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EFFECTIVE TEMPERATURE HYPOTHESIS AND LUKEWARM FEELING IN JAPANESE FIRMS

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ABSTRACT

In Japanese firms, the word "nurumayu" is used on the analogy of a lukewarm bath, and this word expresses lukewarm atmosphere in which employees easily accept the present situation and spend an easygoing time. Lukewarm feeling is a notorious facet of organizational climate in Japanese firms. It is the central hypothesis of this paper that the most useful concept for the analysis of lukewarm feeling is embodied in the definition of the effective temperature as the difference between the system temperature and the body temperature, which are constructs respectively defined as the indexes of propensity to change of the organizational system and the members. The effective temperature hypothesis explains that each member's sense of "nurumayu" is caused by the low effective temperature. Our hypothesis is supported by the data from 10536 white-collar workers in 385 organizational units of 46 Japanese major companies; there is a very strong linear relationship (R^2 = 0.9886) between the lukewarm feeling ratio and the effective temperature.

Keywords: Corporate culture, organizational climate, Japanese, lukewarm feeling, effective temperature hypothesis, propensity to change.

Introduction

This paper is focused on "nurumayu" (in Japanese) feeling in Japanese firms, which is supposed to be caused by not preferable organizational conditions, probably by diseased conditions of the firms. The word "nurumayu" is used on the analogy of a lukewarm bath. Average Japanese enjoy a hot bath, and a lukewarm bath is not hot enough and is at lower temperature than desired. Intuitively it would appear that the meaning typically accorded the term lukewarm comes very close to what we mean by "nurumayu."

In the Japanese firms, this word expresses lukewarm atmosphere in the organization and is usually used in the case that the members easily accept the present situation and spend an easygoing time. They have grown dangerously complacent about maintaining status quo and this lukewarm atmosphere prevents actions that challenge the status quo. In common parlance, employees in Japanese firms refer to a "nurumayu" constitution with reference to their work situation in which they face with a difficult problem of building up an active and vigorous constitution. This problem is treated as the problem of *organizational activation* in the field of the Japanese style organization development (Takahashi, 1992; Kawai, 1992) and is treated as *organized anarchy* of decision processes (Takahashi, 1997a).

Even for researchers who are Japanese speaking, it is difficult to define the concept "nurumayu" in Japanese adequately. Then we study the conditions to cause lukewarm feeling

among the employees in Japanese firms. And then we consider the relationship between such a feeling and the activated state of the organization.

In order to characterize Japanese "nurumayu" phenomena, we preliminarily use the data from the first survey of eleven Japanese companies in 1987 (see the next section for details). We investigated the lukewarm ("nurumayu") feeling in Japanese firms by using the following key question on phenomena:

QUESTION 1. Do you feel that the atmosphere at your working place is lukewarm ("nurumayu")?: 1=yes, 0=no.

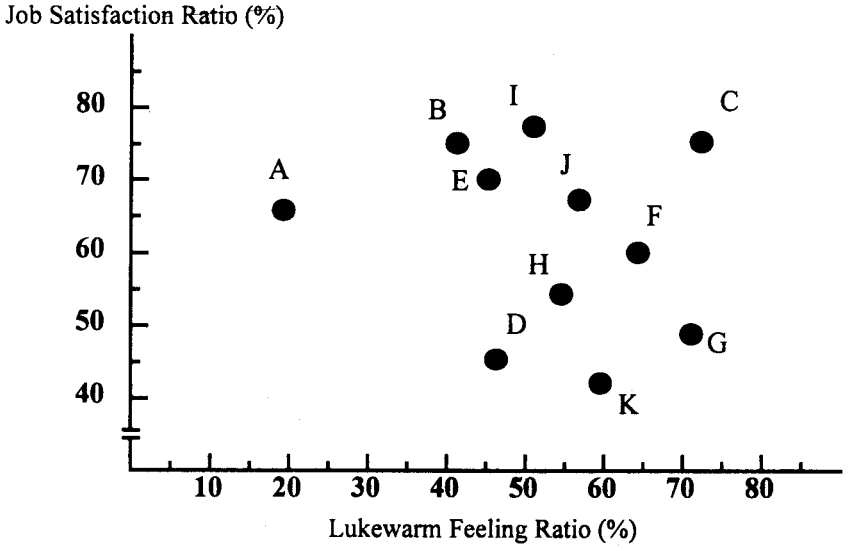
55.4% of the total respondents answered "yes", and 44.6% answered "no". The ratio of "yes" to total respondents in Question 1 is called the *lukewarm feeling ratio*. Pearson's correlation coefficients between Question 1 and the other questions on phenomena are relatively high, but those between Question 1 and job attitudes questions are generally low.

The terms job attitudes and job satisfaction may be typically used interchangeably, and positive attitudes toward the job are conceptually equivalent to job satisfaction (Vroom, 1964, p.99). There are several standard measures for job satisfaction, e.g., JDI (Job Descriptive Index) and MSQ (Minnesota Satisfaction Questionnaire), and there is not universal agreement on one scale. Even though the literature is huge, in order only to illustrate the relationship between lukewarm feeling and job satisfaction, we simply use the following question on job attitudes:

QUESTION 2. Are you satisfied with your job?: 1=yes, 0=no.

62.0% of the total respondents answered "yes", and 38.0% answered "no". The ratio of "yes" to total respondents in Question 2 is called the *job satisfaction ratio*. By using these two ratios, eleven companies are plotted on the scatter diagram and thus Figure 1 is obtained. This figure suggests that the lukewarm feeling ratio is uncorrelated with the job satisfaction ratio. Pearson's correlation coefficient between Questions 1 and 2 is -0.140.

