Putting SDSS into Practical Use: A Creativity Support System to Enable a State of "Mental Alertness"

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Summary
Many people seem to feel sluggish in a fed state and feel mentally alert in a fasting state. However, despite these phenomena having not been proven with scientific evidence yet, many people would empathize with such state of mind. In this paper, based on prior research that shows that Brain-derived neurotrophic factor (BDNF) is secreted in a fasting state to improve brain function, this research reveals the relevance between a fasting state and a state of being alert. We have devised and developed a smartphone application software to control a state of being alert intentionally by applying this mechanism.This system enables the user to enter an alert state consciously by maintaining a fasting a little state. Therefore, this system can have an effect on both the diet; dietary control, and work efficiency by purposely creating an alert state. Based on our hypothesis, which states that by managing meal intake size and meal time, we can control a state of being alert intentionally, we have devised SDSS (Smart Diet Support System). We have also conducted a study to check the validity of our hypothesis and the proposed system.

Key words:
Criativity Support System, Smartphone Apps, Information Design, Cognitive Sciene

1. Introduction

Today, adult obesity is a worldwide problem. For example, it is said that, on a global scale, it is possible that more than one out of three adults experience health consequences due to obesity. These days, obesity is a serious physical and social problem in not only wealthy advanced countries, but also low middle income countries and regions. In order to tackle this problem, not only those who are obese but many people today have a strong interest in adequate diet and feeding control. However, dieting or exercising tends to be expensive. Also, feeding control by oneself is quite difficult to continue. In this research, we believe that continuous dietary control is only possible when it becomes a part of our essential daily tasks. In other words, we theorize that it is beneficial to maintaining a healthy diet and dieting practice, to connect feeding control to the everyday tasks.

Every business person is expected to be very efficient at work each day. Mental alertness is integral if he or she is to be capable in their job. It is assumed that accumulating knowledge or skills is also important, but mental alertness, which provides inspiration and innovative ideas is an essential factor. However, the state of being alert is strongly influenced by physical and mental conditions. It is also affected extensively by sleep, exercise, dietary control and stress. To enable business persons to be very efficient, a wide variety of supportive services and products are marketed. There is a lot of information available based on our understanding and experiences; "you get more work done in the morning." "a plant-based diet aids your mental stability."

Of this information, certain phenomena such as "when you are fed, you feel sluggish" and "when you are fasting, you are alert." captures our attention. Generally it is said that a fasting/fed state is possibly-linked to alertness. For example, one who tends to be sleepy after eating lunch until full, can intentionally eat smaller portions in order to be more efficient in the afternoon. On an empirical basis, many people think that there is a connection between how full you are and alertness. However, these ideas have not been proven with scientific evidence, effect or efficacy. In response, this study has revealed the relationship between fasting/ fed level and alertness based on not sensations but verifications. Utilizing the mechanism, we have proposed and developed the system which enables the user to control a state of being alert consciously.

2. Relevant Studies

The relationship between a fasting/fed state and a state of being alert is not necessarily based on scientific evidence, though it is assumed to exist empirically. It is often the case of a belief based on popular theory.

Perceptions such as sluggish in a fed state and alert in a fasting state are widely recognized on an empirical basis.

We carried out a questionnaire targeting 497 university students that showed that 63.7% of students, (total response of full/ fed/fed a little), expected that they would feel sluggish in a fed state. The results are shown below.

