Emotion - That Which Drives Body and Mind

Shinsuke Shimojo

California Institute of Technology (Division of Biology / Computation and Neural Systems)

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Japan Science and Technology Agency ERATO Shimojo Implicit Brain Function Project

Modern society is filled with unjust and irrational Phenomena. How is this understood from the standpoint of cognitive neuroscience?

War, crime (especially homicide), sickness, inequality, and material luxury and mental poverty.
These are the light and shadow of technology.

1. Emotions

2. Implicit cognition

CONTENTS

1. What are “emotions”?

2. Modern society is entering a dangerous phase.
   (1) Commercialism

3. Modern society is entering a dangerous phase.
   (2) Politics

4. Freedom and compulsion

5. Imagination and creativity

Conclusion: In the near future, we will live in a society where freedom and control will coexist.
Greater importance will be attached to emotion and implicit cognition, and therefore, deeper understanding of both of these areas will be crucial.

1. What are “emotions”?

Emotions are physical and physiological mechanisms that arouse feelings. They are mostly subconscious.
They are the underlying cause of unreasonable human behavior and absurd social systems.

・A classic image of the human being is a being who is intellectual, rational, and practical.
・Human intelligence is symbolic, logical, analytical, and presentational.

→Human essence can be seen as lying beyond those characteristics.

What are “emotions”?

Free association

To Have a foreboding

Bad news. Bad luck. A plane accident…

Blush

Be ashamed. Get tense. Go up to the stage…

Break into a cold sweat

At the last moment. Behind time.
Facing A deadline…

腑に落ちない
(*Funiochinai*)

Cannot agree. Wrong. Anxiety…

Be cheerful

Happy. Excursions. Brilliance. Works…

Sit on the edge of one’s seat

By the skin of one’s teeth. Thriller.
A dead heat…

Fired up

Cheer. Stomach muscles. Kendo…

Jump for joy

Glad. Passing grade. Worked well…

Get goose bumps

Feel a chill. Cliff. Groan …

Emotional story

1. Footpath in cliff (VR). Window side of skyscraper.
2. Settle by the duel. Feel settled (*Ryuin o sageru*). Hara-kiri.

Emotions

Body, physiology, implicitness, feelings, internal organs, reward, desire, and pleasure…

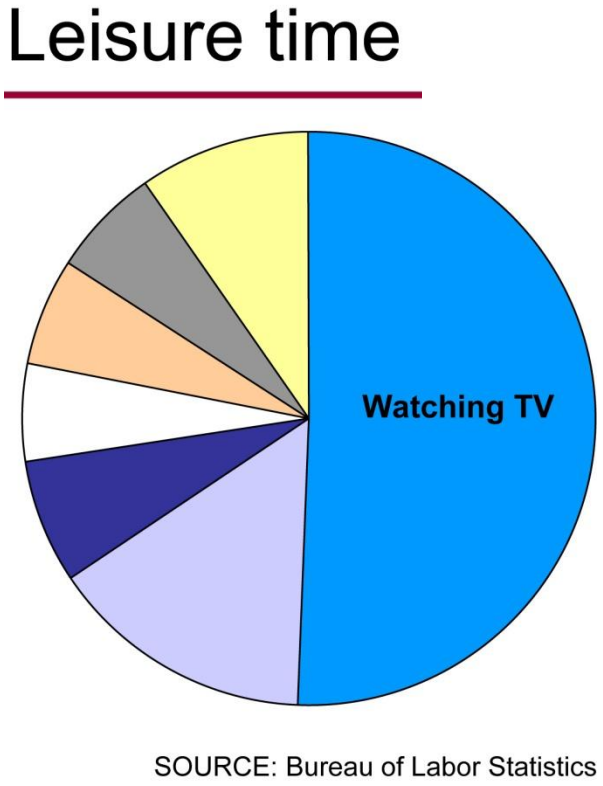
Another system that inseparability relates to the affect system in the human brain

Reward system

1. Neural pathway where activity of an animal is started. The animal acts to gain a reward.
2. Not only biological/primary things such as food, water, sleep and sex, but also secondary things (E.g. . money) and social things (E.g. . praise) are contained.
3. Not only the dopamine system but also other neurotransmitters related?

Can animal studies of the “reward” system be useful?

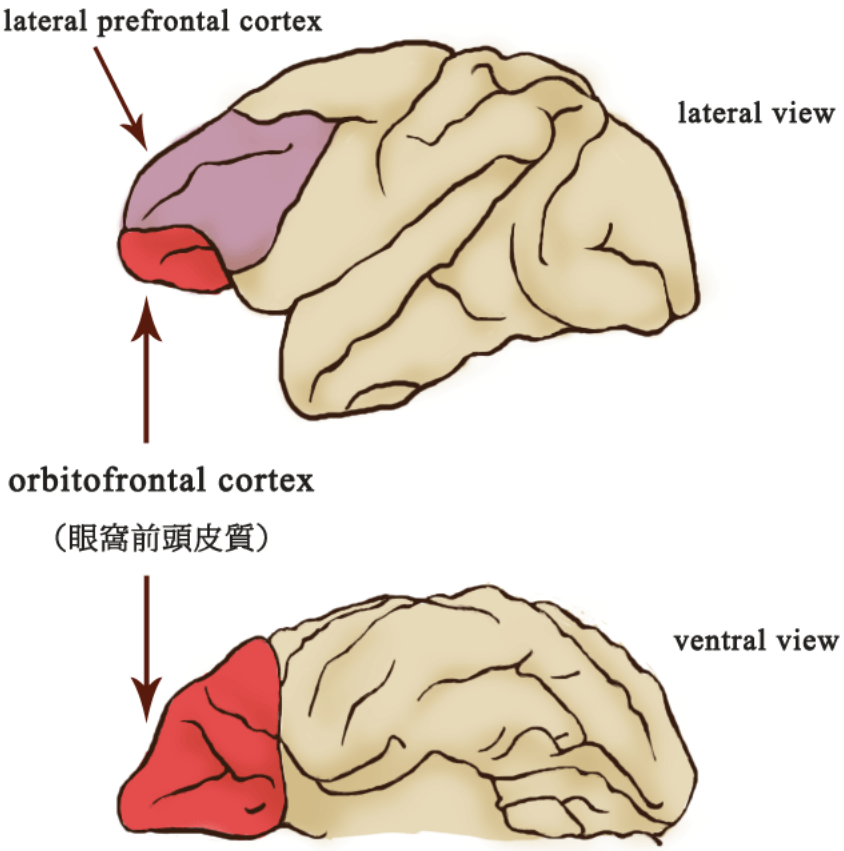
*Defined by animal experiments with juice or food pellets. *Useless in understanding modern human behavior.

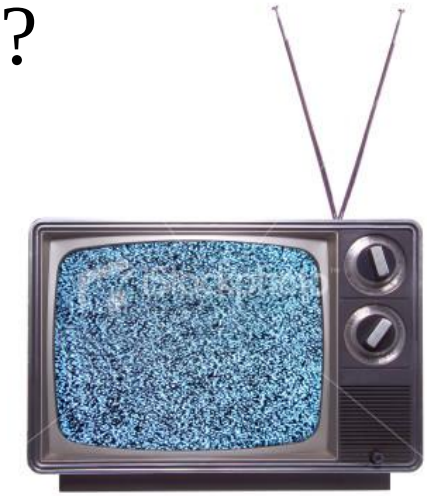


Teenagers are into;
movies, music, games, internet, etc.

--> utterly mysterious.

Is perception inherently rewarding?





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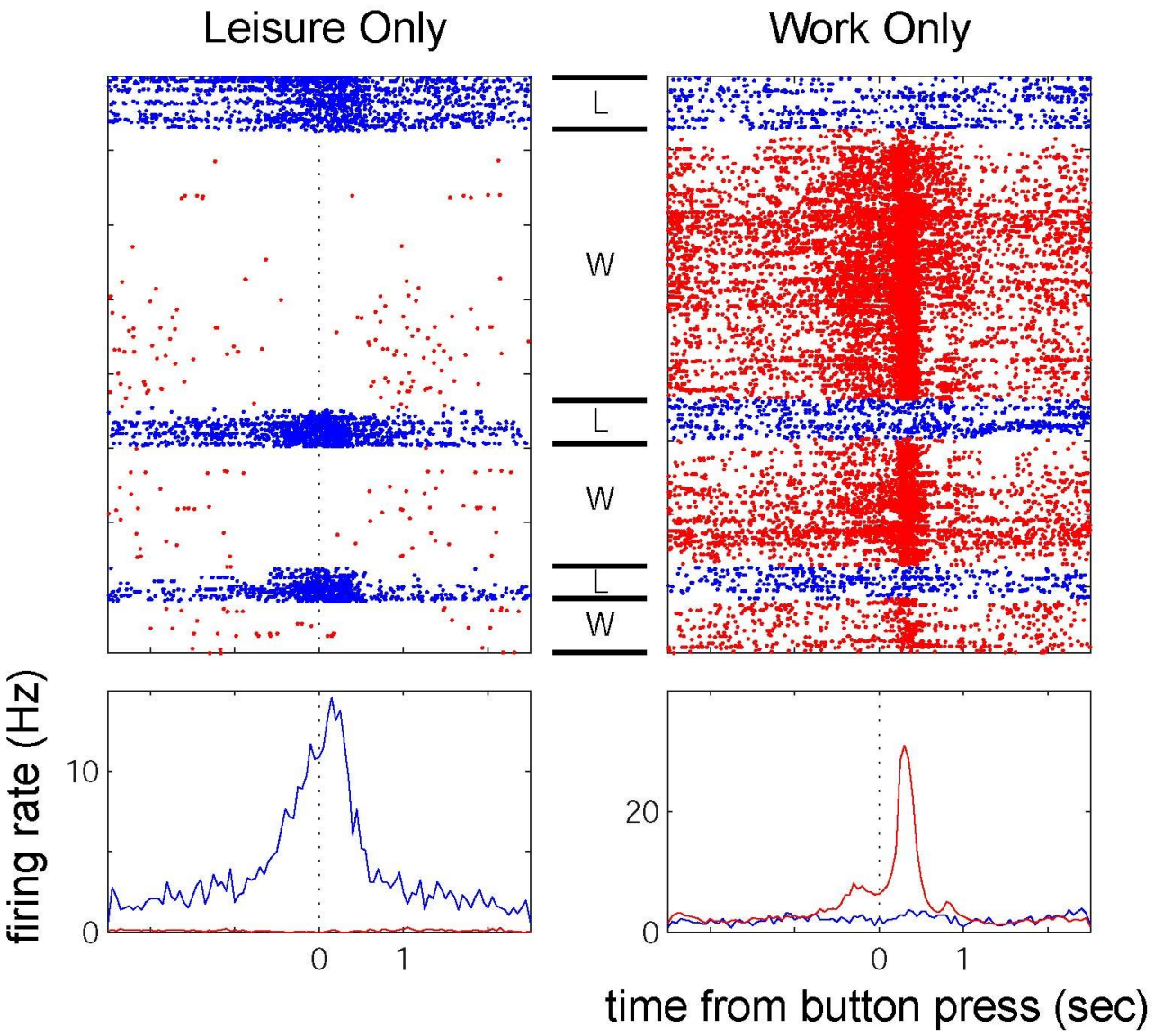
*OFC encodes the subjective value of juice.

*Does it also encode subjective value of watching TV?

MonkeyTV

- Separate Work and Leisure periods
  - Work: Apple Juice or Water
  - Leisure: 11 ‘channels’
    - Next segment of current channel
    - Switch to a segment of a new channel.
- Simultaneously record orbitofrontal (OFC) neurons