FIGURE 1. Scatter Diagram of Eleven Companies.



Lukewarm feeling is a notorious facet of organizational climate in Japanese firms. Hellriegel & Slocum (1974) summarized the relationships between climate measures and job satisfaction. Many studies clearly indicate that organizational climate is related to job satisfaction (Litwin & Stringer, 1968; Pitchard & Karasick, 1973; Lyon & Ivancevich, 1974; LaFollette & Sims, 1975). But the climate-satisfaction linkage is an important problem. Johannesson (1973) raised the question as to whether organizational climate is redundant with job satisfaction. Guion (1973) similarly formed the following conclusion: Perceived organizational climate may simply be a different name for job satisfaction. Johannesson (1973) concluded that alternative designs might include assessing whether or not climate measures behave as do satisfaction measures. Figure 1 shows that our lukewarm feeling ratio seems the promising candidate of climate measure.

These findings also suggest that the lukewarm feeling and the job satisfaction coexist together. Especially, as shown in Figure 1, Company C has the highest lukewarm feeling ratio and the third highest job satisfaction ratio. A further analysis, not shown in this paper, indicates the existence of many organizational units with high lukewarm feeling ratios and high job satisfaction ratios. Therefore, it is not reasonable that a lukewarm feeling is a typical signal of non-activated state of the organization. We need a new framework to determine the relationship between the lukewarm phenomena and the activated state of the organization.

In the next section, as a result of this survey, we propose the effective temperature hypothesis, which explains that each member's sense of "nurumayu" is caused by the low effective temperature. The effective temperature is defined as the difference between the system temperature and the body temperature, which are respectively defined as the indexes of propensity to change of the organizational system and the members. It is the central hypothesis of this paper that the most useful concept for the analysis of lukewarm feeling is embodied in the definition of the effective temperature. The propensity to change is a construct analogous to gravity as used in physical science. The hypothesis we follow is that the lukewarm phenomena concerned are usefully explained if we adopt it.

We develop a method to measure the body temperature and the system temperature, and by using this method, the effective temperature hypothesis is supported by our empirical research on Japanese firms. In 1988, we made the second survey. The data from 626 middle managers of eight Japanese companies verify the effective temperature hypothesis again.

In 1989 to 1990, we made the third survey of 564 white-collar workers of two Japanese manufacturing companies and the fourth survey of 853 white-collar workers of nine Japanese companies, respectively. And then we refined the questionnaire and succeeded in developing an effective temperature "thermometer," which can be used to forecast the lukewarm feeling ratio. This thermometer is supported by eleven surveys' data from 10536 white-collar workers in 385 organizational units of 46 Japanese major companies from 1990 to 2000. These eleven surveys' data indicate a very strong linear relationship (R^2=0.9886) between the lukewarm feeling ratio and the effective temperature measured by the refined thermometer.

From these studies, we conclude that our effective temperature hypothesis provides a useful method to examine the states of the organizations and also explains the boiled frog phenomenon (Tichy & Devanna, 1986) in the organizations.

Effective Temperature Hypothesis

Method

As mentioned above, we made the first survey in 1987. First, we selected eleven Japanese companies who were all members of Japan Productivity Center (JPC) in the industries: petroleum products (Company A), pharmacy (Company B), railways (Company C), retail trade (Companies

D and E), electric service (Company F), electric machinery (Company G), electronic machinery (Companies H and K), communication (Company I), and hotels (Company J). The member companies of Japan Productivity Center are the biggest and representative firms of Japan. Most of them are listed on the First Section of Tokyo Securities Exchange and satisfy the high-level initial listing requirement.

The study was conducted in two phases. Phase 1 began in April, 1987 and was completed by August. In this phase, group interviews were conducted. The respondent of each company was interviewed for approximately two hours to express its corporate and organizational culture. The objectives of Phase 1 were to develop the original questionnaire. We prepared an exhaustive list of frank statements of the job attitudes and the phenomena of non-activated state of the organization. Finally, we carefully revised all the items and prepared the selected list of disjunctive yes-no questions: 25 questions on job attitudes and 25 questions on phenomena. The original questionnaire was written in Japanese.

Phase 2 involved a sampling survey. The objectives of this phase were to obtain fact findings of a "nurumayu" constitution. We initially selected for each company one or more organizational units of white-collar workers in its corporate division. Then we investigated all the employees of the selected 39 organizational units. The research was carried out from August 26 to September 7, 1987 through the delivery-collection and self-recording method. We obtained 580 respondents' data from the questionnaires (response rate was 84.1%). 70.8% were men, 22.6% were managers, and average age was 35.0 years.

System Temperature

Let us trace the origin of "nurumayu." A "nurumayu" feeling is usually explained by the analogy of a lukewarm bath in Japan. How can we take the temperature of the working place? We received a useful hint for taking the temperature from the dictionaries. The best dictionary to consult for determining the origin of Japanese words is the *Kojien* from Iwanami. If you open this dictionary, you will find the word "nurumayu" signified "hot water at a lower temperature or lukewarm water." Furthermore, you will find the prevalent phrase "soak oneself in 'nurumayu' " is used by the Japanese in a sense that "accept the present situation and spend an easygoing time."

