Neuroscience & Science Education

Educational Neuroscience Study Group

Yurdagül Boğar & Gamze Çetinkaya-Aydın

Main Readings for This Presentation

- Oliver, M. (2011). Towards and understanding of neuroscience for science educators. Studies in Science Education, 47(2), 211-235.
- Fugelsang, J., & Mareschal, D. (2014). The Development and Application of Scientific Reasoning. In. D. Mareschal, B. Butterworth & A. Tolmie (Eds) Educational Neuroscience (pp.237-267). Chichester, UK: Wiley-Blackwell.
- Liu, C. J., & Huang, C. F. (2016). Innovative science educational neuroscience: Strategies for engaging brain waves in science education. In M. H. Chiu (Ed.), Science education research and practice in Taiwan: Challenges and opportunities (pp. 233–247). Dordrecht, The Netherlands: Springer.

Towards and understanding of neuroscience for science educators

- What is the neuroscience and how is this relevant to education?
- What are the imaging techniques used in neuroscience?
- Educational neuroscience: a global phenomenon
- Brain, development and learning
- Brain and Intelligence
- Working memory
- How is neuroscience of particular interest to science educators?

What is the neuroscience and how is related to education?

- Neuroscience ‘investigates the processes by which the brain learns and remembers, from the molecular and cellular levels right through to brain systems (e.g., the system of neural areas and pathways underpinning our ability to speak and comprehend language)’ (Goswami, 2004, p. 1).
- Education and neuroscience come together when we consider learning:
- Educational neuroscientists include educators, physiologists, anatomists, cognitive psychologists, imaging specialists and those with interest in learning and development.

What are the imaging techniques used in neuroscience?

- electroencephalographic (EEG)
- event related potentials (ERPs)
- magnetic resonance imaging (MRI)
- positron emission tomography (PET)
- Functional magnetic resonance imaging (fMRI)

Educational neuroscience: a global phenomenon

1) the Organisation for Economic Development (OECD) → Brain and Learning

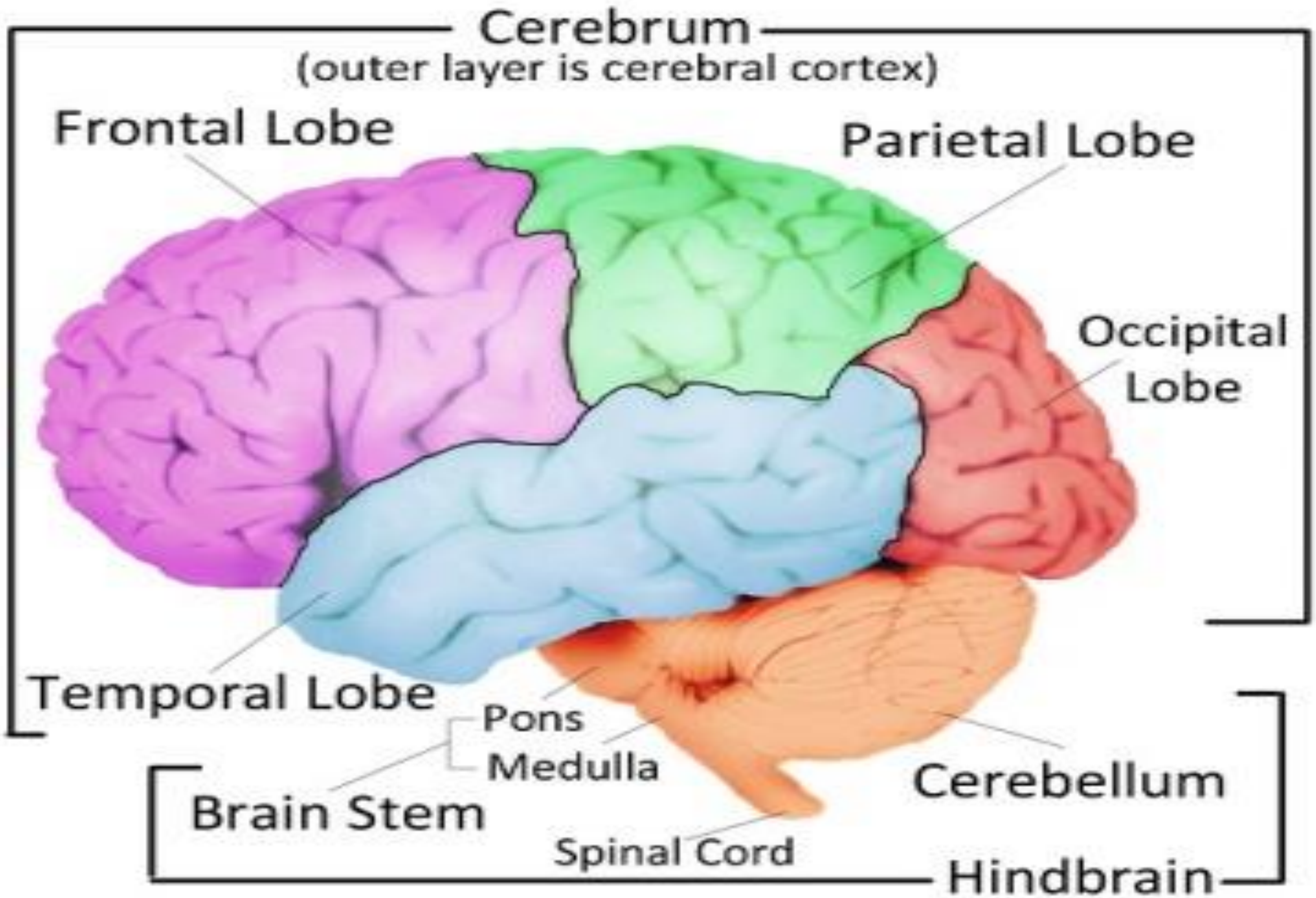
2) the establishment of Science of Learning Centres → In Australia

3) (http://www.aera-brain-education.org/Resources/Resources.aspx)

4) the European Association or Research on Learning and Instruction

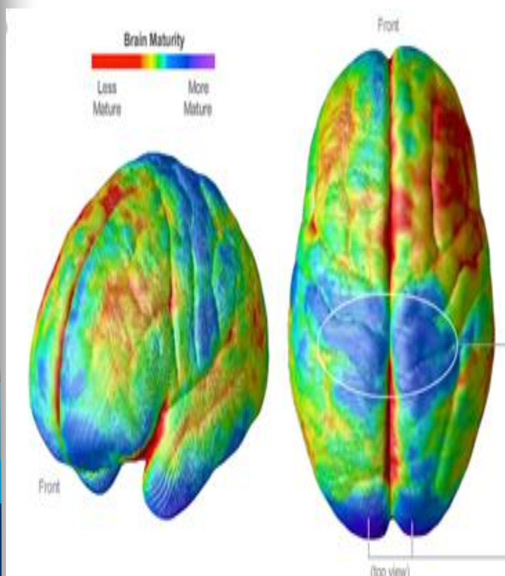
5) The International Mind, Brain and Education Society (IMBES)