Multiple electrodes in the monkey FC



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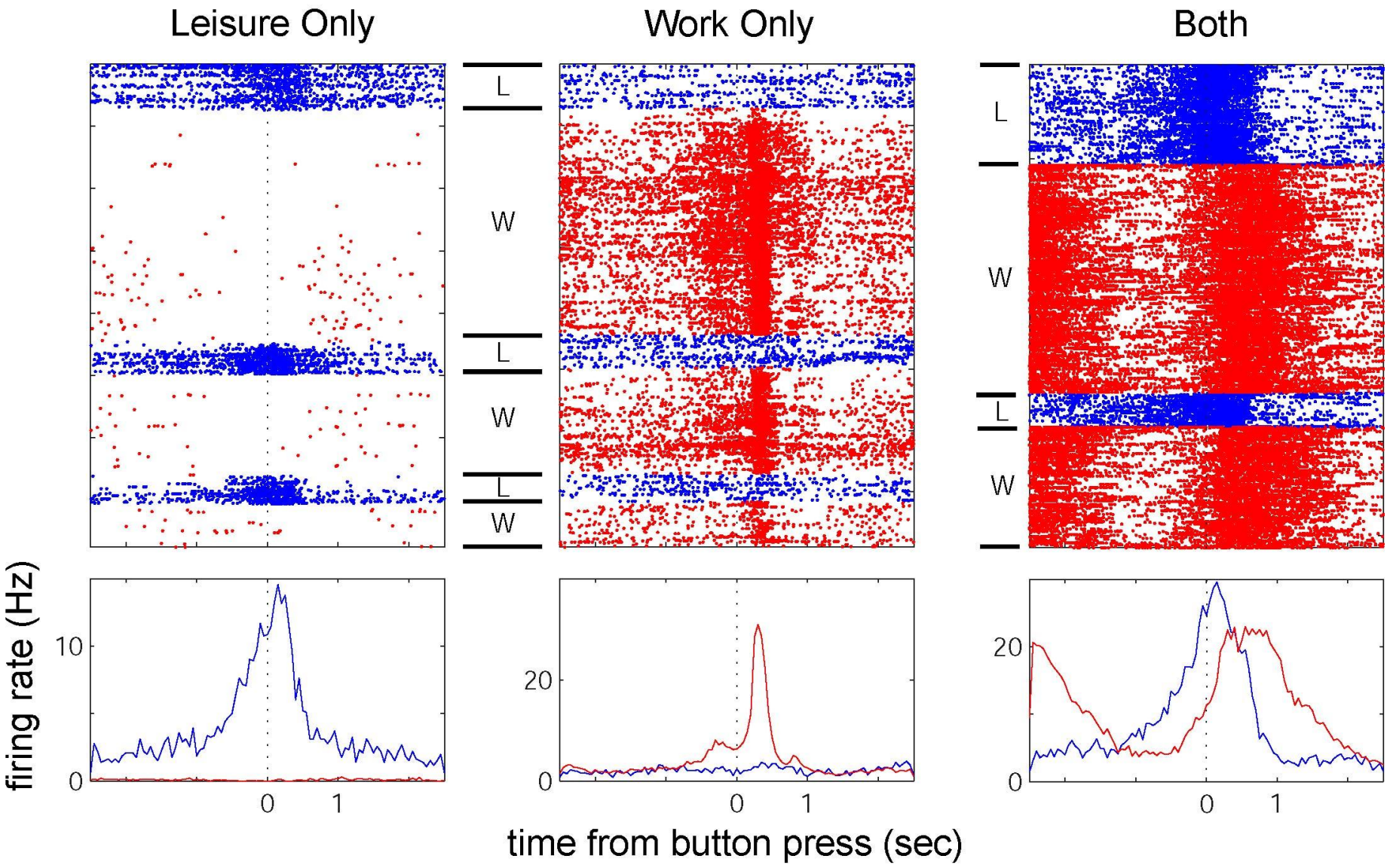
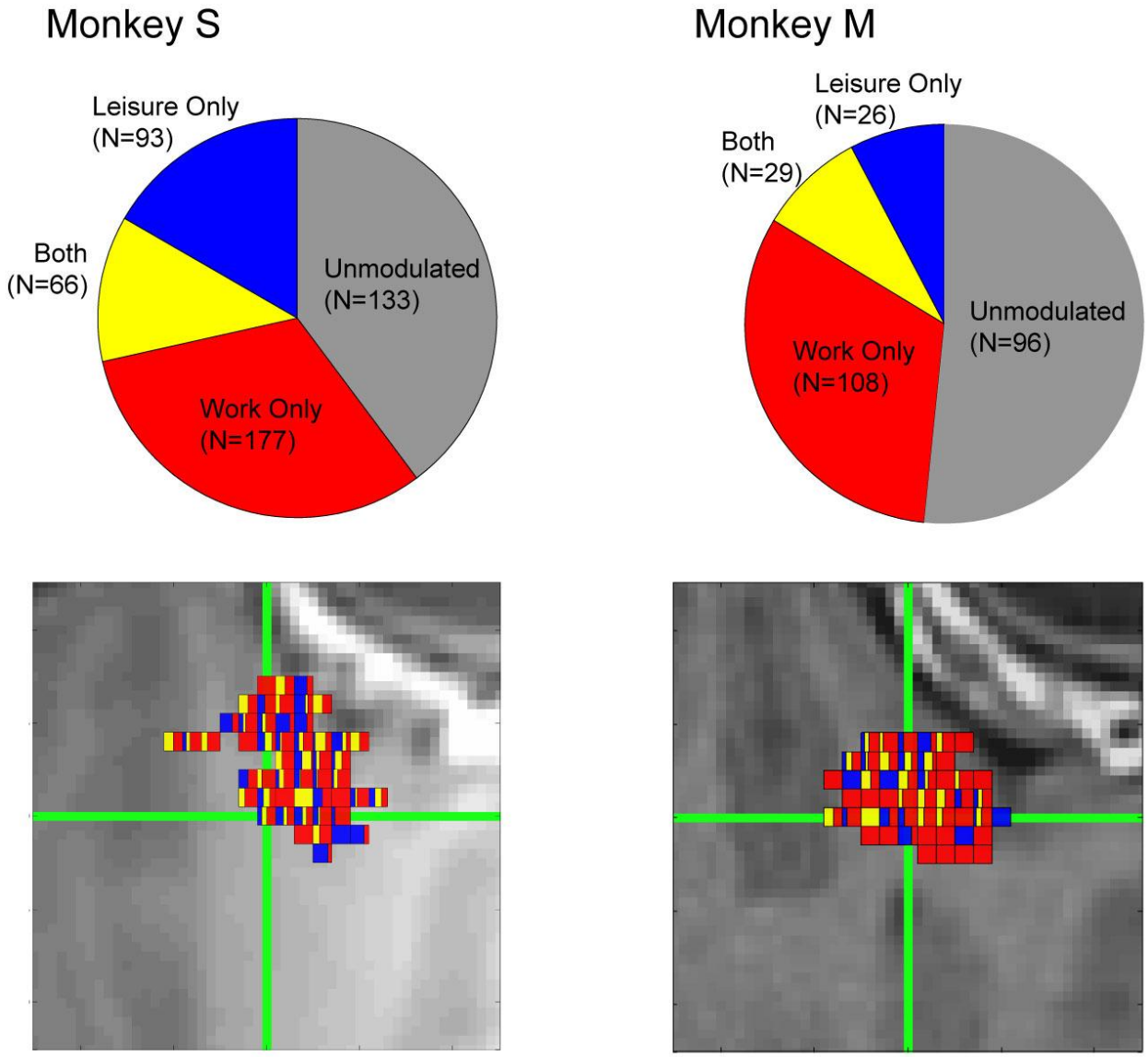
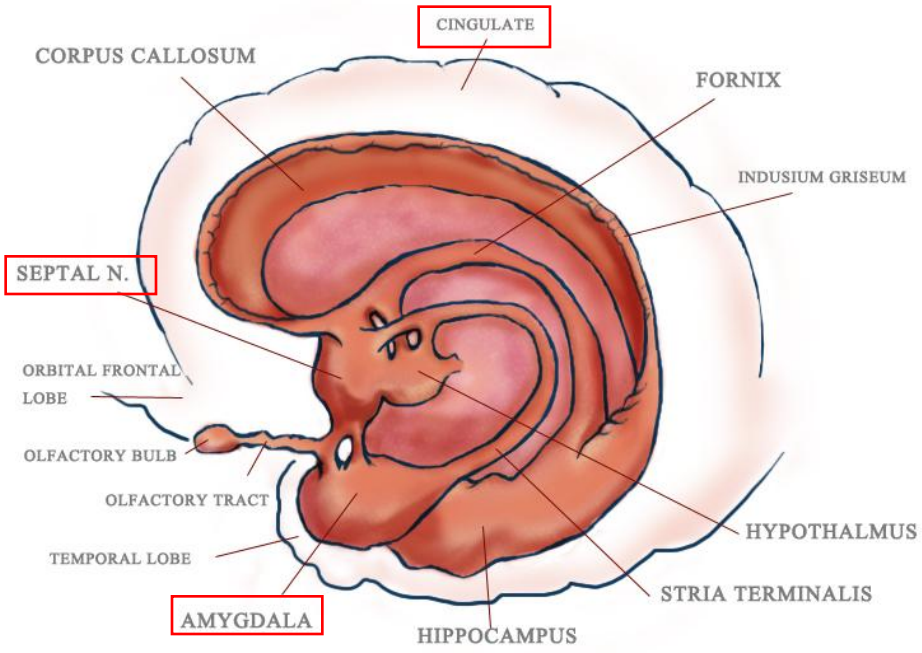


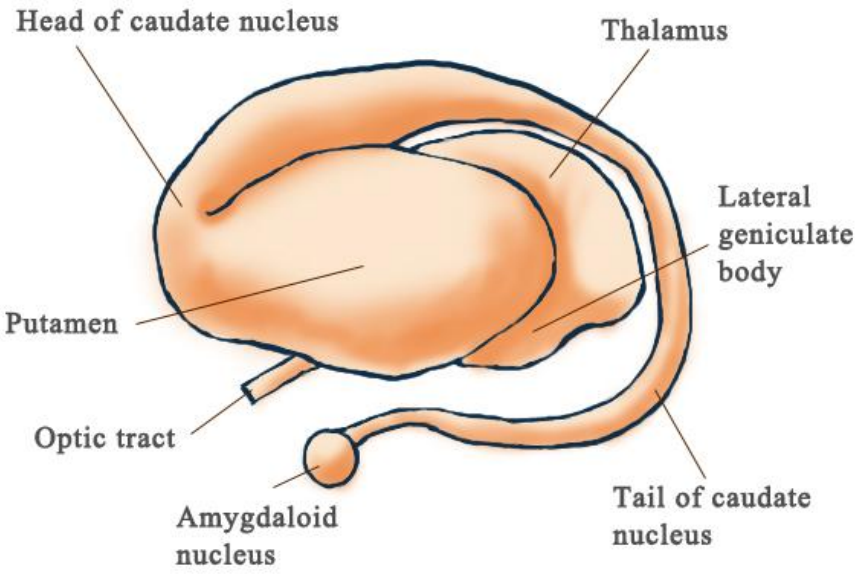


--> ***Common currency*** in the brain!

Campos, Koppitch, Andersen & Shimojo, VSS'08 (MRI scans by Igor Kagan)

Limbic system - the emotional brain





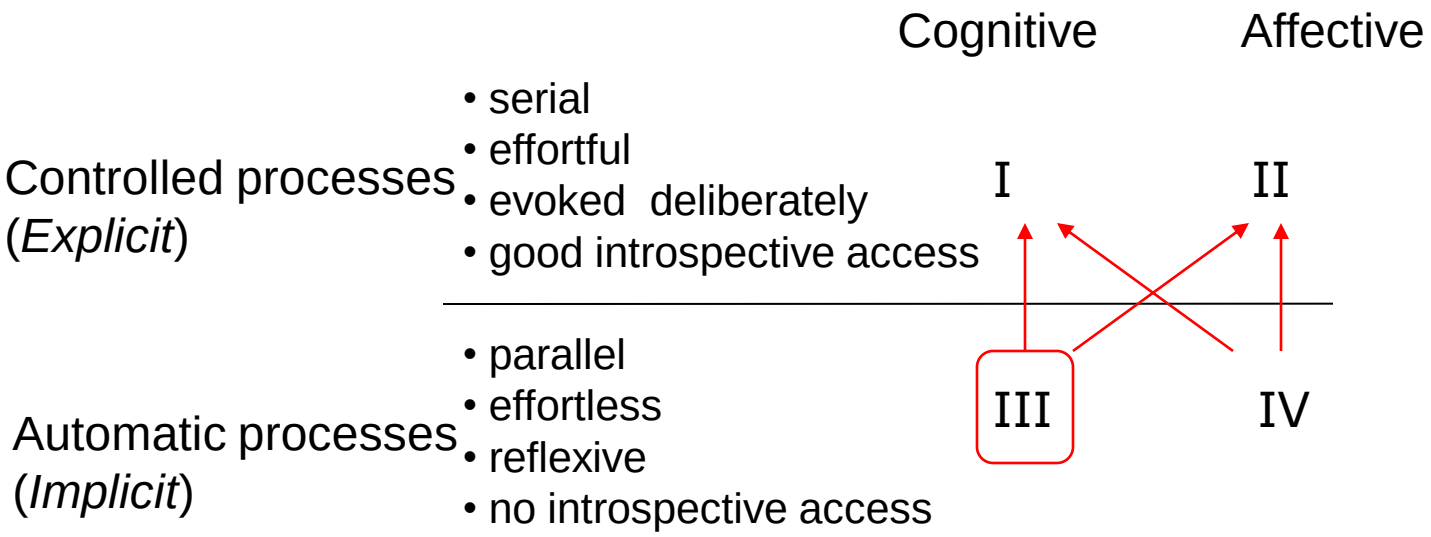
Two dimensions of neural functions for preference -> *choice*

		Cognitive	Affective
Controlled processes (*Explicit*)	• serial • effortful • evoked deliberately • good introspective access	I	II
Automatic processes (*Implicit*)	• parallel • effortless • reflexive • no introspective access	III	IV

Reward and decision making Network in the brain.

(Camerer et al., 2005)

Two dimensions of neural functions for preference -> *choice*



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(Camerer et al., 2005)

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Emotions are physical and physiological mechanisms that arouse feelings. They are mostly subconscious.
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・A classic image of the human being is a being who is intellectual, rational, and practical。
・Human intelligence is symbolic, logical, analytical, and presentational.
→Human essence can be seen to lie beyond those characteristics.

The characteristics of modern society can be understood in the context of emotion and implicit cognition.
Modern society = a society that has an advanced technology that appeals to both emotions and implicit cognition.

2. Modern society is entering a dangerous phase.

(1) Commercialism

・There is an excess of stimulus in commercialism and marketing ploys which control the choices people make.

・Neuroeconomics, neuromarketing

e.g..(1) Is the quality wine really delicious (wine tasting)?

(2) Research of preference and choice behavior (fMRI (subcortical layer and neocortex) and novelty and familiarity).

(3) WTP(Willingness To Pay)-DLPFC。

→Do consumers have free choice? (we need to pay attention to economic factors vs.. the reward mentality)

Excessive Stimulation

- One feature of modern human life

1. Excessive of absolute amount of sense energy (light and sound).
   --> This influences the biotechnology clock, and it becomes a stressor.
   E.g. Pokemon case(2000)

2. Excessive at speed of change.

3. Excessive at speed and breakthrough of upper bound.
   Eg . Infection of speed

Is modern society heading in a dangerous direction?

The Yomiuri Shimbun

4-23-2002

Case: “People suffered fits when they were watching Pokemon.”

-The changing of the colors is dangerous.

