t) \propto \Psi_\omega(t). \tag{5}$$

The strength of the field varies with the parameters k and t_0 whose values become different with the trait of the public. Figure 4 shows a conceptual diagram of this model.

The public interest in energy and environmental problem is unilateral, i.e., they have an interest in it or not. In such a case, the public interest increases when the field becomes strong, but it decreases when the field becomes weak. Hence the proportion of the public $X(t)$, who answer the questionnaire as "very interested", varies according to the following equation as its time variation follows the variation of the field.

$$\frac{1}{C}\frac{dX}{dt} = \frac{1}{C'}\left\{(1-X)\frac{dY(t)}{dt}\right|^+ + X\frac{dY(t)}{dt}\Big|^-\Big\} \equiv (1-X)\Phi(t)^+ + X\Phi(t)^-, \tag{6}$$

where C and C' are constants, $\Phi(t)^+ \equiv d\Psi/dt|^+$ and $\Phi(t)^- \equiv d\Psi/dt|^-$ mean the terms which take the values only when dY/dt becomes positive and negative values,

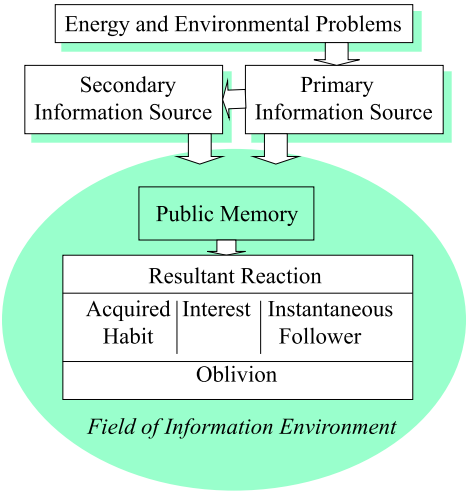


Fig. 4. Conceptual diagram for the field of information environment.

respectively, otherwise they set null. The suffix ω was omitted for clarity. We have a solution of the above equation as:

$$X(t) = C\exp\left\{-\int_{\tau}^{t} C(\Phi(t')^{+} - \Phi(t')^{-})dt'\right\} \times \left[\int_{\tau}^{t} \Phi(t')^{+}\exp\left\{\int_{\tau}^{t'} C(\Phi(t'')^{+} - \Phi(t'')^{-})dt''\right\}dt' + X(\tau)/C\right] \quad (7)$$

where τ and $X(\tau)$ are respectively an initial time and an initial value. In what follows initial values are taken null for the cases of the global warming and the energy saving, and set 0.1 in January 1984 for nature.

In the next section we investigate whether this model can reproduce the real behavior of the public interest.

3.3. *Model calculation and results*

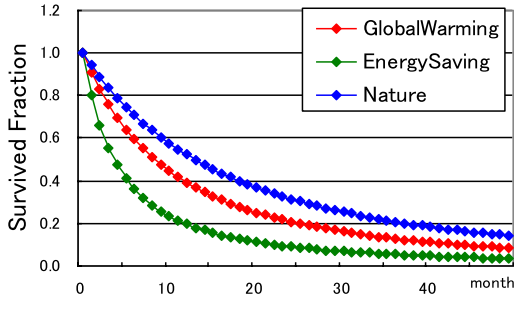
In what follows we set $g = 1.0$ in Eqs. (3) and (4) because the calculation with $g \neq 1.0$ does not fit well in general to observation as compared with the case $g = 1.0$. We determine the values of parameters t_0, k and C so as to fit best for the Eq. (7), where the amount of information shown in Fig. 2 is substituted for the $I(t)$, to the observation in Fig. 1. The fitting is discriminated whether the following χ^2 becomes minimum

$$\chi^2 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{X^i_{\text{cal}} - X^i_{\text{obs}}}{X^i_{\text{obs}}}\right)^2, \quad (8)$$

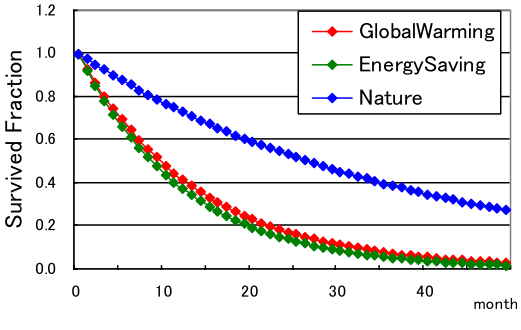
where suffixes caland obs, respectively indicate the values of calculation and observation, and N is the number of the observation, that is the opinion survey, in the

past. The values k and t_0 thus determined give the form of oblivion function, by which the secular variation of the field of information environment can be studied. Figure 5 shows the time-behavior of the oblivion, and the values of their parameters and a constant C are given in Table 2. When we assume the form of the function as a power-law type, the public memory and hence the strength of the field decreases as the $-1.5 \sim -2.5$ powers of time.