Brain, development and learning

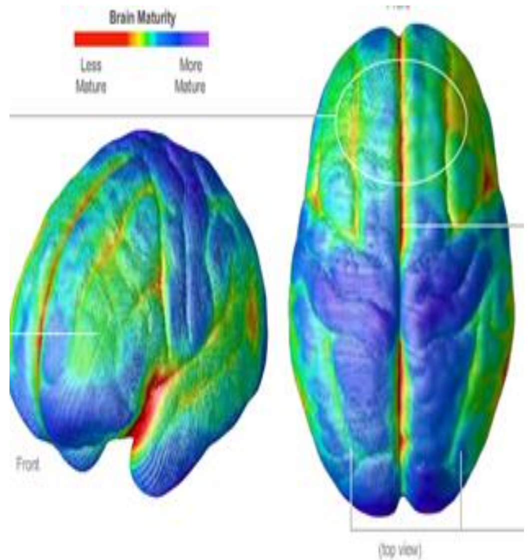


Brain, development and learning

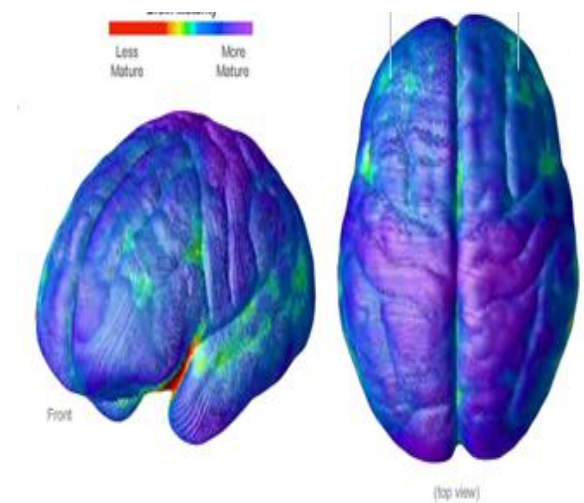
https://www.youtube.com/watch?v=FKBz2ddaPkw



4 year old brain



13 year old brain



21 year old brain

The brain and intelligence

- Intelligence is a very general capability that includes the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience.
- Intelligence is correlated infant mortality, school enrolment, illiteracy, agricultural labour and gross national product (Eppig et al., 2010).
- There are some intelligence tests, such as Raven's matrices or Piagetian reasoning tasks.
- Brain efficiency varies:: highly intelligent people seem to have highly efficient brains and the resting state is lower than less intelligent peers (Deary, Penke, & Johnson, 2010).

The brain and intelligence

- A twin study investigated three components of EF(Executive functions):
- Intelligence is not fixed, is modifiable.
- Intelligence may be dynamic rather than fixed' (Sternberg, 2008, p. 6791).
- Standard intelligence tests are sometimes criticised by some researchers.

The brain and intelligence

- Where is a test that can assess creativity to be found? And what of ‘practical’ intelligence?
- There is yet no consensus on locating genes for intelligence, because it depends on disease, developmental delay or metabolic conditions(phenylketonuria)
- Gene studies suggest a correlation between brain structures, intelligence and brain size but the picture is complex:

Working memory

Having two functions:

1) a temporary storage of information

2) manipulation of information and attention;

- Various components of WM, such as visual, spatial and attention and are correlated with cognitive development.
- They are closely linked and critical for learning

Working memory

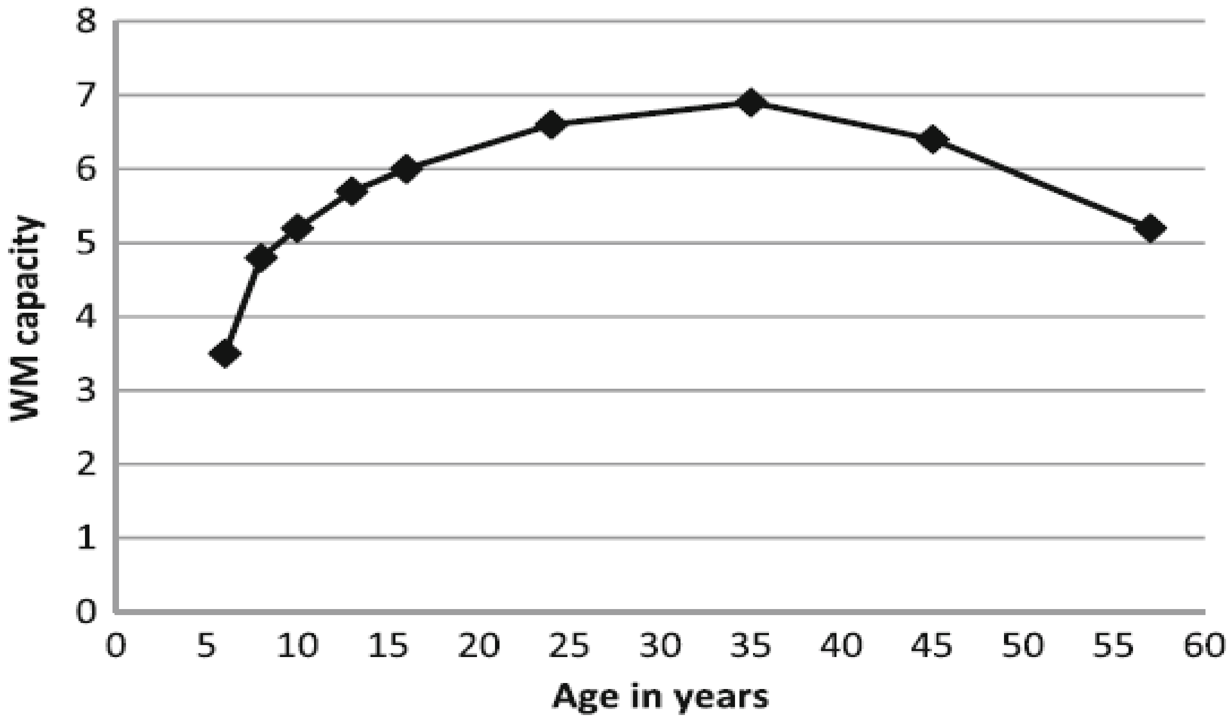
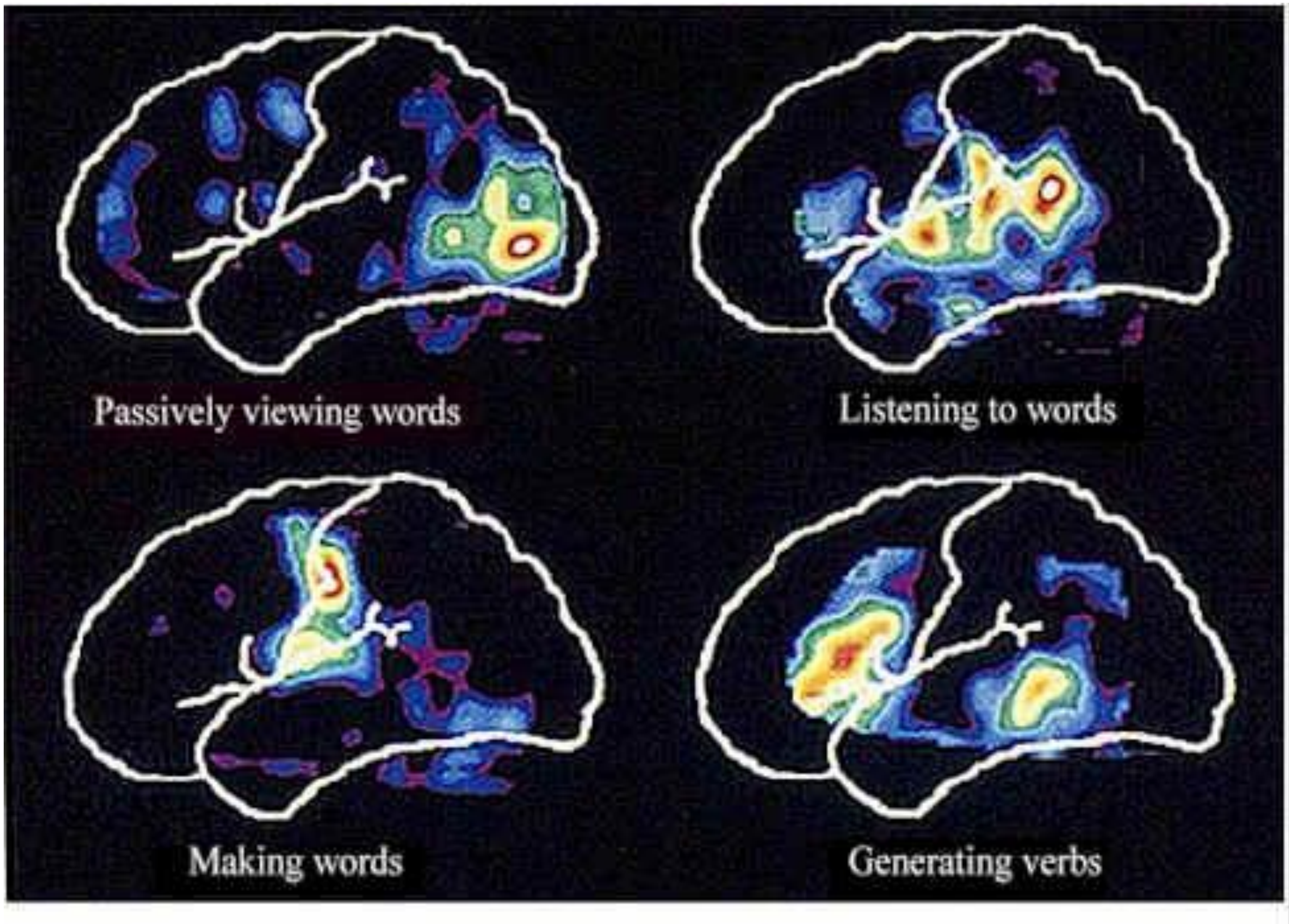