The Yomiuri Shimbun
4-23-02

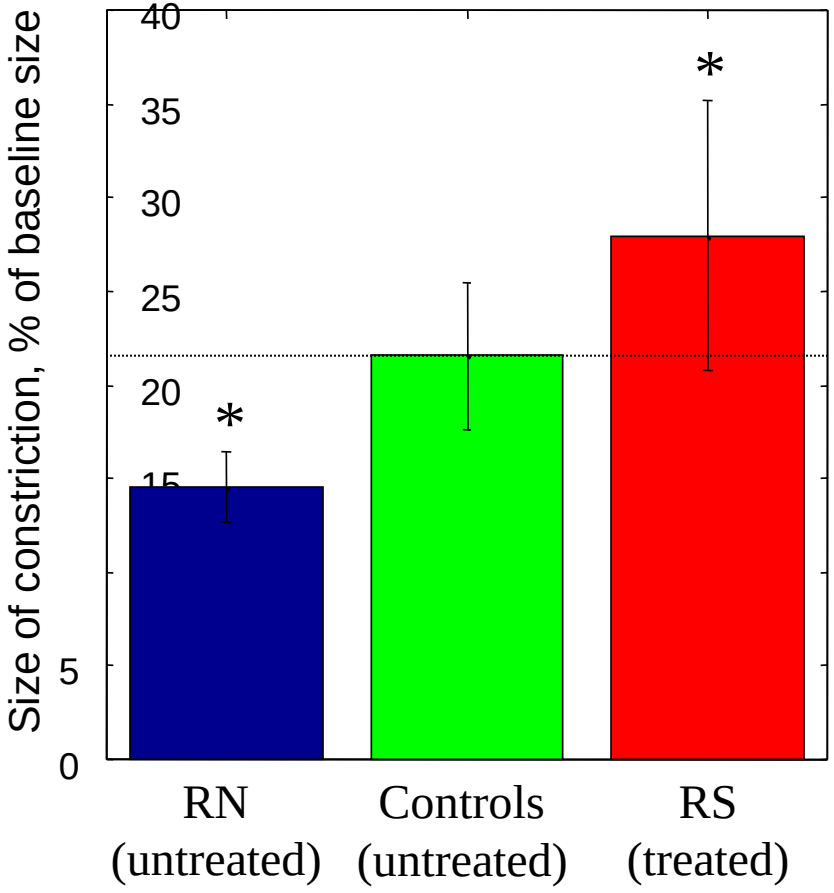
Pokemon case

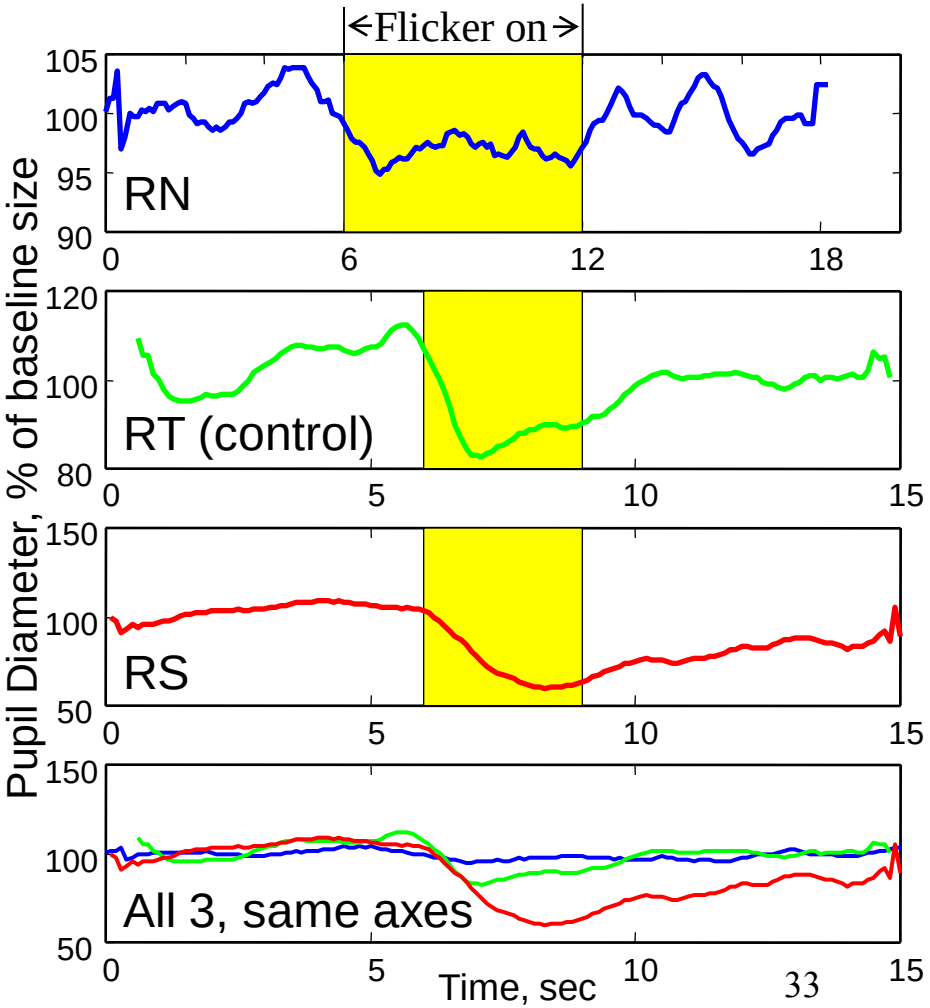
"Sensibility information"?
(1) Physiological and physical
(2) Context-dependent

It appeals to the biological mechanism, fascinates people and becomes their habit.

The experiment of the world got ahead of the labs of cranial nerve science and medicine . (cf. Hollywood)

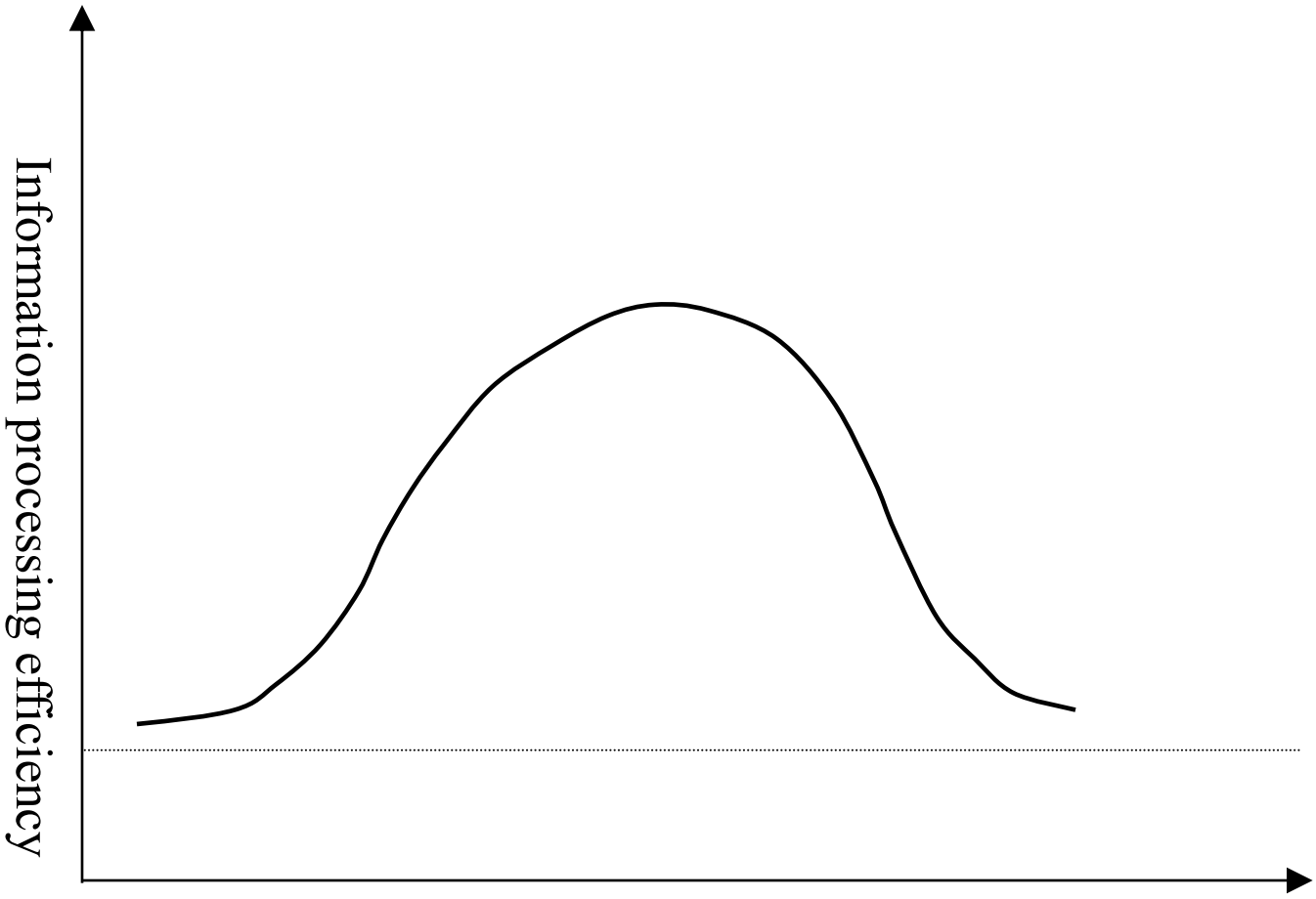
Pupil constrictions - larger than normal in RS(VPA-treated), smaller in RN (untreated).





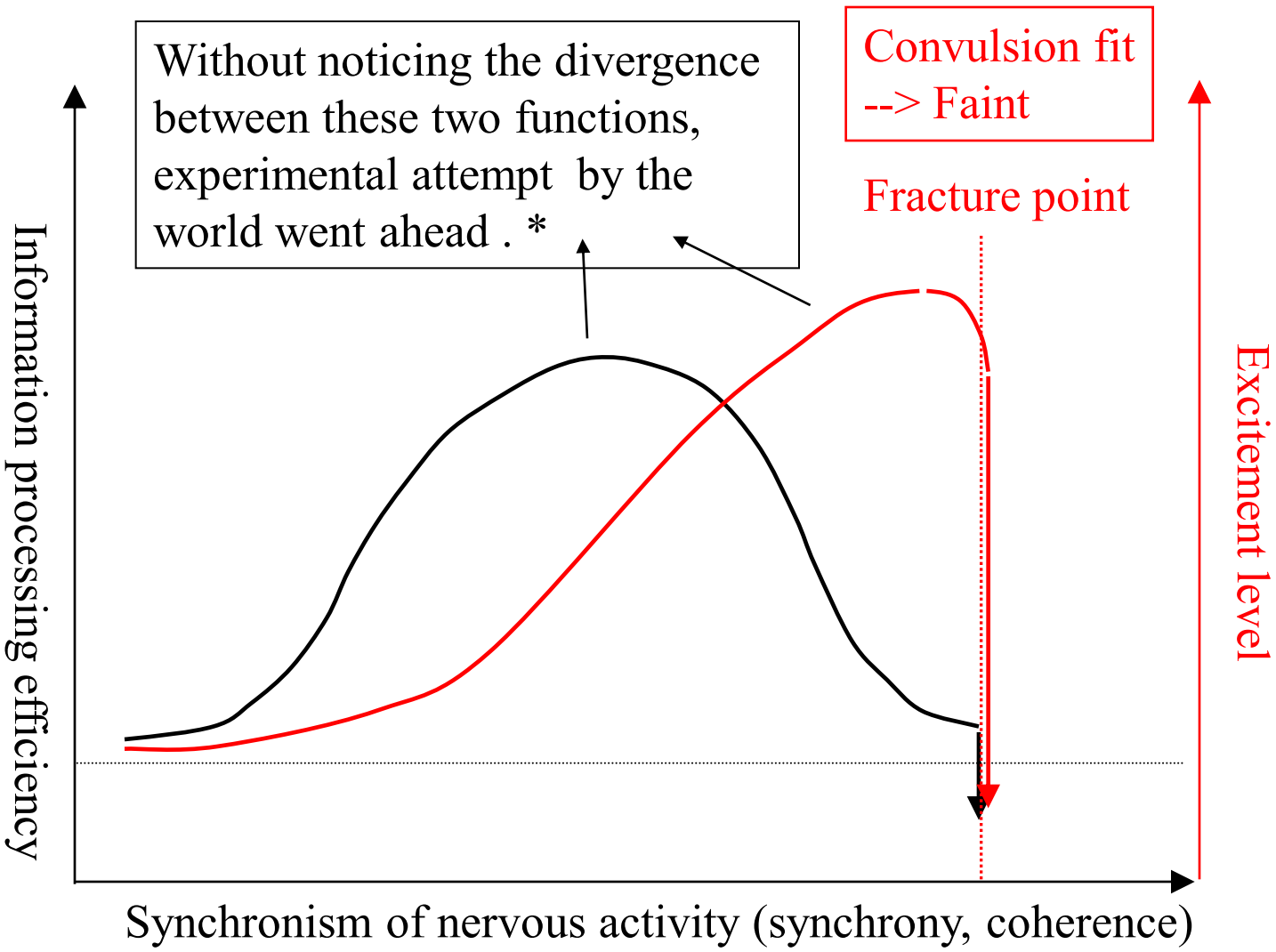
(Sample trials, White-Black Flicker)

Why did the Pokemon case occur?



Synchronism of nervous activity (synchrony, coherence)

It is reinforced by the flicker stimulation.



(* However, this thing shows a great possibility.)

