Survival power of individual preference of environments amid various stressors for health

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This review article has been presented as opening lecture at the 9th International Symposium on Temporal Design, which was held at Osaka University, December 2019. It was commemoration of 20 years since the first issue of this journal of temporal design of architecture and the environment was published. Health and peace as well as environment are most concerned with this journal and individuals; we should be responsible, because we have been directly suffered by damages. It is now turnings point from the first and second stages of life same as animals, to the third stage of human life, which is creation based on a unique individual personality driven by DNA (Ando, Y. Brain-Grounded Theory of Temporal and Spatial Design in Architecture and the Environment. Springer, Tokyo, 2016). The phrase of "time is money" said by Benjamin Franklin in 1748 to encourage young businessmen means that in order to earn money, one must act and therefore use one's time. However, this phrase unfortunately walked alone later. Many individuals were likely to obtain money and resulted particularly environmental destructions and such as struggles with difficult individuals relationship conflict. Accordingly, it brought various stressors due to competitions between individuals and between nations attaining just for economical richness. Resulted losing the individual vital power, for examples, against suffering serious diseases, and nowadays coronavirus with relatively stronger vital power so that it spread easily all over the world. In this article, after demonstrating effects of noise stress on unborn babies and children losing their survival power, on the contrary, brain grounded theory preference of the sound and visual fields that attain much survival power. Dynamical theory of individual preference amid various stressors is described, accepting the sympathetic-parasympathetic nervous system and the related endocrine system. An example is demonstrated to calculate dialysis introduction age (dialysis setup age) in relations to preference and stress factors. Then, an example of designing sound fields in the Kirishima International Music Hall is described based on the theory of subjective preference taking account of the temporal and spatial factors associated with left and right cerebral hemispheres, respectively. In addition, the seat selection system enhancing individual preference is described. For realizing preferred visual environments taking account of both of the temporal and spatial factors mentioned. This may avoid ugly visual designs excluding stressful environments. Finally, we shall discuss toward future individual personality (DNA) based society instead of majority based one, toward maintaining environments and avoiding war without termination.

Keywords: temporal design, dynamical theory of individual preference, stress

1 GLOSSARY AND DEFINITIONS

1.1 Aim of the Journal of Temporal Design in Architecture and the Environment (JTD)

The first issue of JTD was published in the beginning of the first year of millennium 2001, wishing toward healthy individuals throughout the lifetime, and maintaining local environments as well as the global environment further resulting peace. In order to realize for both healthy individuals and maintaining environment, we focus on the temporal design from the short term about 1 ms of the neural activity to the longest cosmic peroiods as well as these spatial designs.

1.2 Definition of Time

Benjamin Franklin said, "Time is money." The purpose of this phrase was to encourage young people to spend more time on working. However, the phrase has become a standalone, encouraging all that is inhumane in the world. Not only at individual but also national level, endeavors are chiefly steered by competition toward who attains more monetary wealth. These competitions have repeatedly resulted in global economic wars and extensive environmental destruction. The Industrial Revolution of the eighteenth century idolized speedy transportation to support mass industrial production and yielded extensive environmental disorder such as the unrestrained discharge of carbon dioxide which has become the most influential greenhouse gas causing global warming today. Results include weakening of survival power and increase of ecological and individual suffering in the form of, for example, serious cancers, cognitive impairment, chronic kidney disease and even pathogenesis by coronavirus.

Now is the turning point from the first and second stages of life, which we share with other animals, to the third stage of life, which is unique to humans. Time consists of the following three stages of life (Ando, 2016).

1. Life of body,
2. Life of mind, and
3. Life of original idea and creation, which are based on unique individual personality driven by DNA so that the individual may obtain the most personal survival vitality. This is called the third

stage of life, which may persist long after the individual life has passed on. There is a possibility of the fourth stage of life, if and when an individual creation is integrated into culture by future generations.

1.3 Definition of Personality

DNA has been developing for a long time since the Big Bang, acting as a seed for individual personality, which is like the flower of a plant. Just as a plant needs the right environment to reach full bloom, so is the temporal and spatial environment important for a human to reach full potential. The significance of designing preferred environments to support individual development of the 1st and 2nd stage of life and even more so, the 3rd stage of life of creations cannot be overstated.

1.4 Individual Preference

Individual preference is the most primitive response of living creatures that steers an organism in the direction of maintaining life, so as to enhance its survival power. Also, a judgment of individual preference is regarded as a basic response reflecting aesthetic value. If various stressors exist, one may lose individual survival power against serious diseases and including those due to coronavirus.

Individual preference first has been well based on neural activities in the central auditory signal processing system and the cerebral hemispheres and is deeply related to the scale value of subjective preference of the sound field and the vision (Ando, 1998, 2009). Under preferred conditions, the brain repeats a similar alpha rhythm for a long period, and in addition, alpha rhythms persist to wider cortical territories. These results reflect the behavior of autonomic nervous and endocrine systems that may be hugely important in terms of vital power amid various stressors.

1.5 Brain-Grounded Theory of Designing Sound Fields and Visions

The auditory model consists of two kinds of internal representations of sound based on the autocorrelation- and cross-correlation-like structures. The autocorrelation function (ACF) describes the monaural and temporal signal at each of the two ears, while the interaural cross-correlation function (IACF) describes the binaural and spatial signals arriving at the entrances of the two ears. It is remarkable that temporal sensations such as loudness, pitch, duration and timbre are well described by the temporal factors extracted from the ACF of the sound signal, and spatial sensations, such as localization, apparent source width (ASW) and subjective diffuseness or envelopment are described by the spatial factors extracted from the IACF (Ando, 1985, 2009, 2019).

The information corresponding to subjective preference of sound fields was found in the effective duration of ACF of the alpha waves in electroencephalographic (EEG) and magnetoencephalographic (MEG) recordings. The repetitive feature of the alpha wave, as measured in its ACF, was observed at the preferred condition. This evidence affirms that the basic theory of subjective preference may be applied to individual preference as well. We have reconfirmed by analyzing MEG recordings that the left cerebral hemisphere is associated with the temporal factors of the sound field, and the effective duration of the ACF alpha wave directly corresponds to the scale value of individual subjective preference. The right cerebral hemisphere was activated by the typical spatial factors, i.e., the magnitude of interaural cross-correlation (IACC) and the listening level (Ando, 1985, 1998, 2009).

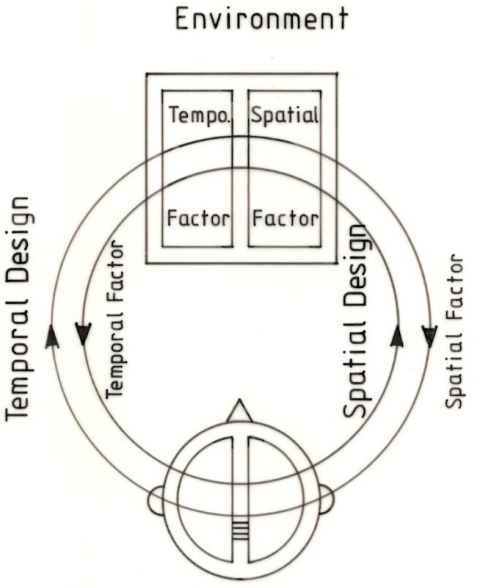

Figure 1: Interaction between an environment consisting of temporal and spatial factors and the left and right human cerebral hemispheres, respectively. This is the ground theory for designing architecture and the environment as well as artistic works. Well-designed environments such as these, realized according to the subjective preference theory, induce further creations (the third stage of life) developing individual personality (Ando, 2016).

The theory of subjective preference was developed first with auditory perception in mind; it can plausibly be extended to predict subjective preferences in analogous dimensions of visual perception. Thus, analogies can then be drawn to temporal and spatial sensations of vision, as well as for subjective preference of visional environment.

For example, the most preferred condition of a flickering light is expressed by the temporal factors extracted from the temporal autocorrelation (ACF) of the modulated light stimulus. Auditory and visual percepts have been well described in terms of the temporal and spatial factors associated with the left and right human cerebral hemispheres, respectively (Ando, 2009, 2016). The left hemisphere of our brain is always reacting to temporal factors, and the right hemisphere is constantly reacting to spatial factors. These facts are bases for the design theory as shown in Figure 1.

Visuality and spatiality are normally considered the main foci in architectural and sculptural creative expressions. By the ’dynamical theory’ of preference for maintaining survival power amid various stressors, we would like to expand on the subjective preference theory and initiate an approach to artistic and/or any environmental form through design according to preference. In order to exam-

ine this theory with stressors and preference factors were analyzed to determine dialysis introduction age (DIA) or dialysis setup age based on a questionnaire, which was distributed to patients attending a hospital in Kobe, Japan (Ando, 2018a,b).

It is remarkable that preferred design of environments may attain survibal power inducing further creations, on the contrary, however, ugly design may act as stressor lossing the power.

1.6 Monaural Factors Extacted from the Normalized Autocorrelation Function (ACF)

The most promising signal processes, in the auditory system after the peripheral process, is the autocorrelation function (ACF), which is defined by

$$\Phi_p(\tau) = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} p'(t)p'(t+\tau)dt \qquad (1)$$

where $p'(t) = p(t)s(t)$, $s(t)$ is the sensitivity of the ear. For convenience, $s(t)$ can be chosen as the impulse response of an A-weighted network. It is worth noticing that the physical system between the ear entrance and the oval window forms almost the same characteristics as the ear's sensitivity (Ando, 1985; 1998).

Thus, the ACF and the power density spectrum mathematically contain the same information. The normalized ACF is defined by

$$\phi_p(\tau) = \frac{\Phi_p(\tau)}{\Phi_p(0)} \qquad (2)$$

There are four significant factors, which can be extracted from the ACF:

1. Energy represented at the origin of the delay, $\Phi_p(0)$
2. The width of amplitude $\phi(\tau)$, around the origin of the delay time defined at a value of 0.5 as shown in Figure 2(a), is $W_{\Phi(0)}$, according to the fact that $\phi(\tau)$ is the even function.
3. Fine structure, including peaks and delays. For instance, τ_1 and ϕ_1 are the delay time and the amplitude of the first peak of the ACF, τ_n and ϕ_n being the delay time and the amplitude of the n-th peak. Usually, there are certain correlations between τ_1 and τ_{n+1}, and between ϕ_1 and ϕ_{n+1}, so that significant and independent factors are τ_1 and ϕ_1 only;
4. The effective duration of the envelope of the normalized ACF, τ_e, which is defined by the tenth-percentile delay, Figure 2(b).

For example, the ACF of pure tones for any phase is a cosine function with its τ_e being infinite, and the ACF of the white noise is $\delta(\tau)$, the Dirac delta function, thus τ_e being zero. Thus, the effective duration of ACF τ_e of general sound signals are between zero and infinite.