Figure 2. Working memory changes over the course of a lifetime as measured by changes in visual-spatial capacity. Source: Swanson, 1999.

The relationship between brain and cognition

- All cognition is the result of neurological activity
  - – most closely linked to cerebral cortex
- Cognition is a product of the brain.
- Understanding the brain and its organization is useful for assessing the plausibility of cognitive theories



Passively viewing words
Listening to words
Making words
Generating verbs

Neuroscience confirms the role of intervention

- There exist a large number of resources to support improvement in cognition.

- Claims about ‘brain training’ are often used in marketing, but not supported by empirical findings, despite their widespread use in schools (Stephenson, 2009).

Neuroscience confirms the role of intervention

- Dyslexia is a neural processing impairment.
- Dyscalculia presents in children with difficulties in calculating.
- Other neuroimaging studies have centred on individuals with identified clinical conditions such as Attention-Deficit/Hyperactivity Disorder (ADHD) (Cherkasova & Hechtman, 2009; Karch et al., 2010), autism (Ecker et al., 2010) and Alzheimer's disease (van der Hiele et al., 2007).

Teaching and learning science

- Osborne and Dillon (2008) point out that ‘the teaching of science is an established cultural practice passed on from one science teacher to another’ (p. 22)
- The teaching of science is difficult to change that culture quickly or easily.
- Teaching and learning include what occurs inside and outside of classroom settings.

Teaching and learning science

- Learning or developing mastery is ‘slow and hard’ (Schwartz, 2009, p. 199).
- In educational contexts, learning is computational, social and contextually driven.

- In a classroom, where are the measurements of cognitive outcomes and how can they be usefully compared across different learning areas?
- How can we use questions in our classrooms that regularly extend thinking?

Implications for teachers and neuroscientist

- Neuroscience is not a panacea for education; it cannot develop teaching strategies or direct teaching practice, nor can it offer strategies for teachers to better engage students in science classes.
- Imaging studies may provide an insight into how we can best tap into the reward systems in students, to better engage them in learning
- As science teachers and educators, perhaps it is up to us to embrace scientific insights more completely in our teaching and preparation of teachers and attend to the findings of neuroscience that are more frequently published in traditional science rather than educational journals, to develop a science of teaching and learning.

Implications for teachers and neuroscientist

- The collaboration between science teachers and neuroscientists needs to address these issues:

1) What do educators need to know about the human brain, the neurology of learning?

2) How can we use reward in our teaching and learning programmes?

3) What is the optimal timing for different forms of learning?

The Development and Application of Scientific Reasoning

- What is the scientific reasoning?
- Historical approaches to the study of domain-general and domain-sprecific scientific reasoning?
- Causal reasoning
- Deductive reasoning
- Analogical reasoning
- Future directions

What is Scientific Reasoning?

- Scientific reasoning is complex in nature (Lawson, 1982; Schunn & Anderson, 1999).
- Hogan and Fisherkeller (2005) defined scientific reasoning as ‘‘the practice of thinking with and about scientific knowledge’’ (p.95).
- Scientific reasoning includes the mental activities that are involved when people attempt to make systematic and empirical based discoveries about the world (Zimmerman, 2000).

What is Scientific Reasoning?

- The most general goal of scientific reasoning process is to extend our knowledge of the world, thus allowing us to gain a more detailed and conceptually richer understanding of the domain of inquiry. (Zimmerman, 2000).

Historical Approaches to the Study of Domain-General and Domain-Specific Scientific Reasoning

- The Domain-Specific Approach: Knowledge about Scientific Concepts

- The Domain-General Approach: Knowledge and Skills of Scientific Investigation

Historical Approaches to the Study of Domain-General and Domain-Specific Scientific Reasoning

- As the coordination of domain-general and domain-specific activities is a highly complex process.
- Researchers studying these processes in children and adults have traditionally attempted to focus their research programs on *either* the conceptual (i.e., domain-specific) *or* the procedural (i.e., domain-general) aspects of the scientific reasoning process in isolation (Zimmerman, 2005).

Historical Approaches to the Study of Domain-General and Domain-Specific Scientific Reasoning

- Concerning the conceptual (i.e., domain-specific) approach, researchers following this research tradition have focused on investigating the nature of the *concepts* *(Zimmerman, 2010)*

- The goal is often to describe and uncover the cognitive mechanisms underlying conceptual development or conceptual *change* as a function of new learning

Historical Approaches to the Study of Domain-General and Domain-Specific Scientific Reasoning

- Researchers are interested in children's and adults' level of understanding, the nature of their knowledge representations, and how their conceptual understanding develops in a variety of scientific content areas, such as biology (e.g., Carey, 1985), climatology (Dunbar, Fugelsang, & Stein, 2007), and physics (McCloskey, 1983).

- Findings of these studies are highly relevant to scientific reasoning.