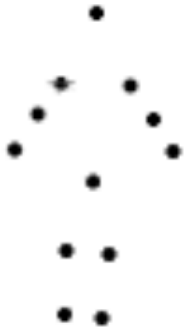
Excessive at speed-->

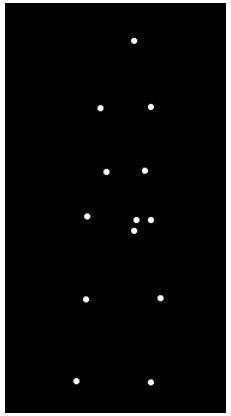
Infection of speed

*Why do New York and Tokyo people talk fast and walk fast?

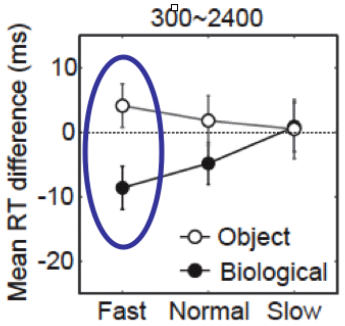
*A test subject stoops and walks slowly after activating the stereotype of
"Elderly person" (Bargh).

*Simple detection reaction time also quickens when the speed of a biomotion movie which does not relate to the problem of the background is increased (Ikeda & Watanabe, 2007). Social facilitation.



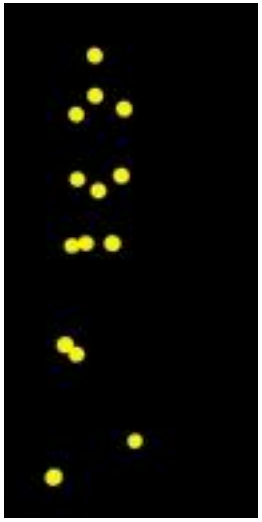


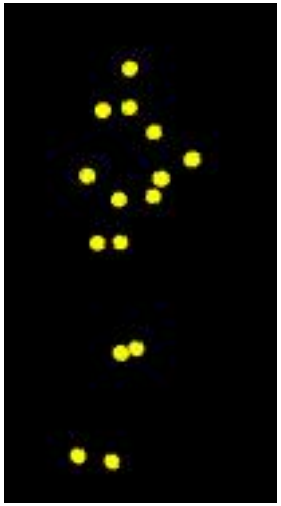
Biological Motion



Psychology physics experiment that uses stimulation

Biomotion





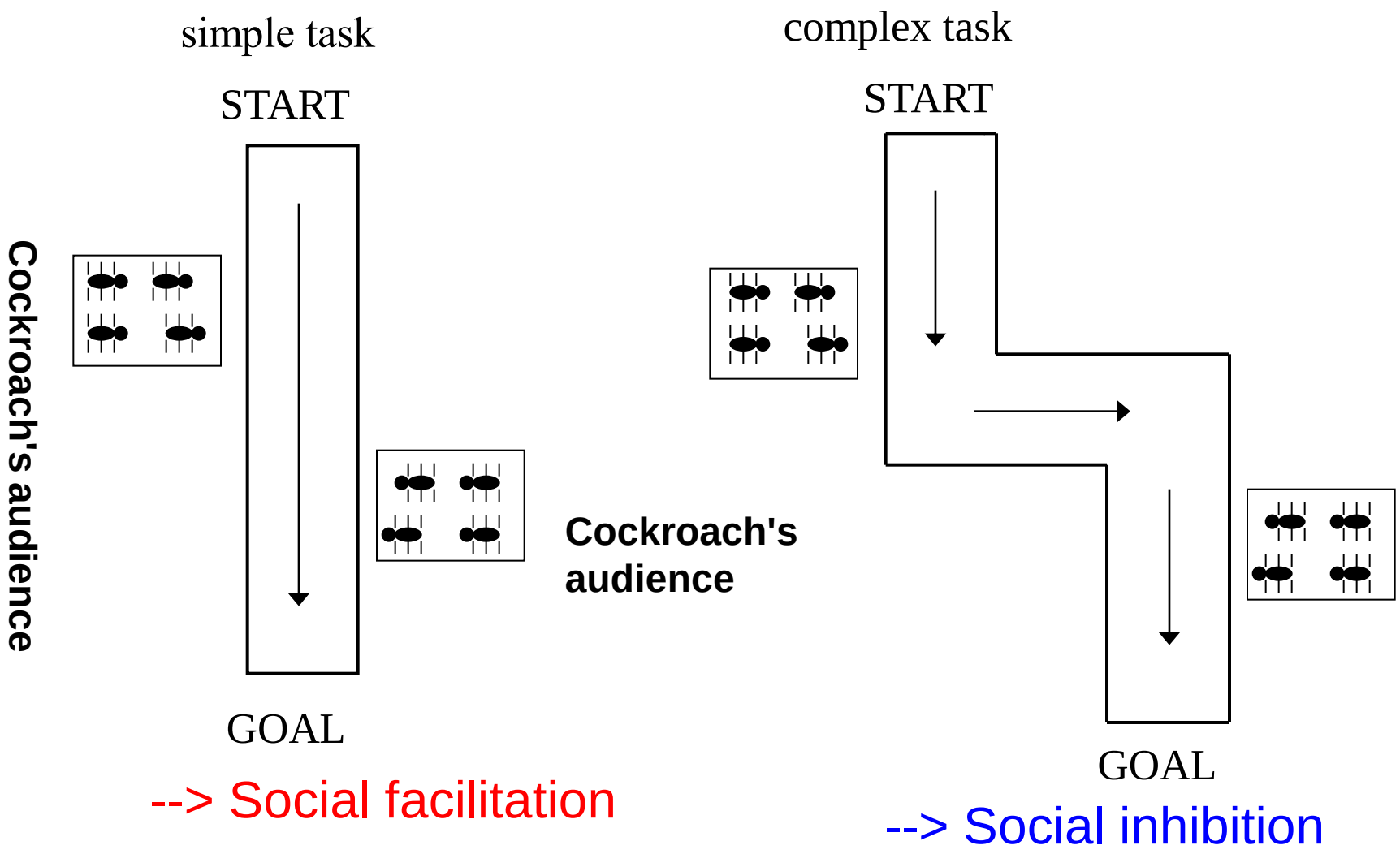
- http://www.biomotionlab.ca/walking.php#BMLWalkingDemos

Sociality and unconscious emotions

Cognitive and social "Existence“ and the influence
of "Others who one does not see "

Cf . ” ***roach race***” experiment(Zajonc).
The spectator's existence promotes the dominant response of the individual more and more.

Cockroach's maze task



＊dominant response

＊It is also kind of excessive of stimulation that there are a lot of others in ones surroundings.

"Excess" in the consuming society

1. Excess of absolute amount of sensory stimulation and gross energy.

2. Excess of change and movement.

3. Excess at speed and breakthrough of upper bound.
   E.g. Infection of speed (Ikeda & Watanabe, 2007)

4. Excess of volume of information.
   Becoming borderless between advertisement and content (information commercial, drama commercial and product placement etc...).

5. Excess of plural and simultaneous channels.

6. Excess of choices.
   (B. Schwartz, "The Paradox of Choice")

Neuro-marketing of wine tasting

(A. Rangel et al.(Caltech), 2008)

*The quality of goods and the taste of food are felt to be better when they have a greater feeling of luxury
*So, aiming at this, there is the marketing strategy in which sellers use high-level package and raise the price on purpose.
*Is it well-grounded judgment from a neuroscience aspect?

Experiment) In the fMRI scanner, various wines are tasted.

Result) When a high price tag was put on the jug wine on purpose, the same intracerebral region which was activated when the quality wine was tasted was activated.

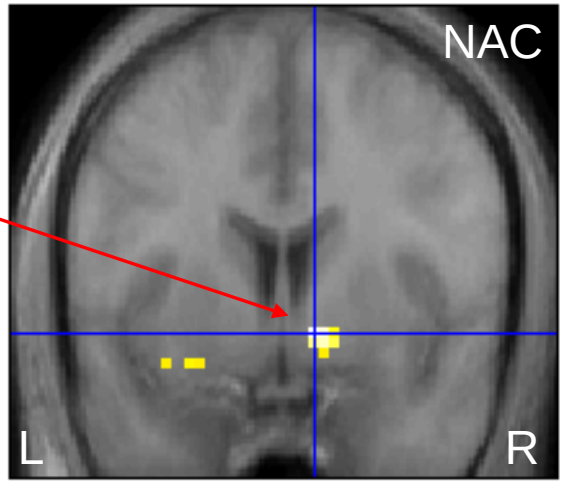
→Classic example of neuro-marketing study.
Methodology) Not only fMRI but also the research example by TMS (later mention)

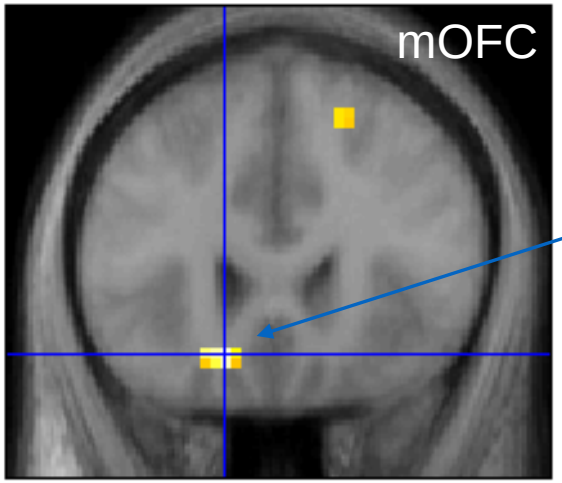
Facial preference

Spontaneous preference - well known (e.g.. infant pref. looking).
But neural mechanisms were not, till very recently.

Latest fMRI study indicates…

Nucleus Accumbens (NAC)