Manuscript received November 5, 2015
Manuscript revised November 20, 2015

Question1: ***Which is the state in which you would feel sluggish?***			
		Responses (Respondents)	Response rate
1	Full	192	38.6%
2	Fed	101	20.3%
3	Fed a little	24	4.8%
4	Neither	22	4.4%
5	Fasting a little	13	2.6%
6	Fasting	47	9.5%
7	Hungry	98	19.7%
Total		497	100.0%

Question2: Which is the state in which you would feel alert?			
		Responses (Respondents)	Response rate
1	Full	1	0.2%
2	Fed	23	4.6%
3	Fed a little	69	13.9%
4	Neither	167	33.6%
5	Fasting a little	173	34.8%
6	Fasting	42	8.5%
7	Hungry	22	4.4%
Total		497	100.0

This questionnaire did not aim to investigate the actual conditions, but rather aimed to unveil their expectations. Therefore, it is clear that many university students expect that they would feel sluggish in a fed state, regardless of the actual conditions. However, the rate of students who expected that they would feel alert in a fed state (total response of full/ fed/ fed a little) was quite low at 18.7%.

A high rate of students, 43.3%, expected that they would feel alert in a fasting state (total response of fasting a little/ fasting), whereas the number of students who expected that they would feel alert in a hungry state, was found to be quite low at 4.4 %. With these results, the expectations of students for a fasting/ fed state and alertness was revealed to be alert in a fasting state. This questionnaire only targeted university students. Though the results might not be absolute, it is indicated that perceptions such as sluggish in a fed state and alert in a fasting state are established to a certain extent.

However, recently the relevance between how full you are and alertness is becoming clear. For example, a study carried out by the Japan National Cerebral and Cardiovascular Center Research Institute shows [1]: "Approximately a 30% restriction on eating (diet control) increases Brain-Derived Neurotrophic Factor (BDNF) to become brain nourishment." Also, according to the study by Professor Shuzo Kumagai from Kyushu University, it is becoming clear that dietary restriction has a great influence on the increase of BDNF expression[2].

Scientific studies have begun to reveal that an increase of BDNF (fasting state) leads you to become alert. [3][4]

However, there are two difficulties with these preceding studies.

1. It is quite difficult to know if a person's level of BDNF is increasing or decreasing in their daily life. The medical approach, which requires specialized skills and environments is not a practical method for daily use. This is not a human-friendly technique for everyday life to provide a clear indication if a person is alert or not.
2. They claim through the use of brain science that *Brainderived neurotrophic factor increases at a fasting state of approximately 30%* and one becomes alert. However, their studies do not clarify, on a general or daily perceptive level *how much fasting results in alert state; how clear that state is, or how long this alert state lasts*.

3. Quantitative Research on a Fasting State and Being Alert

3.1. The Survey Methodology

To fulfill this research we first carried out a questionnaire to clarify the common feelings associated with fasting level or alertness. The survey was conducted on a group of 285 randomly chosen people aged in their teens to their fifties. Here is the survey overview.

Step.1	The survey participants start recording just after waking up. On the survey sheet, (Fig.1, Fig.2) a 24 hour day is divided into 30 minute intervals. Every 30 minutes just after waking up, they record *fed/ fasting* state and *alert/ sluggish* on a scale of one to three.
Step.2	The participants accurately record wake-up time, bedtime, and the time they eat meals or snacks.
Step.3	Repeat this procedure just before going to sleep for 2 days

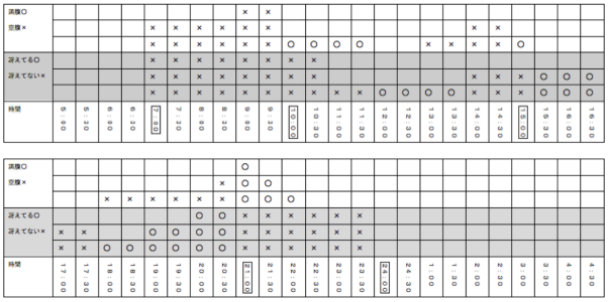

Fig.1: sample of survey sheet

<Alert Level>	<Sluggish Level>
・A little alert : ○	・A little sluggish : ×
・Alert : ○○	・Sluggish : × ×
・Very alert : ○○○	・Very sluggish : × × ×
・Neither : Blank	・Neither : Blank

Fig.2: survey sheet entry method

3.2. Survey Results

Survey results are shown in Fig.3.

