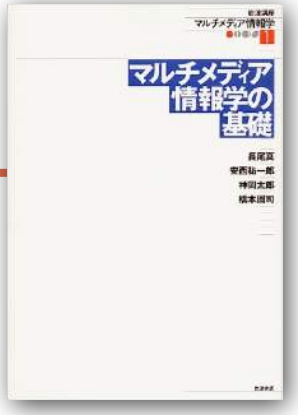
# Cognitive Media Processing #4

**Nobuaki Minematsu**

# Title of each lecture




- Theme-1
  - ~~Multimedia information and humans~~
  - ~~Multimedia information and interaction between humans and machines~~
  - ~~Multimedia information used in expressive and emotional processing~~
  - A wonder of sensation - synesthesia -
- Theme-2
  - Speech communication technology - articulatory & acoustic phonetics -
  - Speech communication technology - speech analysis -
  - Speech communication technology - speech recognition -
  - Speech communication technology - speech synthesis -
- Theme-3
  - A new framework for “human-like” speech machine #1
  - A new framework for “human-like” speech machine #2
  - A new framework for “human-like” speech machine #3
  - A new framework for “human-like” speech machine #4


# A Wonder of Sensation
# - Synesthesia -

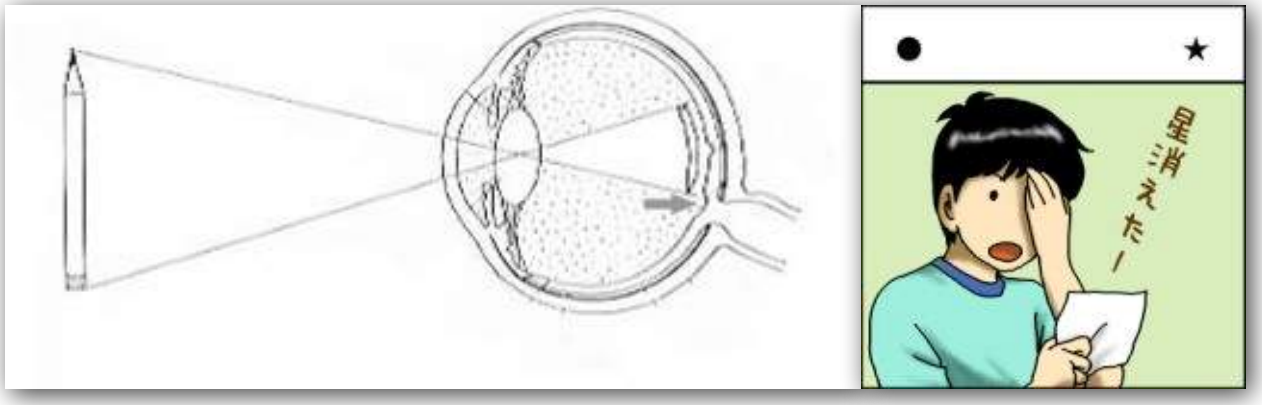
**Nobuaki Minematsu**

# Today's menu

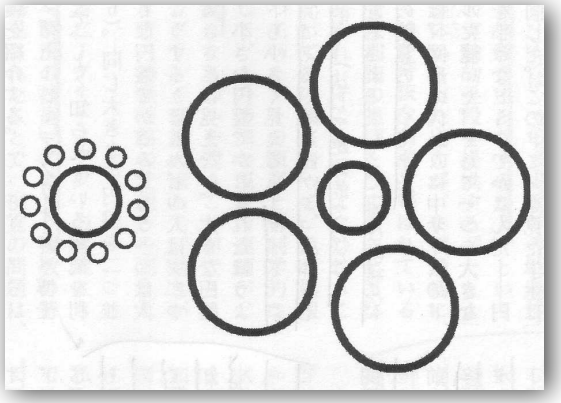
- Wonders of sensation that I've talked about so far.
  - Unconscious processing
  - Blind spot, blind sight, color illusion, size illusion, etc
- Other wonders of sensation
  - Visual sensation described by a doctor with brain damage.
  - Some peculiar behaviors of autistic individuals
  - A claim on brain info. processing from a brain scientist
- BBC documentary + more
  - "Derek Tastes of Earwax" ("共感覚の不思議")
  - "Seeing colors by hearing sounds"
- The first assignment
- Summary