Historical Approaches to the Study of Domain-General and Domain-Specific Scientific Reasoning

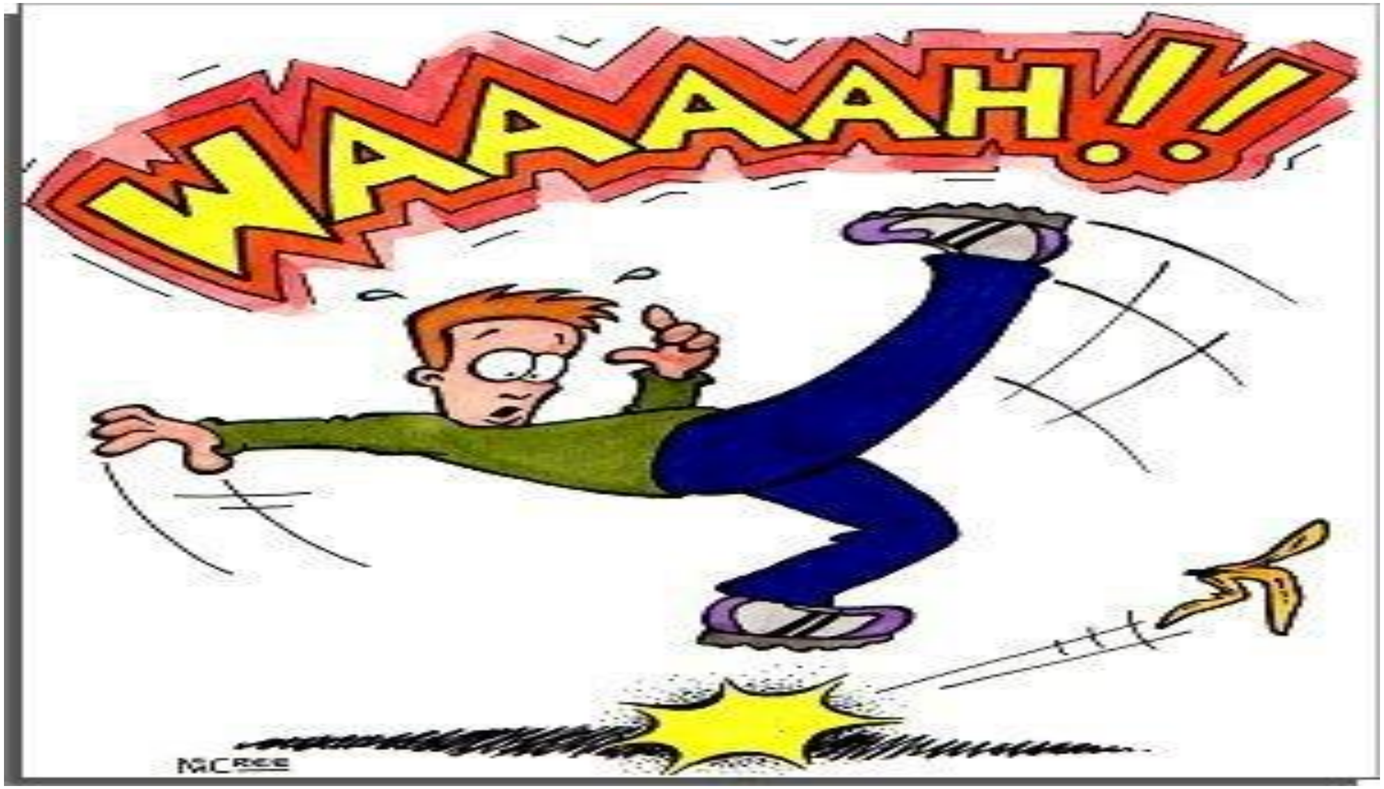
- Concerning the procedural (i.e., domain-general) approach, researchers following this research tradition have focused on understanding the development and application of *domain general skills*, which are reasoning, hypothesis testing, problem solving etc. *(Zimmerman, 2005)*

Historical Approaches to the Study of Domain-General and Domain-Specific Scientific Reasoning

- The primary objective with this approach is to understand cognitive changes in problem solving and reasoning in a domain-general way.
- Because many of these tasks have rich conceptual content, the interpretation of performance was not straightforward.

Causal Reasoning

If you walk on a banana skin you will slip !!!



Causal Reasoning

- Much of scientific theory development involves the construction of comprehensive causal models, therefore, causal reasoning is so important for scientific theory development.

- For example, scientists have spent decades examining whether there is a causal relation between human activities on earth, greenhouse gases, and global warming and whether smoking causes cancer.

Two levels of causal reasoning

1) Causal perception: the perceptual system "directly" attributes causality to an event

2) Causal inference: draws on a more "cognitive" level of understanding of cause and effect

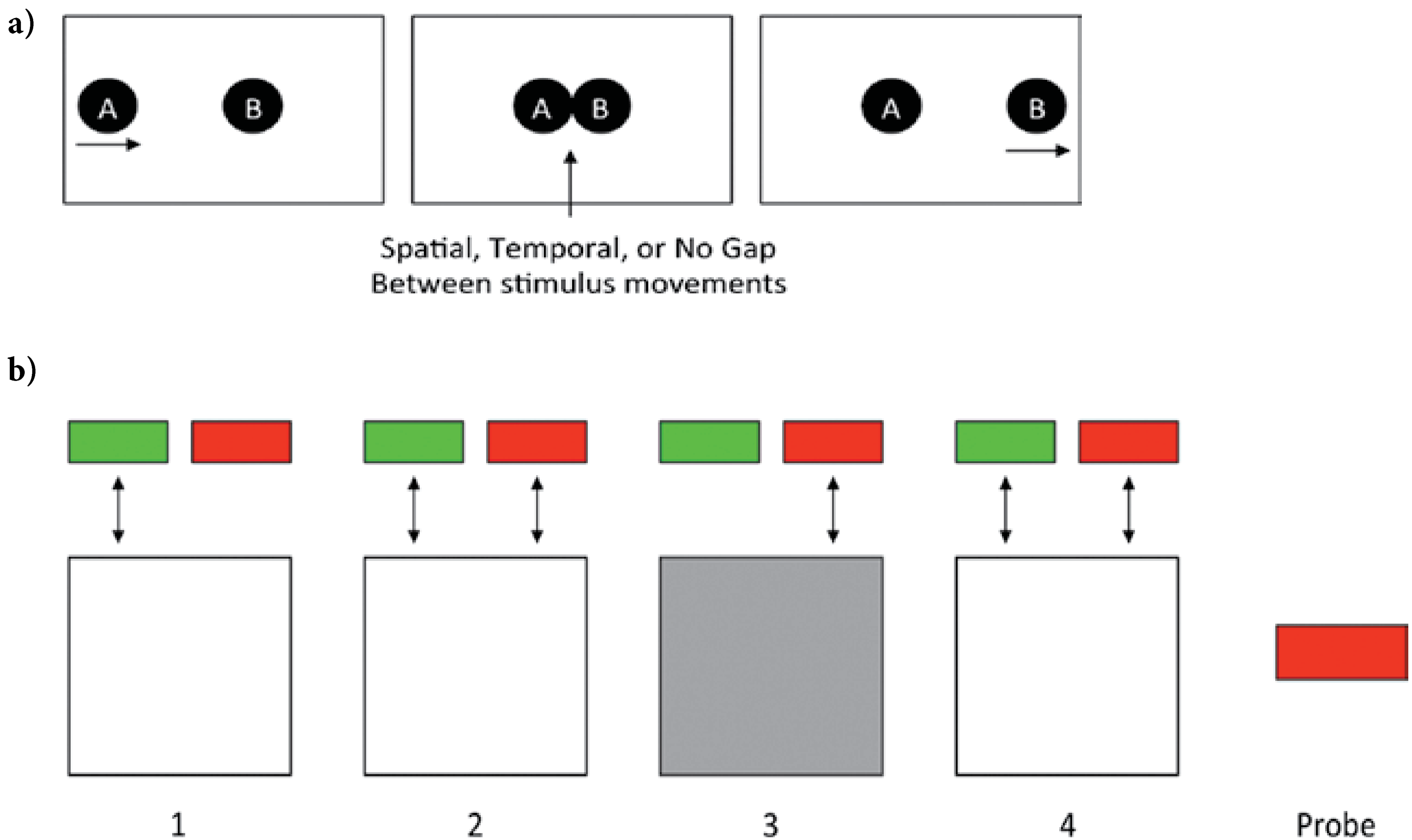


Figure 9.2 Example stimuli used by Roser et al. (2005). (a) A graphical illustration of the causal collision animations used in the causal-perception task. (b) A graphical illustration of the animated causal-inference task.