The top left cell of Fig.3 shows that there were 46 responses (10%) in which respondents felt very alert when they were hungry. Similarly, the bottom right cell of Fig.3, which shows that there were 96 responses (16.7%) in which respondents felt very sluggish when they were full.
Survey results show that the fasting a little state corresponds with the peak state of alertness and alert levels decrease in response to an increase of fed/fasting level. On the other hand, the sluggish/very sluggish level increase in correlation to an increase in fasting level. The figures indicate that all fasting state levels do not necessarily encourage alertness and that the range from a fasting a little state to a properly fasting state is specifically appropriate for creating alertness.

	Very alert	Alert	A little alert	Neither	A little sluggish	Sluggish	Very sluggish
Hungry	193 (42.0%)			54 (11.7%)	213 (46.3%)		
	46 (10.0%)	67 (14.6%)	80 (17.4%)		62 (13.5%)	76 (16.5%)	75 (16.3%)
Properly fasting	472 (56.2%)			89 (10.6%)	278 (33.4%)		
	92 (10.9%)	200 (23.8%)	180 (21.5%)		141 (16.8%)	81 (9.7%)	56 (6.9%)
Fasting a little	706 (58.2%)			139 (11.5%)	368 (30.3%)		
	102 (8.4%)	289 (23.8%)	315 (26.0%)		207 (17.1%)	95 (7.8%)	66 (5.4%)
Neither	1356 (49.2%)			590 (21.4%)	811 (29.4%)		
	201 (7.3%)	493 (17.9%)	662 (24.0%)		402 (14.6%)	218 (7.9%)	191 (6.9%)
Fed a little	755 (50.1%)			190 (12.6%)	562 (37.3%)		
	114 (7.5%)	263 (17.5%)	378 (25.1%)		261 (17.3%)	193 (12.8%)	108 (7.2%)
Properly fed	459 (32.0%)			113 (10.3%)	523 (47.8%)		
	96 (8.8%)	186 (7.0%)	177 (16.2%)		220 (20.1%)	187 (17.1%)	116 (10.6%)
Full	214 (37.2%)			65 (11.3%)	297 (51.6%)		
	46 (8.0%)	71 (12.3%)	97 (16.8%)		108 (18.8%)	93 (16.1%)	96 (16.7%)

Fig.3: Survey Results

4. Length Mental Alertness Lasts

4.1. Lapse Time from a Fed to Alert State

The survey results so far revealed that alertness tends to occur in between a little fasting state and properly fasting state. We can assume that even if one is fed and not alert enough, he or she can become alert with time as they move toward a fasting state.
In this chapter, we show the average lapse time from a fed state to an alert state. The average lapse time recorded by the participants is indicated below: from each fed state there are three identifiable time intervals to the beginning of an alert state.

The Lapse Time to the Beginning of *Alert* Time	
State	The average lapse time
Fed a little	86 min.
Properly fed	112 min.
Full	115 min.

It takes a remarkably short time to reach to the beginning of alertness in a low level of fed state. Both properly fed and full states require almost 2 hours to reach to the beginning of alertness.

4.2. Alert State Duration

The average duration that the state of being alert is maintained is indicated below.

Alert state duration	
State	Average duration
Fed a little	134 min.
Properly fed	135 min.
Full	140 min.

As demonstrated above, the duration of time from the beginning of alert state to the end of that state is uniformly around 140 min. regardless of the fed status.

4.3. Hypothesis based on Survey Results

From the survey results in this study, we formed the hypotheses indicated below.

Hypothesis1 Meal intake time can be decided by subtracting a certain lapse time from the time in which you would like to be *alert*.

Hypothesis2 Meal size can be decided by calculating the time in which you would like to be *alert*.

Hypothesis3 You can control the time in which you would like to be *alert* by controlling meal time and meal size.