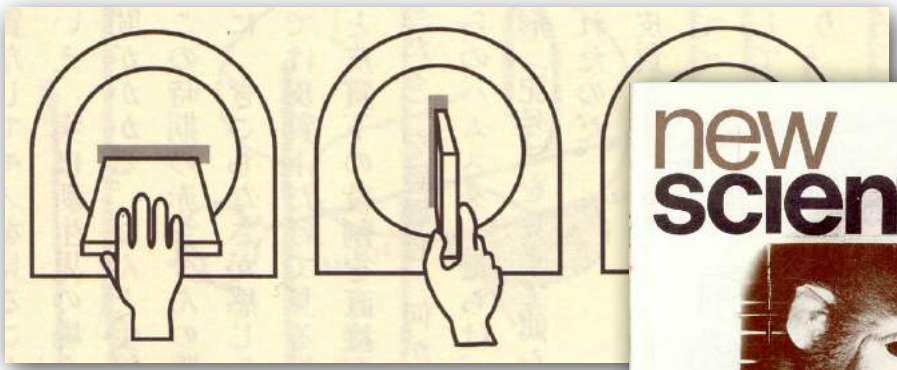
# Wonders of sensation

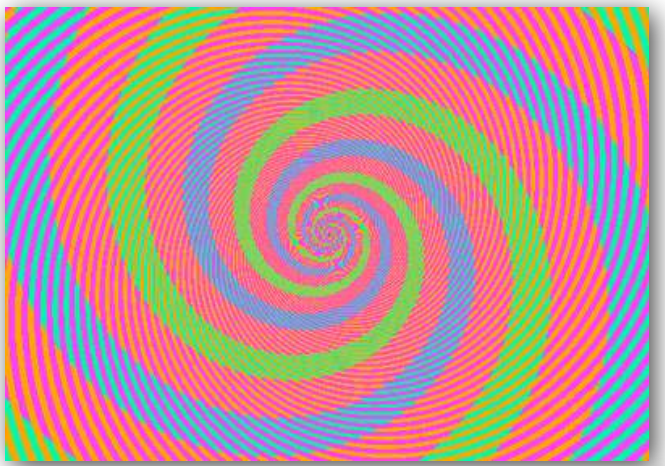
- Examples of unconscious processing





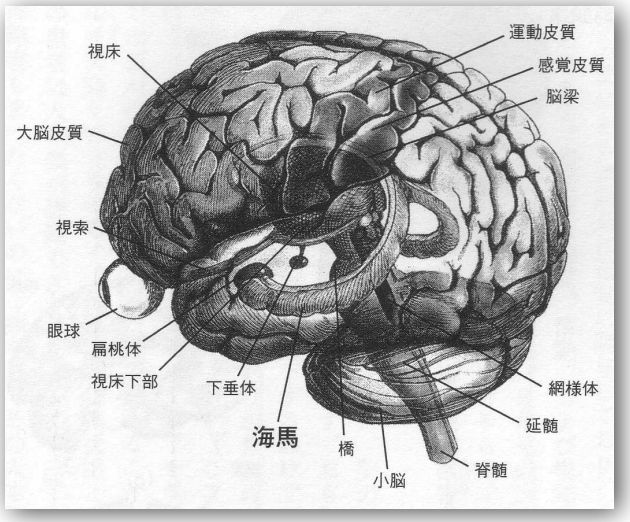





# Emotional processing and the brain

- Emotions in the brain (low road) = rough but very rapid
  - Mostly unconscious and implicit (prelogical)