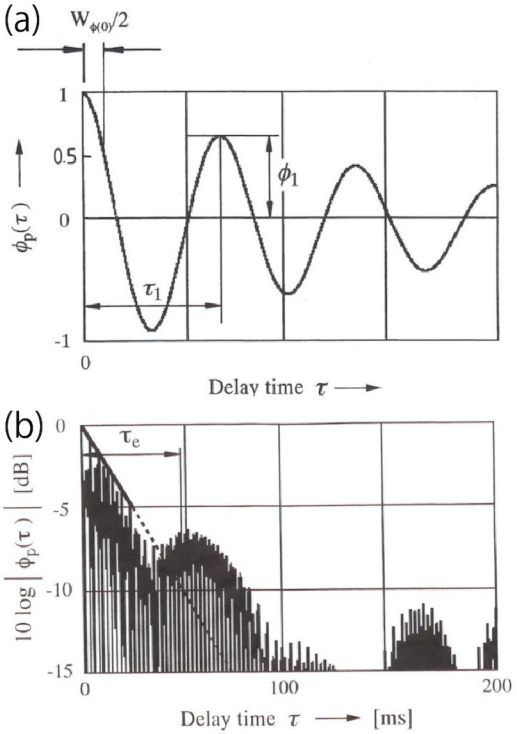

Figure 2: Definition of temporal factors (a) τ_1, ϕ_1, and (b) τ_e of the normalized ACF.

1.7 Four Othogonal Factors of the Sound Field Calculating Subjective Preference at Each Seat

Naturally, judgment in an absolute manner presents a big problem in reliability. Rather, it should be judged using a relative method such as by the paired-comparison test (PCT). This is the simplest method, in that any person older than, for example, two years of age may participate, and the resulting scale value may be utilized for a wide range of applications. From results of subjective preference studies in relation to temporal and spatial factors of the sound field, the theory of subjective preference has emerged (Ando, 1977, 1983, 1985; 1998; 2007).

Since the number of acoustic factors included in the sound signals arriving at both ears is limited, the scale value of any one-dimensional subjective response may be expressed by

$$S = g(x_1, x_2, \cdots x_I) \qquad (3)$$

where $x_1, x_2, \cdots x_I$ are orthogonal factors of the sound field, suffix I is the integer of the number of significant factors. The specialization of human cerebral hemispheres as listed in Table 1 illustrates the highly independent role that these temporal and spatial factors have on any incipient subjective response, including subjective preference (Ando, 1998, 2009). Moreover, a series of experiments have verified that the four orthogonal factors act independently of the scale value, $I = 4$. It has been examined by changing two of four factors simultaneously. Results of a series of subjective preference tests indicate that the units of scale values were constant, so that scale values may be added to obtain the total scale value for a sound field (Ando, 1985, 1998)

$$S = g(x_1) + g(x_2) + g(x_3) + g(x_4)$$

Table 1: Weighting coefficients α_i in Equation 5 of the four orthogonal factors of sound fields obtained with a number of subjects (Ando, 1998, 2009).

Factors i	Normalized factors x_i	α_i	
		$x_i > 0$	$x_i < 0$
Temporal Factors associated with the left hemisphere			
2	$x_2 = log(\delta t_1/[\delta t_1]_p)$	1.42	1.11
3	$x_3 = log(T_{sub}/[T_{sub}]_p)$	0.45+0.75A	2.36-0.42A
Spatial Factors associated with the left hemisphere			
1	$x_1 = 20logP - 20log[P]_p(dB)$	0.07	0.04
4	$x_4 = IACC$	1.45	—

$$= [S_2 + S_3]_{Left hemisphere} + [S_1 + S_4]_{Right hemisphere} \quad (4)$$

where S_i , $i = 1,2,3,4$ is the scale value obtained relative to each objective factor. Equation 4 indicates a four-dimensional continuity.

From the nature of the scale value obtained as a function of each orthogonal factor, it is convenient to put a zero value at the most preferred conditions without loss of any generality. These results of the scale value of subjective preference obtained from the different test series; using different music programs that yield the following common and approximate formula:

$$S_i \approx -\alpha_i |x_i|^{3/2}, i = 1,2,3,4 \quad (5)$$

where x_i is the factor normalized by the most preferred value, and the values of α_i are weighting coefficients as listed in Table G.1(Ando, 1998). If α_i is close to zero, then a lesser contribution of the factor x_i on subjective preference is signified.

The factor x_i is given by the sound pressure level difference, measured by the A-weighted network, so that

$$x_1 = 20logP - 20log[P]_p \quad (6)$$

P and $[P]_p$ being the sound pressure at a specific seat and the most preferred sound pressure that may be assumed at a particular seat position in the room under investigation. It is note worthy that the binaural listening level (LL) usually may be approximated by a single microphone measurement.

$$x_2 = log(\delta t_1/[\delta t_1]_p) \quad (7)$$

$$x_3 = log(T_{sub}/[T_{sub}]_p) \quad (8)$$

$$x_4 = IACC \quad (9)$$

Thus, the scale values of preference have been formulated approximately in terms of the 3/2 power of normalized objective parameters, expressed in logarithm for the parameters, x_1, x_2 and x_3. The remarkable fact is that the spatial binaural parameter $x_4 = IACC$ is expressed in terms of the 3/2 power of its 'real value', indicating a greater contribution than from the temporal 'logarithmic parameters'. By Equation 5, the scale values are not greatly changed in the vicinity of the most preferred conditions, but decrease rapidly outside of this range. Since the experiments were conducted to find the optimal conditions, this theory holds in the range of preferred conditions tested for the four factors (Ando, 1998).

This theory has been well based on neural activities in the central auditory signal processing system and the cerebral hemispheres and is deeply related to the scale value of subjective preference of the sound field (Ando, 2009). Under preferred conditions, the brain repeats a similar alpha rhythm for a long period of time, and in addition, alpha rhythms persist to wider cortical territories. These results may reflect the behavior of autonomic nervous and endocrine systems that may be hugely important in terms of vital power amid various stressors.

1.8 Weighted Equivalent Continuous Perceived Noise Level (WECPNL)

It is expressed approximately by

$$WECPNL \approx dBA + 10logN - 27 \quad (10)$$

where, dBA is the averaged value of the peak noise level and N is the number of jet planes weighted according to each hour of the day $N = N_1 + 3N_2 + 10N_3$, N_1, N_2, N_3 being the number of flights between 07:00 and 18:59 h, and 21:59 and 22:00 h, and 22:00 and 06:59 h, respectively.

1.9 CWS (Creative Work Space)

It consists of 'three distinct panels', specializing in left and right hemispheric tasks, and an information-communication system for the integration of knowledge. The left hemispheric task is a temporal process such as writing, reading, speech hearing, calculation, and logical considerations. The right hemispheric task is a spatial process including pattern recognition, spatial formation, drawing, painting, clay modeling, making scale models and non-verbal communications. The promise of these workspaces lies in the generation of multi-dimensional ideas. This differs from the usual one-dimensional working space, which might create only 'one-dimensional', or linear ideas. It is quite natural to expect similar ideas to stem from one-dimensional space. Eight users reported that the total quality of the CWS system was 2.5 - 15 times (mean value: 5 times) better than one - dimensional desks, which they had been using, and work efficiency increased by 2 - 15 times (mean value: 3 times). All users reported their efficiency increased by 2 times at least ($p < 0.01$). Verbal and non-verbal materials previ-

ously created by a user, which are displayed on the walls around the three panels, may induce further creations.

2 INTRODUCTION

The well-known concept "time is money", this phrase unfortunately walked alone, and particularly environmental destructions and such as struggles with difficult individuals relationship conflict. Also, it brought various stressors due to competitions between individuals and between nations attaining "money" resulted losing vital power. Typical examples, against serious kidney disease, cancers, intractable pain disease and cognitive impairment as well as disease due to coronavirus spread all over the world.

Variety of "stressors" set into motion defense reactions mediated through the autonomic nervous system and the endocrine system (Selye, 1950). Sensory inputs like bright light, noise, temperatures, environmental issues such as dislike sound and visual environments designed ignoring scientific preference theories (Ando, 1985, 1998, 2009, 2016). Life experiences such as heavy drinking, or insufficient sleep can also cause stress. Students and workers may face performance pressure stress from exams including entrance exams and project deadlines. In this review article, we demonstrate effects of noise on development of unborn babies, and specialization of hemispheres of children as a typical stresses on the development of body and mind and creation.

The aim of this article is to recover healthy life from a world filled with integrated and various stressors losing survival power. By means of individual preference as described dynamical theory of preference of life amid various stressors, which is the most primitive response of living creatures so that steer an organism in the direction of maintaining life, so as to enhance its prospects for survival power. To examine this theory, we shall show stressors and preference factors that determine the dialysis introduction age (DIA) or dialysis onset age based on analyzing questionnaire distributed to patients attending a hospital in Kobe, Japan (Ando, 2018a, 2018b). We shall discuss individual based society for maintaining environment and keeping health in the future life.

3 THEORY OF PREFERENCE OF LIFE AMID VARIOUS STRESSORS

3.1 Previous Stress Theory in Life

It is well known that a variety of 'stressors' set into motion defense reactions mediated through the autonomic nervous and the endocrine systems (Selye, 1950). Introduction of the concept of stress in the 1950s coincided with avarice in economical pursuits and the ill idea that, 'time is money'. As a result, an ever-increasing number of people suffer from kidney disease, cancer, intractable pain disease and cognitive impairment as shown in Figure 3. The word 'stress' was not used before the 1950s, and the number of existing central hospitals was considerably lower.

It is normative that human life is so occupied by a wide range of stressors including troubled human relations that the pleasure derived from the process of living is regretfully often drained away. The most serious stressor in human relations is bullying which is typically brought on by the dominance of verbal communication from the left hemisphere only.

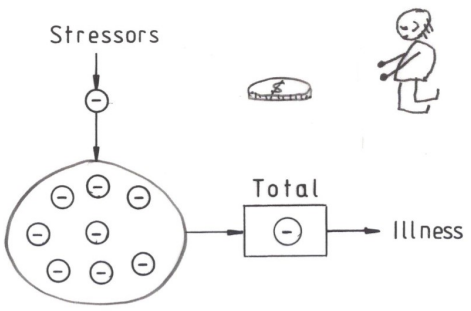

Figure 3: Stress theory describes loss of survival power, which results in suffering and disease, brought on by limited survival power of individuals (Selye, 1950). The total score is always minus. This means diminished vital power at an increasingly young age and seniors being increasingly susceptible to illness due to decreased survival power.

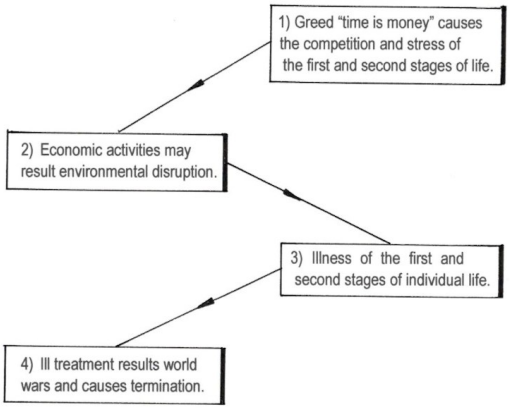

Figure 4: Stress of life caused by the typical ill concept 'time is money', potentially resulting in the global warming and world wars.

Stressors are competitive actions such as trade wars that are targeted at attaining business opportunities for getting money. Endorsement of idolatry for money, status, and academic background will result in a downward spiral, ultimately causing termination of social structure.

