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小久保秀之、山本幹男、渡辺恒夫



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**ISLIS Head Office**  
c/o International Research Institute (**IRI**)  
40A, KK Bldg., 1108-2, Sonno, Inage, Chiba 263-0051 JAPAN

Phone: +81-43-255-5481 Fax: +81-43-255-5482

<http://wwwsoc.nii.ac.jp/islis>

E-mail: [islis@i-iri.org](mailto:islis@i-iri.org)



## Impression and Spontaneous Blood Flow Change at the Temporal Lobe while Guessing for a Hidden Figure

Hideyuki KOKUBO<sup>1,2</sup>, Mikio YAMAMOTO<sup>1,2</sup> and Tsuneo WATANABE<sup>3,2,1</sup>

<sup>1</sup> *Institute for Living Body Measurements, International Research Institute (Chiba, Japan)*

<sup>2</sup> *Center for the Environmental Study of Life and Mind, Faculty of Science, Toho University (Chiba, Japan)*

<sup>3</sup> *Department of Environmental Science, Faculty of Science, Toho University (Chiba, Japan)*

**Abstract:** In a previous study using near-infrared spectroscopy (Yoichi et al, 2002), the authors found spontaneous blood flow change often occurred at both temporal lobes while guessing for hidden figures (clairvoyant condition). This phenomenon was considered to have a relationship to the degree of impression formulation of figures. In the present study, the authors looked at details of the phenomenon. There were 14 participant volunteers. One trial consisted of a 3-minute guessing period and a 3-minute rest period, and 1 run consisted of 3 trials and 69 trials were done in total. The target figure was selected from 5 figures by a pseudo random number function. Then it was displayed on a CRT covered by a gray paper box. After the 3-minute guessing period, subjects gave their answers and degrees of impression formulation (3 degree method). The spontaneous blood flow change at the temporal lobe was observed in 10 trials. The degree of impression formulation was high when the change occurred ( $p < 0.001$ , one-tail). The change also often occurred when subjects made their responses after guessing although the change did not relate to the degree of impression formulation. Ten guessing results were correct, but this number was not significant. Moreover, 3 of 10 correct trials were obtained when the spontaneous blood flow change occurred although it was not significant ( $p = 0.06$ , one-tail). The relationship between the correct response and the spontaneous blood flow change should be researched in further studies.

**Keywords:** fNIRS, functional near-infrared spectroscopy, temporal lobe, guess, clairvoyance, forced choice, spontaneous blood flow change, ESP

### 1. Background

Guessing is considered an important activity which has a close connection with psi, especially, clairvoyance. The details of the physiological mechanism relating to psi need to be elucidated if researchers are to know which areas of the human brain are activated during guessing. For example, there is a report that the prefrontal area of the human brain is activated during guessing (Elliott et al, 1999)<sup>1)</sup>. This finding is very interesting because the prefrontal area is located at the position of the so-called "third eye". This report was done by fMRI (functional magnetic resonance imaging). The authors have also measured brain activities by fMRI

during clairvoyance, and obtained a similar result. However, unfortunately, the authors had to abandon additional work because the subject declined to participate in further fMRI studies.

There are several useful methods to examine brain functions from outside of the body, not only fMRI; for example, EEGs (electroencephalograms), MEGs (magneto-encephalograms), PET (positron emission tomography) and fNIRS (functional near-infrared spectroscopy) can all be used.

fNIRS is the newest non-invasive imaging method which is being developed in Japan. fNIRS can be used to measure the cerebral cortex near the scalp (depth: 2-3 cm) and its spatial resolution is 2-3 cm, although its time resolution is 100ms. fNIRS is quiet and subjects find it to be non-stressful the same as EEG measurements. Therefore

Hideyuki KOKUBO kokubo@a-iri.org  
 International Research Institute (IRI), 40A, KK Bldg., 1108-2, Sonno,  
 Inage, Chiba 263-0051 Japan  
 Phone: +81-043-255-8851 FAX: +81-43-255-8852



NIRS is a suitable method for sensitive subjects such as in the present study.

In the previous study with fNIRS, the authors found a spontaneous blood flow change often occurred at both temporal lobes while guessing for hidden figures (clairvoyant condition)<sup>2)</sup>. Although this was a preliminary study by a few subjects and only small numbers of data were collected, the results suggested that the phenomenon was related to the degree of impression formulation of figures during guessing and also to correct responses. In the present study, the authors studied the details of the phenomenon using more subjects and collecting more data.