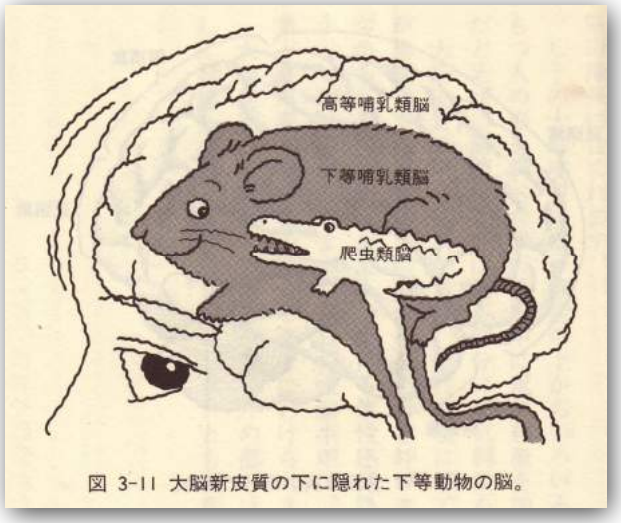



図 3-11 大脳新皮質の下に隠れた下等動物の脳。

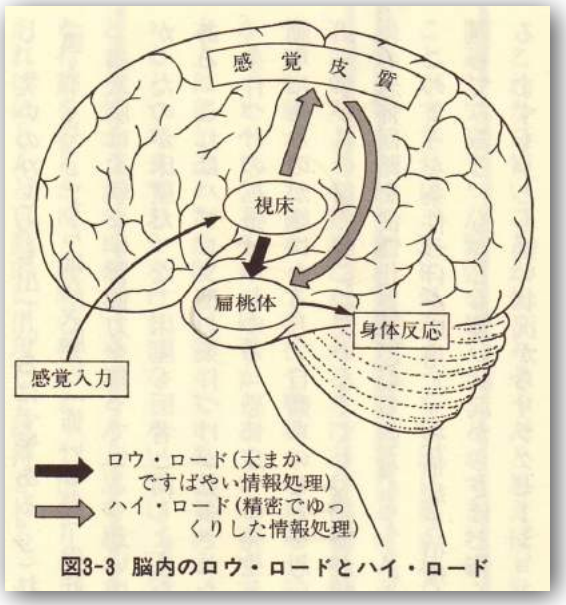
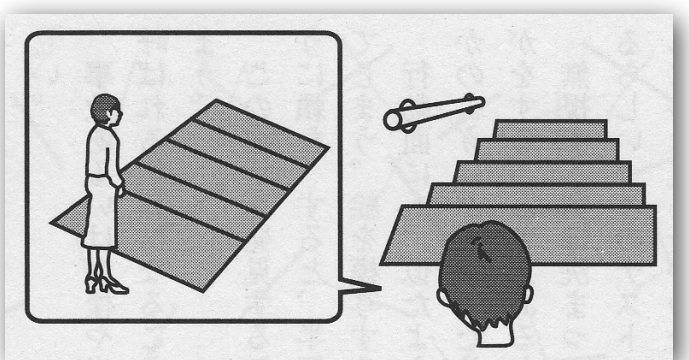


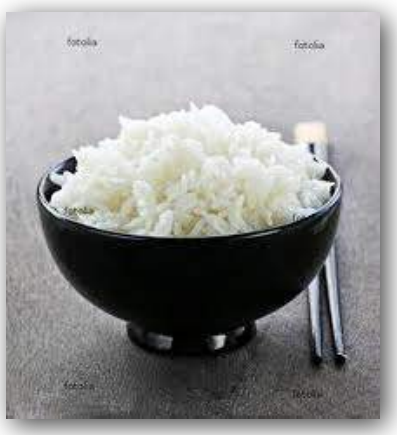
図3-3 脳内のロウ・ロードとハイ・ロード

- Your “conscious” world
  - What you can see, hear, touch, taste and smell “consciously”.
    - Only a part of human information processing
    - Enormous amount of unconscious and background processing.
  - How to make “human-like” information processing machines?
    - Researchers (engineers) have to be aware of our “unconscious” processing.