Our hope is for each individual to surround themselves with their preferred environment so that the three stages of life according to the theory of preference (Ando, 2016) could flourish.

As shown in Figure 4, economic and industrial activities that result in global environmental disruption such as the global warm. To avoid these subsequent terminations by our own flawed behavior, we propose a dynamical theory of individual preference in creations (*Section 4.1*). The development of a creative and sustainable personality can be realized by following the dynamical theory of preference. But, before going into the theory, the most remarkable effects of noise on unborn babies and children in the three stages of human life are discussed.

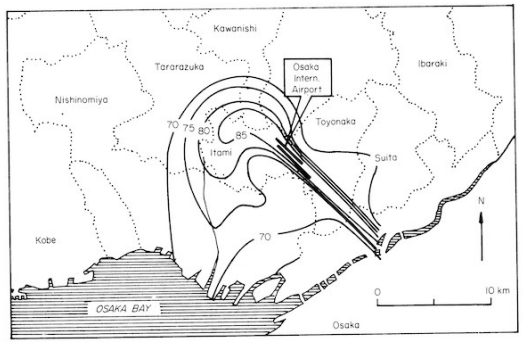

Figure 5: Aircraft noise level in the weighted equivalent continuous noise level (WECPNL) around Osaka International Airport. All living area in Itami City was WECPLN > 70.

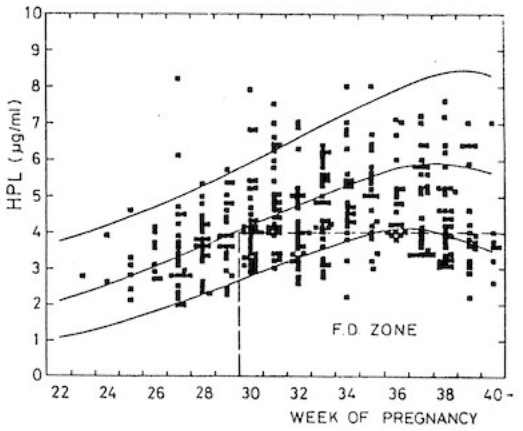

Figure 6: HPL levels of 343 mothers in the noise area (Itami City) by stage of pregnancy (Ando and Hattori, 1977a). Three lines show the 2SD and mean values for normal HPL levels (Lindberg and Nilsson, 1973).

3.2 Effects of Aircraft Noise on Development of Unborn Babies and Children

Our brain vividly and instantly responds to changes in environmental noise within a period of less than about 1.0 s. We should, however, be aware of the 'long-term integrated effects' on unborn babies through maternal placenta over the course of about one year. Exposure to noise qualifies as a psychophysiological stressor; on the other hand, environmental noise is a representative measure of quality of an urban environment. Investigations were performed around Osaka International Airport and the contour lines indicating noise levels are shown in Figure 5.

Long-term noise environment affects unconsciously on the development of the first through third stages of life as a typical stressor. Results clearly indicated:

1) Effects on the Body (the First Stage of Life): Evidence clearly indicated that due to noise stress, survival power in the body was lost during fetal life. Stress in pregnant mothers particularly after 30 weeks of pregnancy as shown in Figures 6 and 7 (Ando and Hattori, 1977a) decreased with the human placental lactogen (HPL) level more than 1SD below the mean in the stage of pregnancy, and even expressed in the fetal danger zone, F.D. Zone (Lindberg and Nilsson, 1973).

The number of children with birth weight less than 3000g was increased as soon as in the noisy environment created by jet planes flying regularly over Itami City rapidly from 1964 onwards compared to the neighboring quiet towns as indicated in Figure 8. This was compelling

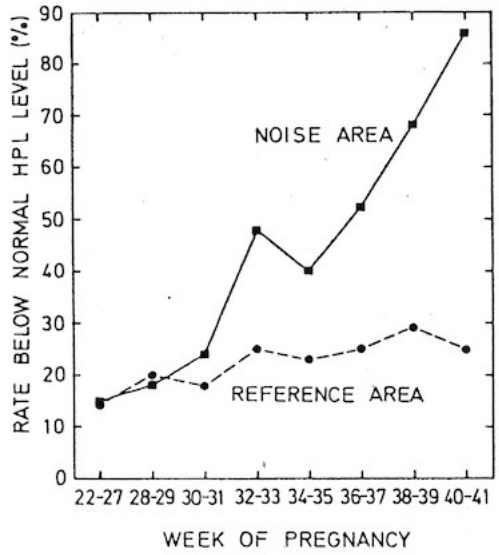

Figure 7: The percentage of mothers with HPL level more than 1SD below the mean in the stage of pregnancy (Ando and Hattori, 1977a). Samples from the noise area were collected at Itami City Hospital in Itami City, and the reference area was collected at the Kanebo Hospital in Kobe and Kobe University Hospital.

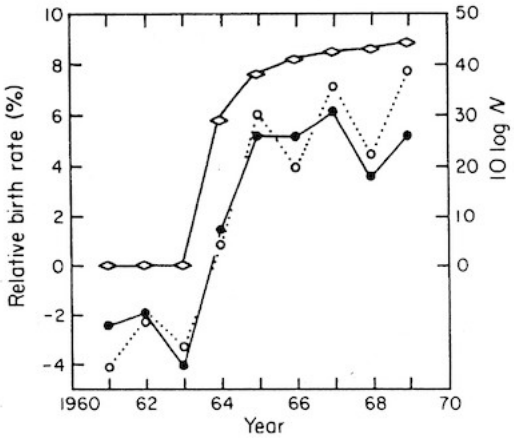

Figure 8: Relative birthrate under 3000 g in the noisy area (Itami City) and in reference to the neighboring low noise area, which relates to the number of jet planes using Osaka International Airport. Filled circle: Male. Open circle: Female. Open diamond: Number of jet planes parameter $10logN$, N being the number of jet planes using the airport.

evidence showing that survival power in the bodies of these children was considerably affected. Heights of children boys and girls of 3 years old were decreased by the living noise level over WECPNL 80 as shown in Figure 9 (Schell and Ando, 1991).

2) Effects on the Mind (the Second Stage of Life): Effects of aircraft noise on reaction of sleeping babies (2-4 months old) were reconfirmed by means of electroplethysmography (PLG) that questionnaire investigating reactions (Wake up and cry, Surprised reaction or No reactions at all) in relation to the pregnancy-periods when the mothers had moved into the noisy area (Ando and Hattori, 1970, 1973).

Results of PLG are shown in Figure 10. Most of the sleeping babies were tested in their own home environments visiting by reaction inspection vehicle. Groups were formed based on the time when the mother had started living in the noisy area. Majority of babies whose mothers had moved to the noisy area before conception or during

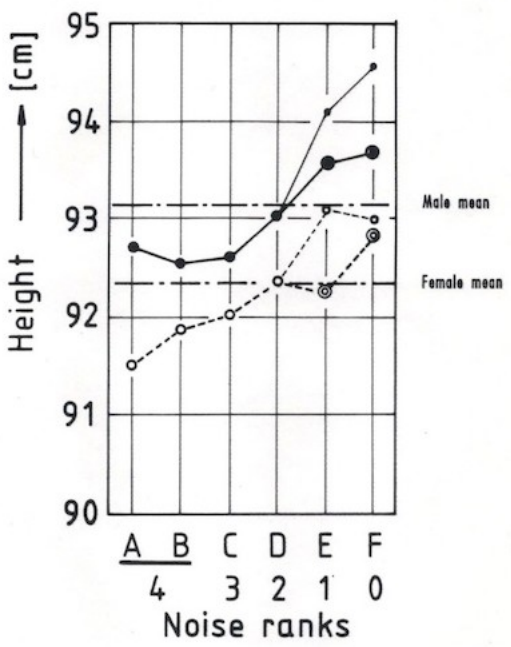

Figure 9: Mean heights of boys (filled circles) and girls (open circles) investigated at three years of age according to noise ranks of living area classified by (4: WECPNL > 85, 3: WECPNL 80-84.9; 2: WECPNL 75-79.9; 1: WECPNL 70-74.9; 0: WECPNL < 69.9). Smaller circles denote means of Kawanishi children, while enclosed circles denote means of Toyonaka children (Schell and Ando, 1991).

the first five months of pregnancy did not react to daily aircraft noise presumably due to 'prenatal adaptability', however, they did react to 'unusual music' stimuli, which was accredited to 'selective adaptation'. These postnatal effects of aircraft noise on the sleep of babies were shown to depend on the pregnancy-period when their mothers had moved into the noise area (Ando and Hattori, 1977a); 1% significance level between Group (I & II) and Group (III & IV) was achieved. The majority of babies in Groups (I & II) did not react to jet noise at peak levels of 70-90 dBA and they continued to sleep, however, babies in Groups (III and IV also V) reacted at 70-80 dBA, and some of them were afflicted enough to wake up and cry. Thus, about 70% of babies fewer than 4 months of age whose mother had moved into the noisy area before the first half of pregnancy were already adapted to the noise. But, the babies who had been subjected to noise in the later part of pregnancy (Group III and Group IV) were not more adapted to the noise, i.e., 100% of the babies reacted to the noise at 80-90 dBA.

It is remarkable as shown in Figure 10 that only less than 30% of the babies whose mothers had moved into the aircraft noise area before conception or during the first half of pregnancy reacted to noise during their sleep, even though the peak level was 80 dBA. On the contrary, of the babies whose mothers had moved into the noise area in the later half of pregnancy or after giving birth, as well as those living in a quiet area throughout, 100% reacted to 80-dBA-noise level.

3) Effects on Development of Cerebral Hemispheres (the Third Stage of Life): The whole body and soul may performed creations and design, so that all of three stages of human life are fully cooperated. The temporal

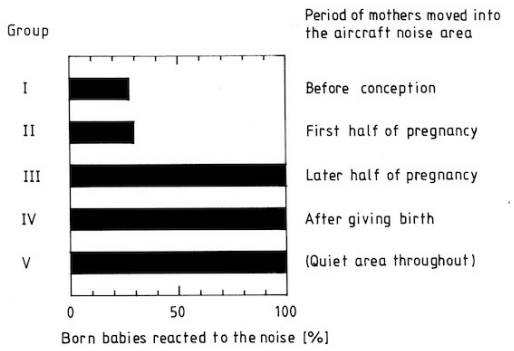

Figure 10: Percentage of plethysmogragh (PLG) reactions of each group (I-V) during sleep in response to the jet plane noise at peak levels 70 and 80 dBA.

and spatial objectives associated with the left and right cerebral hemispheres, respectively, as shown in Figure 1, see for example, CWS (Creative Work Space) described in *GLOSSARY AND DEFINITIONS*.

Development of hemispheric specialization in children living in noisy areas was clearly different upon testing for two different types of mental work: an adding task associated with the left hemisphere, and identifying lack of visual patterns - a task associated with the right hemisphere. (Ando, Nakane and Egawa, 1975, Ando, 1988) Tests were carried out in classrooms of two primary schools in a noisy area near the Osaka International Airport, and in two primary schools in a quiet area. The total number of participants (TNP) was 1,286. The no-stimulus group was tested in a normal classroom without any reproduced sound (NP = 572). The noise group was tested while being exposed to jet plane noise at 90-100 dBA peak (NP = 572). The music group was tested while listening to an excerpt from the fourth movement of Beethoven's Ninth Symphony at 80-90-dBA peak (NP = 142).