Now, we define a *propensity to change* as the propensity not to accept the present situation and not to spend an easygoing time and to challenge the status quo. Deci (1975) has asserted that people engage in many behaviors in order to feel a sense of competence and self-determination. Our concept of a propensity to change is within the same general camp. Using the need for feeling competent and self-determining, Deci considers the concept of the need for challenge, that is, the concept of a propensity to change. In order to examine a "nurumayu" feeling, we first consider the organization's propensity to change. You may easily suppose that the organization of a high propensity to change has a high temperature and its members would feel hot in it. If it has a low propensity, its temperature is low and its members would feel lukewarm in it. To take the temperature of the working place, by multivariate analysis (see Takahashi (1989) for details) and logical examination, five questions were selected from among 25 yes-no questions on phenomena as follows:

S1. Have high performing individuals been consistently promoted and given raises? (1=yes; 0=no)
S2. Is the atmosphere one which welcomes "positive failure" which would serve as a lesson to all? (1=yes; 0=no)
S3. Is your immediate superior able to exert influence on his or her superiors? (1=yes; 0=no)
S4. Are the present ways of doing jobs very unlikely to change? (1=no; 0=yes)
S5. Do all the members believe they can move up the ladder to a certain extent solely on the basis of seniority? (1=no; 0=yes)

For questions S1, S2, and S3, "yes" means a high propensity to change. And for S4 and S5, "no" means a high propensity to change. The yes-no answer of the question S*i* can be quantified and represented by a dummy variable S_i, i=1,...,5. The dummy variable takes only two values, zero and one, which signify that the observation belongs in one of two possible categories. Variables S_1, S_2, and S_3 are dummy variables designating the two categories, 1 for "yes" and 0 for "no". Variables S_4 and S_5 are also dummy variables coded as 0 for "yes" and 1 for "no". These dummy variables can be used to take the temperature of the working place, which is called the *system temperature* (*SINDEX*) and calculated as follows:

$$SINDEX = S_1 + S_2 + S_3 + S_4 + S_5.$$

SINDEX is an integer from 0 to 5. By system temperature, we try to measure the propensity to change of the organization as a system.

To test the validity of the system temperature, we use categories of "lukewarm" and "non-lukewarm", which are based on Question 1. For the lukewarm group (the group of "yes" respondents in Question 1) and the non-lukewarm group (the group of "no" respondents in Question 1), we calculate means of *SINDEX* as follows: 3.05 for the total (N = 525), 2.72 for the lukewarm group (N = 292), and 3.46 for the non-lukewarm group (N = 233). Thus by t-test, the lukewarm group has significantly lower *SINDEX* than the non-lukewarm group at level 0.001 (t = -6.61). Therefore it is a promising trial that a lukewarm feeling would be explained by the system temperature, *SINDEX*.

But *SINDEX* of Company C having the highest lukewarm feeling ratio is 2.73 and is not conspicuous in Table 1 comparing the averages of *SINDEX* for eleven companies. Table 1 indicates that there are significant differential effects at level 0.001 by F-test. Hence it is difficult to characterize Company C aptly only by *SINDEX*.

TABLE 1. System Temperature (*SINDEX*).

Company	*N*	*SINDEX*
A	19	4.00
B	27	3.19
C	55	2.73
D	18	2.50
E	96	3.72
F	78	2.36
G	65	2.86
H	53	2.92
I	26	3.92
J	40	3.15
K	48	2.81
Total	525	3.05
$F(10,514)$		8.80
		$p < 0.001$

Body Temperature

The system temperature is not sufficient to explain the high lukewarm feeling ratio of the high job satisfaction ratio company, like Company C. We should find an alternative way to explain a lukewarm feeling. The problem of Company C demands the careful consideration of not only the phenomena but also the individual job attitudes. The biological temperature of the human

body is normally 36 to 37 degrees Centigrade. But, we consider the organization person characterized by the organization personality (Barnard, 1938). Does everyone have always a constant body temperature as an organization person? Does the high job satisfaction ratio company (like Company C) have a high average of body temperature? Does high body temperature emphasize lukewarm feelings?

Now, we hypothesize that the body temperature of an organization person may form a basis for his or her lukewarm feeling, where the *body temperature* is defined as the propensity to change of the individual as an organization person. In other words, the body temperature is an index to the organization personality not to accept the present organizational situation and not to spend an easygoing time and to challenge the status quo in the organization.

To take the body temperature, by multivariate analysis (Takahashi, 1989) and logical examination, five questions were selected from among 25 yes-no questions on job attitudes as follows:

B1. Do you constantly seek improved ways of doing your jobs better than the others? (1=yes; 0=no)
B2. Do you wish to maintain the "status quo" by avoiding to cause mistakes or problems rather than improving your performance by risk taking? (1=no; 0=yes)
B3. Do you constantly seek to improve your practical knowledge and expertise required to do your job? (1=yes; 0=no)
B4. Do you continually welcome challenging new jobs? (1=yes; 0=no)
B5. Do you hope to be promoted faster than the others at your company if possible? (1=yes; 0=no)

For question B2, "no" means a high propensity to change, and for the other four questions, "yes" means a high propensity to change. The yes-no answer of the question B*i* was represented by a dummy variable B_i, i=1,...,5: B_1, and B_3 to B_5 respectively designated the two categories, 1 for "yes" and 0 for "no"; and B_2 coded as 0 for "yes" and 1 for "no". The dummy variables can be used to take the body temperature (*BINDEX*) as follows:

$$BINDEX = B_1 + B_2 + B_3 + B_4 + B_5.$$

BINDEX is an integer from 0 to 5.

TABLE 2. Body Temperature (*BINDEX*) and Effective Temperature (*T*).

Company	*N*	*BINDEX*	*T*
A	19	4.05	-0.05
B	27	3.52	-0.33
C	55	4.04	-1.31
D	18	3.44	-0.94
E	96	3.68	0.04
F	78	3.23	-0.87
G	65	3.45	-0.58
H	53	3.26	-0.34
I	26	4.54	-0.62
J	40	3.98	-0.83
K	48	3.25	-0.44
Total	525	3.60	-0.55
$F(10,514)$		4.07	3.34
		$p < 0.001$	$p < 0.001$

Table 2 compares the averages of *BINDEX* for eleven companies by *F*-test, and there are significant differential effects at level 0.01. Company C having the third highest job satisfaction ratio has the third highest body temperature (*BINDEX* = 4.04).