# Some facts caused by brain damages

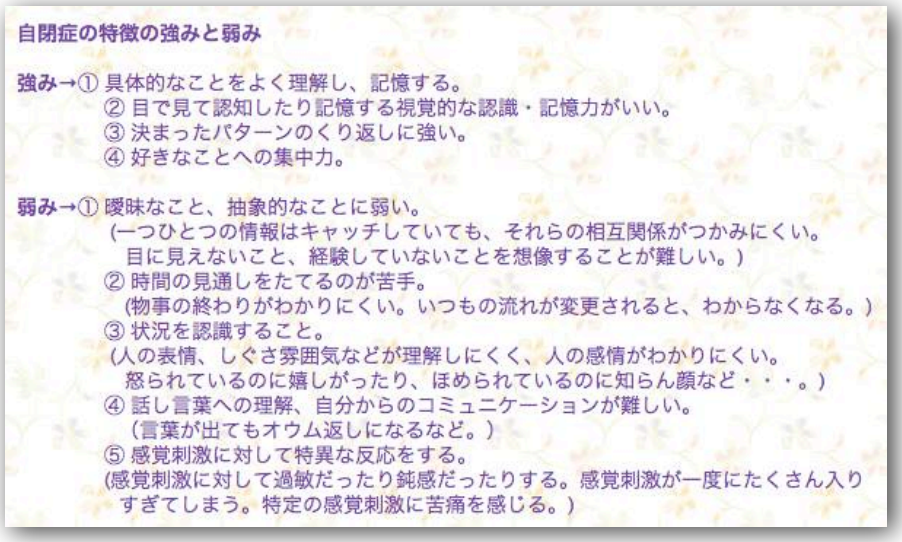
- “I’m living with a damaged brain.” (Dr. Kikuko Yamada)
  - Higher-level brain dysfunction (高次脳機能障害)
    - A part of the brain does not function well and she can be aware of that.
    - A medical doctor herself describes what she can sense through her damaged brain.
  - Seeing = conversion of a 2D image into a 3D image
    - What happens if the visual region of the brain has some dysfunction.
    - Stairs = just a plane with some linear segments
      - Cannot tell whether the stairs go up or down.
    - Chopsticks partially hidden at the background of a rice bowl.
      - Two separate objects cannot be bound into one object.
    - Shadows cannot give depth perception.
      - No difference between the two images below.





# Sensation by autistics

- What are autistics good at and poor at?
  - Good at
    - remembering very detailed aspects of stimuli.
      - Especially their visual memory is often extraordinary.
    - processing constantly repeated patterns.
    - concentrating a (given) specific task.
  - Poor at
    - dealing with something abstract or invisible.
    - capturing the relations of things although good at capturing a specific one thing.
      - Good at capturing an element but poor at capturing elements as a whole.
    - dealing with temporal development including future planning
    - understanding the environments properly.
      - Hidden messages are difficult to detect, ex. facial expressions, metaphors, etc.
    - understanding spoken language.
      - In cases of severely damaged autistics, their first language is written language.
    - smooth communication with others.
    - dealing properly with sensory stimuli.
      - Their sensitivity of sensory stimuli is too good. Can hear the sounds that non-autistics cannot hear.
      - Difficult to select important stimuli / difficult to ignore irrelevant stimuli.