The time pattern and spectrum of the music were similar to the jet noise. The sound stimulus was reproduced from two loudspeakers set at the front of the classroom during every alternative period, during the tasks given by

$$i = 2n \tag{11}$$

where $n = 1, 2, \cdots 7$ for the adding task, and $n = 1, 2, \cdots 5$ for the search task.

Examples of a task of one period are shown in the upper part of Figure 11 (a) (60 s/period) and Figure 11 (b) (30 s/period). A 'work amount curve' of individual work produced in each period was drawn for all test results. The mean work performance is not discussed here, because there were no significant differences between different conditions. Of particular interest in evaluating the test results is the rate of 'V-type relaxation'. This type of relaxation is thought to cause by an abandonment of effort when mental functions are disturbed.

This score is classified into two categories according to the occurrence of a sudden large drop in the work amount curve during each task. This was assessed by $M_i < M - (3/2)W$, $i = 1, 2 \cdots N$, where M is the mean work performance and W is average variation of the curve excluding an initial effect in the first period, $i = 1$.

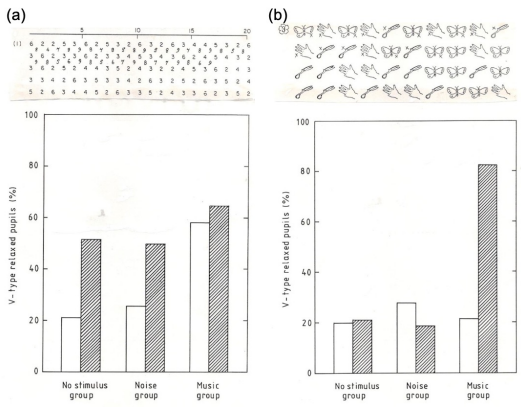

Figure 11: (a) Proportion of V-type relaxed children during adding task (9-10 years old). Unshaded bars are results from children from quiet living areas; Shaded bars show results for children from noisy areas. Upper part indicates the adding task neighboring two digits of one period of N (= 15). (b) Proportion of V-type relaxed children (7-8 years old) during the search (pointing out a lack of visual patterns by symbol x) task. Unshaded bars are results from children from quiet living areas; Shaded bars show results for children from noisy areas. Upper part indicates the task pointing out a lack of the pattern of one period of N (= 10).

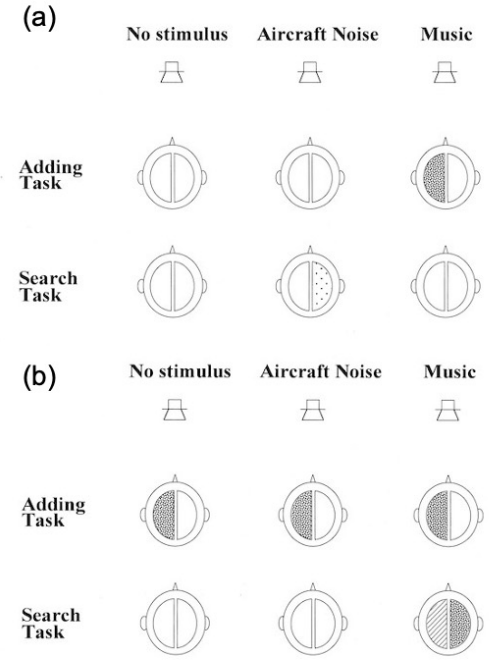

Figure 12: (a) Activated hemispheres of children from a quiet living area: Marked by shaded hemispheres indicates interference between mental tasks and sound stimuli. (b) Activated hemispheres of children from a noisy living area: Marked by shaded hemispheres indicates interference between mental tasks and sound stimuli or long-term jet noise in living area. Interference effects are quite different for children from a quiet living area as shown in Figure 12 (a).

As shown in Figure 12 (a), in a quiet living area, the percentage of V-relaxed children who had been given the adding task (N = 15) was much greater in the music group than in either the no-stimulus group or the noise group ($p < 0.01$). In the music group, as is expected, interference effects could be observed between music and the adding task, because hearing music and performing an adding task are both associated with the left cerebral hemisphere.

As shown in Figure 12 (b), concerning the pattern search the task (N = 10), the only significant difference between participants from different living areas was found in the music group ($p < 0.01$). Concerning the adding task, at the no-stimulus group we are seeing the long-term integrated effects of living in a noisy area, and no significant effects were observed either with or without noise reproduction.

Thus, development of cerebral hemispheres was greatly affected by the noisy living area. Results of the mental task were not dependent on gender, birth-order or birth-weight of the child, the working status of the mother, whether or not the mother had suffered from toxicosis during pregnancy, the child's gestational age when the mother moved into the noisy area, or the child's feelings about jet plane noise (Ando et al, 1975).

It is clear, therefore, that integrated effects of environmental noise on the specialization of cerebral hemispheres may strongly influence the development of personality as a source of creation.

Note that the author wished to proceed with further investigations on the effects of the noise around the Osaka International Airport on miscarriages, deformed children and stillbirth. Over 13,000 babies a year were still born in the noisy living area at around 1975. However, his kidney was beginning to be weaken, hindering his daily routine considerably to a point where he could not get out of bed. Thereafter, he decided to give up on further investigations on noise stress on unborn and born babies. At that time fortunately, he could work on studying subjective preference of the sound field of concert halls in Goettingen as an Alexander-von-Humboldt fellow.

So far, we discussed the negative effects of noise, but if pregnant mothers and born babies listened to preferred music, then survival power might be greatly enhanced according to the following theory.

4 PREFERENCE OF LIFE AMID VARIOUS STRESSORS

4.1 Dynamical Theory of Preference of Life Amid Various Stressors

Maintaining our environments in the long haul can be achieved by a variety of preferred creations springing from the actions of a variety of unique personalities based on their DNA, which may ultimately integrate as culture.

To keep health by avoiding various stressors, this paper proposes attaining survival power by means of a dynamical theory of preference amid various stressors of life as indicated in Figure 13 (Ando, 2018a, b; Ando and Jõgi, 2019). It is emphasized the most powerful preference so that a life based on the unique DNA of each individual may flourish. Knowledge achieved by nourishing creativity which is associated with both cerebral hemispheres, can later integrate into culture and thus last long after the end of an individual life in society (the third stage of individual life).

Survival power for the third stage of preferred human life can be achieved and maintained by the dynamical theory of preference (Figure 13). It has been indicated as follows:

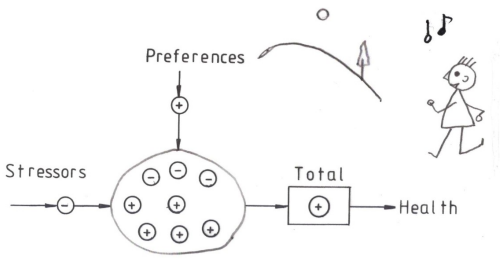

Figure 13: Dynamical theory of preference for life maintaining survival power amid various stressors. This supports and maintains survival power - health - even within such a vast variety of stressors.

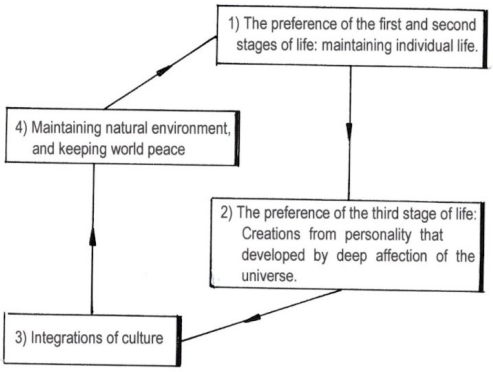

Figure 14: The preference for life in the first and second stages of life normally leads to maintaining individual life, and preference-based creations in the third stage of life that integrate with culture hopefully maintain the environment and support peace ad aeternum (Ando, 2018b).

(1) Preferred sound and visual fields are effective for supporting the three stages of life by induced long values of ACF τ_e of cerebral α-wave (Ando, 2009, 2016), which may transfer to the autonomic nervous and endocrine systems strengthen survival power.

(2) Any creative activities resonating with DNA support an individual in attaining optimal survival power as sustainability affords these creations the chance of being integrated into social culture which lasts much longer than the individual lifetime (third stage of life). In other words, the third stage of life may continue to the fourth stage of life in culture even after the end of individual life (Danjo, 2014; Ando, 2016).

As shown in Figure 14, this theory supports and maintains survival power - health - even amidst a vast variety of stressors. The biggest survival preference related to one's unique personality (DNA) is predominantly expressed when we select our field or direction in life. Human genetic manipulation should basically not be done. Simultaneously, personality-driven creations expand our awareness of our preferences. Other wonderful things exist in nature that are provided by the affection power of nature such as, for example, fresh air, green leaves, water streams, but also music and drawings that individuals have created serve as expressions of preference. Non-verbal communications performed at ages one or two clearly associate with the right hemisphere. It is also interesting to note that non-verbal communication is often performed with animals and plants in taking care of them.

The preference for life in the first and second stages of life normally leads to maintaining individual life, and preference-based creations in the third stage of life that integrate with culture hopefully maintain the environment and support peace ad aeternum (Ando, 2018b).

Again, performing preferred creative activities resonating with one's personality (DNA) might help to maximize survival power since the products of these activities may later become integrated with social culture, signifying a form of life extension.

4.2 An Experiment on the Theory: Effects of Preference and Stress on Dialysis Introduction Age (DIA)

To examine the dynamical theory of preference of life amid various stressors, this section shows to determine dialysis introduction age (DIA) or onset age of dialysis with stressors and preference factors investigated a questionnaire distributed to patients attending a hospital in Kobe, Japan (Ando, 2018a,b). To predict DIA according to 16 factors of stress and preference in addition to factors of dwelling environment as well as clinical history obtained, the mathematical quantification theory (Hayashi, 1950) was applied. All questionnaire data collected was 34 but valid data was 30 without lack of data, which were unanswered. The DIA data were rearranged by rounding ages, for example, 55 is 50 and 68 is 60.

It is remarkable that individual clinical history of past high blood pressure and proteinuria records was unexpectedly insignificant. But, the following eight effective factors were could utilized in calculating DIA: 1) human relations; 2) hard work over the years; 3) consumption of alcoholic beverages; 4) noise pollution at the dwelling; 5) other pollutions; 6) smoking; 7) number of hospitalizations; 8) number of times moving house. Note that other factors included gender, pets, bad odors, past noise pollution were insignificant.

Remarkable and significant results were that troubled inter-human relations that are potential accelerators of dialysis introduction age (DIA), caused by severe stress ($p < 0.01$) as indicated at the top of Figure 15. On the contrary, the preference factor of social drinking ($p < 0.05$) in an amount less than 180 cc of Japanese Sake in a day as indicated on the third row of the table, as it has been said to be the best of all medicine, that postponed DIA. As indicated on the second row of the table, 'hard work' for less than 29 years acted as stressor, but for more than 30 years postponed DIA due to habituation effects relative to period shorter than 29 years ($p = 0.05$). As indicated on the fourth row, noise pollution acted as a stress factor ($p < 0.1$).