Hypothesis

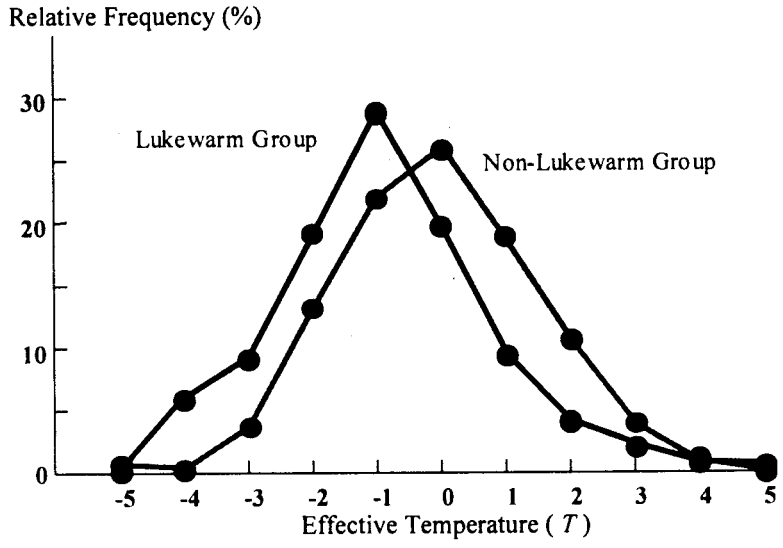
As we noted earlier in this section, we can expect that the organization persons would have lukewarm feelings on the basis of their body temperature. For example, there exists the tendency for the organization persons having high body temperature rather than low body temperature to have lukewarm feelings at the same level of system temperature. Therefore we can specify their expected consequences in the following hypothesis.

***Hypothesis* 1 (*Effective Temperature Hypothesis*). Define the *effective temperature* (*T*) as follows: *T* = *SINDEX* - *BINDEX*. Then the respondent expressing a lukewarm feeling has a lower effective temperature than the respondent expressing a non-lukewarm feeling.**

General support for the simplified equation in Hypothesis 1 is provided and examined by principal components analysis and discriminant analysis (see Takahashi (1989) for details).

Let us begin with the analysis of Hypothesis 1. We calculate the means of the effective temperature *T* as follows: -0.55 for the total (*N* = 525), -0.91 for the lukewarm group (*N* = 292), and -0.09 for the non-lukewarm group (*N* = 233). By *t*-test, the lukewarm group has the significantly lower mean of effective temperature than the non-lukewarm group at level 0.001 (*t* = -5.79). In fact, Figure 2 clearly supports Hypothesis 1.

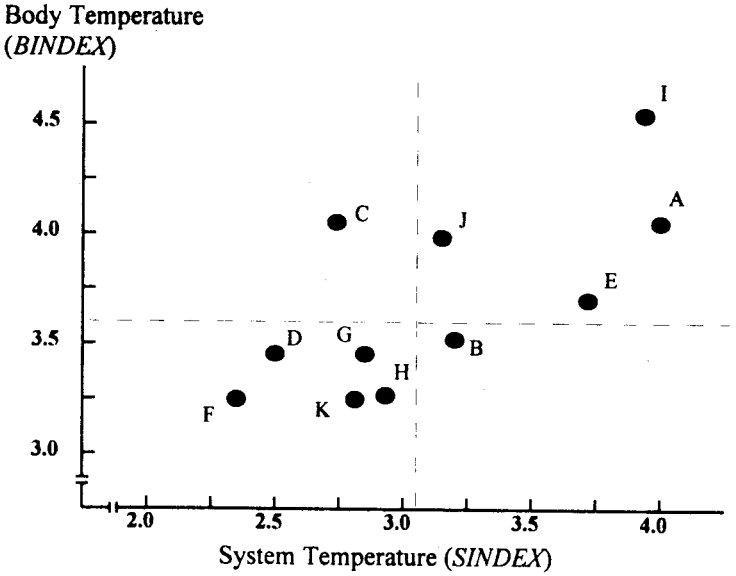
FIGURE 2. Relative Frequency Diagram.



On the other hand, Table 2 has compared the averages of the effective temperature *T* for eleven companies by *F*-test, and there are significant differential effects at level 0.001. Company C has the lowest effective temperature: *T* = -1.31. Moreover, Figure 3 designates that only Company C is located at the lukewarm area of low system temperature and high body temperature.

From the above discussion, our empirical research supports Hypothesis 1, and the highest lukewarm feeling ratio of Company C can be explained by the lowest effective temperature.

FIGURE 3. Scatter Diagram of Eleven Companies. (Dotted lines indicate the means.)



Follow-Up Test on Middle Managers

In 1988, a follow-up was made in order to verify the effective temperature hypothesis again. First, we selected eight Japanese companies who were also members of Japan Productivity Center in the industries: railways, precision machinery, retail trade, motor vehicles and equipment, communication, electronic machinery, and banking (2).

We initially selected for each company two or more organizational units, then we investigated all the middle managers of the selected 37 organizational units. The research was carried out from August 31 to September 5, 1988 through the delivery-collection and self-recording method. We obtained 626 middle managers' data from the questionnaires (response rate was 81.3%). 99.2% were men, an average age was 42.3 years, and of course 100% were managers.