In this paper, we proposed a feeding support system to control meal intake time and meal size based on the time in which you would like to be alert. As this system would be used as part of a daily diet routine, we have devised and developed a smartphone application software.

5. Smart Diet Support System

5.1. System Overview

Smart Diet Support System（SDSS）developed in this study enables us to be alert at a time which we would like to be alert by controlling meal size in our daily lives.
This system calculates the meal time which is required by the user in order for them to make most of their alert state. This specified time is determined by using back calculation. It proposes the most appropriate meal size and meal time based on two conditions; Time slot in which you would like to be alert/ Meal size which you want to have. Basically, it is required to target a properly fasting state, a potent effect on dieting can be expected.

5.2. Software Mechanism

[STEP1] **Input of the Time Slot in Which You Would like to be Alert**
You need to select the beginning/end time of the time slot in which you would like to be alert.

[STEP2] **Input of Meal Size You Want to Have**
This software presents proper meal intake time by selecting the meal size which you want to have from three levels; Have a light meal/Have a normal meal/ Have a big meal

[STEP3] **To Avoid Impossible Combinations**
If the theoretically-impossible combination regarding the relationship between alert state duration and the lapse time from fed to fasting state, is selected, an error occurs, and resetting is required.
The following are the combinations for which errors occur:

1. When *light* is selected and the beginning time of the desired alert time slot is set as less than 86 minutes later than the current time.
2. When *light* is selected and the end time of the desired alert time slot is set as more than 220 minutes later than the current time.
3. When *light* is selected and the length of the desired alert time slot is set to be more than 134 minutes.
4. When *normal* is selected and the beginning time of the desired alert time slot is set as less than 112 minutes later than the current time.
5. When *normal* is selected and the end time of the desired alert time slot is set as more than 247 minutes later than the current time.
6. When *normal* is selected and the length of the desired alert time slot is set to be more than 135 minutes.
7. When b*ig* is selected and the beginning time of the desired alert time slot is set as less than 115 minutes later than current time.
8. When b*ig* is selected and the end time of the desired alert time slot is set as more than 255 minutes later than current time.
9. When b*ig* is selected and the length of the desired alert time slot is set to be more than 140 minutes.

If an error message is displayed, the user is required to come back to the screen for a Desired Alert Time and start the input again. SDSS can provide an efficient performance by enabling the user to be alert for the full length of the time slot for which he or she would like to be alert.
SDSS can provide an efficient performance by enabling the user to be alert for full length of the time slot for which he or she would like to be alert.

6. Theory Verification (1)

6.1. Verification Overview

Using a prototype system, a verification of the theory which has been proposed in this study was carried out among 33 examinees. Their profiles are indicated as below.

Gender	Number of people	Age	Average age
Male	18	24-57	33.4
Female	15	22-49	32.8
Total	33	22-57	33.1

In this verification, to make it simple, meal size was set as *a normal meal.* We examined validity of hypotheses and the system effectiveness by changing meal time. Although a time slot during which the user wants to be alert can be input by him or her, this time we carried out the verification on the condition that time slot during which the user wants to be alert was set at 60 minutes uniformly, a fixed condition, to facilitate the comparison.

6.2. Verification Methodology

The following is the verification procedure by the prototype system. The verification was a comparative study implemented over three days using different conditions.

(1) **Day 1:** The examinee decides an arbitrary 60 minutes during which he/she would like to be alert.
(2) They eat the size of meal to the extent to which they feel properly fed (Select have a normal meal in the application) at the time specified by the system.
(3) The examinees evaluate their *alert/sluggish level* for the specified 60 minutes on 7 scales : （very alert/ alert/ a little alert / normal/ a little sluggish/ sluggish/ very sluggish）.
(4) **Day 2:** The examinees eat the size of meal to the extent to which they feel properly fed at an earlier time than the time suggested by the system. They evaluate their alert level on 7 scales.
(5) **Day 3:** The examinees eat the size of meal to the extent to which they feel properly fed at a later time than the time suggested by the system. They evaluate their alert level on 7 scales.