As shown in Figure 16, DIA calculated with 8 factors is roughly agreeable with the DIA reported by the participating patients. The coefficient determination was 0.59 i.e., high enough in this kind of investigation. It is remarkable that the second significant factor was preferred alcoholic beverage less than 180 cc, i.e., enjoying a glass of wine or Japanese Sake to eliminate stress. This has been said the best medicine to relief stress, and thus postpone DIA.

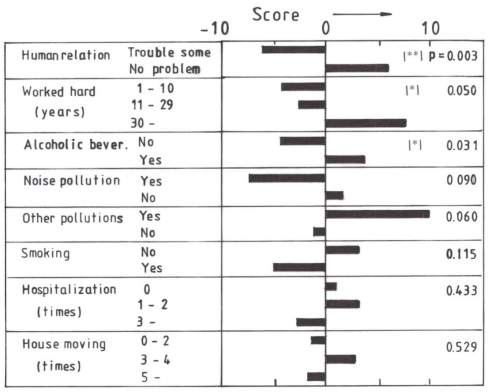

Figure 15: Results of each category of eight factors in calculating DIA by the analysis. Symbols [**] and [*] signify significant levels 0.01 and 0.05, respectively.

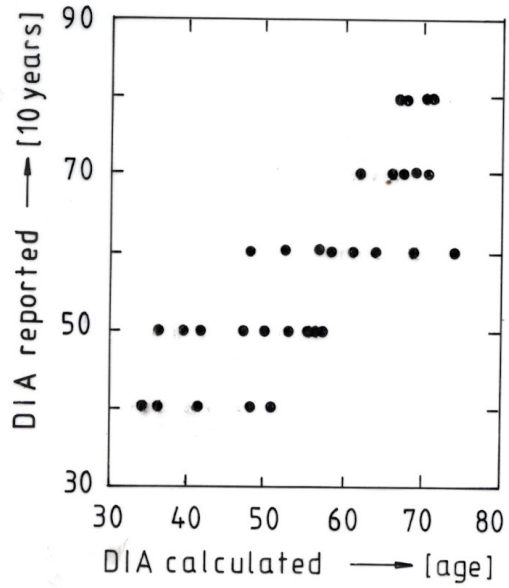

Figure 16: Relationship between DIA calculated utilizing results of analysis, and DIA (10 years as round number) reported in the questionnaire by each patient. Remarkably, DIA may be roughly described by eight factors indicated in Figure 15.

4.3 Remarks

Nowadays, our life is widely occupied by various stressors including troubled human relations throughout the world. To live a healthy and joyful life, we have proposed a dynamical theory of preference amid the stresses (*Section 4.1*).

Remarkable results were that troubled inter-human relations are potential accelerators of dialysis introduction age (DIA), caused by the accompanying severe stress ($p < 0.01$). On the contrary, the preference factor was social drinking in an amount less than 180 cc of wine or Japanese Sake ($p < 0.05$).

To conclude, even the onset ages of cancer and dementia could be more exactly predicted according to the described dynamical theory of preference of life amid various stressors. Thus, this theory might plays an important role in preventive medicine.

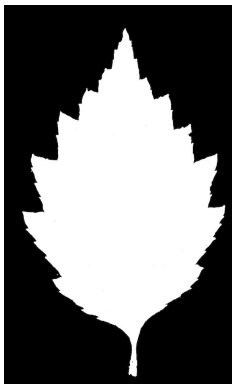

Figure 17: Fractal-shaped leaf was applied to the audience level plan of the Kirishima International Music Hall, which opened in 1994. The international Symposium on Music and Concert Hall Acoustics was held at this venue in 1995.

5 LEAF-SHAPED CONCERT HALL DESIGN, AND INDIVIDUAL SEAT-SELECTION ENHANCING PREFERENCE

5.1 Discovery of a Fractal-Shaped Leaf

On an evening in 1984, when we were working in the forest near living place (Hiyodoridai), we happened to discover a wonderful leaf shown as a sketch in Figure 17. This leaf became the turning point from an experiential design method (Beranek, 1962) to a scientific theory of subjective preference of the sound field for concert halls (Ando, 1977, 1983, 1985). Music is typical non-verbal communication between composers and listeners, mediated by interpreters and performers. Music preferred by an individual may attain the survival power throughout the life, thus the sound filed highly recommended to be the most preferred by the listener. It is not very typical to acknowledge that the sound field of a concert hall is in fact a second musical instrument, which plays an important role in the formation of a listening experience.

The leaf shape was applied to the acoustic design of the Kirishima International Music Hall, which opened in 1994 (Ando, 1998). This shape turned out to be an excellent template for realizing the most excellent sound field by calculating the scale value at each seating position which realized the optimal magnitude of interaural cross-correlation, $IACC < 0.4$ (Ando, 1977, 1983, 1985, 1994, 1998, 2007, 2009). This knowledge was unknown in the design of concert halls until the author published first paper (Ando, 1977).

5.2 Spatial Factors for Listeners

The typical spatial factor IACC should be kept as small as possible for every hall, maintaining $\tau_{IACC} = 0$ so that no image shift would be perceived. This is realized by suppressing the strong direct sound and reflections from the ceiling, and by encouraging appropriate reflections from the sidewalls at particular angles. If the source signal contains mainly frequency components around 1 kHz as usual, the reflections from the side walls are adjusted to be centered at roughly 55 degrees to each listener, measured from the median plane of the listener (Ando, 1998). For realizing this condition, therefore, the fractal-shaped leaf

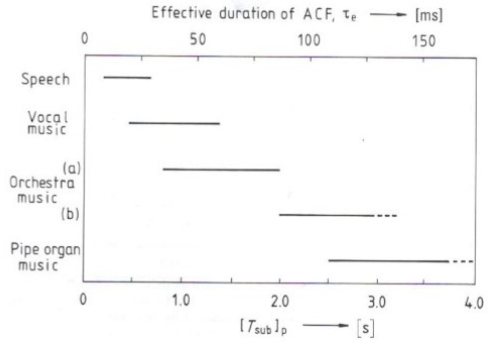

Figure 18: Preferred reverberation times of several sound sources estimated by Equation 12 in terms of $(\tau_e)_{min}$, i.e., the minimum effective duration of ACF of each sound source.

was applied to the audience level plan of the Kirishima International Music Hall, which opened in 1994.

5.3 Temporal Factors for Listeners

If the main purpose of the hall is performance of pipe organ music, the preferred temporal orthogonal factor $[T_{sub}]_p$ should be longest due the range of $(\tau_e)_{min}$ extracted from the running ACF of music signals such that (Figure 4.1; Ando, 1998),

$$[T_{sub}]_p \approx 23(\tau_e)_{min} \tag{12}$$

Thus, $(\tau_e)_{min}$ is selected to be relatively longer, centered on about 200 ms ($[T_{sub}]_p \approx 4s$). When the concert hall is designed for the performance of chamber music, the range of $(\tau_e)_{min}$ is selected near value 65 ms ($[T_{sub}]_p \approx 1.5s$). The conductor or the sound coordinator selects suitable music motifs with a satisfactory range of $(\tau_e)_{min}$ of ACF to achieve a music performance that blends the music and the sound field in the hall.

In order to adjust the preferred initial time delay gap $[\Delta\tau_1]_p$ for each music performance location, the position of each instrument is carefully selected on the stage. For instance, if the value of $(\tau_e)_{min}$ for violins is shorter than contrabasses with mainly low frequency ranges, the position of the violins is shifted closer to the left wall of the stage and the position of the contrabasses is shifted closer to the center as viewed from the audience.

5.4 The Sound Field for Performance of Musicians on Stage

For music performers, the temporal factors are much more critical than the spatial factors, because musicians perform over a sequence of time. Having reflections with a suitable delay time relative to the values of $(\tau_e)_{min}$ of the source signals is of particular importance (Nakayama, 1984, Sato, Ohta and Ando, 2000, Ando, 2009). Without any spatial subjective diffuseness, the preferred directions of reflections are in the median plane for music performers, resulting in $IACC \approx 1.0$. This condition is quite different from the listeners' preference, $IACC < 0.4$. To satisfy these acoustic conditions, maximizing scale values for both musicians and listeners is what leads to the final scheme of the concert hall.

5.5 Seat Selection System Enhancing Individual Preference

To maximize individual subjective preference for listeners, a special seat selection system for testing each listener's subjective preference was first taken into use at the Kirishima International Concert Hall in 1994 shown in as Figure 19 (Sakurai, Korenaga and Ando, 1996). The system used allows for testing the subjective preference of sound fields of four listeners at the same time. Since four orthogonal factors of the sound field influence the preference judgments independently (Ando, 1985, 1998), each single factor was varied, while the other three were fixed near the most preferred condition for the average listener.

5.6 Examples of Seat Selection

The music source was orchestral, 'Water Music' by Handel; minimum effective duration of the running autocorrelation function, $(\tau_e)_{min}$ was 62 ms (Ando, 1998). The total number of listeners participating was 106. Typical examples of the test results, as a function of each factor, for listener BL are demonstrated in Figure 20.

Scale values of this listener were close to the averages of subjects collected previously: the most preferred $[LL]_p$ is 83 dBA, $[\Delta\tau_1]_p$ is 26.8 ms (the preferred value calculated was 24.8 ms, where $[\Delta\tau_1]_p = (1 - log10A)(\tau_e)_{min}$ for the total amplitude of reflections $A = 4$), and the most preferred reverberation time was 2.05 s (the preferred value calculated is 1.43 s). Thus, the center area of audience seats was preferred for listener BL, as shown in Figure 21(a). With regard to IACC, results from all listeners indicated that the scale value of preference increased with decreasing IACC value.

The seats are classified into three parts according to the scale value of preference calculated by Equation 4 summating S_1 through S_4. The black portion of seats indicates preferred areas, about one third of all seats in this concert hall, for subject BL.

Since listener KH preferred a very short delay time of the initial reflection, $[\Delta t_1]_p$, his preferred seats were located close to the boundary walls as shown in Figure 21(b).

For listener DP, whose preferred listening level was rather weak (76.0 dBA) and preferred initial delay time short (15.0 ms), the preferred seats are in the rear part of the hall as shown in Figure 21(c).

In sound fields like these, individual listeners are able to enhance their satisfaction from the bottom of their personality (DNA), supporting their survival power in the concert hall. Musicians on stage are also affected. In such conditions, overall music culture can evolve greatly.