Two levels of causal reasoning

- Causal perception are based on physical contact interactions (Visual-spatial processes)
- Causal inferences are based on statistical associations (linguistic processing)

Causal reasoning

- More recent functional brain imaging studies (using PET and fMRI) have shown that the left hemisphere has a distinct advantage for linguistic processing (Milner, 1962), whereas the right hemisphere has a processing advantage for visual–spatial information (Corballis, 2003; Corballis, Funnell, & Gazzaniga, 2002).
- This dissociation is true for most (but not all) right-handed individuals, and fewer left-handed individuals

Complex Causal Reasoning

- When we speak of complex causal reasoning in the present context, we are referring to the inferential processes associated with evaluating new observations (i.e., empirical data) to test an existing theory.
- Fewer studies have focused on the underlying brain correlates of more complex causal reasoning (Fugelsang & Dunbar ,2005; Parris, et al. 2009)

Causal Theories

- The causal theories could be either plausible or implausible.
- Under some conditions, the theory would set up the participant to believe that a causal relation existed, and the data were consistent with that theory (strong covariation) (Plausible)
- Under other conditions, the theory would set up the participant to believe that a causal relation did *not* exist and the data were inconsistent with that theory (weak covariation) (Implausible)

a) Plausible Theory

b)Implausible Theory

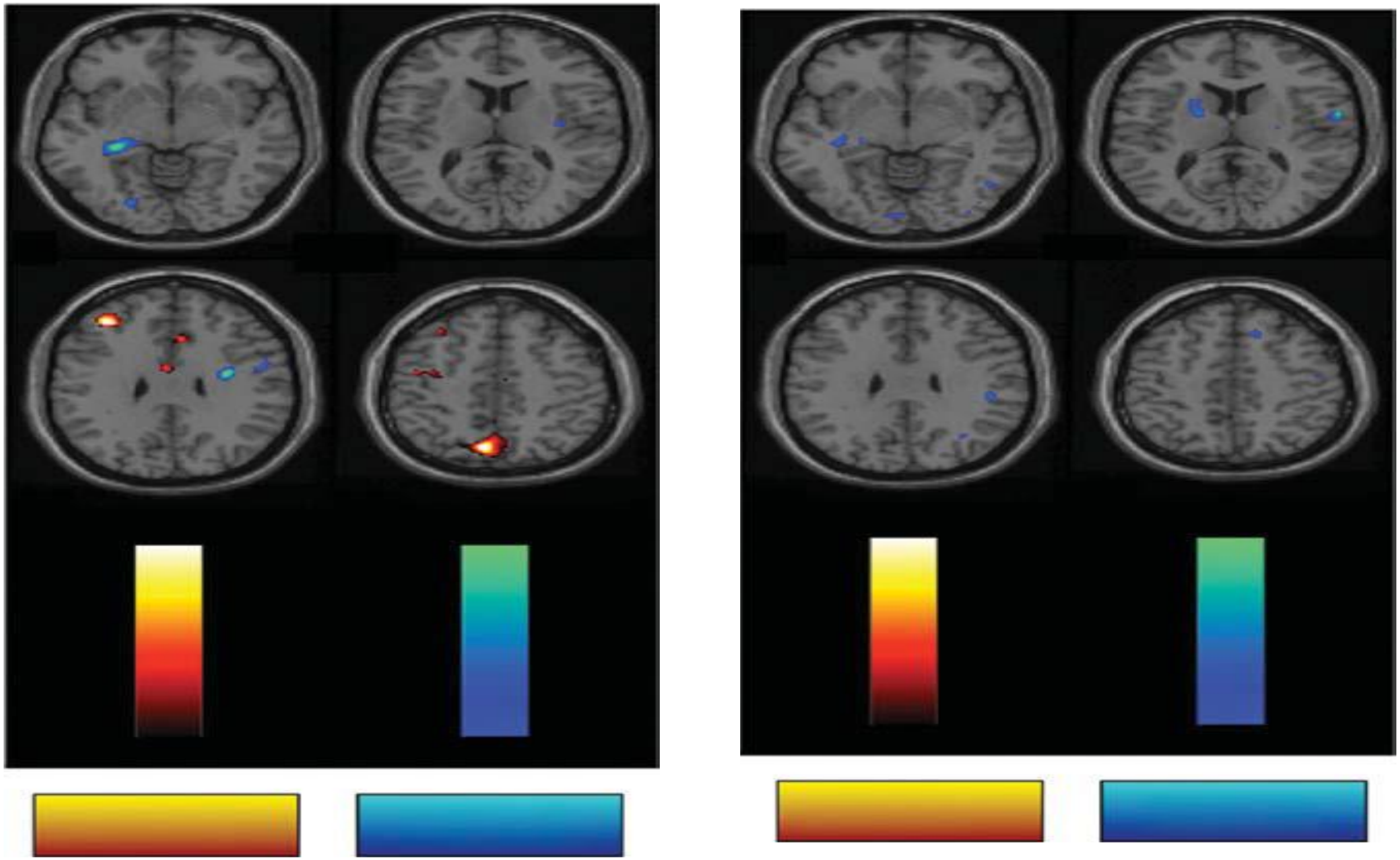
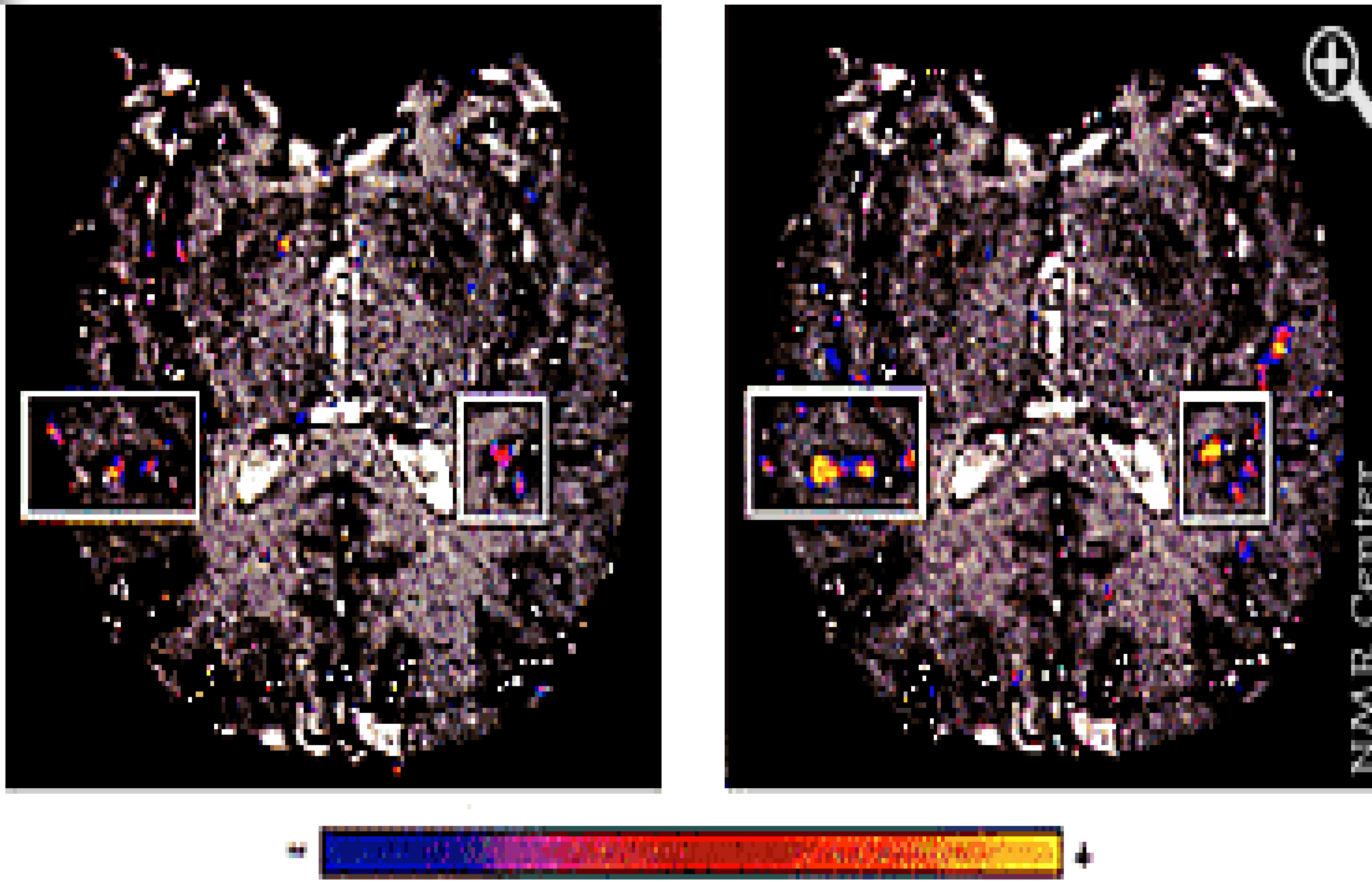