In this way, we proved the validity of the hypotheses and the system by comparing the verification results.
The average duration that the state of being alert is maintained under the condition of properly fed is 135 minutes. Also, lapse time to the beginning of alert time is 112 minutes. In this verification, the 60 minutes in which the examinee wanted to be alert had to be within the135 minutes time frame. The time slot in which the user wanted to be alert was 60 minutes by default. For example, if it is the case that an arbitrary 60 minutes for which the user wants to be alert is placed at the beginning of the time slot during which he/she can be alert, it means that the user has to finish eating the meal 112 minutes before.
Also, if it is the case where an arbitrary 60 minutes for which the user wants to be alert is placed at the end of the time slot during which he/she can be alert, the user has to finish eating the meal 187[formula:112+(135-60)]minutes before.

6.3. Verification Results

Verification results are shown in Fig.4.

	Proper meal time	End of meal time is earlier than proper meal time (Fed)	End of meal time is later than proper meal time (Fasting)
Very alert	3(9.1%)	0(0%)	1(3.0%)
Alert	8(24.2%)	2(6.1%)	2(6.1%)
A little alert	10(30.3%)	1(3.0%)	5(15.2%)
Normal	5(15.2%)	7(21.2%)	18(54.5%)
A little sluggish	5(15.2%)	14(42.4%)	5(15.2%)
Sluggish	2(6.1%)	7(21.2%)	2(6.1%)
Very sluggish	0(0%)	2(6.1%)	0(0%)

Fig.4. Verification Results

The verification results show the following tendencies: A state of fasting beyond the properly fasting state indicates an alert state in most of the cases: A state of fed beyond the properly fed state indicates a sluggish state.
The total response of alert (very alert/ alert/ a little alert) in accordance with the condition of proper meal time was 63.6%. The response of normal state was 15.2% in total. On the contrary, the total response of sluggish (a little sluggish/ sluggish/ very sluggish) was 21.3%.
According to the results, we found that out of the number of examinees who felt changes in their alert/sluggish level, the examinees who had meals at proper meal times in line with our hypothesis, answered alert in a higher rate. Also, under the condition that the end of meal time was earlier than the proper meal time (fed at the specified time to be alert desired by the user), whereas the total response of alert（very alert/ alert/ a little alert） was 9.1%, the total response of sluggish (a little sluggish/ sluggish/ very sluggish) was 69.7%. Thus a fed state not only prevented the user from being alert but also created a higher rate sluggish state. Under the condition that the end of meal time was later than the proper meal time(fasting at the specified time to be alert desired by the user), the total of alert （very alert/ alert/ a little alert） was 24.3%, and the total response of sluggish (a little sluggish/ sluggish/ very sluggish) was 21.3%. On the other hand, the response of normal was 54.5%, which was over half. It means that a fasting state rarely correlates a sluggish state, comparing with a fed state.
We can say that this verification indicated that: a fasting state tends to lead to an alert state: a fed state tends to impede a state of being alert.

7. Theory Verification (2)

We also experimented under the condition of changed meal size with fixed meal intake time.

7.1. Verification Overview

In accordance with the meal time suggested by the system, the verification was carried out using three different meal sizes on each day of three days. The three meal sizes are:

1. A normal meal
2. A big meal（fed state）
3. A light meal（fasting state）

In response to those three meal sizes, the examinees evaluated their alert/sluggish level for a specified 60 minutes on 7 scales. The examinees defined each of the meal sizes according to their own usual meal sizes.

7.2. Verification Results

Verification results are shown in Fig.5.