To test Hypothesis 1, we calculated the means of the effective temperature: -1.03 for the total (N = 609), -1.19 for the lukewarm group (N = 422), and -0.66 for the non-lukewarm group (N = 187). Thus by t-test, the lukewarm group has the significantly lower effective temperature than the non-lukewarm group at level 0.001 (t = -4.11). We obtained a figure, not shown in this paper, almost similar to Figure 2. Therefore, the empirical research on middle managers also supports our Hypothesis 1.

Furthermore, we obtain the empirical evidence that the lukewarm feeling ratio of the middle managers is very high. For Question 1, 69.7% of the total respondents answered "yes" and 30.3% answered "no". Why is the lukewarm feeling ratio of the middle managers so high? The mean of *SINDEX* is 3.06, which is almost equal to 3.05 of the first survey in 1987. Thus, the high lukewarm feeling ratio of the second survey in 1988 cannot be explained by the system temperature. But, the mean of *BINDEX* is 4.09 in 1988. This is remarkably higher than 3.60 of the first survey in 1987. Hence, by using our effective temperature hypothesis, the distinguished

high lukewarm feeling ratio of the second survey in 1988 is clearly explained from the fact that the middle managers have the high body temperature in Japanese firms.

Refinement of the "Thermometer"

Unfortunately, we were only able to use categories of "lukewarm" and "non-lukewarm" based on Question 1. Then, although we expected that most respondents of the non-lukewarm group have high system temperature and low body temperature, the non-lukewarm group includes many respondents having high system temperature and high body temperature. For those who indicate that they have high body temperature, high system temperature would not cause hot feelings.

If the discrepancy between the non-lukewarm group and the "hot" group is appalling, it is not appropriate to compare the mean of the effective temperature of the lukewarm group with that of non-lukewarm group. We are now in position to propose a new version of Hypothesis 1.

***Hypothesis* 2 (*Refined Effective Temperature Hypothesis*). The lukewarm feeling ratio of a group is in reverse proportion to its mean of the effective temperature.**

Method

We were prompted to search for a more refined "thermometer" with better properties to explain the lukewarm feeling ratio. The first survey in 1987 and the second survey in 1988 used same questions S1 to S5 and B1 to B5 in order to test Hypothesis 1. These ten questions were selected from among only 50 questions of the first survey which was planned to get fact findings of the "nurumayu" phenomenon. The *SINDEX* scale are heterogeneous, e.g., merit system, change, atmosphere regarding failure. But the *BINDEX* scale seems more homogeneous, e.g., Kaizen motivation, ambition. There are some prospects of improvement on the questions. If measures of them could be developed, they might prove to be useful criteria in evaluating the validity of our effective temperature hypothesis.

In 1989 to 1990, we made the preliminary third survey of 564 employees of two Japanese manufacturing companies (response rate was 84.1%). In this third survey, we prepared a comprehensive list of 100 yes-no questions made of preceding surveys' questions and new questions. Through this preliminary survey, we selected 35 questions from among these 100 questions by multivariate analysis (see Takahashi (1993; 1997b) for details).

Using these 35 questions, we made the fourth survey in 1990 in order to refine the "thermometer" to measure the effective temperature. We selected nine Japanese companies who were members of Japan Productivity Center in the industries: motor vehicles and equipment (3), communication, railways (2), petroleum products, banking (2). We initially selected for each company one or more organizational units, then we investigated 39 organizational units. The research was carried out from September 5 to 10, 1990 through the delivery-collection and self-recording method. The questionnaires were completed by 853 white-collar workers (response rate was 88.9%). 80.8% were men, 23.3% were managers, and an average age was 34.9 years.

By multivariate analysis, Questions S2 to S5 and B2 to B5 were replaced by newcomers, and the following questions were selected (see Appendix).

System Temperature

S1. Have high performing individuals been consistently promoted and given raises? (1=yes; 0=no)

S6. Is avoiding failure considered more important than improving performance through trial and error? (1=no; 0=yes)

S7. Is the atmosphere one which welcomes challenging new jobs? (1=yes; 0=no)

S8. Is adopting the corporate culture more important than developing your own individuality? (1=no; 0=yes)
S9. Is the atmosphere a competitive one in which members strive to achieve their goals? (1=yes; 0=no)

Body Temperature
B1. Do you constantly seek improved ways of doing your jobs better than the others? (1=yes; 0=no)
B6. Do you do your job in the way you want regardless of the way it was done in the past? (1=yes; 0=no)
B7. Do you go out of your way to do new jobs before they are assigned to some sections? (1=yes; 0=no)
B8. Do you believe you are able to cut your own way to success even at another company? (1=yes; 0=no)
B9. Do you obey the orders of your superiors even if you disagree? (1=no; 0=yes)

For three questions S6, S8 and B9, "no" means a high propensity to change, and for the other seven questions, "yes" means a high propensity to change. These yes-no answers were quantified by dummy variables: S_6, S_8 and B_9 respectively designated the two categories, 0 for "yes" and 1 for "no"; and the other variables coded as 1 for "yes" and 0 for "no". These dummy variables can be used to take the system temperature (*SINDEX*), the body temperature (*BINDEX*), and the effective temperature (T) as follows:

$$SINDEX = S_1 + S_6 + S_7 + S_8 + S_9,$$

$$BINDEX = B_1 + B_6 + B_7 + B_8 + B_9,$$

$$T = SINDEX - BINDEX.$$

To test these refined "thermometers," additional ten surveys in 1991 to 2000 using same method were conducted. In total of 1990 to 2000, we selected 385 organizational units from 46 Japanese major companies who were JPC's members. When perceptions are measured on the same questionnaire using basically the same item format, the correlation between variables obtained in this way is potentially inflated because of a large number of potential third variables that may influence the relationship. In order to avoid this response-response problem, in each survey, we used the questionnaire having 60 or more questions, and most of them except for our "thermometers" were replaced by new other questions every year.