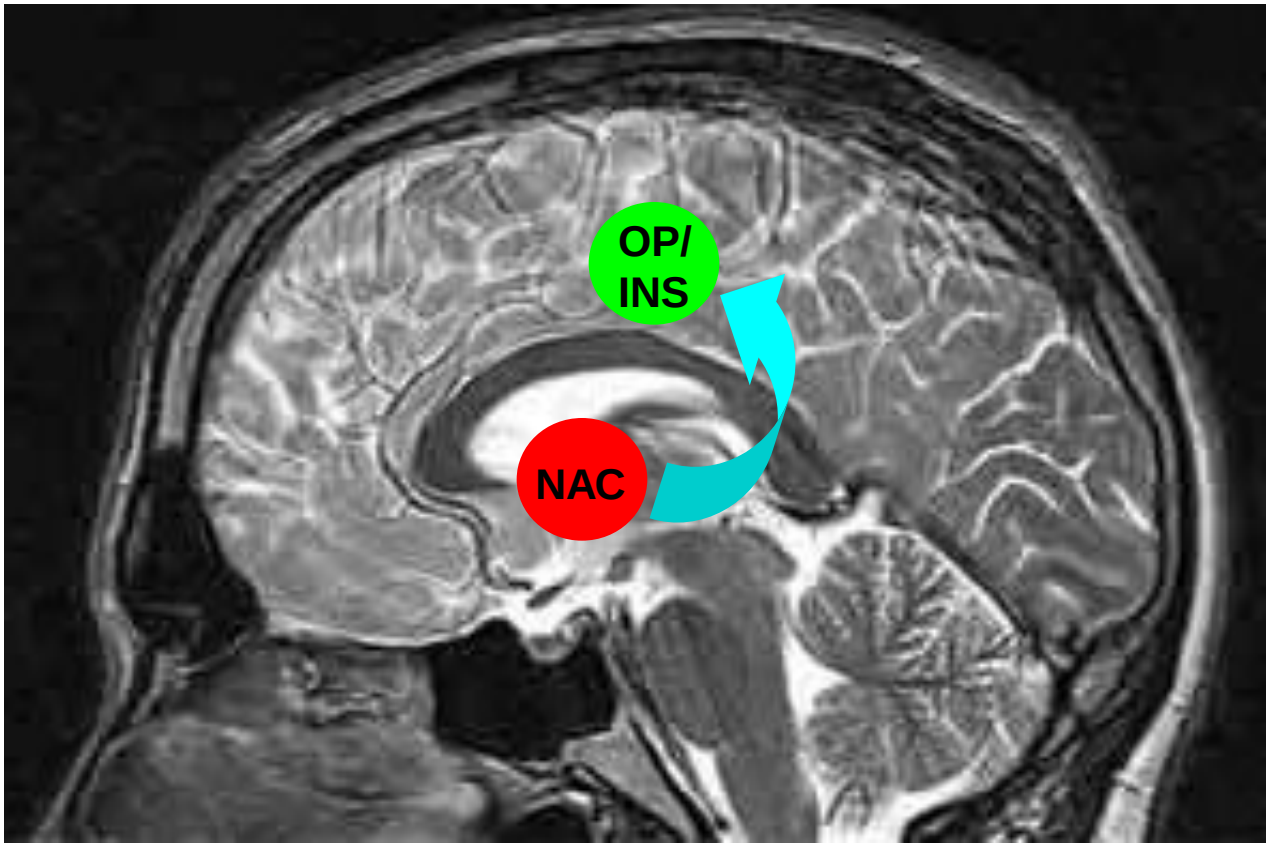




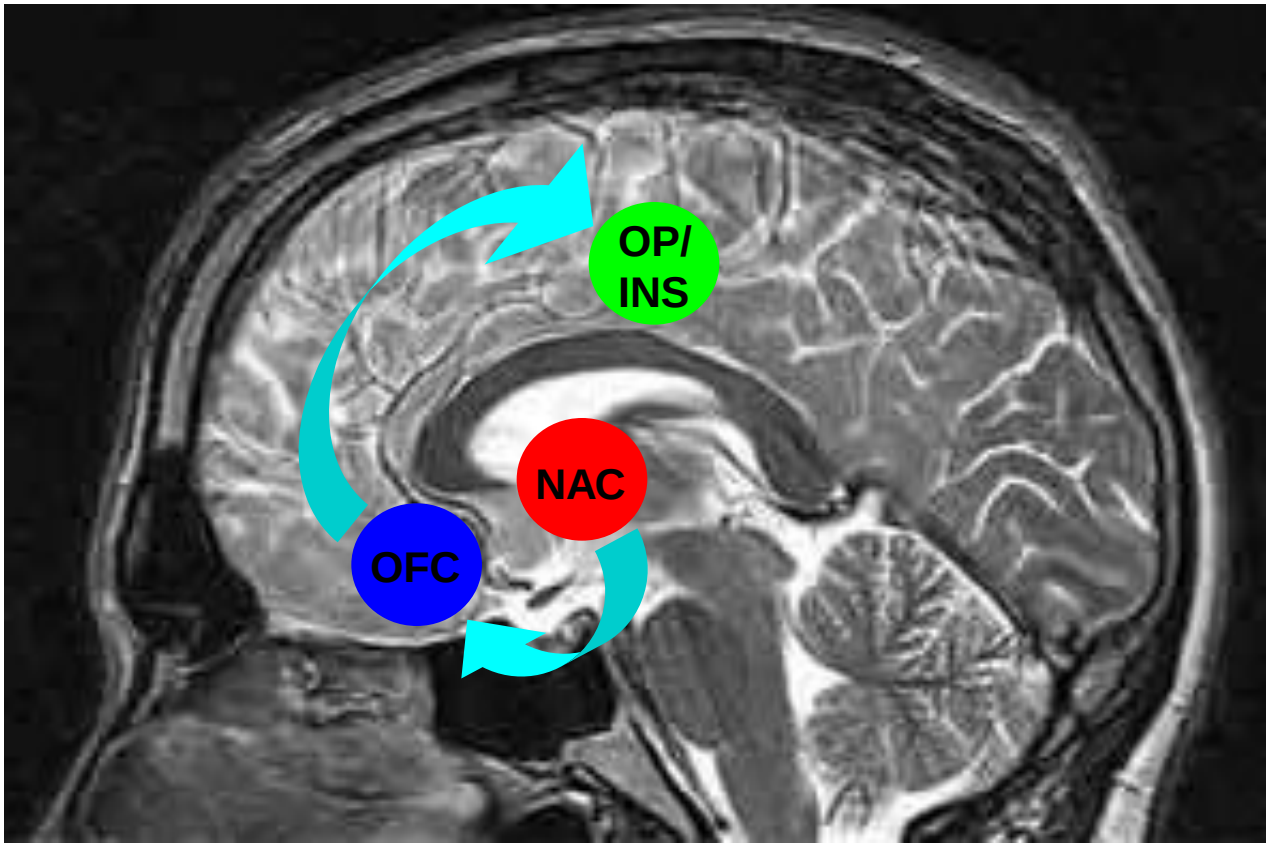
Medial orbito frontal cortex (OFC)

(Kim, Adolphs, O'Doherty & Shimojo, *PNAS* '06)

NAC	mOFC
Fast	Slow
Responsive to novel faces only	Responsive to familiar faces
Independent on attentional focus	Dependent on attentional focus
Related to group preference	Specific to individual preference



NAC communicates with OP/INS ***directly*** <u>when decision is easy</u>.
More automatic, reflexive, and affective.



Call for help from NAC to OFC <u>when decision is difficult</u>.
More controlled, more cognitive.

Basal forebrain

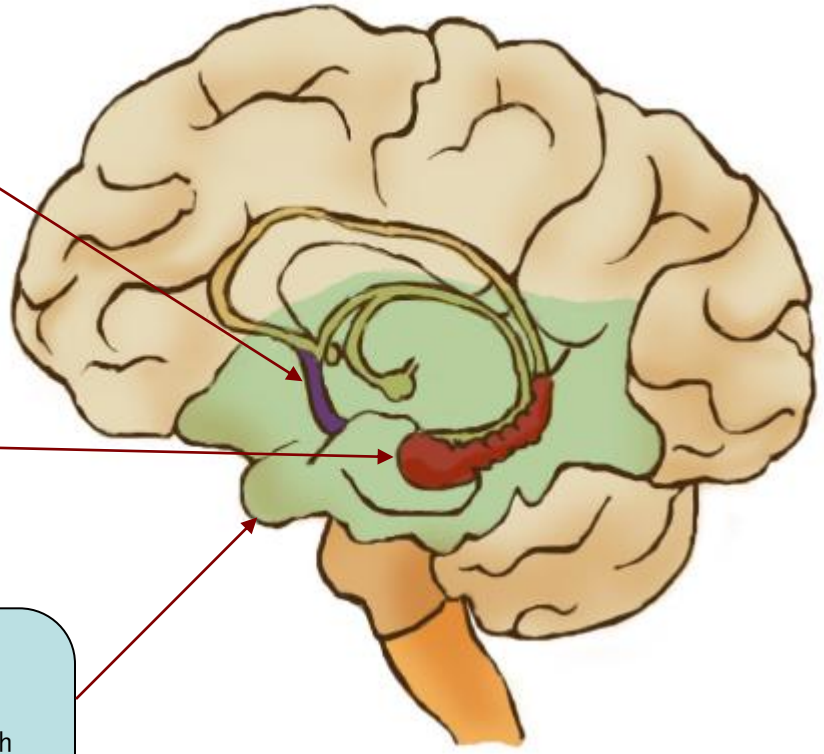
When this area is damaged, although a few events can be remembered, it becomes impossible to recall when they happened. Thus, it is thought that the basal forebrain relates to fixing the time when an old event happened.

Hippocampus

When the hippocampus that touches inside of temporal lobe is damaged, anterograde amnesia which is a loss of the ability to create new memories is caused.

Temporal lobe

When the temporal lobe part which surrounds the hippocampus is damaged, a retrograde amnesia is caused. It becomes impossible for the patient of the retrograde amnesia to recall an old memory.



The area that relates to the memory is adjacent to and overlaps the emotion area.

Preference and Memory

- No doubt, but how precisely ? -

Beer advertisement

"Novel, yet somehow nostalgic."

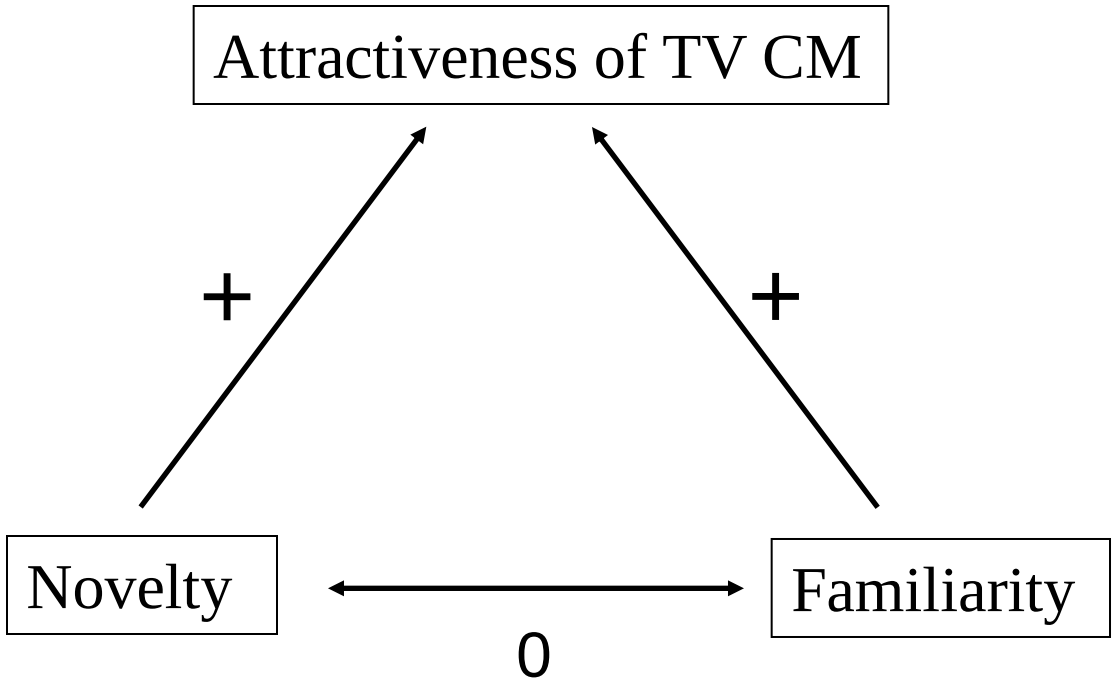
Novelty ⟷ Familiarity

‡ SAPPORO BREWERY

＊ Underage drinking is prohibited by law.

Novelty vs. familiarity in TV CMs - pass analyses

(Shimojo et al., in prep.)



* Novelty and familiarity contribute as "Cause" of the charm quotient of CMs.
* On the other hand, no correlation between novelty and familiarity .

How do past experiences affect preference?

*Two principles in the literature - Seemingly inconsistence:

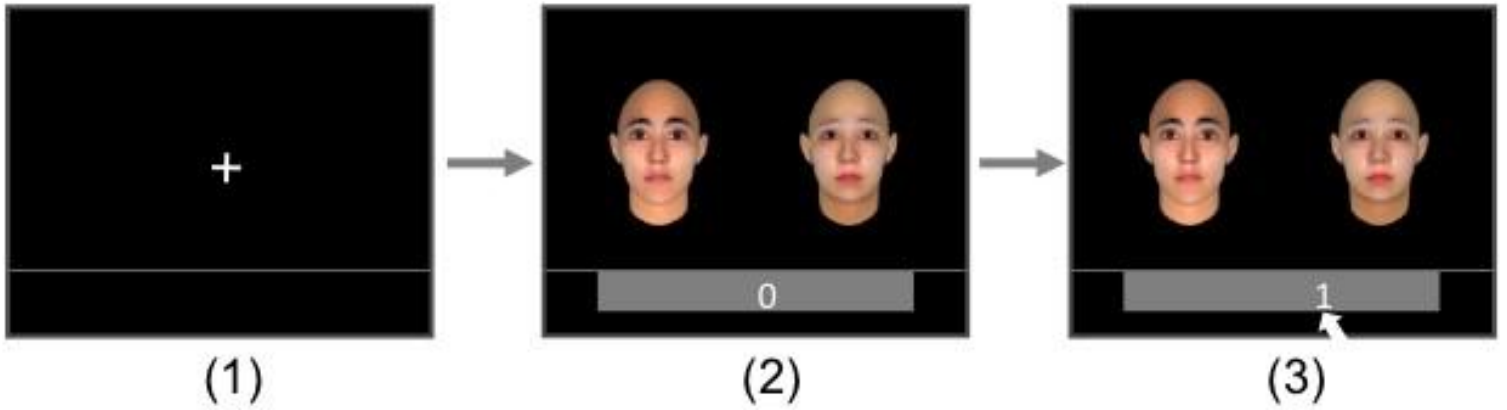
NOVELTY (N) vs. FAMILIARITY (F)

* N dominant in infants (e.g., Fantz, 1960) and animals,
  but F in special cases (Meltzoff, in 1970-80's; J. Piaget).
* F dominant in adult literature
  e.g.. mere exposure effect - repeated visual exposure to an object type increases attractiveness/preference of it
  (Zajonc, 1968; Zajonc et al., 1972; Bornstein, 1989).

*Shimojo et al. (VSS '07) showed a segregation of the two principles across object categories.

Old vs. New - Which do you prefer?

Procedure (1 trial)

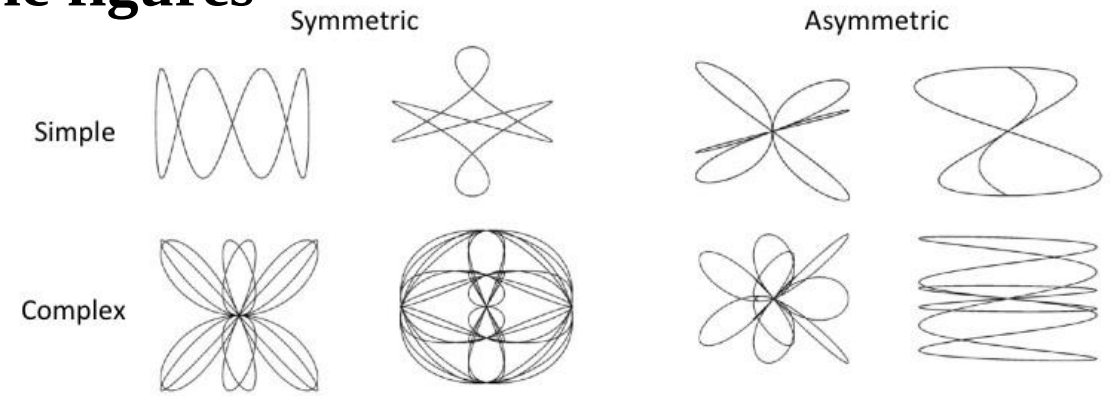


* The subject judged relative preference in a 7-point scale.
* The same old face is repeatedly presented 26 times(trials), paired with a new face each time.
* The same procedures applied to natural scenes and geometric figures as well.