	Normal meal size	Big meal size	Light meal size
Very alert	3(9.1%)	0(0.0%)	1(3.0%)
Alert	9(27.3%)	0(0.0%)	5(15.2%)
A little alert	5(15.1%)	3(9.1%)	5(15.2%)
Normal	10(30.3%)	4(12.1%)	14(42.4%)
A little sluggish	4(12.1%)	6(18.2%)	3(9.1%)
Sluggish	2(6.1%)	14(42.4%)	5(15.1%)
Very sluggish	0(0%)	6(18.2%)	0(0.0%)

Fig.5 Verification Results n=33

The results shows that among those who took a normal meal size, the total response of alert (very alert/ alert/ a little alert) was 51.5%.
Of those who ate a big meal size, the response of alert state was 9.1%.
Those respondents who had a light meal size, responded that the alert state was 33.4%.
Thus, it is clearly indicated that a normal meal size is effective in creating an alert state.
Among those who had a normal meal size, the total response of sluggish (a little sluggish/ sluggish/ very sluggish) was 18.2%. On the other hand, for a big meal size, the response of sluggish was 78.8%, which was quite a high rate. For a light meal size, the response of sluggish just stays at 24.2%. These results mean that whereas a fasting state tends to create an alert state, a fed state tends to generate a sluggish state.

8. SDSS Practical Model Development

Based on the theory verification testing using the prototype system, SDSS was practically utilized. The iOS application has been completed and has started going into circulation. In this chapter, the system flow of the SDSS practical model is described in detail.

8.1. Initial Screen

Tap “Select Desired Alert Time” to start input. Fig.6

Fig.6 Initial Screen

8.2. Settings for Time Slot and Meal Size

8.2.1. Settings for the beginning time of the desired alert time slot

Fig.7 is the settings screen for the time and meal size. Each input block is displayed one above the other.
First, a user needs to set the beginning time of the time slot in which he or she wants to be alert. In Fig.7, 15:00 is exampled to make the user alert from 15:00.

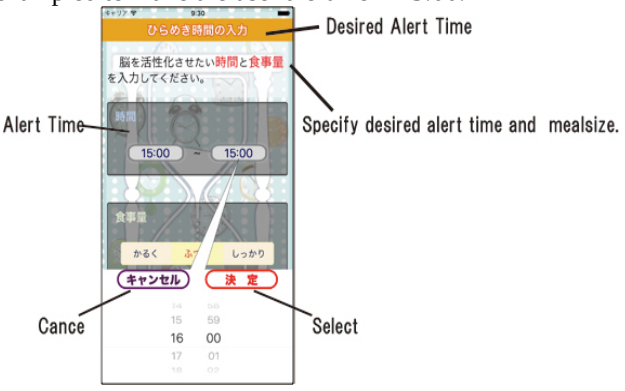

Fig.7 Beginning Time Setting and End Time Setting

8.2.2. Setting for the end time of the desired alert time slot

16:00 is exampled to assume that the business person wants to be alert for 1 hour (Fig.7). This means that the alert state will be maintained from 15:00 to 16:00. For example, the settings may be used for an important business meeting which is held from 15:00 to 16:00.

8.2.3. Meal Size Setting

Next, the meal size which the user wants to intake needs to be specified. Select one of the options below; light when you want to have a light meal; normal when you want to have a normal meal; big when you want to have a big meal. Fig.8

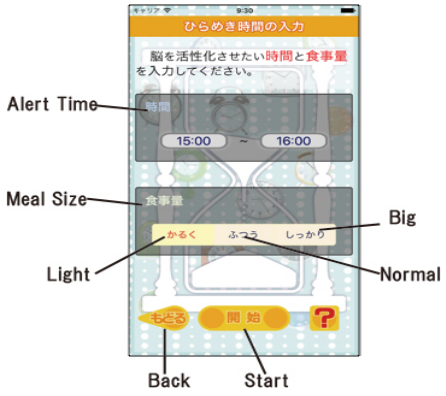

Fig.8: Meal Size Setting

8.2.4. SDSS Exemption

After setting the time slot and meal size, tap Start at the bottom of the screen to complete the settings, and then the application will start working. All the user has to do now is to control the meal time following the SDSS instruction. Once the settings have been completed, Fig.9 is displayed. Fig.9 indicates that the user needs to finish a light meal sometime between 12:20 and 13:34 to have an alert state from 15:00 to 16:00.