## 2. Methods

**Term and Facility:** The study was done at the Research Laboratory of the Institute for Living-Body Measurements at the Information and Research Center of the International Research Institute from June 2nd to 21st, 2005.

**Subjects:** Subjects were 14 healthy adult volunteers (8 males, 6 females): average age was 44.8 years old. Several subjects had not experienced any training for clairvoyance.

**Physiological Measurements:** Brain blood flow was measured by OMM-3000 (Shimadzu, Japan)<sup>3)</sup> which uses 3 near-infrared lasers (wavelengths: 780, 805 and 830nm). There were a maximum of 16 emitting and receiving probes. The measurement area was mainly at the right temporal lobe; 6 runs (18 trials) were done at the right temporal lobe; 16 runs (48 trials) were at the right temporal and frontal lobes; 1 run (3 trials) was at motor area. Moreover, skin conductance and pulse of several subjects were also measured by MP150 (BioPack, USA) at 200Hz. Skin conductance was measured at the second joints of both second and fourth fingers of the subjects' left hands by the exosomatic method (DC 0.5V constant). The pulse was measured at the tip of the middle finger of the subjects' left hands.

**Target and Response:** Selecting and displaying of the target were controlled by a computer. The experiment was a forced choice experiment. Subjects used a switch box to give their responses which were recorded by the computer.

The sets of target figures were geometric symbols (circle, square, cross, waves, star) and photos of fruits (peach, orange, chestnut, banana, grape). One set was selected before each run. The target figure was chosen at

$p=1/5$  by a pseudo random number function at the time of each trial. The target figure was displayed on a liquid crystal CRT covered by a thick gray paper. Background color of the CRT was changed every second. The experimenter's monitor was also covered by a thick paper, except for a small area at the bottom-right so that the stage of the experiment could be tracked.

The degree of impression formulation was evaluated as 1; "not obvious", 2; "partial" or 3; "obvious" by subjects.

**Procedure:** Fiber probes for fNIRS (OMM-3000) were attached to the subject's head after procedural instructions were given. The room lighting was a little dim. Experiments started when the subject's brain blood flow was stable.

One trial consisted of a 3-minute guessing task period and a 3-minute rest period, and 1 run consisted of 3 trials. Each subject did 1 or 2 runs. During the guessing task, each subject concentrated on merely guessing what the hidden figure was that was displayed on the covered CRT. After the task, subjects chose one from five figures, and evaluated the degree of their image formulation.

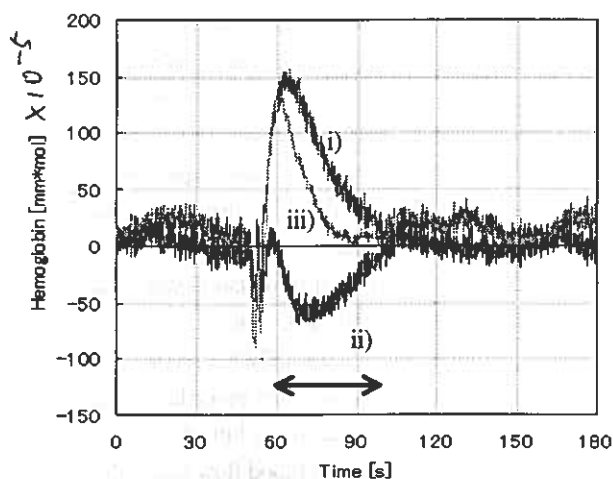
The experimenter checked his monitor and announced the stage of experiments. After each run, he promptly reported the results to the subjects.

## 3. Results

Data from 69 trials (23 run) could be analyzed in most cases.

Spontaneous blood flow changes of the temporal lobe were observed in 10 out of 65 trials; 4 trials were excluded because it was not easy to recognize the change due to the subjects' heads moving too much during the task. Fig. 1 shows an example of spontaneous blood flow change during the guessing task. There was a tendency that the degree of impression formulation was high when the change occurred ( $p<0.001$ , one-tail) (Table 1).

Also, spontaneous blood flow changes were often observed when subjects made their responses using the switch box. These were seen 14 times in 62 rest periods; 7 trials were excluded because it was not easy to recognize the change due to the subjects' heads moving too much during the task. However, there was no significant relationship between the evaluation and the change during the rest (Table 2).