Figure 9.3 Average brain activation patterns occurring when participants viewed data *inconsistent* versus *consistent* with a plausible theory (a) and an implausible theory (b). Adapted from Fugelsang, J. A., & Dunbar, K. N. (2005). Brain-based mechanisms underlying complex causal thinking. *Neuropsychologia*, *43*, page 1208, with permission from Elsevier.


NMR Center

Deductive Reasoning

Chapter 9 - The Development and Application of Scientific Reasoning (cont’d)

Law of detachment:

$P \to Q$ (conditional statement)	If $90° < A < 180°$, then A is an obtuse angle.
P (hypothesis stated)	$A = 120°$.
Q (conclusion deduced)	A is an obtuse angle.

Law of syllogism:

$P \to Q$	If Larry is sick, then he will be absent.
$Q \to R$	If Larry is absent, then he will miss his classwork.
Therefore, $P \to R$.	Therefore, if Larry is sick, then he will miss his classwork.

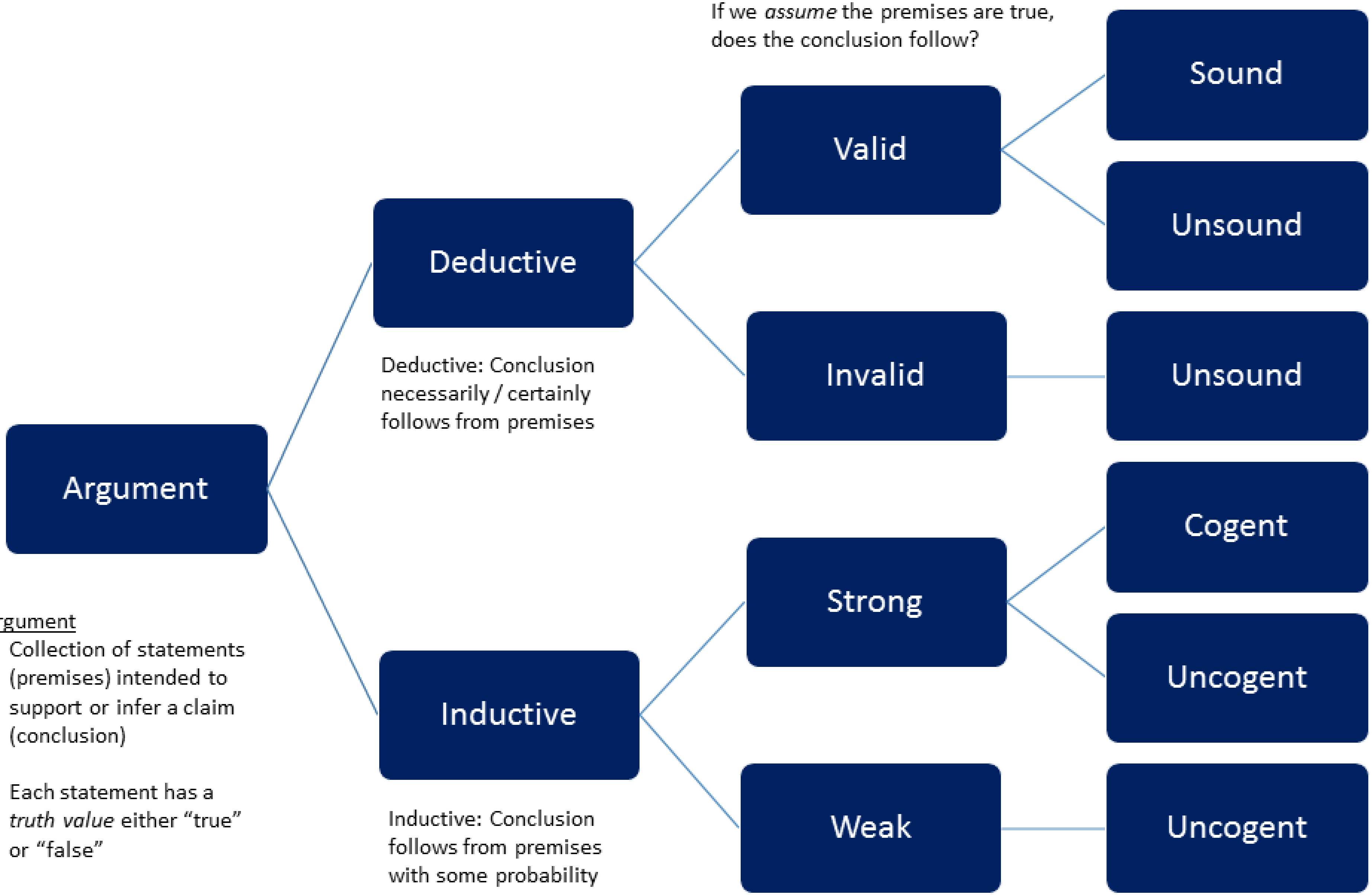
Law of contrapositive:

$P \to Q$.	If it is raining, then there are clouds in the sky.
$\sim Q$.	There are no clouds in the sky.
Therefore, we can conclude $\sim P$.	Thus, it is not raining.