Calculations are shown in Figs. 6(a)–6(c) superimposed on the observation of the public interests. The fitting of the calculation is almost satisfactory for the two cases of the global warming and the energy saving, and this indicates that the public interest in those matters are surely influenced by the memory of the information in the past, namely the field of information environment. On the other hand in the case of nature, the fitting of the calculation to the observation cannot be good before $\sim$2000. This may be due to a broad range of nature that the public conceive in answering the questionnaire, including not only nature relating to the environmental problem, but also nature for leisure and sightseeing, industry, national parks and so on. W should note that the calculation by Eq. (7) only corresponds to the environmental problems.



(a)

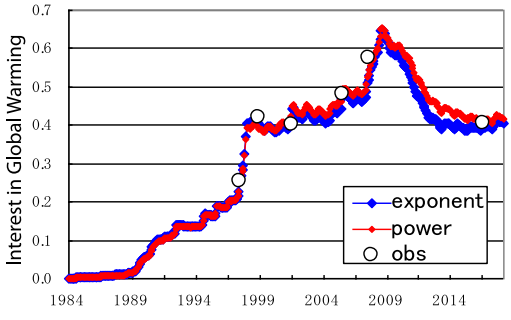


(b)

Fig. 5. Survival fraction of memory calculated by using the oblivion functions of (a) the power-law type and (b) the exponential type.

Table 2. Values of parameters for the two types of oblivion function.

	Power-law type			Exponential type	
Subject	k	t_0	C	t_0	C
(a) Global warming	2.01	20.3	2.86e4	13.6	2.95e4
(b) Energy saving	1.55	6.46	3.55e4	12.1	2.73e4
(c) Nature	2.36	38.0	3.46e5	37.8	2.64e5



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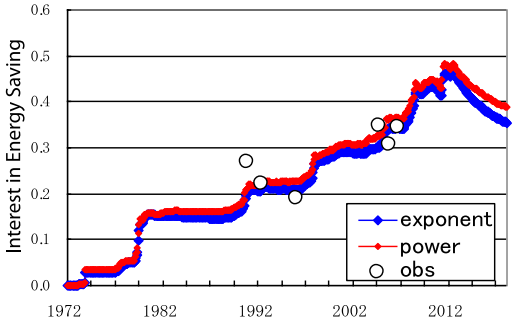

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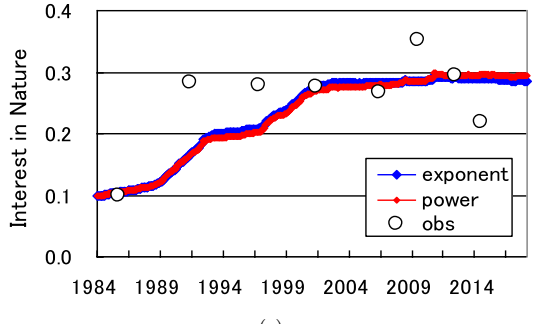

(c)

Fig. 6. Comparison of calculation with the observed public interest in (a) the global warming, (b) the energy saving and (c) nature. The averaged interest between male and female is used for the observation in (a).

Figure 7 shows the secular variation of the public memories, which are just proportional to the strength of the field of information environment, regarding the three matters. All of these (a), (b) and (c) have a common tendency to decrease with time after $\sim$2000, indicating the weakening of the public interest in energy and environmental problems in that period, which seems to continue even now. The actual circumstance[37] that the public understanding on the global warming has scarcely been improved in spite of the elapse of a long time of about 17 years is probably due to the continuation of the status quo or the decrease of the strength of the field.

3.4. *Implication for glass-roots movements*

In the case of a strong field lasting during a long time, for instance for the energy saving, it possibly influence not only on the public interest but also on the habitual action for the energy saving. Once the actions for the energy saving, such as turning-off lights in an unnecessary case, relaxing the temperature of refrigerators, and weakening the condition for room temperature, are accepted and well-established as the custom in the public's everyday life, those habits are hardly lost because of the

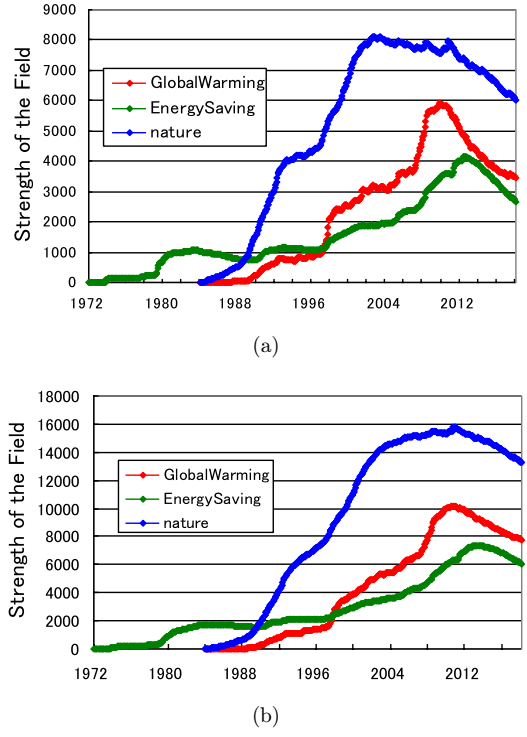

Fig. 7. Time-varying strength of the field of information environment for the cases of oblivion functions of (a) the power-law type and (b) the exponential type.

economical saving to which those actions lead and of the social ethics that endorses the energy saving as the good action.

