

# Cognitive Psychopathology: An essential tool for the frame analysis of mental disorders

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# What is cognition?

## Cognition

[lat. *cognoscere*

«to know», «to become acquainted with»]

# What is cognition?

- “... the term “cognition” refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations... Given such a sweeping definition, it is apparent that cognition is involved in everything a human being might possibly do; that every psychological phenomenon is a cognitive phenomenon.”

Neisser, U. (1967). *Cognitive psychology*. New York: Meredith

- “*Human cognition*: all higher cognitive processes, such as memory, language, problem solving, imagery, deduction, and induction.”

Anderson, J.R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.

- “*Cognition* is the mental processes that are involved in perception, attention, memory, problem solving, reasoning, and making decisions.”

Goldstein, E.B. (2007). *Cognitive Psychology: Connecting Mind, Research and Everyday Experience*. Belmont: Wadsworth Publishing

- “... internal processes involved in making sense of environment and decided what action might be appropriate. These processes include attention, perception, learning, memory, language, problem solving, reasoning and thinking.”

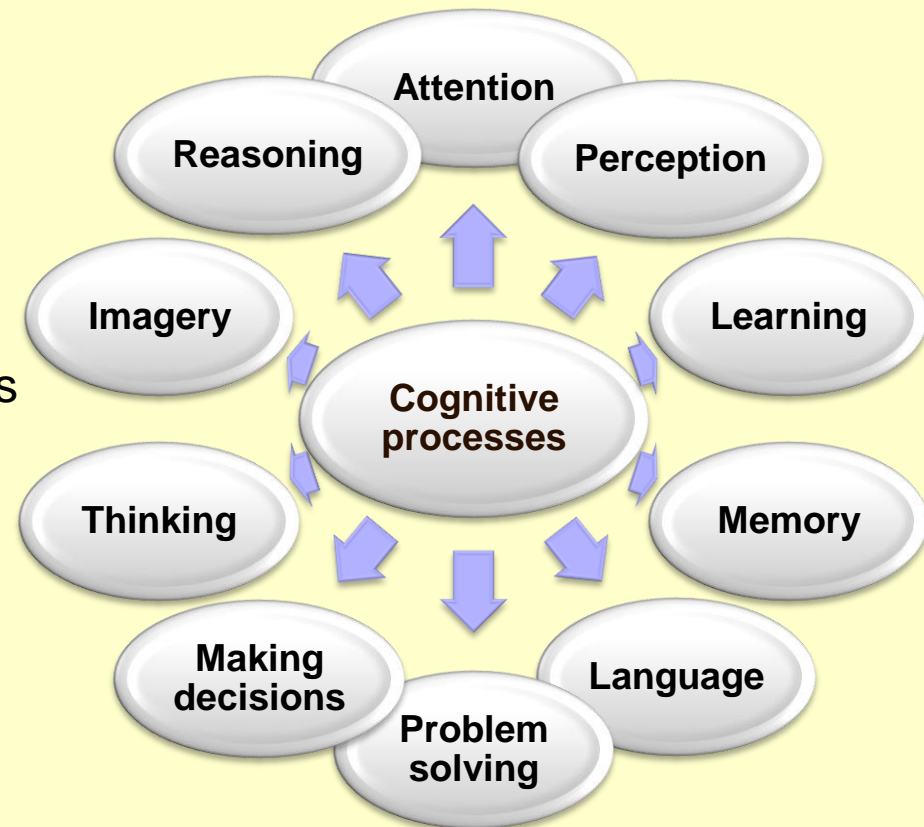
Eysenck, M.W. & Keane, M.T. (2010). *Cognitive Psychology: A Student's Handbook*. New York: Psychology Press

# What is cognition?

Cognition is a construct of a range of cognitive processes, which:

- Cannot be directly measured
- Can be operationalized via standardized assessment methods

- Reaction time
- Event-related potential (ERP)
- Scores in neuropsychological tests
- Etc.