6 EXAMPLES OF INDIVIDUAL PREFERENCE OF SPATIAL AND TEMPORAL VISION

6.1 Preferred Regularity of Spatial Texture

As defined in the beginning of this article, individual preference is the most primitive response of living creatures that steers an organism in the direction of maintaining life, so as to enhance its survival power. Also, a judgment of individual preference is regarded as a basic response

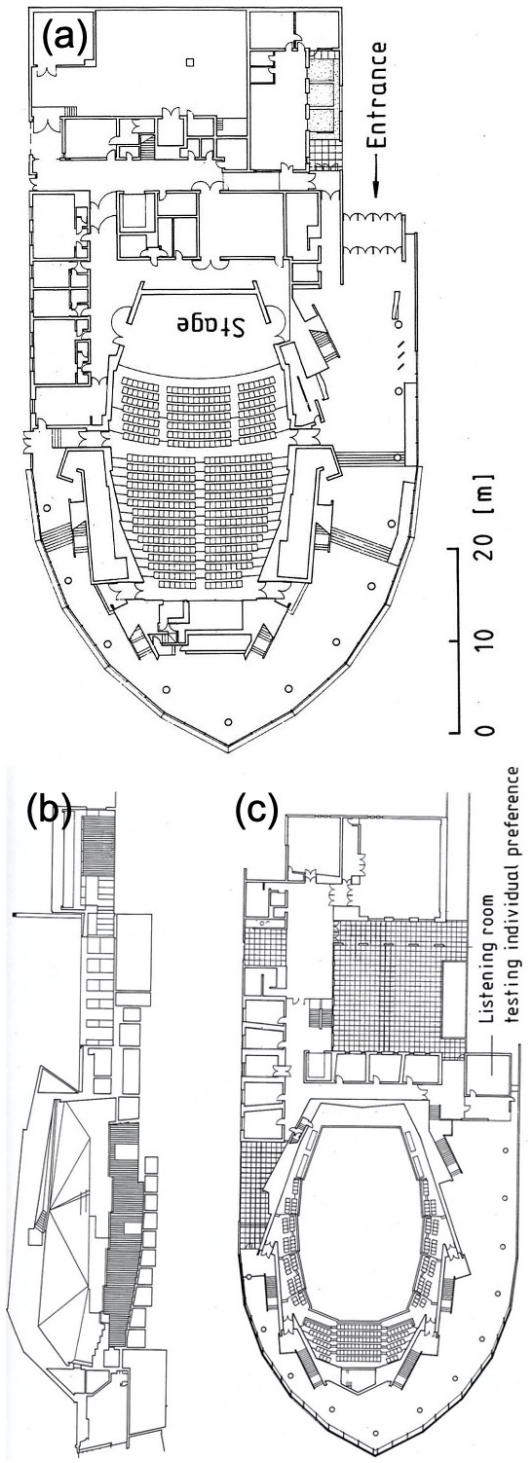

Figure 19: (a) The leaf-type concert hall (Kirishima International Music Hall) designed by architect Maki (1997) opened in 1994. (b) and (c) Scheme of the Kirishima International Concert Hall (Miyama Conceru) designed by architect Maki (1997) as a leaf type. (b) Longitudinal section. (c) Plane of balcony level.

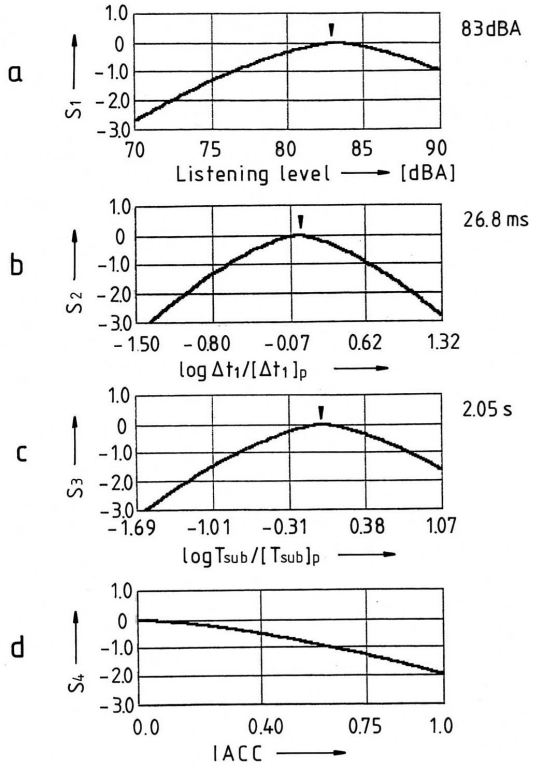

Figure 20: Typical examples of the scale value of subjective preference obtained by the paired comparison test (PCT) for each of the four orthogonal factors of the sound field (subject BL), which were similar to averaged values with a number of listeners. (a) The most preferred listening level was 83 dBA. (b) The preferred initial time delay gap between the direct sound and first reflection was 26.8 ms. (c) The preferred subsequent reverberation time was 2.05 s. (d) Subjective preference as a function of IACC. The most of listeners are similar tendency, so that it is called the consensus preference.

reflecting aesthetic value. Individual preference has been well based on neural activities in the central auditory signal processing system and the specilization of cerebral hemispheres (Ando, 2009). Dynamical theory of individual preference amid various stressors is described in Section 4.1, accepting the sympathetic-parasympathetic nervous system and the related endocrine system.

Subjective preference test for textures as shown in Figure 22 was conducted by changing the factor ϕ_1 (Figure 5.2). The size of a texture displayed was 10 cm and 10 cm on the PC with 33.5 cm and 20.5 cm. The PCT was conducted changing textures (Ando, 2009).

Four orthogonal factors $\Phi(0)$, ϕ_1, δ_1 and δ_e may be extracted from the two-dimensional ACF (Ando, 2009, 2016). In order to compare the degree of fluctuation in the texture, the amplitude of the first peak ϕ_1 in the ACF as perceived regularity was considered, because the distance δ_1 was roughly constant.

Ten, 22-to 24-years old subjects participated in the experiment. All had normal or corrected to normal visual acuity. Two-dimensional textures were displayed under a dark surrounding. The display was set at a distance of 1.5 m from the subjects. Subjects were presented pairs of two stimuli and asked to judge, which they preferred (PCT). All possible pairs from the five selected stimuli as shown in Figure 22 were presented in a random order in one session. All subjects conducted ten series of sessions, giving a total of 100 judgments.

Results for all subjects are shown in Figure 5.3. The scale value of the subjective preference has a single peak value for each subject, even allowing some individual differences. The most preferred range was found in the value of ϕ_1 for each subject. Subjects did not prefer textures, which had a too high or too low value of ϕ_1. The most preferred for each individual was $0.13 < [\phi_1]_p < 0.76$. However, outside of this range may act as "stressors" in

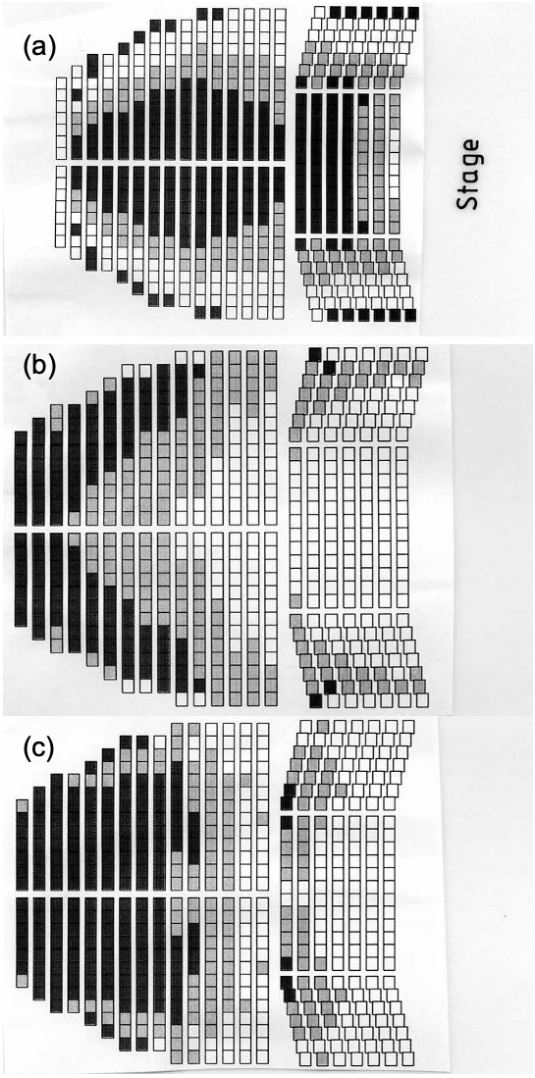

Figure 21: (a) Preferred seating area calculated by Equation 4 for subject BL. (b) Preferred seat area calculated for subject KH. (c) Preferred seat area calculated for subject DP.

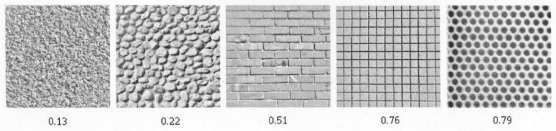

Figure 22: Two-dimensional spatial and significant textures by value of ϕ_1 (regularity) extracted from the normalized ACF as defined by Figure 23 used for subjective preference judgment by the paired comparison test (PCT).

visual texture.

It is worth noticing that there are many examples designing periodical pattern such as quadrangle back-wall on stage enclosures of some concert halls, and periodical windows structure of the modern buildings with $\phi_1 > 0.8$, these are not preferred acted as stressors for the second stage (mind) of life losing the survival power.

The upper figure shows a degree of individual differences. The scale values of all individuals and number of subjects, the scale value of preference can be approximately expressed by the same as Equation 5,

$$S \approx -\alpha[x]_p^{3/2} \tag{13}$$

where $[x]_p$ is $\phi_1 / [\phi_1]_p$, the averaged weighting coefficient

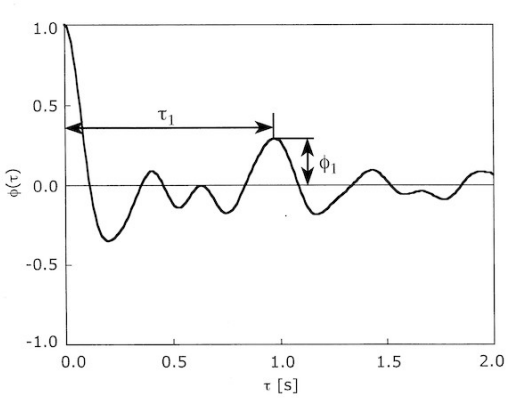

Figure 23: Definition of spatial factors τ_1 (spatial pitch) and ϕ_1 (regularity or spatial pitch strength) extracted from the spatial autocorrelation function of the two-dimensional textures.

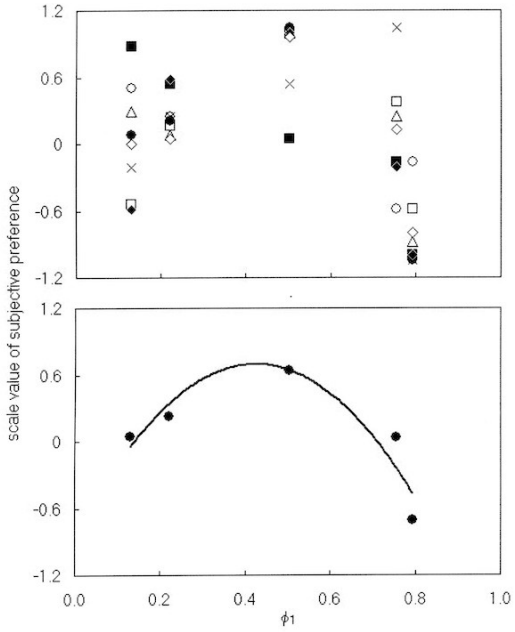

Figure 24: Above: Scale values of preference obtained from ten individual subjects. Below: Averaged preference values and a curve fitted with Equation 13.