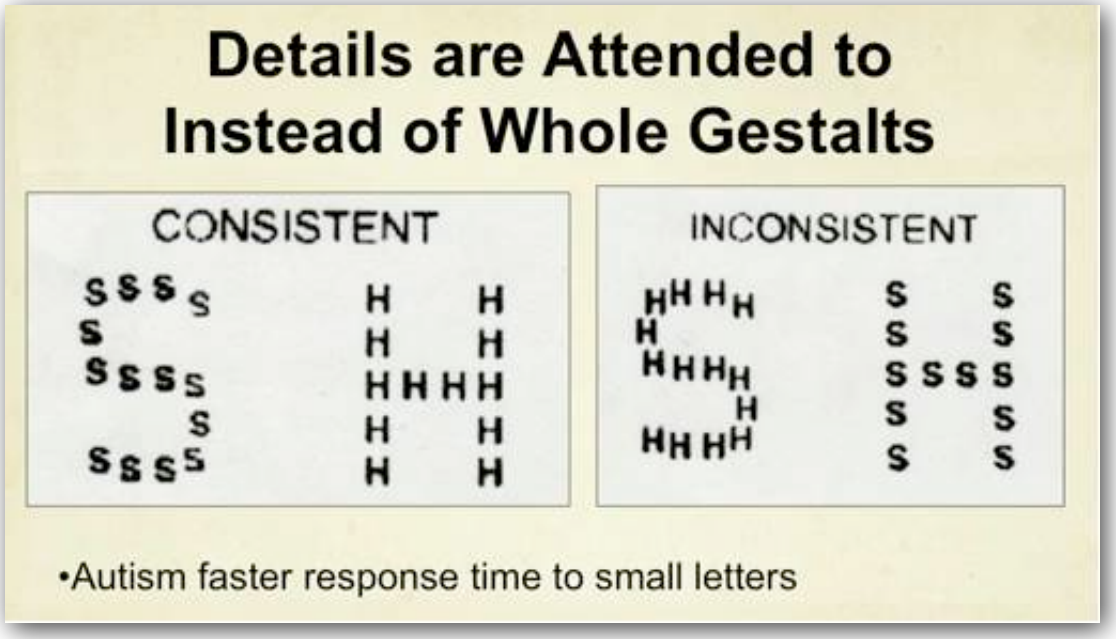

自閉症の特徴の強みと弱み

強み→① 具体的なことをよく理解し、記憶する。
② 目で見て認知したり記憶する視覚的な認識・記憶力がいい。
③ 決まったパターンのくり返しに強い。
④ 好きなことへの集中力。

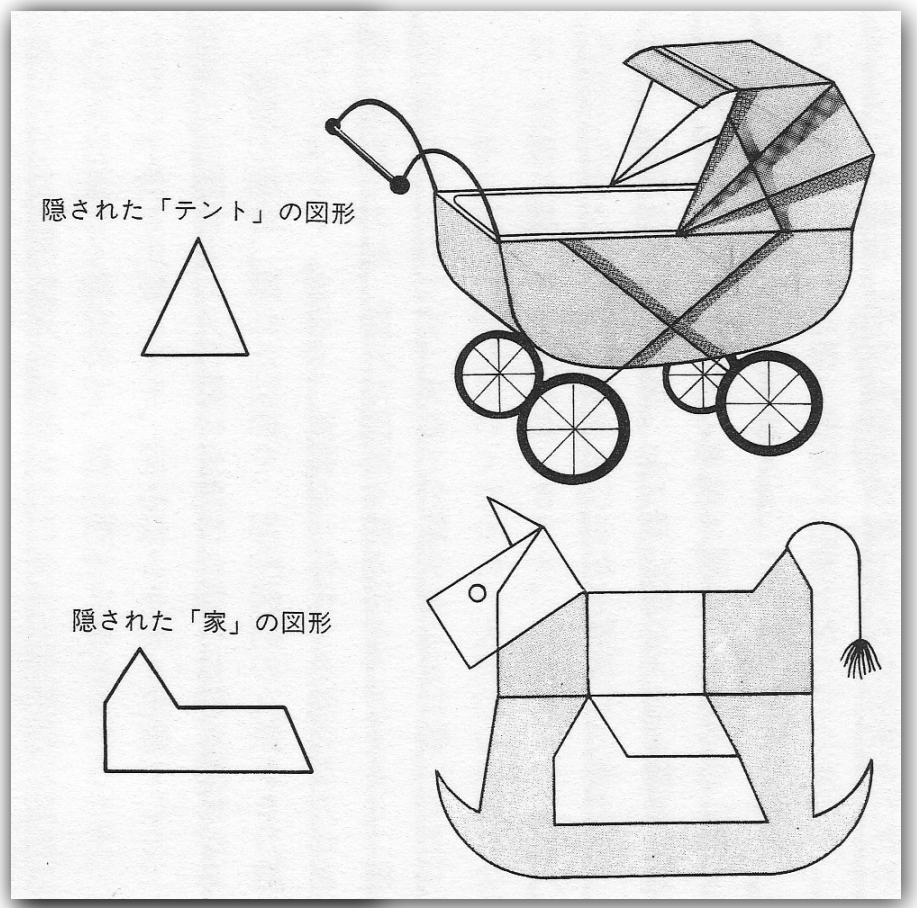
弱み→① 曖昧なこと、抽象的なことに弱い。
(一つひとつの情報はキャッチしていても、それらの相互関係がつかみにくい。
目に見えないこと、経験していないことを想像することが難しい。)
② 時間の見通しをたてるのが苦手。
(物事の終わりがわかりにくい。いつもの流れが変更されると、わからなくなる。)
③ 状況を認識すること。
(人の表情、しぐさ雰囲気などが理解しにくく、人の感情がわかりにくい。
怒られているのに嬉しがったり、ほめられているのに知らん顔など・・・。)
④ 話し言葉への理解、自分からのコミュニケーションが難しい。
(言葉が出てもオウム返しになるなど。)
⑤ 感覚刺激に対して特異な反応をする。
(感覚刺激に対して過敏だったり鈍感だったりする。感覚刺激が一度にたくさん入りすぎてしまう。特定の感覚刺激に苦痛を感じる。)