**Fig. 1 Example of Spontaneous Blood Flow Change during Task (Right Temporal Lobe)**

i) oxy-Hemoglobin ii) deoxy-Hemoglobin iii) Total Hemoglobin

**Table 1 Evaluation of Impression Formulation and Spontaneous Blood Flow Change during Task**

Change	Yes	No	Sum
Evaluation			
3	7	2	9
1 or 2	3	53	56
Sum	10	55	65

\* Except 4 trials which were excluded because it was not easy to recognize the change due to the subjects' heads moving too much during the task.

**Table 2 Evaluation of Impression Formulation and Spontaneous Blood Flow Change during Rest**

Change	Yes	No	Sum
Evaluation			
3	1	7	8
1 or 2	13	41	54
Sum	14	48	62

\* Except 7 trials which were excluded because it was not easy to recognize the change due to the subjects' heads moving too much during the task.

**Table 3 Hit/Miss and Spontaneous Blood Flow Change during Task**

Change	Yes	No	Sum
Score			
Hit	3	6	9
Miss	7	49	56
Sum	10	55	65

\* Except 4 trials which were excluded because it was not easy to recognize the change due to the subjects' heads moving too much during the task.

Hit score of guessing was 10 out of 69 trials, and this was not significant ( $Z = -1.14$ ).

Three out of 10 correct trials were obtained when the spontaneous blood flow change occurred although it was not significant ( $p = 0.06$ , one-tail) (Table 3)

#### 4. Discussion

The present study is the 1st in a 2-part experimental series. More detailed analysis will be done after all data are collected, but at least the present research supports the expectation that the spontaneous blood flow change at the temporal lobe occasionally generated during guessing is related to the plainness of the guess image. The frequency of appearance of the spontaneous blood flow change was 1 time in 7-8 times. This phenomenon is considered to be a physiological event which corresponds to the so-called flash, intuition or inspiration encountered in everyday life. It is expected that a similar phenomenon happened not only in figure guessing but in various target guessing.

In the authors' previous study<sup>2)</sup>, responses were given orally, but that was replaced by button pushing in the present study. In order to push the button, the problem of movement of the subject's head occurred. It is necessary to devise a method of fixing the head in future studies.

In this research, it was observed that the spontaneous blood flow change often occurred at the temporal lobe at the time of responses. In 4-5 times, the frequency of appearance was once, and this was higher than the frequency during the guessing task. Image formulation happened possibly by seeing the figures shown on the switch box.

In 10 trials which had spontaneous blood flow change during the guessing, results of guessing and targets were in agreement in 3 cases although the number was not significant. The size of the sample population was small in the present study, therefore statistical detection is difficult even if there is a weak middle relationship between hitting and spontaneous blood flow change. It is necessary to collect and evaluate more data in future studies.

There was one case that spontaneous blood flow change occurred at the prefrontal area simultaneously when the change arose at the temporal lobe. However, it cannot be judged whether this is a specific phenomenon of the subject since there are few examples. Further studies are needed.



## 5. Conclusions

When guessing what a hidden figure was, spontaneous blood flow changes arose at the temporal lobe approximately once in 7 to 8 times. This phenomenon was considered to be a phenomenon corresponding to image formulation of the figure equivalent to a flash, intuition or inspiration as received in daily life.

The relation between the spontaneous blood flow change and hits/misses of guessing should be researched after collecting more data.

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## References

- 1) Elliott R, Rees G and Dolan RJ: Ventromedial prefrontal cortex mediates guessing, *Neuropsychologia*. Apr; 37(4): 403-11, 1999.
- 2) Yoichi H, Kokubo H, Chen W, Zhang T, Haraguchi S, Kawano K and Yamamoto M: Brain blood volume change under an ESP task measured by optical topography, *Journal of International Society of Life Information Science*, 20(2): 637-641, 2002
- 3) Chen W, Zhang T, Wang F, Kokubo H and Yamamoto M: Change of hemoglobin concentration of cerebral cortex and respiration frequency during qi-emission task, *Journal of International Society of Life Information Science*, 21(2): 473-492, 2003



## 図形推測における印象度と側頭葉の突発的血流変化

(Impression and Spontaneous Blood Flow Change at the Temporal Lobe while Guessing for a Hidden Figure)