In 1991, we investigated all the white-collar workers in 30 organizational units of six Japanese companies in the industries: railways (2), retail trade, electric service, communication, banking. The research was carried out from August 28 to September 2, 1991. We obtained 907 respondents' data from the questionnaires (response rate was 89.2%). 87.2% were men, 29.0% were managers, and average age was 36.6 years.

In 1992, we investigated all the white-collar workers in 27 organizational units of seven Japanese companies in the industries: railways, hotels, construction, security, life insurance, consultant, computer. The research was carried out from September 2 to 7, 1992. The questionnaires were completed by 740 white-collar workers (response rate was 89.6%). 76.4% were men, 25.1% were managers, and average age was 35.5 years.

In 1993, we investigated all the white-collar workers in 33 organizational units of six Japanese companies in the industries: railways (2), petroleum products, banking, communication, security. The research was carried out from August 25 to 30, 1993. We obtained 1160

respondents' data from the questionnaires (response rate was 91.0%). 86.8% were men, 18.1% were managers, and average age was 38.0 years.

In 1994, we investigated all the white-collar workers in 39 organizational units of eight Japanese companies in the industries: heavy industries, real estate development, railways, house building, construction consultant, computer, banking (2). The research was carried out from August 31 to September 5, 1994. The questionnaires were completed by 829 white-collar workers (response rate was 93.7%). 72.0% were men, 24.6% were managers, and average age was 35.7 years.

In 1995, we investigated all the white-collar workers in 41 organizational units of six Japanese companies in the following industries: electric (2), railways, construction, hotels, banking. The research was carried out from August 30 to September 4, 1995. We obtained 1061 respondents' data from the questionnaires (response rate was 89.4%). 77.2% were men, 23.8% were managers, average age was 37.3 years.

In 1996, we investigated all the white-collar workers in 37 organizational units of six Japanese companies in the following industries: computer, railways (2), banking (2), communication. The research was carried out from September 4 to 9, 1996. We obtained 801 respondents' data from the questionnaires (response rate was 94.9%). 86.8% were men, 16.8% were managers, average age was 39.4 years.

In 1997, we investigated all the white-collar workers in 31 organizational units of six Japanese companies in the following industries: chemical products, railways, textile mill products, computer, banking (2). The research was carried out from August 27 to September 1, 1997. We obtained 827 respondents' data from the questionnaires (response rate was 87.6%). 75.0% were men, 20.3% were managers, average age was 37.1 years.

In 1998, we investigated all the white-collar workers in 52 organizational units of eight Japanese companies in the following industries: computer, railways, tobacco, general machinery, pharmacy, banking (2), service. The research was carried out from September 2 to 7, 1998. We obtained 2330 respondents' data from the questionnaires (response rate was 86.3%). 69.5% were men, 12.5% were managers, average age was 33.9 years.

In 1999, we investigated all the white-collar workers in 27 organizational units of four Japanese companies in the following industries: railways, construction, textile mill products, banking. The research was carried out from September 8 to 13, 1999. We obtained 790 respondents' data from the questionnaires (response rate was 89.7%). 82.9% were men, 18.5% were managers, average age was 39.6 years.

In 2000, we investigated all the white-collar workers in 29 organizational units of 11 Japanese companies in the following industries: computer (2), pharmacy, precision instruments (2), cement, textile mill products, road passenger transport, banking, life insurance, real estate development. The research was carried out from September 6 to 11, 2000. We obtained 618 respondents' data from the questionnaires (response rate was 90.9%). 81.1% were men, 24.8% were managers, average age was 36.9 years.

Totally, through the eleven surveys from 1990 to 2000, we obtained the data from 10916 white-collar workers in 385 organizational units of 46 Japanese companies (14 companies were investigated twice or more but their organizational units were different in each survey). Total response rate was 89.3%. In total, 78.4% were men, 20.2% were managers, and average age was 36.4 years. After the elimination of missing values, the data from 10536 white-collar workers are analysed.

Results

According to Figure 3, the old versions of two indexes were positively correlated. If so, subtracting the measures may not make sense psychometrically. But according to the surveys from 1990 to 2000, Pearson's correlation coefficients between refined *SINDEX* and *BINDEX* show

wide variation: 0.230 in 1990, 0.152 in 1991, 0.132 in 1992, 0.095 in 1993, 0.051 in 1994, 0.069 in 1995, 0.094 in 1996, 0.172 in 1997, 0.073 in 1998, 0.141 in 1999, and 0.059 in 2000. The pooled correlation coefficient is 0.108. Thus these refined two indexes are not strongly correlated nor always correlated, and two measures have different content.

TABLE 3. Effective Temperature and Lukewarm Feeling Ratio.