Argument Terminology

<u>Determining validity or strength</u>

If we *assume* the premises are true, does the conclusion follow?



Sound: Valid and All Premises="True"

Cogent: Strong and All Premises="True"

Deductive: Conclusion necessarily / certainly follows from premises

Inductive: Conclusion follows from premises with some probability

<u>Argument</u>

- Collection of statements (premises) intended to support or infer a claim (conclusion)
- Each statement has a *truth value* either "true" or "false"

Source Information: Patrick J. Hurley "A Concise Introduction to Logic-12th Ed."

Deductive Reasoning

- Reasoning processes that assess the degree to which a conclusion logically follows from stated information (i.e., premises).
- Deductive reasoning is useful in the scientific enterprise as much of scientific thinking involves reasoning from known (i.e., previously established) information.

Deductive reasoning is profoundly affected by the content with which one is reasoning.

Abstract Form

You have been hired as a clerk. Your job is to make sure that a set of documents is marked correctly, according to the following rule: "If the document has a vowel on one side, then it must have an even number on the other. You have been told that there are some errors in the coding of the documents, and that you need to find the errors. Each document has a letter rating on one side and a numerical code on the other. Here are four documents. Which document(s) do you need to turn over to check for errors?

A	D	4	7

Concrete Form

You have been hired as a bouncer in a bar and you must enforce the following rule: "If a person is drinking beer, then they must be over 19 years old." The cards below have information about four people in the bar. One side of each card lists a person's age and the other side shows what he or she is drinking. Which card(s) do you need to turn over to be sure no one is breaking the law?

Drinking Beer	Drinking Coke	22 Years of Age	16 Years of Age

Belief-bias effect

- People are more likely to judge a conclusion as valid if it is believable, regardless of whether or not the conclusion follows necessarily from the information contained in the premises.

- Regions within the lateral prefrontal cortex initiate cognitive control to mediate the successful resolution of belief–logic conflicts during deductive reasoning.

Belief-bias effect

- Anterior cingulate (ACC): Monitor the presence of conflict in a cognitive task. (Evaluative)
- Dorsal lateral prefrontal cortex (DLPFC): Alerted to resolve the conflict. (Executive)
- The relatively late maturing of the DLPFC across development could explain the relatively prolonged development of the ability to resolve inconsistencies between prior beliefs and new evidence in scientific learning and discovery.

Left dorsal lateral prefrontal cortex (DLPFC) cognitive conflict durumunda aktif olan bir bölge. Bilgisayar ortamında öğrencinin reasoning'le ilgili problemleri çözerken bu bölgenin aktiflik seviyesine göre bilgisayar tarafından cognitive conflict'i çözmelerine yardım edecek anlık destek sunulsa nasıl olur? (Ecenaz)

Conceptual Change

- Misconceptions and naive thinking about nature have possibly never disappeared from the brains of adolescents, adults, seniors, and professional scientists and, therefore, need to be inhibited.
- Learning science is neither about rejecting or replacing misconceptions, nor about simply acquiring new knowledge; it is about controlling and inhibiting a spontaneous tendency that the human brain seems to have for nonscientific explanations.

Empirical bias

- Both unschooled children and unschooled adults will generally succeed on logical reasoning tasks in familiar domains, but do so on the basis of knowledge-based inference rather than applying the rules of formal logic. Only once they have gone to school are they able to overcome this “empirical bias” and reason abstractly and counterfactually.

Deductive reasoning process

- Premise encoding - premise integration - conclusion validation
- Areas in the frontal and parietal cortices are differentially recruited at different times in the deductive reasoning process as the participant steps through a syllogistic reasoning problem.

Reasoning brain networks

- Both language-based and visual–spatial modes are engaged during logical reasoning.

- The evidence points to a fractionated system that is dynamically configured in response to certain task and environmental cues.

- The degree to which language-based or visual–spatial modes are recruited can depend on many factors, including, but by no means limited to, the type of logical relation to be reasoned with (e.g., Categorical versus conditional), and the content of the problem (e.g., Concrete versus abstract).

Analogical Reasoning

Analogical reasoning

1. S is similar to T in certain (known) respects.
2. S has some further feature Q.
3. Therefore, T also has the feature Q, or some feature Q* similar to Q.

Analogical reasoning guidelines

1. The more similarities (between two domains), the stronger the analogy.
2. The more differences, the weaker the analogy.
3. The greater the extent of our ignorance about the two domains, the weaker the analogy.
4. The weaker the conclusion, the more plausible the analogy.
5. Analogies involving causal relations are more plausible than those not involving causal relations.
6. Structural analogies are stronger than those based on superficial similarities.
7. The relevance of the similarities and differences to the conclusion (i.e., to the hypothetical analogy) must be taken into account.
8. Multiple analogies supporting the same conclusion make the argument stronger.

Analogical reasoning

- Analogical reasoning processes play a fundamental role in the scientific discovery process.
- Scientists use information from one relatively known domain ("the source/analog," or earlier situation) and apply it to another domain ("the target," or present problem).
- One's ability to draw analogies between two disparate domains has also been linked to fluid intelligence and creativity.

Analogical reasoning

- Scientists would make use of between 3 and 15 analogies in a single one-hour laboratory meeting.
- If the goal of the scientist was to fix a methodological problem in one of their experiments, the analogies generated were predominantly based on superficial features close to the domain of interest.
- If the goal was to formulate new hypotheses, the scientists generated and focused on analogies that were based upon sets of higher-order structural relations.

Analogical reasoning

- Participants in the cognitive laboratory do not easily use analogies when reasoning.
- Participants' reasoning performance was facilitated by exposure to a previous analogous problem only if the analogy between the two problems was made explicit to them.

Neural underpinnings of analogical reasoning

- Verbal analogical reasoning depends on multiple pfc-mediated systems.
- The lateral frontopolar cortex is sensitive to the integration of multiple sources of semantic information required to complete the analogical equivalence judgments, whereas the anterior left inferior pfc iss modulated by the associative strength of the first word pair.
- The activity in frontopolar cortex increased as the semantic distance in the analogies increased.

Future directions

- It is vital to extend neuroimaging studies downwards to younger ages in order to better understand the modes of reasoning that are most effective in young children and the kind of training that might be most effective at promoting proper scientific reasoning.
- Such findings would also help us to identify *when* and *which* skills are receptive to training, such as that provided in the classroom, and which skills are not developed enough to be receptive to classroom-based science education.

Questions?

Innovative Science Educational Neuroscience: Strategies For Engaging Brain Waves In Science Education Research

Chia-Ju Liu & Chin-Fei Huang

Mind vs. Brain

- «The brain does not think, but a human being thinks with the help of his/her brain. The brain is an operational mechanism and that the mind controls that mechanism actively.»
- «The purpose of education is to improve every student's potential, but not to try to train their brains.»
- Evald Ilyenkov (1966)

Science Educational Neuroscience

- The understanding of cognitive processing in students' science learning requires greater emphasis, and the engagement of neuroscience is a better way to help us to fully understand cognitive processing.
- Findings from neuroscience would provide many insights into science education research.

Neuroscience Technologies

The electrical activity from the cerebral cortex in different brain areas could provide biological evidence to help researchers infer participants' cognitive processing.