小久保秀之<sup>1,2</sup>、山本幹男<sup>1,2</sup>、渡辺恒夫<sup>3,2,1</sup>  
 (Hideyuki KOKUBO<sup>1,2</sup>, Mikio YAMAMOTO<sup>1,2</sup> and Tsuneo WATANABE<sup>3,2,1</sup>)

<sup>1</sup> 国際総合研究機構 生体計測研究所 (日本, 千葉)

<sup>2</sup> 東邦大学理学部 心と生命の環境学研究センター (日本, 千葉)

<sup>3</sup> 東邦大学理学部 生命圏環境科学科 (日本, 千葉)

**要旨:** 筆者らは近赤外分光法による脳活動研究において、隠された図形を推測するとき (透視条件)、左右の側頭葉で時折、突発的な血流変化が起こることを見出した (Yoichi et al, 2002)。この突発的血流変化は、推測中に浮かぶ図形イメージの明瞭さ (印象度) と関係が深いと思われた。本研究では、この現象をさらに詳しく調べるため、健康な男女 14 名による実験を行った。1 試行は 3 分間の推測と 3 分間の休憩とし、連続 3 試行で 1 ランとした。標的図形は 5 種 1 組の中から任意の 1 つを擬似乱数によって等確率に選び、覆いをしたディスプレイに表示した。被験者は 3 分間の推測後、心に浮かんだイメージを回答し、さらにそのイメージの印象度を 3 段階で答えた。計 69 試行の実験の結果、推測中に側頭葉で突発的血流変化が起こった場合 (10 試行)、強い印象度を回答する傾向があることが確認された ( $p < 0.001$ , 片側)。また、回答行動に伴って突発的血流変化の起こることも見出されたが、印象度との間に有意な関係は見られなかった。推測結果と標的との一致は 10 試行で、偶然の範囲内であった。しかし、推測中に突発的脳血流変化があった 10 試行では、有意ではなかったものの、推測結果と標的が一致することが多かったため (一致 3 回,  $p = 0.06$ , 片側)、今後さらにデータを増やして調べる必要がある。

**Keywords:** fNIRS, functional near-infrared spectroscopy, temporal lobe, guess, clairvoyance, forced choice, spontaneous blood flow change, ESP

### 1. はじめに

推測は、サイ、特に透視と呼ばれる現象と密接な関連をもつ精神活動と考えられる。もし、推測中の脳の活動部位がわかれば、サイに関係する生理機構の詳細を理解できるに違いない。たとえば、推測中に脳の前頭前野が賦活しているという報告がある (Elliott ら、1999)<sup>1)</sup>。大変興味深いことに、前頭前野は、いわゆる「第 3 の眼」の場所に対応している。この報告で使われた手法は fMRI (機能的磁気共鳴画像) であった。Elliott の報告以前に、筆者らの一部も fMRI を使っていわゆる能力者の測定を試み、同様に前頭前野が賦活する結果を得ていたが、被験者がその後 fMRI を拒否

したため、詳細な研究を断念せざるを得なかった。

fMRI 以外で体外から脳活動を知る方法としては、脳波 (EEG)、脳磁 (MEG)、陽電子断層診断法 (PET)、機能的近赤外分光法 (fNIRS) がある。fNIRS は、日本で開発が進んでいる最も新しい非侵襲画像化法である。fNIRS は頭皮から深さ 2-3cm の大脳皮質しか測れず、空間分解能も 2-3cm であるが、時間分解能は 100ms である。さらに、測定時の被験者の身体負担が脳波測定と同程度と軽く、測定に伴う騒音も無いという特徴がある。これは、本研究のように特に感受性が高いと思われる被験者を対象にする場合に好ましい特徴である。

筆者らが fNIRS を用いてこれまでに行った研究<sup>2)</sup>では、隠された図形を推測するとき (透視条件)、左右の側頭葉で時折、突発的な血流変化が起こることが観察された。この突発的血流変化の有無は、推測中に浮かぶ図形イメージの明瞭さ (印象度) と関係が深い

小久保秀之 kokubo@a-iri.org  
 263-0051 千葉市稲毛区園生町 1108-2 KK ビル 40A  
 国際総合研究機構(IRI) 電話 043-255-8851 FAX 043-255-8852



と思われた。また、突発的脳血流変化が起こったときに、推測結果と標的図形とが一致する傾向にあるようにも思われた。しかし、この研究は予備的なものであり、試行数・被験者数も少なかったため、本研究では実験規模を拡大し、さらに詳しく調べることにした。