Question 1	Effective temperature (T)											
	Year	-5	-4	-3	-2	-1	0	1	2	3	4	5 Total
1. Yes Lukewarm	1990	14	34	68	98	98	82	46	18	3	1	0 462
	1991	17	52	84	133	121	101	60	26	9	1	0 604
	1992	23	40	90	97	103	93	46	20	11	2	0 525
	1993	24	64	125	136	132	113	62	30	8	4	0 698
	1994	22	51	87	104	110	91	62	33	11	4	0 575
	1995	45	87	126	152	149	104	74	35	7	6	1 786
	1996	23	64	91	111	125	76	49	16	10	3	0 568
	1997	15	47	94	109	104	84	51	18	7	3	0 532
	1998	63	124	195	265	251	234	133	50	29	5	0 1349
	1999	17	59	93	101	104	81	35	17	7	2	0 516
	2000	15	54	60	82	92	53	39	18	4	1	0 418
	Total	278	676	1113	1388	1389	1112	657	281	106	32	1 7033
2. No Non-Lukewarm	1990	3	12	31	51	80	69	61	31	8	7	1 354
	1991	1	8	20	34	55	59	53	27	8	8	0 273
	1992	1	8	24	20	35	47	27	17	3	0	0 182
	1993	1	14	31	60	75	90	77	50	16	8	2 424
	1994	2	9	22	22	42	43	40	27	14	3	1 225
	1995	0	9	13	51	44	54	41	31	6	6	1 256
	1996	3	12	16	33	37	42	35	22	5	3	0 208
	1997	5	7	21	35	54	60	46	18	17	2	1 266
	1998	5	24	70	110	165	204	151	107	40	18	2 896
	1999	1	4	8	26	56	63	52	24	8	6	0 248
	2000	1	5	11	31	32	44	24	16	6	1	0 171
	Total	23	112	267	473	675	775	607	370	131	62	8 3503
Total		301	788	1380	1861	2064	1887	1264	651	237	94	9 10536
Lukewarm Feeling ratio (%)		92.4	85.8	80.7	74.6	67.3	58.9	52.0	43.2	44.7	34.0	11.1 66.8

We use the pooled lukewarm feeling ratios of eleven surveys from 1990 to 2000 as indicated in Table 3. The means of *SINDEX* and *BINDEX* are 2.13 and 3.16 respectively. The standard deviations of *SINDEX* and *BINDEX* are 1.54 and 1.33 respectively.

The graph of the lukewarm feeling ratio versus the effective temperature in Figure 4 suggests a straight line relationship. It is fairly clear that a point ($T = 5$) would deflate the slope of the line. This point should be regarded as outliers. We had only nine respondents (0.1% of the sample) at $T = 5$ as designated in Table 3, so that we were reluctantly compelled to measure the lukewarm feeling ratio with large sampling error at $T = 5$. Therefore, by dropping this point from the data, a linear model is fitted to the data. To test Hypothesis 2, we regressed lukewarm feeling ratio on the effective temperature. The estimated coefficient are given in Table 4, and every coefficient is significant at level 0.0001. The high value 0.9886 of R^2 indicates a very strong linear relationship between the lukewarm feeling ratio and the effective temperature. For each degree increase in the effective temperature, the lukewarm feeling ratio is expected to decrease by 6.5%, and the lukewarm feeling ratio is almost 60% at 0 degree. Thus the thermometer of the effective temperature can be used to forecast the lukewarm feeling ratio.

FIGURE 4. Graph of the Lukewarm Feeling Ratio Versus the Effective Temperature.

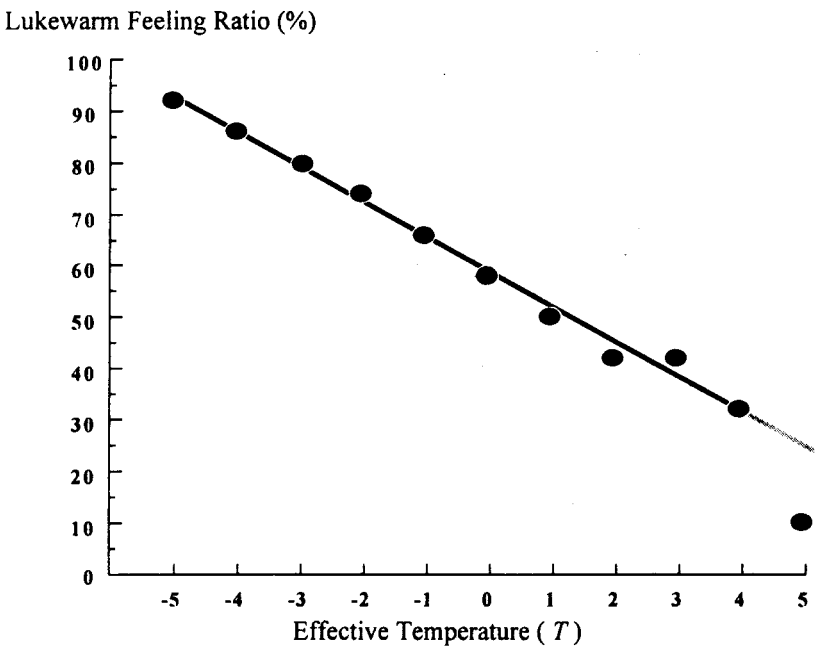
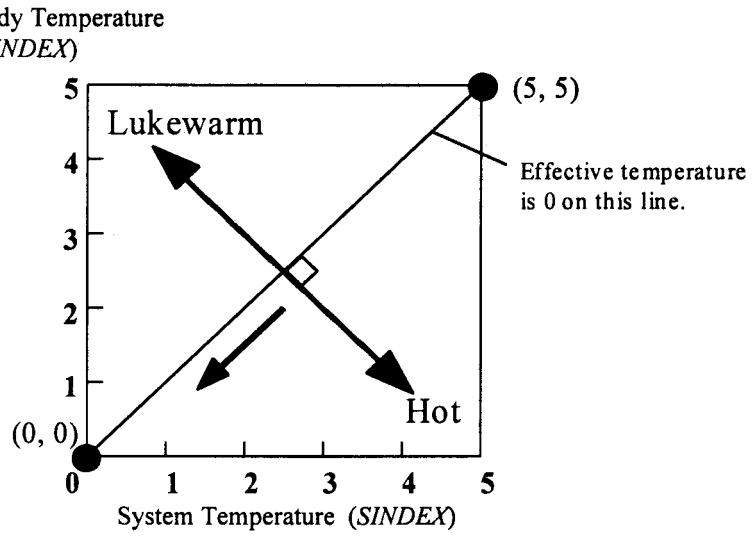


TABLE 4. Regression Analysis of Lukewarm Feeling Ratios (Except for $T = 5$).