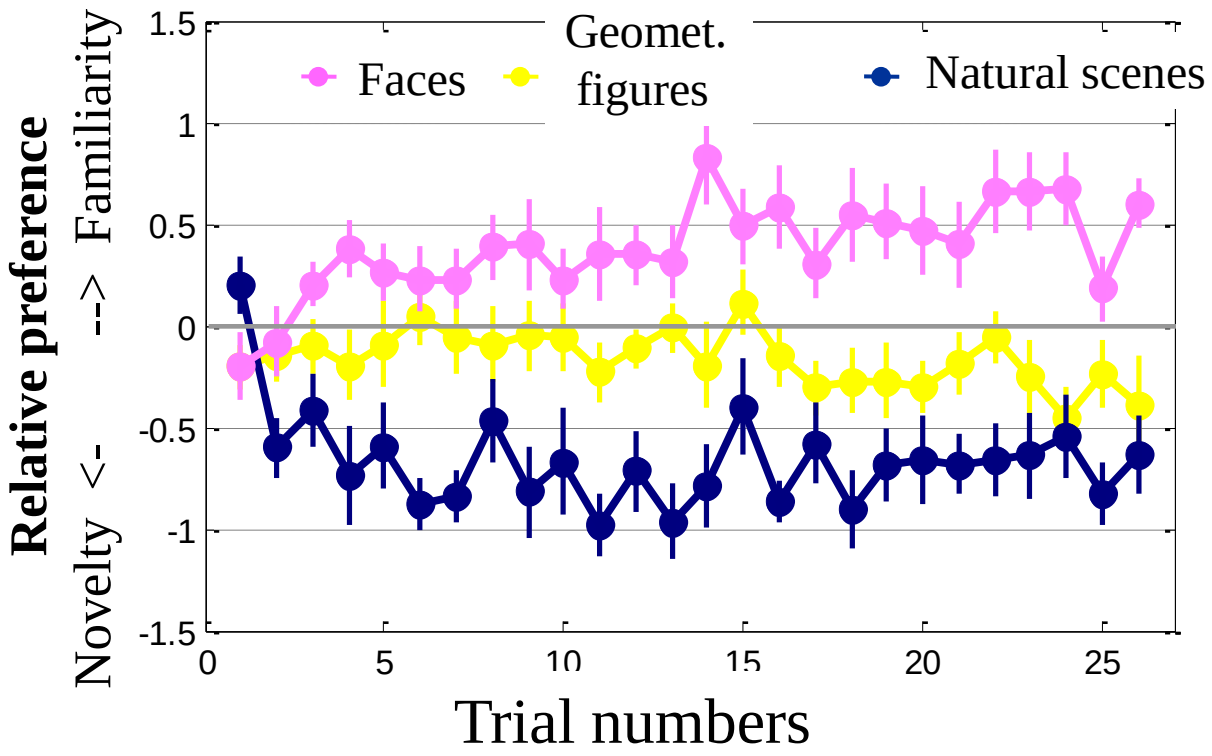
Examples of stimulus

2. Natural scenes

3. Geometric figures



Main results



Segregation:

Faces -> Familiarity dominant.
Natural scenes -> Novelty dominant.
Geometric figs -> Novelty (weak).

Effect of break (1-3 wks): Effects canceled, but quickly come back.

Why are commercials attractive?

Recommendation for a better advertisement?

--> Testimonial familiarity + contextual novelty.

e.g.. O2 (cell phone) CM - Beckenbauer in a fantasy world.

There are a lot of examples of hit CMs that belong to this genre in Japan.

Advertisement, CM

＊A feature of modern society
They will expand more and more in the future.
＊They deeply relate to the mechanism of the emotions and the implicit cognition.

To begin with, why are advertisements and CM effective?

1. Logical persuasion (white robe CM and comparison CM)

2. Association of meaning (brand image and halo effect)

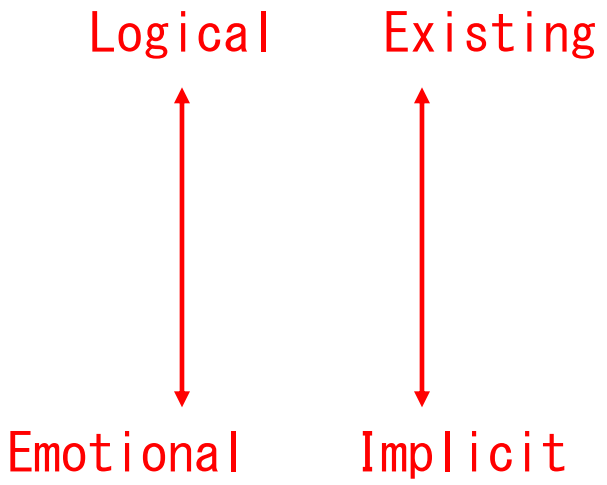
3. Effect of memory (priming and simple presentation effect)

Advertisement, CM

＊A feature of modern society
They will expand more and more in the future.
＊They deeply relate to the mechanism of the emotions and the implicit cognition.

To begin with, why are advertisement and CM effective?

4. Analytical persuasion (white robe CM and comparison CM)
3. Association of meaning (brand image and halo effect)
2. Effect of memory (priming and simple presentation effect)
1. Two kinds of conditioning (classic/tooled, PIT)



Pavlovian-Instrumental Transfer - How have commercials been effective?

Action choice?

Reach left

Reach right

Hypothesis) Is the relation of two kinds of conditioning mechanisms in the base of the effect of CM?
However, there is no positive proof.
(classical conditioning/instrumental conditioning)

1) In CMs, pavlovian conditioning is created. ▲ - cola.

2) At a shop (instrumental situation), Would the associative cue (brand icon, product itself) triggers the associated response more?

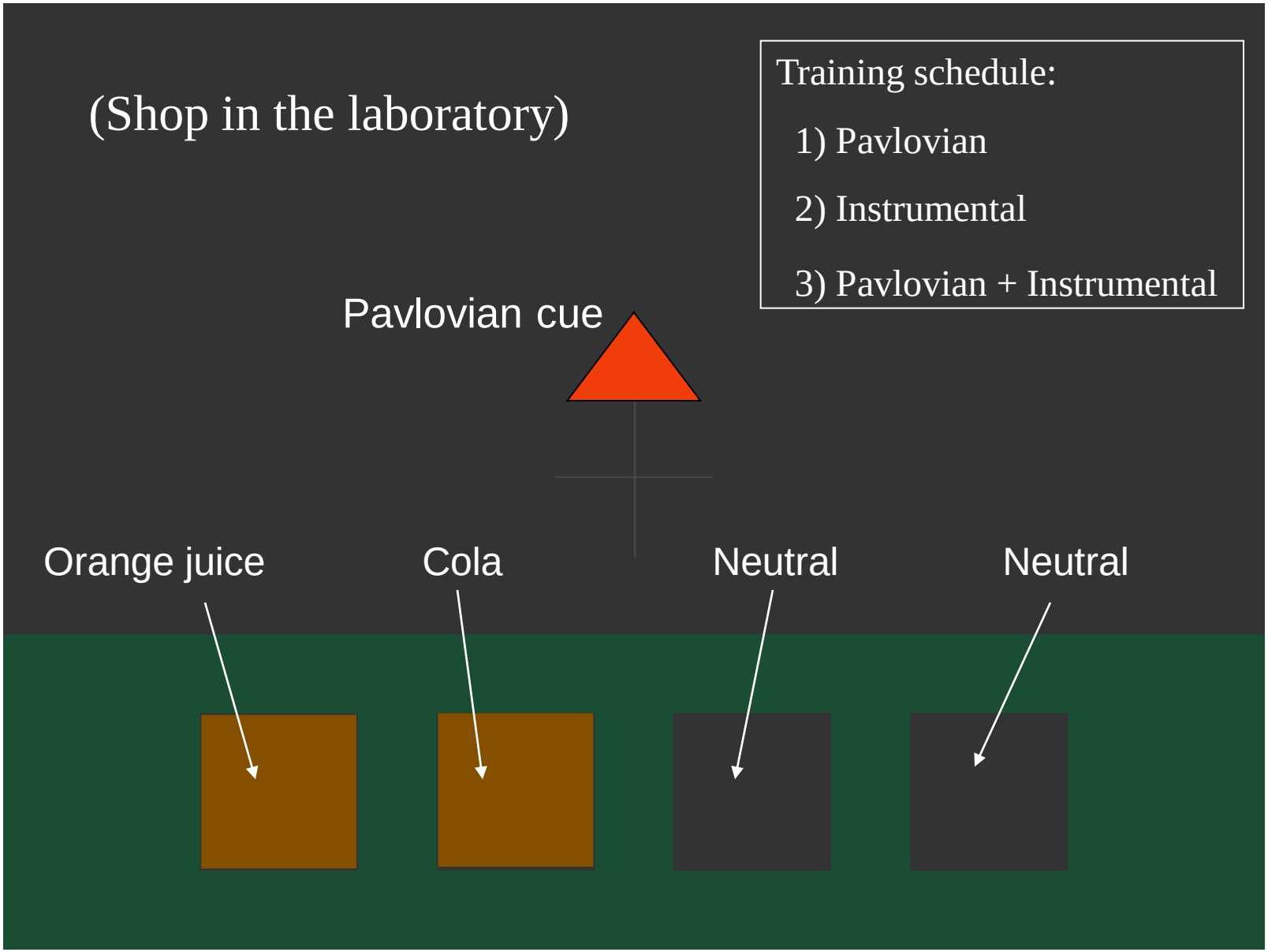
(Shop in the laboratory)

Training schedule:

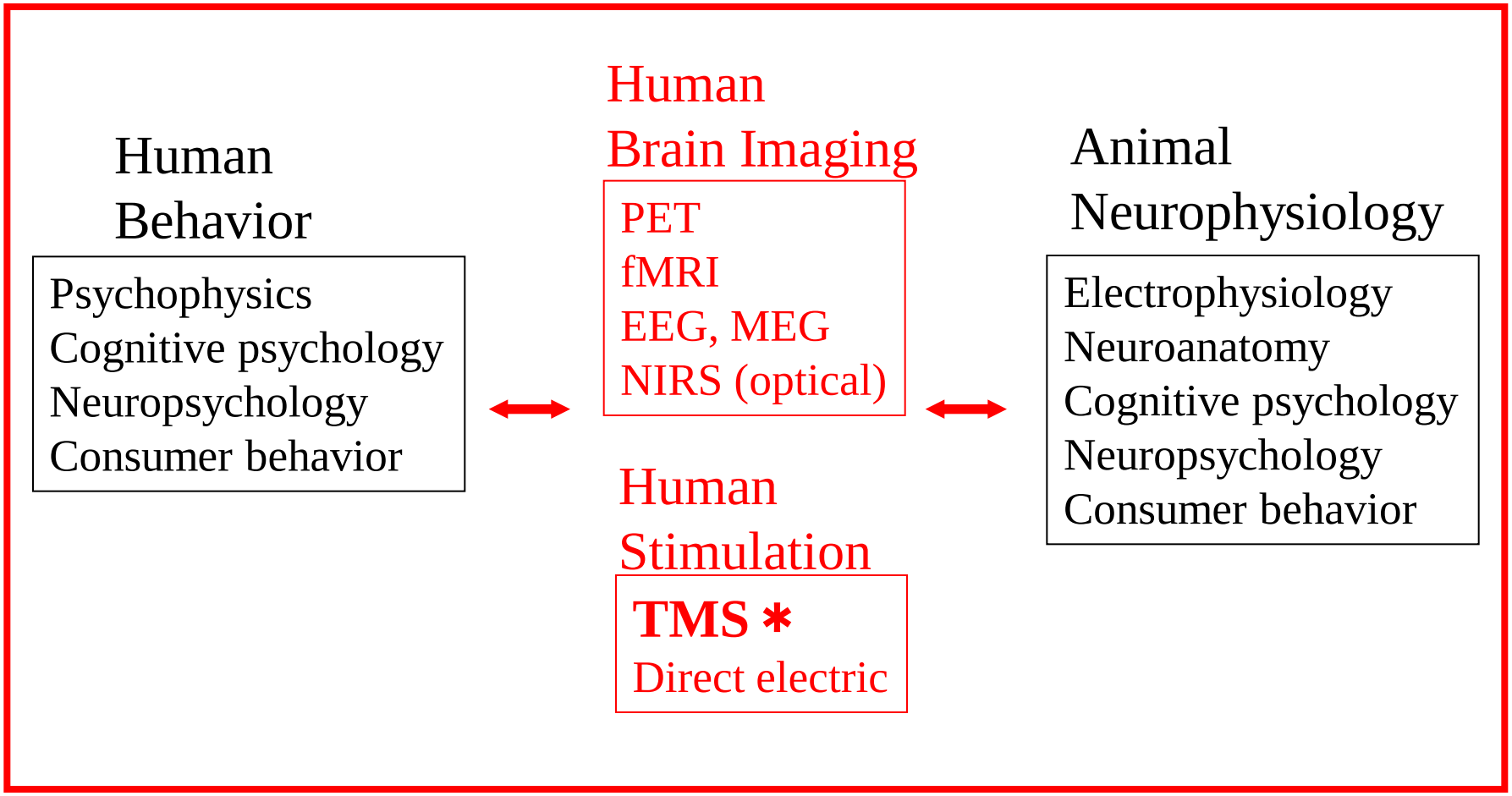
1) Pavlovian

2) Instrumental

3) Pavlovian + Instrumental



Bridging the gap

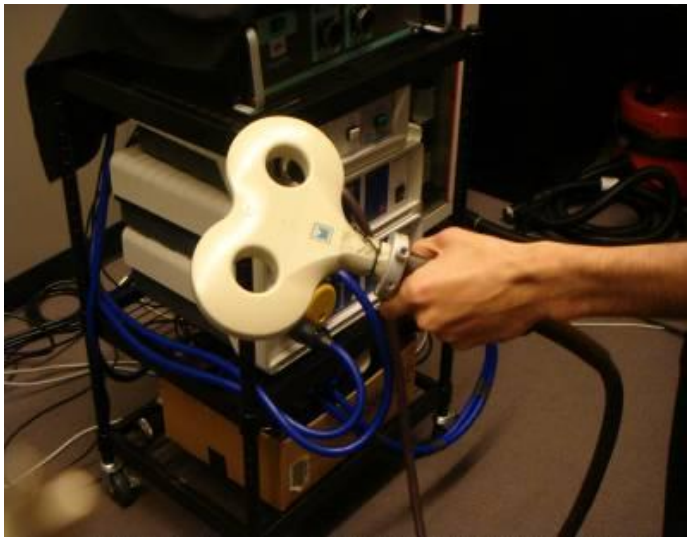


Used to be independent fields. Now, integrated!