# Sensation by autistics

- Which do you perceive at first?




- Find this piece in the whole picture.



# Face! Face! Face!

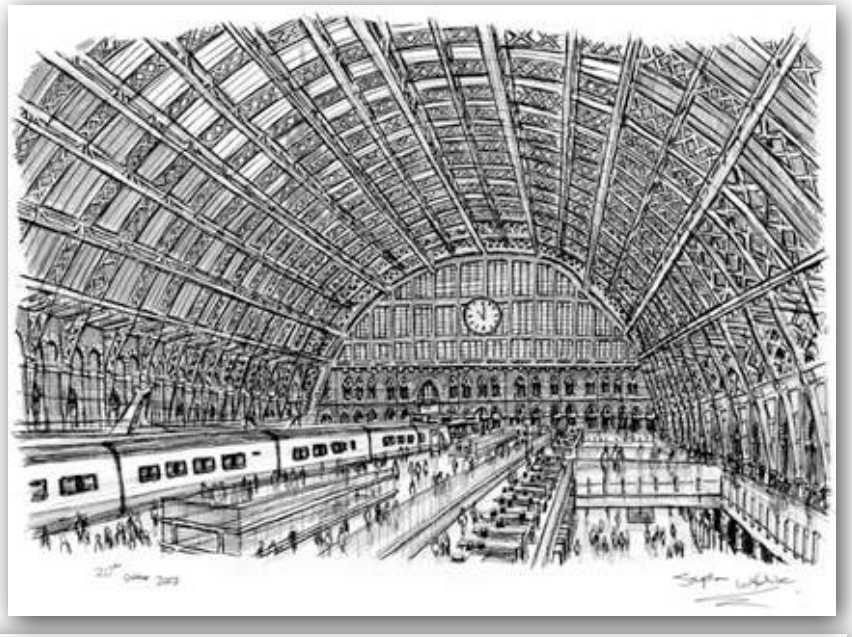
- Some experimental facts

図2　サッチャー錯視（Thompson,1980）

図1　顔と見えるか，果物と見えるか
（M. Moscovitch et al, Journal of Cognitive Neuroscience, 9, 1997）
普通はこの絵を見て，顔と果物を同時に見ることができる．しかし，物体失認の患者はこれに人の顔は見えても，果物を見ることができなかった．反対に相貌失認の患者の場合は，果物ばかりが目立つであろう．