Variable	Coefficient	Standard error	t	Significance
Effective temperature (T)	-6.521	0.248	-26.330	$p = 0.0001$
Constant	60.092	0.722	83.227	$p = 0.0001$
$R^2 = 0.9886$ (Adjusted $R^2 = 0.9872$)		$F(1,8) = 693.284$		$p = 0.0001$

FIGURE 5. Boiled Frog Phenomenon Explained by Effective Temperature.



Discussion

Thus far, we explain the lukewarm feeling by the effective temperature defined as the difference between the system temperature and the body temperature. If our effective temperature hypothesis is valid, lukewarm feelings may mislead the members' judgment on the state of their organization. For example, the northeast corner (*SINDEX* = 5 and *BINDEX* = 5) of Figure 5 has the same effective temperature 0 as the southwest corner (*SINDEX* = 0 and *BINDEX* = 0). But these two corners represent two extremes of the organizational state. The northeast corner represents the activated state of the organization (Takahashi, 1992). The white-collar workers in Japanese firms use the term "activated state" to refer to the state where both of members and the system have the highest propensity to change. However, the southwest corner represents typical non-activated state, where both of members and the system make scarcely any changes. (Thus, it is also clear that the northwest area of lukewarm is neither the typical non-activated state nor the typical activated state of the organization!)

Let us apply this model to the persons whose body temperature declines. Consider persons who are in the process of gradually moving along the line from (5, 5) to (0, 0) in Figure 5. According to the hypothetical framework that we have proposed, they would feel suitable or at least would not respond to avoid catastrophic consequences because their effective temperature is always 0. A similar phenomenon is called the *boiled frog phenomenon* in the management theory (Tichy & Devanna, 1986), which comes from a classic physiological response experiment. If we place the frog in a pan of boiled water, it will promptly jump out. But, if the frog is placed in a pan of cold water and the heat is turned up very gradually, the frog will sit in the pan until it boils to death. Tichy & Devanna (1986, p.46) explain that, like the frog, the organization and its members do not respond to trigger events in time to avoid catastrophic consequences, since the cultural cocoons created by the organization surround them with a false sense of security. Our effective temperature hypothesis offers an alternative and scientific explanation of an organizational version of the boiled frog phenomenon in comparison with their "cultural cocoons" theory.

Appendix

Principal-Components Analysis

By principal-components analysis, we obtain eigenvalues; 1.696, 1.104, 0.844, 0.712, 0.645 for S_1 and S_6 to S_9. The first eigenvalue exceeded unity and the rest fell heavily. The first principal-component *SPRIN*1 is as follows:

$$SPRIN1 = -2.226 + 0.923S_1 + 0.919S_6 + 0.996S_7 + 0.815S_8 + 0.977S_9.$$

All the weights are at the almost equal level, then in a practical sense *SINDEX* can be calculated as the equally weighted sum of S_1 and S_6 to S_9:

$$SINDEX = S_1 + S_6 + S_7 + S_8 + S_9.$$

Similarly, we obtain eigenvalues; 1.960, 0.980, 0.820, 0.659, 0.581 for B_1 and B_6 to B_9. Only the first eigenvalue exceeded unity and the rest fell short of it. The first principal-component *BPRIN*1 is as follows:

$$BPRIN1 = -2.672 + 1.147B_1 + 1.012B_6 + 1.037B_7 + 0.706B_8 + 0.665B_9.$$

The weights of B_8 and B_9 are slightly small, but we may also conclude that *BINDEX* can be calculated as the equally weighted sum of B_1 and B_6 to B_9:

$$BINDEX = B_1 + B_6 + B_7 + B_8 + B_9.$$

Discriminant Analysis

Discriminant analysis was performed by using the ten dummy variables between two groups: A "lukewarm" group and a "non-lukewarm" group, which were based on Question 1. We obtained the following linear discriminant function:

$$u = -0.414 + 0.097S_1 + 0.263S_6 + 0.653S_7 + 0.514S_8 + 0.711S_9 - 0.254B_1 - 0.311B_6 - 0.022B_7 - 0.138B_8 - 0.191B_9.$$

Each respondent would be classified into "lukewarm" if $u < 0$ and "non-lukewarm" if $u > 0$. The weights of S_1 and S_6 to S_9 are all positive and the weights of B_1 and B_6 to B_9 are all negative. This supports our Hypothesis 1 that the effective temperature is defined as the difference between the system temperature and the body temperature. However, the absolute values of these weights scatter. Is this critical in classifying into two groups? Table 5 compares the results of classification. Actual error rate of classification by using the linear discriminant function is 38.0% and is almost equal to 38.5% by using the effective temperature (each respondent was classified into "lukewarm" if $T \leq 0$ and "non-lukewarm" if $T > 0$). Therefore, our data verify this equally weighted equation of Hypothesis 1: $T = SINDEX - BINDEX$.

TABLE 5. Classification Summary.

From Question 1	Number of respondents classified into two groups				
	Discriminant Function		Effective temperature		
	Lukewarm	Non-lukewarm	Lukewarm	Non-lukewarm	Total
Lukewarm	284(61.5)	178(38.5)	394(85.3)	68(14.7)	462
Non-lukewarm	132(37.3)	222(62.7)	246(69.5)	108(30.5)	354
Total	416	400	640	176	816
Error rate	(178+132) / 816=38.0%		(68+246) / 816=38.5%		

Row percents are in parentheses.

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