The public cognition for the energy saving in Japan became rapidly to rise at around 2011, and its reasonable view has been distributed broadly in the society. This is owed to the fact that the news media such as the newspaper and TV together with various sorts of public relations had simultaneously reported the risk caused by energy shortage and the necessity of energy saving at the occurrence of energy risk in the first half of 2011. Such solicitation against energy crisis and the enthusiasm for turning energy to the natural one; however, have been a passing phenomenon at that time. After the period of the enthusiasm, a part of the public has gradually lost their concern about the risk and retuned to the former life style where they have never been aware of it. According to an article of a newspaper.[38] The proportion of the public is 13% who say "do no longer any actions for energy saving" in the middle of 2017. If this really is the case, setting 100% for the public who took some action for the energy saving in 2011–2013, the proportion had decreased to about 87% in June 2017. Although the ratio of the value in Fig. 7(b) in 2017 relative to that in 2011–2013 indicates the decrease of about 30% which is rather larger than the above 13%, the decreasing tendency of the public proportion is consistent to each other in this period. Such estrangement from the actions for energy saving indicates the necessity for holding the field of information environment sufficiently high so as to compensate the decrease of the public concern. Then in order to hold the intensity of the field after 2011–2013, by what amount of information had been required anew?

To sustain the X in Eq. (6) to be constant, it is required that $\Phi^- = \Phi^+ = 0$. Since by their definition $\Phi^+ = 0$ (or $\Phi^- = 0$) when $\Phi^- \neq 0$ (or $\Phi^+ \neq 0$). Hence in the case $\Phi^+ = 0$, the condition for $X = const$ is $\Phi^- = 0$, namely

$$\frac{d}{dt}\int_0^t I(t') \cdot \Omega(t : t')dt' = 0, \tag{9}$$

and hence the quantity $I(t)$ is required to be

$$I(t) = -\int_0^t I(t') \cdot \frac{d\Omega(t : t')}{dt}dt'. \tag{10}$$

We had been required, therefore, to release the information by the amount given by (the absolute value of) Eq. (10), according to which the information released after 2011–2013 had to be continuously increased to the present by $\sim$10 and $\sim$20 articles/month, respectively, for the cases of oblivion functions (3) and (4), to hold the field nearly constant. When we consider, for instance, the grass-roots movement of the public or the weak organization who can only take measures as some types of public relations in a local region, that amount of information to continuously supply seems uneasy to realize so that the prevention of the public interest to attenuate with time, even for the limited number of public dwelling in the local region, seems difficult.

In order for the public relations by the local organization to promote the public action for a certain matter, for instance, the energy saving to be effective, the utilization of the field of information environment already formed by the other media may be a feasible way. In this case the strength of the field close to which they pay attention must be carefully checked whether it is close to a critical point, that is, the so-called tipping point.[39] If it is the case, since the energy saving is recognized by the public as an important social issue, the public easily notice those activities of public relations. This makes them easy to persuade the public, leading more and more the public notices to their movements, resulting in an excessive effect over Eq. (10) even in the local region.

This seems also to be the case of SNS used as a measure of promotion, where the information once released by the local media rapidly diffuses into the network to result in a strong atmosphere for the energy saving.[40] Such a phenomenon seems to be the effect of the small-world network which is probably formed in the local community with non-uniform interaction between community members. In the small-world network, it is pointed out that the quite efficient result for transferring information in the society under a certain soat of chance.[41] Indicating the importance of the timing for releasing publicities and for beginning the activity to induce the change of public actions.

4. Conclusion

A large part of opinion dynamics hitherto has targeted to the cognitive change of individuals, so that there exist few models to estimate the collective change of feeling or interest of the whole public in the society. In this paper we introduced the field of information environment to intend the treatment of macroscopic change of the public interest in some matters in Japan, and construct a model to express its time-variation.

The field defined in the social sciences[1,2] is a quite psychological one in its character. The field in this paper is corresponding to the atmosphere of the information environment that is caused primarily by the information from the news media. Such a collective field of atmosphere is substantiated by the memory of the information in the past, so that the public interest in energy and environmental problems is changed with the extent of oblivion. It was found that such a model can generally reproduce well the secular variation of the public interest in those problems with scarcely depending on the form of oblivion function. The time scale indicated by the fitting parameter t_0 for forgetting the memory; however, is dependent on the form of that function together with the matters in which the public are interested, ranging from $0.5 \sim 3.0$ years. When a power-law type is adopted for the oblivion function, the power was found to be $-1.5 \sim -2.5$. To sustain the public interest, new information is required that compensates such oblivion. For the local people who intend the public enlightenment for a certain matter, they are required to choose the best timing for releasing their message so as to resonate with the subject that widely prevails at that time.

Although in this paper the public interest only for the Japanese was studied, the method and the model that treat the public reaction are not restricted only to the Japanese society but universal for all societies in the world. It is interesting to apply the methodology to other societies with different culture and different information environment and to compare the results from the view point of social psychology.

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