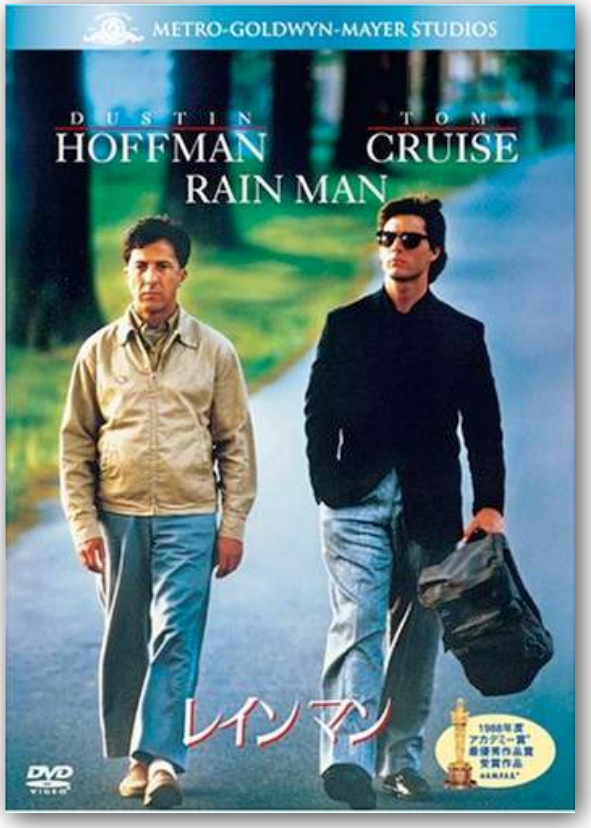
# Sensation by autistics

- Stephen Wiltshire as “human camera”
  - Extraordinary memory of visual stimuli, especially buildings in a landscape.
  - But poor at spoken language, environmental changes, etc.



# Sensation by autistics

- Kim Peak as “walking library”
  - A model of “Rain Man” in the movie entitled as “Rain Man”
    - He has an extraordinary memory of numbers.
  - He can remember all the sentences in the books that he read.
  - But he is poor at reading between lines, detecting hidden messages.




# Similarity?

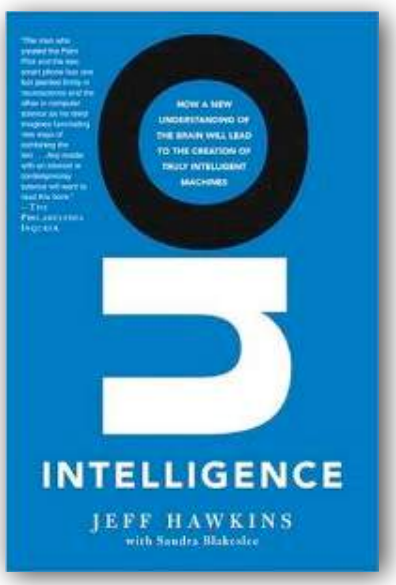
- Good at memorizing facts
  - Poor at generalizing those facts and extracting hidden information in the facts.