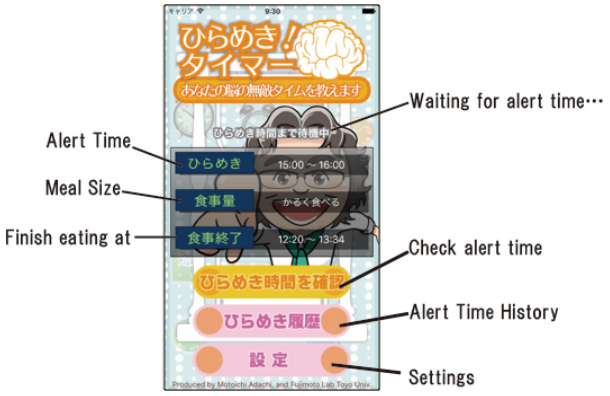

Fig.9 Screen displayed after completing settings

8.2.5. Meal Time Notification

When it gets to the beginning/end time of the time slot in which you have to finish the meal, SDSS will notify you with beep, vibration and a message.（Fig.10, 11）

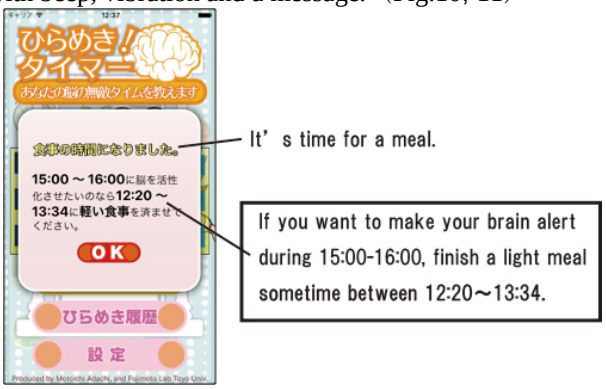

Fig.10: Time Notification Screen-1

Fig.11: Time Notification Screen-2

8.2.6. Notification for the Alert Time

When it gets to the beginning time of the time slot in which you are alert, a notification message is displayed with a beep and vibration. Fig.12, 13

Fig.12: Notification Screen for the Alert Time-1

Fig.13: Notification Screen for the Alert Time-2

9. Usability Survey

9.1. Usability Survey Overview

To examine SDSS effectiveness and usability, a survey was held with 114 business persons. Survey participants were required to download SDSS, which is on APP Store and use it twice (2 days) in 1 week. They evaluated its effectiveness after use.

9.2. Usability Survey Method

The survey was conducted on a group of 114 randomly chosen people aged from eighteen to sixty-two. Since differences based on gender were not identified in the previous investigation, gender differences were not taken into consideration in this survey. Basic attributes of the participating business persons was their intellectual labor.
The participants evaluated effectiveness on 5 scales promptly after using the application twice.
5 scales (very alert/alert a little /neither/not very alert/not alert at all) were set to evaluate the effectiveness in answering the question: “How much did you find yourself alert with diet control by using SDSS?”

9.3. Usability Survey Results

Survey results of the 114 business persons is shown in Fig.14.

How did you find SDSS? (114 participants/228 answers)	
Very effective	28.9%(66 responses)
Effective a little	46.5%(106 responses)
Neither	18.4%(42 responses)
Not very effective	5.3%(12 responses)
Ineffective	0.9%(2 responses)

Fig.14: Survey Results

Positive evaluation: very alert and alert a little (172 responses) was found to be 75.4% in total, which is quite high, whereas negative evaluation: not very alert and not alert at all stayed at 0.6 % (14 responses), which is less than 1% while the Neither response was found to be 18.4 %(42 responses), which is almost 20%. Taking more than 75% positive responses into consideration, it can be supposed that SDSS can be effectively used for business persons.