$\alpha \approx 3.9$, and the most preferred value for texture regularity was found $[\Delta 1]_p \approx 0.41$.

6.2 Flickering Light in Temporal Vision

These factors are extracted respectively from the temporal ACF associated with the left hemisphere (Table 2) and the spatial ACF associated with the right hemisphere of the visual field (Ando, 2009).

In order to obtain basic data for the temporal aesthetics of flickering light, PCTs were conducted. Subjective preference for a flickering light in terms of the ACF factors of the stimulus signal was also conducted (Soeta, Uetani and Ando, 2002). It was found that the preferred sinusoidal period $[T]_p$ of the flickering light is roughly

$$[T]_p \approx 1.0s \tag{14}$$

To attain more representations of subjectively preferred conditions in addition to the sinusoidal signal given by Equation 14, a fluctuation was introduced to the preferred

Table 2: The most preferred fluctuations in flickering light $[\phi_1]_p$ for each observer and the averaged value.

Observer	$[\phi_1]_p$
A	0.51
B	0.50
C	0.47
D	0.58
E	0.45
F	0.90
G	0.27
H	0.33
I	0.33
J	0.31
Averaged	0.46

sinusoidal flickering light centered on 1 Hz. In this procedure, the amplitude of the first maximum peak extracted from the temporal ACF of the flickering light stimulus was the fluctuation factor ϕ_1 as shown in Figure 23, which was controlled by changing the bandwidth of the noise (1, 2, 4, 8 and 16 Hz) over the period of 1 Hz.

It is worth noticing that subjective preference for flickering light was obtained by the PCT, which was investigated in terms of ACF factors of the signal in the time domain. The most preferred degree of fluctuation was found around $[\phi_1]_p \approx 0.46$, and the scale value of preference was formulated approximately in terms of the 3/2 power of the normalized ϕ_1 of flickering light by the most preferred value, $[\phi_1]_p$ similar to Equation 13, also. Thus, a certain degree of fluctuation in both temporal and spatial factors is a visual property maximizing subjective preference (Soeta et.al, 2005, Ando, 2009).

In the natural environment, we may find many visual aspects in temporal fluctuation, such as leaves in the wind and clouds in the sky, twinkling stars due to air currents, flames and flows of water in a river. Flames in a bonfire and glittering sunlight reflecting from the water surface provide us with a lively and splendid environment. These temporal aspects may stimulate the left hemisphre due to temporal aspects.

Subjective preferences of individual differences was rather wide ranging between 0.27 and 0.90 of ϕ_1. The averaged value for the participating subjects was $[\phi_1]_p \approx 0.46$ (Soeta, et al., 2005). Individual results of the most preferred fluctuation factors $[\phi_1]_p$ are listed in Table 2. The value of ϕ_1 is the degree of fluctuation that corresponds to "pitch strength" in sound signals. In music performance, it is a kind of artistic expression in the temporal domain.

The averaged weighting coefficient has been obtained with a number of subjects, $\alpha \approx 11.0$ in Equation 13. Considering the thermal environment, the effects of "breeze" could be described by applying the factors ϕ_1 and τ_1, which are extracted from the ACF of wind speed.

6.3 Oscillatory Movements of a Target in Temporal Vision

A good visual example of oscillatory movement of a target as shown in Figure 25 is a wall clock. Results of preference judgments applying the PCT for sinusoidal movements of a single circular target without any fluctuation on a

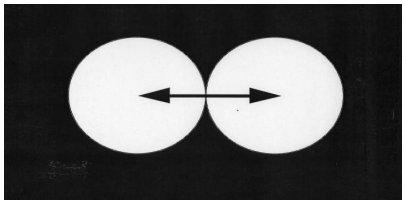

Figure 25: Stimulus target applied of showing an example of the horizontal movement.

Table 3: The most preferred periods [T]p of vertical and horizontal movements of the target for each subject and the averaged values.

Subject	Vertical [s]	Horizontal [s]
A	1.15	1.28
B	1.05	1.82
C	0.78	1.31
D	1.16	1.79
E	0.85	0.91
F	0.83	1.65
G	1.08	1.31
H	0.81	1.04
I	0.93	0.98
J	1.10	1.12
Averaged	0.97	1.26

monitor screen are mentioned in this section. The period of stimulus movements was varied separately in the vertical or horizontal direction.

The stimuli were displayed on a CRT (width about 20 cm and height about 15 cm) monitor presenting 30 frames per second - a single white circular target moving sinusoidal (Soeta, Ohtori and Ando, 2003). The diameter of the target was subtended 1° of the visual angle (1.22 cm). The movement of the stimulus is expressed as:

where A is the amplitude and T is the period of the stimulus. In all experiments, the amplitude A was fixed at 0.61 cm on the monitor screen, corresponding to 0.5° of the visual angle. The white target and black background corresponded with gray levels 40 and 0.5 cd/m^2, respectively. The monitor presenting the stimuli was placed in a dark room 0.7 m away from the subject' s eye position to maintain natural binocular vision.

Subjective preference for the period of movements in the horizontal and vertical directions was examined separately. The period of stimulus movement T in Equation 15 was varied at six levels: $T = 0.6, 0.8, 1.2, 1.6, 2.0$, and 2.4 s. Thirty pairs combining six different periods constituted each series, and 10 series were conducted for all 10 subjects in the experiments by the PCT.

$$h(t) = A\cos(2\pi t/T) \tag{15}$$

The individual values of preference for movement oscillation periods in the vertical and horizontal directions are listed in Table 3. Results indicate that the most preferred periods ($[T]_p$) for all subjects are about 1.26 s in the horizontal direction and about 0.97 s in the vertical direction ($p < 0.01$).

As far as the author knows, typical clock periods are rather fast so that people living in houses would feel busy and get unconsciously "stressed".

6.4 Specialization of the Cerebral Hemispheres for the Visual Field

We have investigated subjective preference for the visual field related to alpha-wave activities on both the EEG and the MEG. The ACF τ_e value of the alpha wave range at the preferred period of the flickering light was longer than those for the less preferred period for all subjects ($p < 0.01$). Remarkably, averaged values of τ_e and ϕ_1 extracted from the ACF of the MEG alpha wave from the left area were significantly larger than those from the central and right areas ($p < 0.01$). Also, effects of the subjective preference and measurement position on values of τ_e, $\Phi(0)$ and ϕ_1 extracted from the ACF of the MEG alpha wave (eight subjects) were examined, when the single circular target moved in the horizontal direction. The values of τ_e and ϕ_1 for the preferred stimuli were longer than those for the less preferred stimuli ($p < 0.01$). It is obvious that the value of τ_e correlated with the value of ϕ_1 ($r = 0.72$, $p < 0.01$), but not to the value of $\Phi(0)$ ($r = 0.23$). It is concluded that the averaged values of τ_e and ϕ_1 from the left area were significantly longer than those from the central and right areas.

We analyzed the MEG signals from the entire head in response to visual stimuli in which the temporal factor ϕ_1 was manipulated using different bandwidths of flicker noise centered on 1 Hz (Okamoto, Nakagawa, Yano and Ando, 2007). The results showed that the τ_e values of the alpha rhythm observed around the left occipital area were significantly larger for the most preferred stimuli than those for the less preferred stimuli. This tendency indicates that the stimuli in the preferred condition, with regard to changes of the temporal factor in the visual signal, increase the stability of the alpha rhythm around the left occipital area.

We also found in the MEG study that the values of τ_e and ϕ_1 from the left occipital area were significantly larger than those from the central and right occipital areas, but such tendencies were not found in the EEG study. So far, it is reconfirmed that the left hemisphere is mainly associated with the temporal factor of the visual field as similar to the sound field (Ando, 2009).

The study on the relationship between the EEG response and the subjective preference by varying of the period of the horizontal movement of the single target showed as follows: The value of τ_e of the alpha waves for stimulus at the most preferred condition was longer than that for stimulus at the less preferred conditions ($p < 0.01$). This tendency was maximum at O1 in the left hemisphere. The value of $|\Phi(\tau)|_{max}$ of the alpha waves for stimulus in the most preferred condition was greater than that for the stimulus in the less preferred conditions ($p < 0.01$). Considering this fact together with the similar repetitive feature in the alpha wave increased, the brain repeats the "alpha rhythm" in the time domain, and this activity spreads wider over the area of the brain cortex at the preferred stimulus condition.

Table 4 summarizes the cerebral hemisphere specialization to visual temporal factors, which were observed here, that indicates the left hemisphere dominance. It has been reported that the left cerebral hemisphere is much concerned with linear, sequential modes of thinking, such as speech and calculation. In contrast, the right hemisphere tends to perceive space in multiple-dimensional and non-temporal terms for the visual field (Sperry, 1974; Davis and Wada, 1974; Galin and Ellis, 1975; Levy and Trevarthen, 1976). Subjective preference about time-factored experience for the sound field takes place in the left hemisphere, and the spatial factored experience in the right hemisphere.

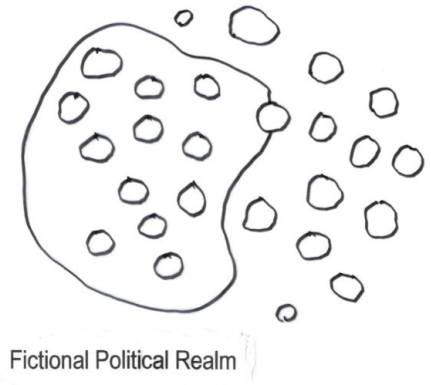

Figure 26: From Globalization of Majority Based Society to Individual Based Society. Globalization is indicated by a realm; however, there will be always preference of individuals outside of the realm. In order to all of individuals may satisfy as a minimum unit of society due to their preference, because number of people existing on the earth is limited integer. It is small enough from a computer memory as well as the whole universe.

7 DISCUSSION TOWARD FUTURE SOCIETY

7.1 From Globalization of Majority Based Society to Individual Based Society

Nowadays, it is normative that human life is so occupied by a wide range of stressors as described previously. For example, environmental noise affecting unborn babies and children in beginning of human life, ugly visual design and troubled human relations that the pleasure derived from the process of living is regretfully often drained away by stress. Serious illness such as cancer, kidney disease, dementia, and intractable disease and due to coronavirus spread around the world that caused by losing individual survival power. It is considered that the survival power of all of individuals in the whole world has been clearly less than that of the coronavirus, for example.

Therefore, negative spiral of society throughout the world will be resulted, if globalization of majority based society will not changed into following individual based society as shown in Figure 26. For instance, in order to reduce greenhouse gas by temporal design stopping the global warming is one of the hardest problems. How we could control of problem of industrial productions and the related mass transportation global activities that was initiated in 1830?

We emphasize here original creativity as for third stage of life, preferred individuals activity resonating with personality associated with DNA, and with the left and right cerebral hemispheres, respectively, associating with temporal and spatial objectives (Ando, 2016). Most generally, subjective preference is regarded as a primitive response of

Table 4: Left hemisphere specialization observed in EEG and MEG alpha waves in relation to the temporal factors of the visual field (Ando, 2009).