Cognitive neuroscience of Emotion/decision making, Neuroeconomics, Neuromarketing

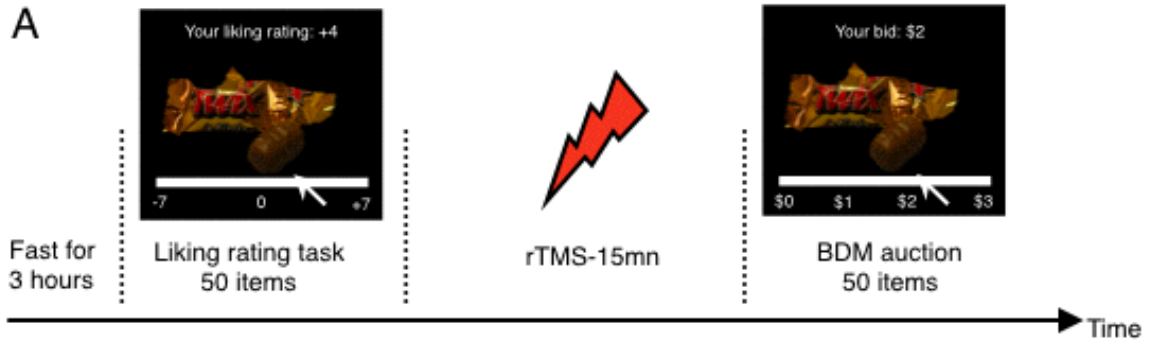
Implicit and dynamic aspects of choice decision

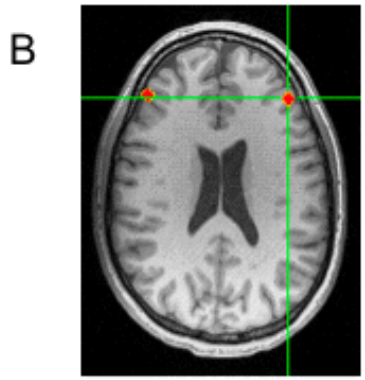
Transcranial Magnetic Stimulation (TMS)

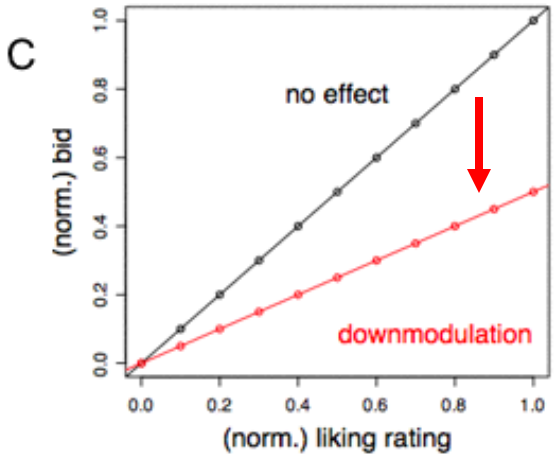


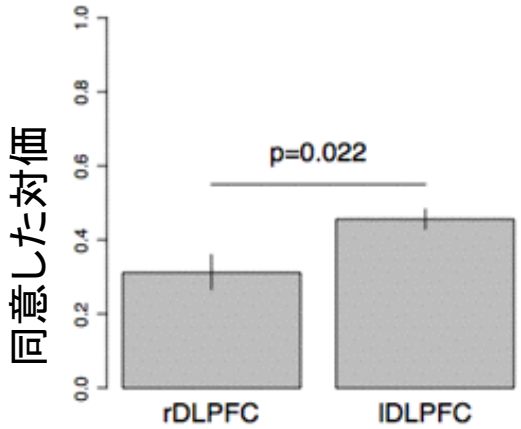
＊ Another intriguing tool for knockout / lesion of a brain part.

＊ Research example: The forehead areas which relate to rewards participate in WTP (Willingness To Pay) .Research by rTMS.









∗ The dorsolateral part of the left prefrontal area relates to WTP.

∗ When this area is "Functionally knocked out“ with rTMS, this judgment is ruined.(Camus, et al., in preparation)

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“Attention Economy” vs. Reward

The important thing about the advertisement is attracting attention.

vs.

People see only the things which they want to see. (They can not see other things).

→ Which is correct?
 a) Up-to-date question of marketing
 b) Question related to modern people's "Freedom" and the controls on it.

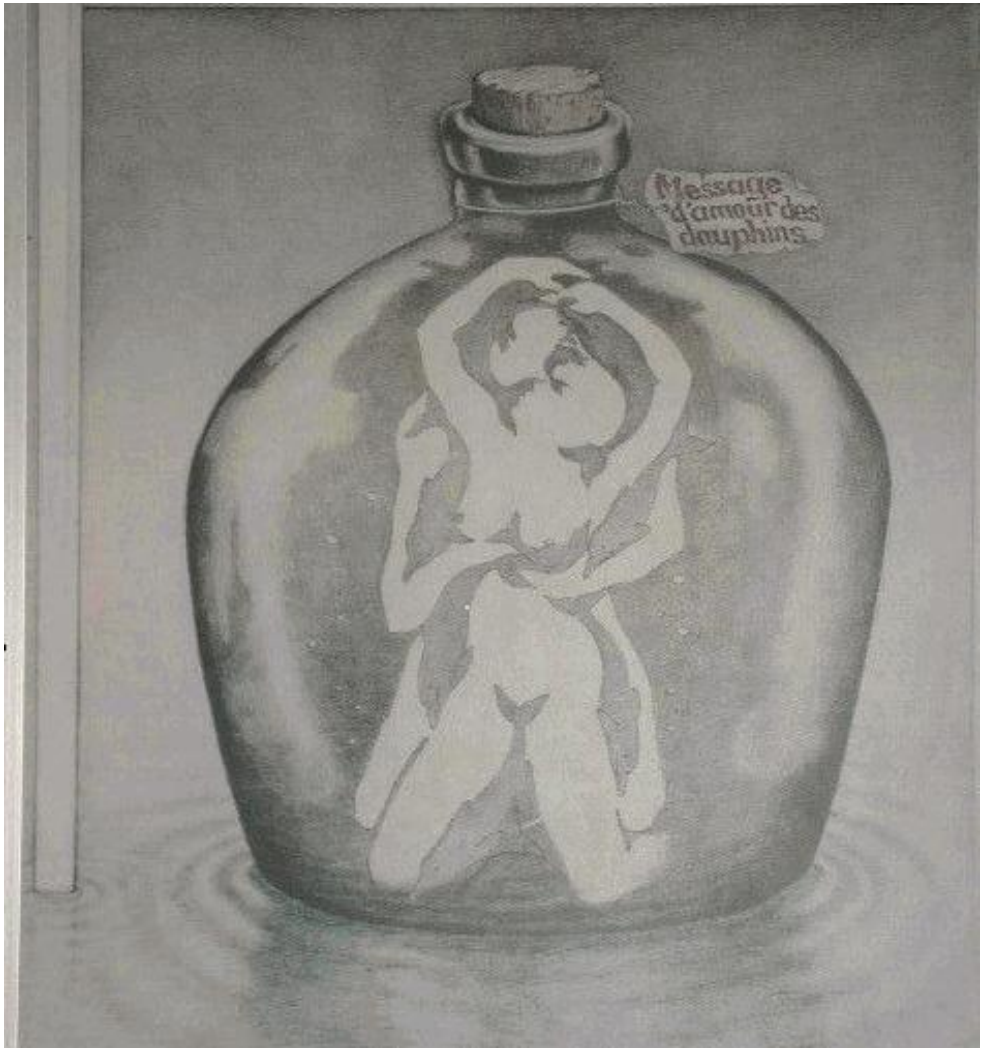
Attention economy

Example) Banner-type message of the Internet

1	2	3
4	5	6
7	8	9

How much would you charge for each space (1-9) for adv.?

However, on the other hand,
People see only things which they want to see.

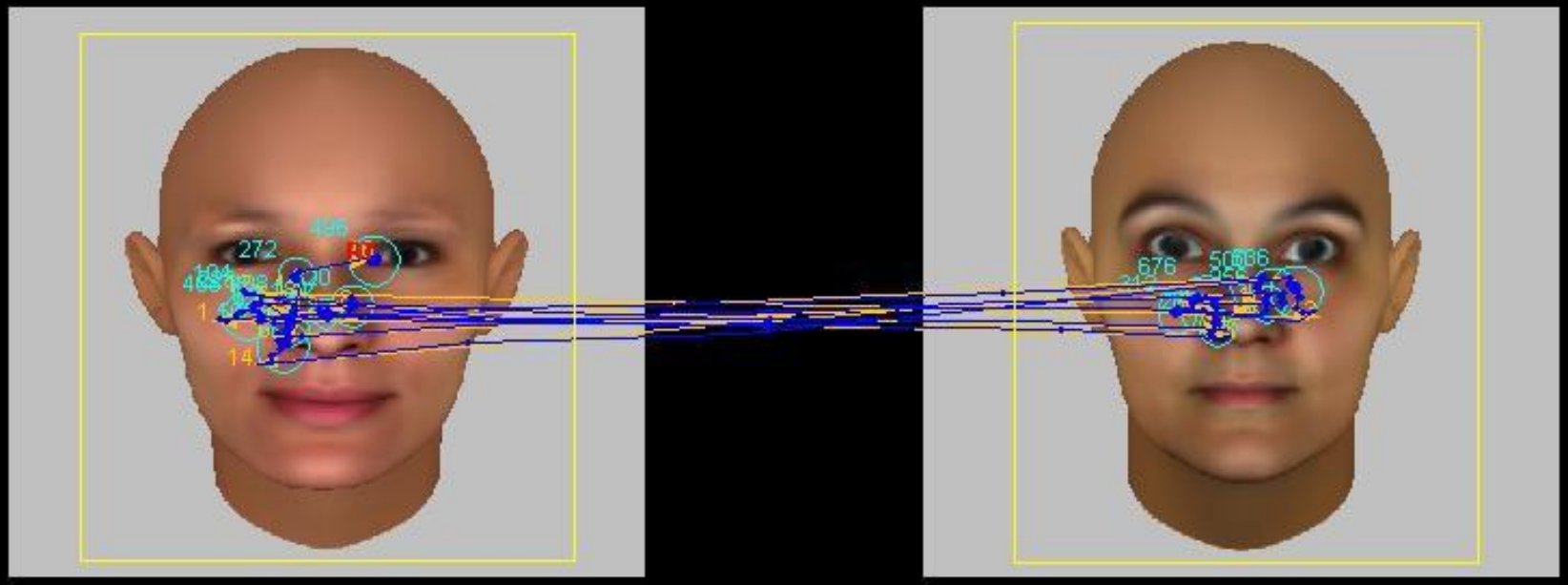

Message
d'amour des
dauphins

http://www.gallery-diabolus.com/gallery/artist.php?image=928&id=utisz&page=135

People see only the things which they want to see.
However, there are rubbernecking and another aspects that result in the fact that a sadder story creates a stronger impression.
→More accurately, people accept only the things with high emotional value.

Is it attention economy or a reward?
→ The research of the Gaze and preference : for the reference.

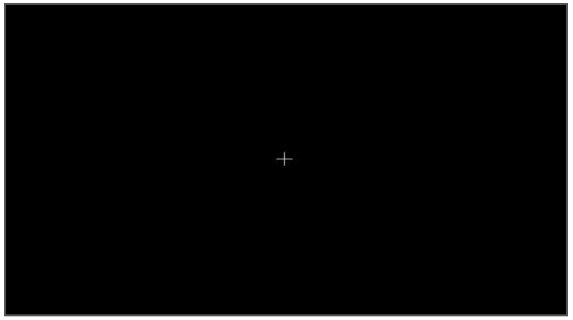
Gaze and preference decision



Facegen Modeller / EyeLink 2 : Raw data

*The bias of the gaze is caused before subjective preference decision.
* Subjects are not aware of the gaze bias.
*Preference decision can be manipulated by manipulating gaze!

Gaze and preference: Experimental paradigm



Stimuli; free inspection, no time limit

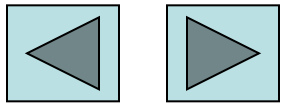
Fixation point (1 s)

-Faces in a pair were **matched (/maximized)** for attractiveness (pre-experiment rating), gender, race and age.