# A report from CBS news

- The Tool Man

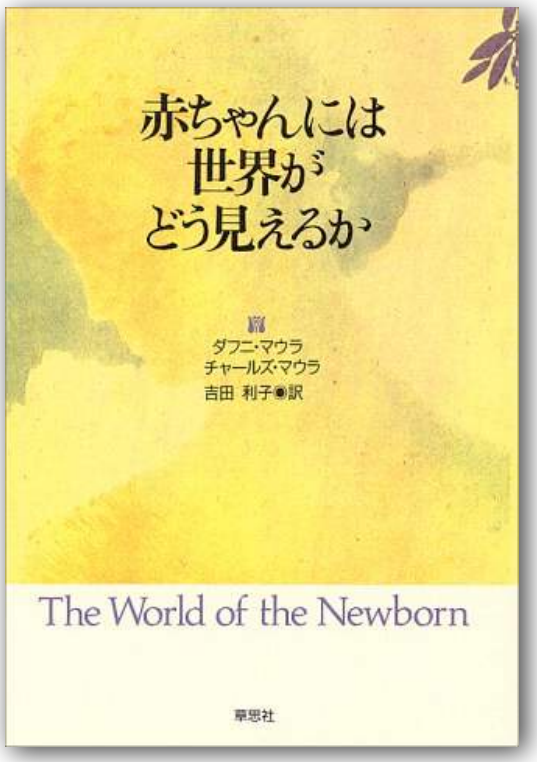
# A claim from a brain scientist

- Rewiring in the brain
  - Visual information can be linked to the tongue.
    - “Taste” region of the brain can be rewired to “vision” region of the brain.
    - “Audition” region of the brain can be rewired to “vision” region of the brain.
- The essence/core of info. processing is the same among regions?
  - Visual cortex, auditory cortex, motor cortex, etc
    - The function of brain regions seems to be different from each other.
  - Organizing principle for cerebral function (V. Mountcastle, 1978)
    - 大脳皮質の構成原理
    - The function of each region seem rather independent but the unit of the cerebral cortex (大脳皮質), which is called “column”, has a very similar anatomical structure in any region.
    - Implies that a universal information algorithm exists in the cerebral cortex, irrespective of physical differences in sensory stimuli?

# A wonder of sensation

- A 45-min documentary film on synesthesia made by BBC
  - Perceiving colors by seeing or hearing numbers
- Every baby is like that.
  - “The world of the newborn” (D. Maurer and C. Maurer, 1989)

# “Seeing colors in sounds”

- “音に色が見える世界” (J. Iwasaki)

図3　著者には平仮名・片仮名がこのような共感覚色に見えている。

図8　著者が同じ部首の各漢字に見ている共感覚色。

図7　著者が色彩を表す漢字に見ている共感覚色。

図9　「立」、「日」、「心」を近づけて「意」を作るときに、著者が見ている共感覚色。

# “Seeing colors in sounds”

- “音に色が見える世界” (J. Iwasaki)


図16 著者がラテン文字に見ている共感覚色。

図17 著者が数字・数概念に見ている共感覚色。


図18
著者が音階に見ている共感覚色。上部の込み入った様々な色は、雅楽や民族音楽に見ることが多い。

# Today's menu

- Wonders of sensation that I've talked about so far.
  - Unconscious processing
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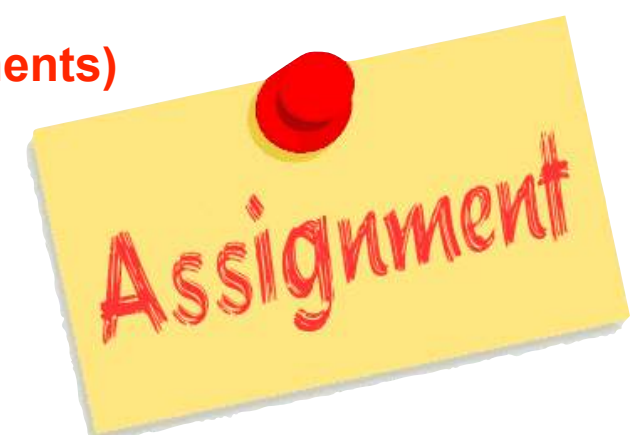
- Other wonders of sensation
  - Visual sensation described by a doctor with brain damage.
  - Some peculiar behaviors of autistic individuals
  - A claim on brain info. processing from a brain scientist
- BBC documentary + more
  - "Derek Tastes of Earwax" ("共感覚の不思議")
  - "Seeing colors by hearing sounds"
- The first assignment
- Summary

# Assignment

- Assignment
  - Read a research paper related to the first four lectures of this class.
  - **Submit your summarization and your comments in addition to the paper.**
  - All the materials used in the lectures are available at:
    - http://www.gavo.t.u-tokyo.ac.jp/~mine/japanese/media2019/class.html
    - Ramachandran's article on synesthesia is also found there.
- Length
  - A few pages of A4 size.
- Submission
  - Your report should be sent to mine@gavo.t.u-tokyo.ac.jp in the form of PDF.
  - **The filenames must be in the following format.**
    - **36-302439_nobuaki-minematsu.pdf (summary and comments)**
    - **36-302439_paper.pdf (paper)**
    - **[student_id]_[name].pdf and [student_id]_paper.pdf**
- Deadline = 23:59:59 on Oct. 29.
  - You have two weeks to go.



# Recommended books