Table 12.1 The corresponding brain areas and cognitive functions

Brain areas	Cognitive functions	Education applications (examples)
Frontal lobe	Specialized verbal or reading abilities, memory, attention, emotions, reasoning	Reading skills, reading strategies, learning motivation
Parietal lobe	Memory, attention and mathematics abilities	Learning attention, number sense, mathematics problem solving
Occipital lobe	Visual processing, working memory about spatial abilities	Spatial abilities about chemistry, physics or mathematics
Temporal lobe	Auditory processing, emotions, working memory	Emotions about learning, verbal abilities about learning

Emotion and Scientific Creativity

- Without neuroscience technologies, we can never be certain of the participants' real emotions at a certain point.
- Researchers need to seek more meticulous and detailed data in science education research. Individual differences still exist.

Liu ve Huang'ın (2016) çalışmasında "scientific creativity and emotions" olarak bir başlık açmış. Bu çalışma grubun ilk haftalarında yaratıcılık konusu ile ilgili de birtakım konuşmalar geçmişti. Burada bahsedilen "scientific creativity" ın tanımını pek anlayamadım (Duyguları nasıl ölçtüklerini anlatmışlar ama scientific creativityden bahsetmemişler). Fen Bilimlerinde sıklıkla kullanılan bir terim olabilir. Bu sebeple size de nedir nasıl ölçülür danışmak istedim. (Sinem)

Scientific creativity

Motivation for Scientific Research → Formulate Research Problems → Generate Search Space → Reduce Search Space → Conduct Exhaustive Search

- A creative scientist knows how to correctly formulate research problems, can generate an extensive search space for a selected problem, can assemble or formulate the necessary methodological knowledge to reduce the search space into manageable dimensions, and can conduct exhaustive search in the reduced search space.

- Scientific creativity as a kind of intellectual trait or ability producing or potentially producing a certain product that is original and has social or personal value, designed with a certain purpose in mind, using given information.

Scientific creativity test (Hu, 2002)

1. Write down as many as possible scientific uses as you can for a piece of glass. For example, make a test tube.
2. If you can take a spaceship to travel in the outer space and go to a planet, what scientific questions do you want to research? Please list as many as you can. For example, are there any living things on the planet?
3. Think up as many possible improvements as you can to a regular bicycle, making it more interesting, more useful and more beautiful. For example, make the tyres reflective, so they can be seen in the dark.
4. Suppose there was no gravity, describe what the world would be like? For example, human beings would be floating.
5. Use as many possible methods as you can to divide a square into four equal pieces (same shape). Draw it on the answer sheet.
6. There are two kinds of napkins. How can you test which is better? Please write down as many possible methods as you can and the instruments, principles and simple procedure.
7. Design an apple picking machine. Draw a picture, point out the name and function of each part.

Affect and Computer-Based Learning

- Male and female students did the mathematics task better with applause feedback than without it.

- The applause feedback is more useful for male students than for females. Gender difference is real.

- Eğer bu sonuçlar, sinirbilim verisi kullanılmayan bir eğitim araştırmasında bulunmuş olsaydı, güvenilirliği ve geçerliliği farklı olur muydu? Neden?
  - Peki bu durum, sinirbilim ve eğitim araştırmaları ilişkisi hakkında bize ne gibi bir yol gösterebilir?
- Liu ve Huang'ın (2016) araştırma sonuçlarına göre, bir testte alkış dönütü almanın, kadınlara oranla erkeklerde daha fazla olumlu duygular oluşturduğu bulunmuştur. Belki biz de bilgisayar tabanlı testlerde farklı türde ödüller vererek kadınları daha çok nelerin mutlu ettiği araştırabiliriz. (Ecenaz)

Mental Rotation and Chemistry Learning

- Low-achieving students used similar strategies to identify 2D chemical structural formulas as they did to identify 2D figures because they did not realize that the 2D chemical structural formulas were the projections of 3D chemical structural formulas. On the other hand, the HSG students used different strategies to identify 2D figures and 2D chemical structural formulas because they understand that the concepts of 2D figures and 2D chemical structural formulas are different.

- It is important to teach students to use analytical strategies to identify chemical structural formulas, but the teachers also need to consider the basic cognitive strategies of mental rotation when teaching the strategies and materials related to chemical structural formulas.

The Challenges for Future Researchers

- The validity of the methodologies and technologies of science educational neuroscience needs to be confirmed by professional science educational neuroscience experts but not only by neuroscience researchers.
- The inferences of the evidences from neuroscience need to be explained carefully. Many results from neuroscience data could only explain physiological responses which do not involve thinking.
- Scholars who intend to become interdisciplinary researcher need to realize the importance of team work, and make efforts to cooperate with professional groups.

Suggestions for Science Education Researchers

Focus on the new findings of neuroscience and apply this evidence to interpret the findings in science education research.

Suggestions for Science Teachers and Educators

- A science teacher or educator should clearly understand which cognitive abilities the students need to have to learn each science concept, and help the students to try their best to perform the corresponding cognitive abilities.

- A science teacher or educator need to know that the characteristics and limitations of each student’s brain are different and unique, and their mission is to help each student perform their best.

Questions

Kitap chapter'inda Fugelsang ve Mareschal bilimsel akil yürütme ile ilgili farkli akil yürütme olgularindan bahsetmis: analogical reasoning, deductive reasoning ve causal reasoning olmak uzere. Bu olgularin fen eğitiminde kullanildigi yerlere ornek verebilir misiniz? Bu akil yurutme süreçleri geliştirilebilir mi ve nihai sonuçta bilimsel akil yürütmenin "iyilestigine" yönelik bir varsayimda bulunulabilir mi? Bulunuldugu takdirde, bunun öğrenmeyle ilişkisi nasil kurulabilir? (Gamze T.)

Questions

Fen öğretimi uygulamalari için uzun vadeli profesyonel gelişimi gözlemlemek ve sonucunda iyi sinifici uygulamalarini aciga cikarmak amacıyla yapilan bir calismada Roehrig ve arkadaslari (2012), orta okul biyoloji ogretmenlerinin sinirbilim içerik ve sorgulamaya dayali pedagojik uygulama bilgilerini geliştirmek amacıyla uc yillik yoğunlastirilmis yaz programlari serisi tasarlamislardir. Ilk arastirma sorusu olan "ogretmenler sinirbilim içerik bilgilerini artirabiliyor mu?" ya cevap aramak için yapilan on ve son test skorlari karsilastirildiginda fen ogretmenlerinin sinirbilim içerik bilgilerinin arttigi ve calistay sonunda yapilan oz değerlendirme anketinde ise sinirbilim ile ilgili ozguvenlerinin yüksek olduğu ortaya cikmistir. Bagimsiz gözlemciler tarafından calistaya katilan ogretmenler sinif içinde gözlemlendiklerinde, calisma kagidi ve ders anlatimi gibi yöntemlere cok az basvurduklarini ve ozellikle öğrencilerin kendi deneylerini tasarlayabilecekleri ortamlar yarattiklarini raporlamislardir. Calismanin sonunda sinirbilimin de bu pedagojik uygulamalarda etkisinin olduğu ve fen ogretmenlerinin öğrencilerin nasil daha iyi öğrenebileceklerini nöronlar ve sinaptik bağlar araciligiyla kavrayabildikleri one surulmustur. Siz bu ongoruye katiliyor musunuz? Neden? (Gamze T.)

Questions?