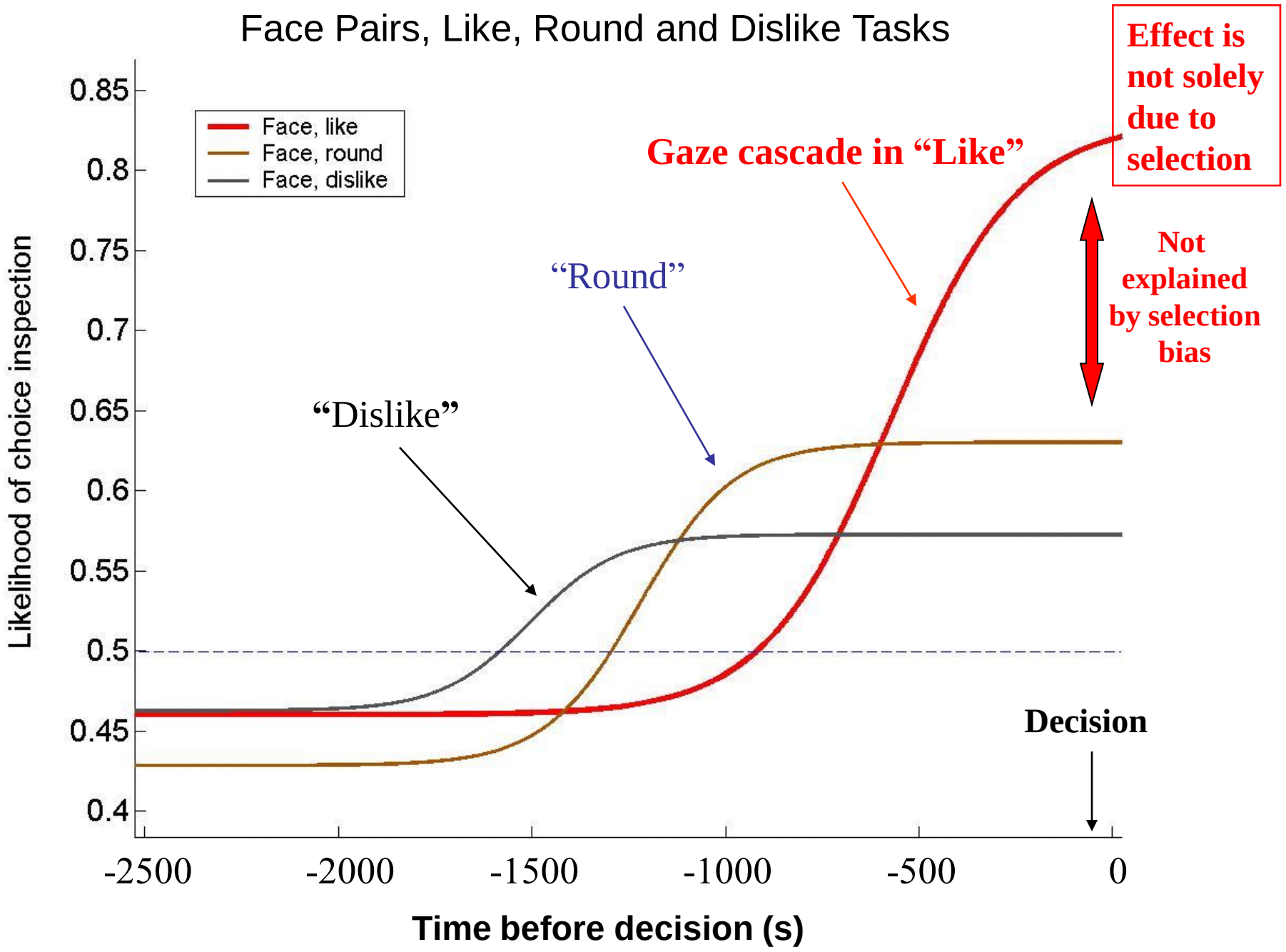
-**Free observation time.**

-Pooled gaze data time-locked to, and backwards from the decision (button pressing).

Key press upon decision (depend. on task)

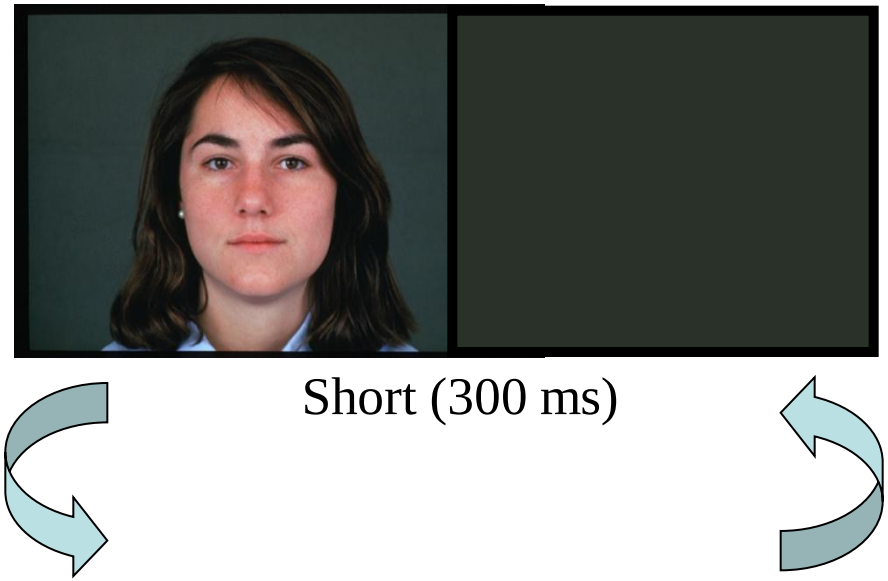


(Shimojo et al., *Nat. Neurosci.*, 03)


Face Pairs, Like, Round and Dislike Tasks
Face, like
Face, round
Face, dislike
Likelihood of choice inspection
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
-2500
-2000
-1500
-1000
-500
0
Time before decision (s)
Gaze cascade in "Like"
"Round"
"Dislike"
Decision
Effect is not solely due to selection
Not explained by selection bias

Preference decision can be manipulated by manipulating gaze!

(1) Pre-rating of attractiveness --> (2) pairing. (3) Gaze Manipulation (2, 6 or 12 loops) . (4) Press a button for preference.



Short (300 ms)

Long (900 ms)

(N= 15, or 13)

2 loop → 51.2 %

6 loops → 59.0 %

12 loops → 59.2 %

(significant preference bias towards the longer-gazed)

Control experiments suggest: The preference bias can ***not*** be attributed to mere exposure.

Gaze cascade effect : *Findings*

1. A bias towards to-be-chosen object (e.g.. face) *before* conscious preference decision.
2. Not a confirmation process, rather a *dynamic precursor* of the final choice.
3. *Specific* to preference (like) task only.
4. Can manipulate preference decision by manipulating gaze.
5. *Not* limited to faces (e.g.. geometric figures, commercial products).
6. Occurs with more than 2 alternatives (e.g.. 4-alternative FC).
7. 2nd time - still a gaze cascade, either the same, or a reversed pref.
8. Subjects were not aware of the gaze bias, or actively denied its causal contribution to the preference decision.

→An orienting response of the body is an indispensable unconscious pioneering process of a conscious preference decision.
The body precedes the mind.

Gaze cascade: Implications

**James-Lange theory: Mind first, or body first?*

*Cast some doubt on the neo-classical economics (utility) view
(Ariely & Norton, '08)

＊Attention economy vs. Reward→ It is mistaken to understand Attention economy "vs." Reward. They are dynamically connected.

Summary of preference research

1) Novelty vs. Familiarity → "Career "* for a long term decides present preference.
(*Career : The whole of short-term/long-term interaction that reaches from inheritance to body, nerve, and environment.)

2) Cascade of gaze→ Even the present preference is decided by the dynamics of the implicit cognition lasting for a few seconds.

3. Modern society is entering a dangerous phase.
(2) Politics

(1) Homeland security and the threat of terror

(2) The relationship between faces and election outcomes (Todorov et al.)

Inferences of Competence from Faces Predict Election Outcomes

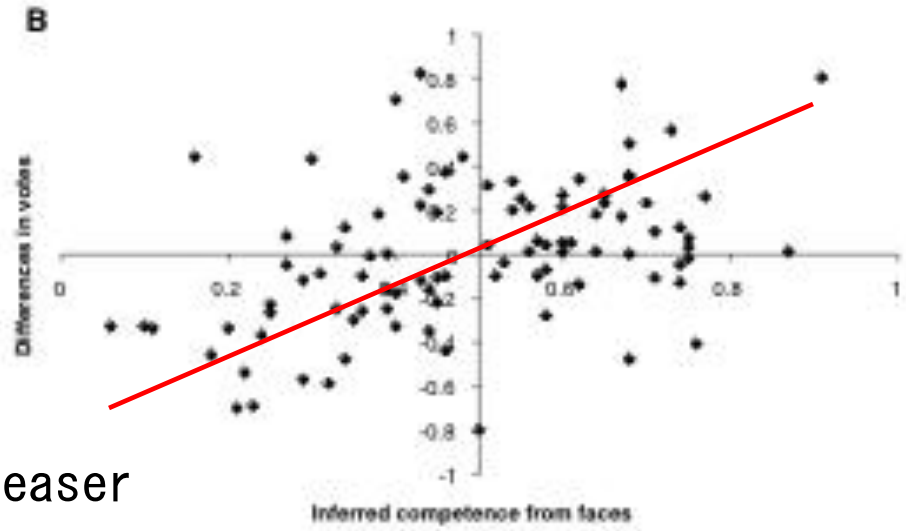
Inferences of Competence from Faces Predict Election Outcomes
A. Todorov, Anesu N. Mandisodza, A. Goren, C. C. Hall
Science 10 June 2005:Vol. 308. no. 5728, pp. 1623 – 1626 Fig. 1

Alexander Todorov,[1,2]* Anesu N. Mandisodza,[1]† Amir Goren,[1] Crystal C. Hall[1]

We show that inferences of competence based solely on facial appearance predicted the outcomes of U.S. congressional elections better than chance (e.g., 68.8% of the Senate races in 2004) and also were linearly related to the margin of victory. These inferences were specific to competence and occurred within a 1-second exposure to the faces of the candidates. The findings suggest that rapid, unreflective trait inferences can contribute to voting choices, which are widely assumed to be based primarily on rational and deliberative considerations.

Which person is the more competent?

*Test subjects don't know the candidate's face and result (another state).
*"Ability" is evaluated only from the impression of the face.



→There was high correlation between the "ability" and an actual vote.

In politics, face (=emotional releaser stimulus)operated secretly.

Cf. TV drama "Just" (Takuya Kimura)

4. Freedom and compulsion

When neuroscience is pursued, determinism (compulsion and control) prevails.

This is true even for behavior based on free will.
→" Bereitschaftspotential" (readiness potential)

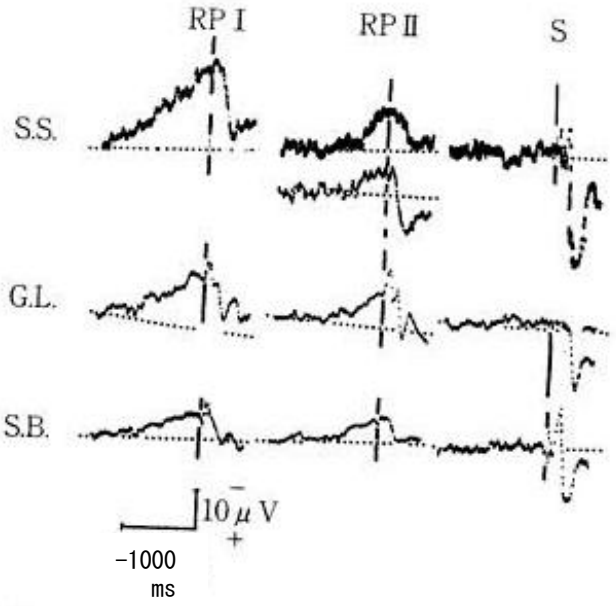


Figure 4.2　自発的に起動する自発的な行為に先行する準備電位(RP)

RPI: Readiness Potential in trial scheduled beforehand to act between some time range. From -800 to -1000ms . (Compared with the onset of muscle movement.)
RPII: Readiness Potential in trial not scheduled beforehand. -550ms

550ms (RPII) - 150ms (Subjective onset of intention) = 400ms.
The nervous activity has started 400ms before voluntary intention to the act do.

‡ Benjamin Libet(author), Shimojo Shinsuke " Mind time —*nou to isiki no jikan*—" p153 Figure 4.2

Along with the previous consideration of marketing, where has our freedom of action gone?

Are freedom and compulsion (control) really incompatible?
Or rather, are they compatible?

e.g.. (1) Is magician's "Force" technique compulsion?
(2) Choice blindness (Johansson et al.).
(3) Congestion of freeway
(4) Flow planning of a city and department store.
(5) Chairs at McDonald's.

It is inevitable that decision making on the part of people living in today's society will become more situation-dependent and history-dependent.
This immediately means that freedom and compulsion (control) will come close to and overlap each other.

5. Imagination and creativity

When do you feel you are free?
→ A feeling of freedom relies on alternative possibilities (and the ability to imagine them).
On the other hand, a feeling of regret also relies on them.

The imaginative ability relies on sensory memory and motivation.

Implicit cognition and creativity

What makes creative discoveries possible?
Why do you feel a sense of recognition even if the discovery is hitherto unknown to you?

→Tacit knowledge, implicit emotion, a rich process of cognition must be involved.

Wisdom is not transparent.

"Transparency" means : the state where one intentionally and perfectly knows what can be known, and completely does not know what can not be known. e.g.. "Axiom" and "Theorem" of mathematics

Implicit wisdom becomes the base of the feeling of recognizing again (previously described) .
Much part of preconscious is shared among people.
Feeling of familiarity(For discovery and solution).
Deja vu (At excellent art and design).
Therefore, (sooner or later,) original invention/discovery and creation becomes accepted by people.

To begin with, we live in the common environmental world.

The answer to the problem was beforehand (and implicitly) in tacit knowledge.

An original discovery is just to expose it to evident and subjective wisdom.

A lot of things can be understood when we think so.

(1) Impression suddenly produced by the scene seemingly unrelated to the subject.
(2) However, there is a feeling of recognizing it again.
(3) "Columbus's egg" Phenomenon (approval by people).
(4) In many cases, the first hint comes from the surrounding field.

Originality comes from the sea of tacit knowledge and is approved by it.

Conclusion

In the near future, we will live in a society where freedom and control will coexist.

Greater importance will be attached to emotion and implicit cognition, and therefore, deeper understanding of both these areas will be crucial.