## 2. 実験方法

**実験場所・期間**：実験は2005年6月2日から21日にかけて、国際総合研究機構、情報・研究センター内の生体計測研究所の研究室にて行った。

**被験者**：被験者は健康な成人男女14名（男8名、女6名）で、平均年齢は44.8歳であった。被験者の内の若干名は、過去に透視等の訓練の経験がなかった。

**生理測定**：脳血流測定には、780nm, 805nm, 830nmの3波長の光を用いる近赤外光イメージング装置 OMM-3000（島津製作所製）を用いた<sup>3)</sup>。送光極、受光極は、それぞれ最大16極。測定部位は右側頭を主とし、右側頭のみ6ラン（18試行）、右側頭-前頭16ラン（48試行）、運動野1ラン（3試行）であった。また、一部の被験者に対し、左手第2指-第4指の第2節で直流0.5V定電圧通電法にて皮膚コンダクタンスを、第3指第1節にて指尖脈波を、それぞれMP150（BioPack社製）にて、200Hzで測定した。

**標的と回答**：標的の選択・呈示、および回答の記録にはコンピュータを使用した。また、推測結果・印象度の回答は強制選択とし、専用のスイッチボックスによるボタン押し方式とした。

標的画像は、幾何図形（円、四角、十字、波線、星）、または果物の写真（桃、みかん、栗、バナナ、葡萄）の2組のうちのいずれか1組を使用し、毎試行ごとに擬似乱数によって等確率で標的を決定した。また、1秒ごとに背景の色を変えた。標的は被験者の前に設置した液晶ディスプレイに表示し、実験中、そのディスプレイ全面を灰色の厚紙で覆った。実験者側のモニターは、実験進行の情報を示す右下隅のみを露出して、他の部分を段ボールで覆った。

印象度は、1. はっきりしない、2. 多少はイメージが浮かんだ、3. イメージが鮮明の3段階評価とした。**実験手続き**：実験教示の後、fNIRSの光ファイバプローブを被験者頭部に装着し、測定部位の脳血流が安定するのを待って、実験を開始した。意識集中しやすいよう、実験中は部屋の照明を少し暗くした。

3分間の推測と3分間の休憩で1試行とし、連続3試行で1ランとした。各被験者は、1または2ランを行った。3分間の推測課題中、被験者は、厚紙で覆わ

れた液晶画面に表示されている図形をただ推測することだけに集中した。3分経過した後に、被験者は標的と思われる図形を1つ回答し、さらにそのイメージの明瞭さ（印象度）を回答した。

実験者は実験者側モニターの情報を基に、音声で実験進行を被験者に指示した。またラン終了後に、結果を被験者に示した。

## 3. 結果

実験の結果、計23ラン（69試行）の有効データが得られた。

測定中に被験者の頭部が動くなどの理由で、突発的脳血流変化の有無を容易に判別できないデータを除くと、65試行中の10試行で、推測課題中に側頭葉で突発的脳血流変化が起こった（Fig. 1）。このとき、推測中に浮かんだイメージが鮮明（印象度評価3）と回答が有意に多かった（Table 1）（ $p < 0.001$ 、片側）。