9.4. Free Description

Examinees were asked to give feedback on the usability and impressions of SDSS freely as an option. Some feedback is shown below.

- I could concentrate on the operation because I was not sleepy and did not have a heavy feeling in the stomach.
- Having followed the timer instruction, my mental speed was rather good. I became more productive.
- When it got to my alert time, after having the meal at a specified time, my head was very clear. I could face facts in a calm way.
- I used the application when I had to take an exam and I could answer the questions smoothly. As it saved time for reviewing, I could pass the exam.
- I used the application for my daily routine work and could focus on the work more.
- I could notice mistakes before they occurred in advance.
- My head was clear and I had the feeling that I was full of ideas.
- I could feel the relevance between meal time and concentration timing remarkably.

10. Conclusion and Discussion

Nowadays most business persons are interested in mental alertness and the ability to come up with ideas. Behind the trend is the fact that in today’s environment they can easily access to the Internet anytime because of improved computer performance and rapid spread of mobile devices such as smartphones. Every single day, the value of accumulating knowledge is decreasing. Almost any kind of knowledge can be acquired by an Internet search. Instead, “what to search and how to search” and “how to use search results” are becoming increasingly important. The Importance of mental alertness to enable the ability to come up with ideas or flexible thinking attracts rising attention and is an especially great concern amongst business persons. The World offers a great number of books and websites about mental alertness in relation to the ability to come up with idea.
Also, meal control is as much an interest as mental alertness for business persons. They have strong interest in

healthcare by dieting or meal restriction as they tend to have meals at irregular hours. There are a large number of workout gyms, slimming products or services. However it was difficult to enable mental alertness and diet control at the same time. Both had poor relation and correlation with each other though they were business persons' major concerns.

The results of this study showed that maintaining a little (properly) fasting state leads to mental alertness. Also it showed that a fed sate does not lead to mental alertness.

In fact, maintaining a little (properly) fasting state is the most effective way to healthy dieting and rebounds from dieting and health problems rarely occur. This results in enabling a state of mental alertness. It was a great achievement for this study to enable mental alertness and diet control, business persons' major concerns, at the same time.

One can control mental alertness by using SDSS, the application proposed in this study and as the result, this enables his or her diet control (dieting).

11. Further Research

SDSS proposed in this study is already put into practical use and has started going into circulation. However, to promote its continuous use, the current SDSS greatly reflects intuitive usability and convenience on the system and the interface. Therefore it is difficult to say that SDSS accommodates lifestyle choice or specific preference. Especially when it is assumed that quantitative difference of exercise influences on the SDSS effects, and at this stage, it has not been adopted to the system yet. Also, though it currently only targets business persons, who engage in intellectual labors, in modern life, every kind of occupation or position demands creativity and alertness.

To provide more accurate support from this application, we have to take age, gender, and quantitative difference of exercise into consideration.

Regarding each factor, if it causes differences in effects, further validation based on a larger scale questionnaire parameter is required to be examined. Furthermore, the logic for each factor to become most effective should be defined by recalculation and the application needs to be improved to be more personal and useful. Also, the placebo effect is a matter for concern. It is undeniable that the placebo effect, "Make yourself alert", influenced the results since the aim of the survey: This is an application to make yourself alert, please test if it is effective was informed to the participants. Therefore, a verification hiding a factor to make the user alert from the participants is also required.

This system, which enables the user to enter a state of being alert at a specified time by controlling meal intake size and meal time, also has the potential to be used as an effective tool for dieting. Today, many people have to live with obesity and overeating. It is our aim to demonstrate the extent of the effect that this system can have on dieting by focusing on how to keep on the right side of a fasting state.

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