Temporal Factor	EEG, ACF τ_e value of α-wave	EEG, CCF $\|\phi(\tau)\|_{max}$ value of α-wave	MEG, ACF τ_e value of α-wave
Period of the flickering light, T	$L < R$ (SW)	$L\&R$ (SW)	$L > R$ (SW)
Period of the horizontal movement of target	$L > R$ (SW)	—	—

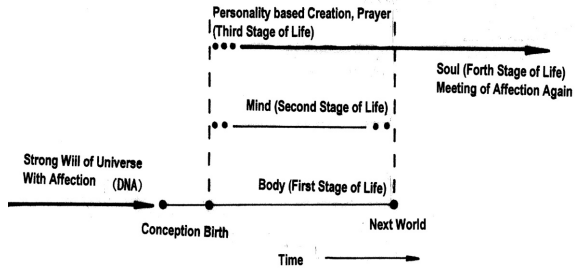

Figure 27: Three stages of human life defined that are taken into consideration in designing the temporal and spatial environment (Ando, 2016). Human life consists of 1) life of body; 2) life of mind, and 3) life of original idea and creation is based on a unique individual personality that may persist long after the individual has passed on possibly as culture. Thus, it may attain the most survival power. The third stage of life is the most unique and joyful to human that makes philosophically wider and lives longer than the first and second stages of life. The third stage of life could be outgrown to the forth stage of life if it will be accepted by future generations (Danjo, 2014).

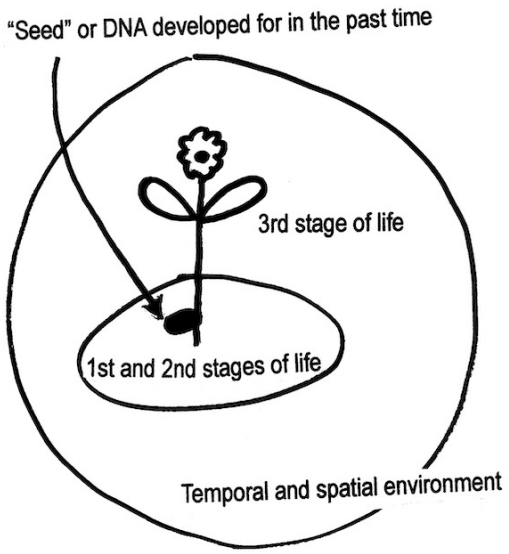

Figure 28: Development of the third stage of human life originated from individual personality (DNA) "seed" that is nurtured in preferred or esthetic temporal and spatial environment (Ando, 2016). Everyone is a genius because of different DNA given by Nature. Personality (DNA) for unique idea and creation may be well developed and effloresced like a flower of plant. This is the third stage of life and great possibility to remain as a parting gift to be the forth stage of life (Danjo, 2014). There are huge numbers or rather infinite countable number of fields are unknown to be clarified by individuals who are existing over the earth, about $7.55x10^9$ at present time in 2020.

living creatures that entail judgments that steer an organism in the direction of maintaining life, so as to enhance its prospects for survival. Balance of creations and recreations in individual life are highly recommended. Preference is not luxurious; therefore, it may deeply be associated with the base of aesthetics. This article introduced our inherent, built-in survival power by means of dynamical theory of individual preference amid various stressors of life as mentioned in Section 4.1.

7.2 Individual Based Society

For temporal design of the human environment, three stages of life are considered here, which is granted to each individual personality driven by DNA. The first is the physical life, the second is the spiritual and mind life. These two are in common to animals; only differences are just degrees. The third is very human as shown in Figure 6.2 that is the noblest among the three.

All of individuals may cover together all of fields needed for health, maintaining environments and keeping peace in the whole world. It is a wonderful fact to have all individuals born in different DNA thus different personality available obtaining for different original ideas and creations (third stage of life).

It goes without saying that science and art are always immature, because known are limited and ever under developing. They say that the 19th and 20th centuries were the era, in which technology made rapid progress. However, there existed all sorts of destructions behind such progress as a result. Those were namely environmental destructions and wars. It was probably because we were overconfident about science and technology, which was merely a tool for mankind. In order to make a coming age of human life into reality, it is desired to understand mankind itself better with the third stage of life. On this account, we should prepare an environment where every man's sensitivity, which do not incline to technology but include science and art that can be enhanced.

The question of how many years mankind will be able to survive is the primary factor of individuals and social concern. There have been major wars under the plea of the racial liberation, religious liberation or the liberation of a state, and such possibility cannot be denial at present. Therefore, we hope to make "liberation of unique individuality (the third life)" one of ultimate objective of this article. The liberation of individuality here means to accept diverse valuable individualities of yours and others, and cultivate creativity, which can only be achieved by each individual potential (Figure 28).

A well-designed environment would be a meeting place for art (aesthetic) and science (*Sections 4.2-4.4*), and, in turn, may help to discover the individual personality as the minimum unit of society. Everyone is a genius because of different DNA given by Nature for long time. Temporal and spatial factors associated with the left and right cerebral hemispheres, respectively, may be well designed blending of a built environment and the Nature (Ando,

2009, 2016). Such environments, in turn, may help for development of human cerebral hemispheres, especially for the period during from the very beginning of life to about three years of age. It is said that the soul of a child of three years old is the same at a hundred years old.

Space (land) was thought to be a personal possession, and time was thought to be equal in the past. But in fact space including environment is something common to all mankind from generation to generation, and time does belong basically to individuals. It is ideal to build environment as well as a society where people can enjoy healthy physical, spiritual and individual time for assisting original idea and creation, ex. by utilizding the creartive work space, CWS (Ando, 2016).

Above all, we would like to define the nurture of creativity (making a contribution generation after generation) originating in individual time, which is unique to mankind, as the liberation of individuality. In other words, there are mysteries solvable only by each person's individuality due to different personality (DNA) and different viewpoint, which will never be generated again. Such a solution may only gain its eternal value once it is unveiled, but it is no exaggeration to say that those mysteries remain unsolved if solutions were unfound as a result of uniform education (Figure 28).

Mysteries of this sort exist in a place of every human activity, and providing a place for each individual to nurture a task, given to him/her and sprout out at their heart shall be the starting point of education and creation. We believe that this kind of education will be ultimately established, so that human and global environment (time and space) contributes to a healthy development of culture and science. For above reasons, it is ideal to liberate the original individuality from all idol worships of mere economic efficiency, status, reputation and so forth. Such idea of an individual liberation will not only be a process towards peace as it entails mutual respects but also hold hidden potential of becoming the path to protect all lives from environmental destructions. In order to develop individual personality and creation and any activity, we are attempting to provide a temporal design of our environment for the third stage of life as a hope for living, in addition to the first and second lives. That might be a base of each individual and development of healthy society and environment (Figure 6,4).

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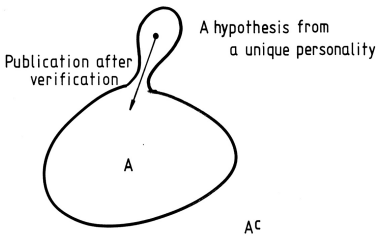

Figure 29: Sets of known A and unknown A^C. Creations start to have a hypothesis from a unique personality. After verification of the hypothesis, it may be published. This is a process of the third stage of life. When this kind of creations is integrated, then we call it "culture" (Ando, 2016).

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It is worth noticing that the dimension of the head of newborn babies is relatively large because this part is initially developed in the body. If we consider analogy of this, it is highly recommended that the facilities related to unique individual potentiality (Figure 30) should be the first designed in house ex. CWS, and in addition urban, such as a museum, a concert hall, a library, a church, a temple and an institution, which may act as an important role for developing the third life of the individual.

1) Individual Power of Survival (Maximizing Preference - Minimizing Stress)

Maintaining our environments in the long haul can be achieved by a variety of creations preferred springing from the actions of a variety of unique personalities based on DNA, which ultimately integrate as culture. So that minimizing stresses are realized.

2) Individual Power of Affection (Maximizing Affection - Minimizing Avarice)

Individuals endorsing a particular affection value may play important role avoiding bullying, recovering environments and keeping peace. On the other hand, a nation with highly valuing idolatry such as money and status might result in being terminated for global environments and even subject to occurring possible nuclear war and also that utilizing biological weapons. Well-educated individuals for the third stage of life are never developing nuclear and/or biological weapons and using them in this world.

3) Entrance Examination of Universities and Colleges (Maximizing Asking a Purpose of Studies - Mini-

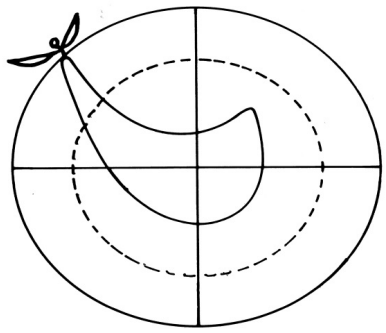

Figure 30: Individual potentiality to a particular direction due to the personality (DNA seed) and discover something originals that have not previously known because of unique DNA (Ando, 2016). There is infinite countable number of unknown fields, which individuals should be tackled. For example, the typical directions are music, pictorial art, formative arts, athletics, mathematics, science, engineering, literature, medicine, history, geophysics, agriculture, economics, business, and others that should be done by individuals. It is regret that the fields of the Nobel Price are so limited that balance of society is being resulted almost termination. Dotted line is a record of an honor student, who is always high records in all of fields; however, they subject to never produce creations from the bottom of personality. This is not the objective of education.

mizing Testing Just for Knowledge)

A universal education and a globalization subject to suffering stress and consecutive Illnesses. Objectives of this article is shifting from animal stages of body and mind, to the third stage of human life. As is discussed here, any original idea and creative activities resonating with personality (DNA) may attain the most survival power of Individuals and thus society, because it may be integrated in culture that is far longer than the individual lifetime. Therefore, in order to ask, for example, individual purpose of students together with its originality and creation to be performed after entrance that is far more important than testing just for a wide range of knowledge.

ACKNOWLEDGE

The author has noticed the words of "individual power of affection", when he was informed from the daughter of, Professor Hiroshi Hattori who was just passed away in the end of January 2018. We have investigated together the most of research works on effects of jet plane noise on unborn babies and children (Ando and Hattori, 1970, 1973, 1974, 1977a,b). Since the mid-1970's, the author has been invited several times by the physics institute in Goettingen as an Alexander - von - Humboldt Fellow to work on the research for subjective preference of the sound field in concert halls (Ando, 1985, 1998, 2009). As a matter of fact, the author himself has been on set dialysis treatment since 2009, attending the Kidney Center at Konan Hospital once a week. On the other days, he was performing peritoneal dialysis by himself beside a small creative work space (CWS) on one day in a week. He noticed a potential for an investigation by means of distributing questionnaires to colleagues. Before investigation, Dr. Akira Fujimori, Director of the Kidney Center at Konan Hospital kindly allowed the work and provided useful comments on the report. Also, Dr. Hiraku Kadoguchi, Director of the Kenshukai Clinic for his kind instruction for hemodialysis since September 2019.

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