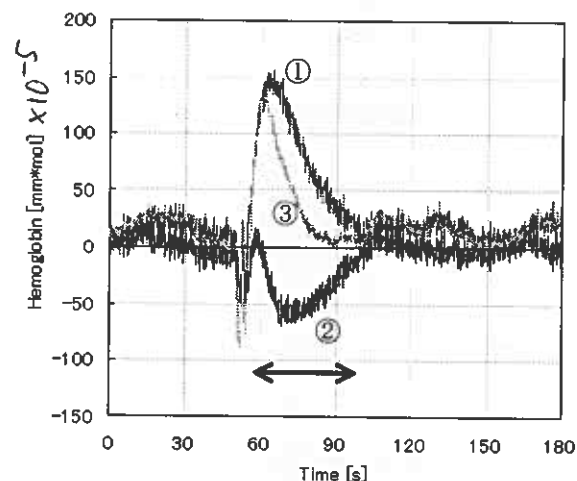


Fig. 1 推測時の突発的脳血流変化の例（右側頭葉）  
 ①酸化ヘモグロビン ②脱酸化ヘモグロビン  
 ③総ヘモグロビン

Table 1 推測時の突発的脳血流変化の有無と印象度評価

突発的脳血流変化 印象度評価	あり	なし	計
3	7	2	9
1または2	3	53	56
計	10	55	65

\* 測定中に被験者の頭部が動くなどの理由で、脳血流変化の有無を判定できなかった4データを除く。



また、被験者が回答するよう指示を受けてボタン押しするとき、回答行動に伴う突発的血流変化がしばしば観察された。そのような場合は、突発的血流変化の有無を容易に判別できないデータを除くと、62 試行中の 14 試行であった。しかし、回答時の血流変化の有無と、印象度評定との間には有意な関係は見られなかった (Table 2)。

Table 2 回答時の突発的血流変化の有無と印象度評定

突発的血流変化 印象度評定	あり	なし	計
3	1	7	8
1 または 2	13	41	54
計	14	48	62

\* 測定中に被験者の頭部が動くなどの理由で、血流変化の有無を判定できなかった7データを除く。

推測結果と標的との一致は全 69 試行中の 10 試行で、有意ではなかった ( $Z = -1.14$ )。推測課題中に突発的血流変化があった 10 試行については、的中がやや多かったものの有意ではなかった (Table 3) ( $p = 0.06$ , 片側)。

Table 3 推測時の突発的血流変化と推測結果の的中

突発的血流変化 的中・非的中	あり	なし	計
的中	3	6	9
非的中	7	49	56
計	10	55	65

\* 測定中に被験者の頭部が動くなどの理由で、血流変化の有無を判定できなかった4データを除く。

#### 4. 考 察

本研究は、全 2 シリーズの実験の第 1 シリーズである。より詳細な分析は全シリーズのデータがそろった後に行う予定であるが、本研究だけでも、図形推測中に時折発生する側頭葉での突発的血流変化が、推測イメージの明瞭さに関係するとの予想は、裏付けられた。突発的血流変化の発生頻度は 7~8 回に 1 回の割合であった。この現象は、日常生活におけるいわゆるひらめきや直感に相当する現象と考えられる。図形推測に限らず、さまざまな推測課題においても、類似の現象

が起こっていると予想される。

先の筆者らの実験<sup>2)</sup>では回答を口頭で行ったが、本研究では回答方式をボタン押しに変更した。このため、ボタンを押すために被験者の頭部が大きく動くという問題が新たに発生した。頭部の固定法を今後工夫する必要がある。

本研究では、しばしば回答時に側頭葉で突発的血流変化が起こることが観察された。発生頻度は 4~5 回に 1 回の割合であり、推測時の発生頻度よりも高かった。おそらく、回答ボタンに示された図形を見ることで、図形イメージの明瞭化が起こったのであろう。

推測中に突発的血流変化があった 10 試行では、有意ではなかったものの、推測結果と標的が一致することがやや多かった。突発的血流変化の有無と的中試行との関係が弱~中程度の相関であるなら、本研究の標本数では検出がむずかしい。今後さらにデータを増やして調べる必要がある。

側頭葉で突発的血流変化が生じたとき、前頭前野でも同じパターン血流変化が生じた例が 1 例だけあった。例数が少ないため、その被験者特有の現象であるのか、判断することができない。この点も、今後、調べる必要がある。

#### 5. 結 論

隠された図形を推測する時、7~8 回に 1 回程度の頻度で、側頭葉で突発的な血流変化が生じる。この現象は、ひらめきや直感に相当する明瞭な図形イメージの形成に対応する現象と考えられる。

突発的血流変化と推測結果の的中・非的中との関係は、今後、さらにデータを増やして調べる必要がある。

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#### 参考文献

- 1) Elliott R, Rees G and Dolan RJ: Ventromedial prefrontal cortex mediates guessing, *Neuropsychologia*. Apr; 37(4): 403-11, 1999.





- 2) Yoichi H, Kokubo H, Chen W, Zhang T, Haraguchi S, Kawano K and Yamamoto M: Brain blood volume change under and ESP task measured by optical topography, *J. Intl. Soc. Life Info. Sci.*, 20(2): 637-641, 2002
- 3) Chen W, Zhang T, Wang F, Kokubo H and Yamamoto M: Change of hemoglobin concentration of cerebral cortex and respiration frequency during qi-emission task, *Journal of International Society of Life Information Science*, 21(2): 473-492, 2003