# Approaches to human cognition (I)

## Experimental cognitive psychology

### Psychological experiment

- Experimental manipulation of independent variable(s)
  - Stimulus onset interval (SOI)
  - Task difficulty level
  - Compatibility/ incompatibility of presented items
  - The presence of distractors
  - Etc.
  
- Assessment of dependent variable(s)
  - Reaction time
  - Number of produced units
  - Quality (goodness) of performance
  - Kind of errors /number of errors
  - Etc.

# Approaches to human cognition (II)

## Neurophysiological and neuroanatomical methods (non-invasive)

- **Electroencephalography (EEG)**
  - Direct assessment of brain electrical activity
  - Event-related potentials (ERPs)
  - High temporal resolution
- **Functional magnetic resonance imaging (fMRI)**
  - Indirect assessment of neuronal activity
  - BOLD-signal (blood oxygenation level dependent)
  - High spatial resolution
- **Magnetoencephalography (MEG)**
  - Recording of magnetic fields, induced by electric brain activity
  - High temporal resolution

# Approaches to human cognition (II)

## Neurophysiological and neuroanatomical methods (non-invasive)

- **Electroencephalography (EEG)**

Real-time monitoring of the neuronal activity

- **Functional magnetic resonance imaging (fMRI)**

Identification of task-specific regions, connectivity networks, changes over time associated with cognitive processes

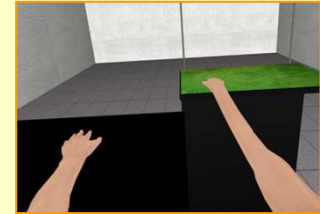
- **Magnetoencephalography (MEG)**

Temporal dynamics of brain processes and their localization

# Approaches to human cognition (III)

## Virtual Reality

- Creation of situations that are close to daily life
- Experimental control
- Experimental method without time or space limitations
- 3-D virtual environment
- Interpersonal parameter via avatars



Kilteni K et al. PLoS One. 2012;7(7):e40867.



Parsons T, Rizzo A. Annu Rev of CyberTher and Telem. 2008;6:23-28.



Han K et al. Comput Biol Med. 2012;42(8):841-847.



Hamburger K, Knauff M. PsychNology Jour. 2011;9(2):137-163.



# Approaches to human cognition (IV)

## Neuropsychological assessment

Cognitive processes	Neuropsychological assessment
<b>Attention</b>	TAP, test battery for attentional performance; d2 Test of Attention; TMT-A/ TMT-B, Trail Making Test
<b>Language</b>	Controlled Word Association Test; Aachen-Aphasia-Test
<b>Memory</b>	Rey-Figure-Test
<b>Motor functions</b>	LNNB, Luria-Nebraska Neuropsychological Battery
<b>Working memory</b>	Letter-Number Span Test; N-Back-Tasks
<b>Executive functions</b>	Stroop-test; Tower of London; WCST, Wisconsin-Card-Sorting-Test
<b>Social cognition</b>	ToM-Test
<b>Intelligence</b>	IST-2000; HAWIE
<b>Perception</b>	P50; N100; Mismatch Negativity

# Cognitive psychopathology

- **Concept:**

Cognitive dysfunctions contribute to the

- development,
- maintenance,
- recurrence,

of mental disorders or symptoms

- **Objects of study:**

Cognitive dysfunctions underlying mental disorders:

- cognitive impairments,
- cognitive biases,
- dysfunctional beliefs

# Cognitive psychopathology

- **Research goals:**

- To gain a better understanding of the pathophysiology of mental disorders
- To establish direct relationships between cognitive dysfunctions and clinical symptoms
- To examine the cognitive difficulties for better understanding normal cognitive processes

- **Clinical goals:**

- To develop new methods for assessing psychopathological symptoms
- To improve patient treatment
- To contribute to future psychiatric classification

# Cognitive psychopathology

## Classification of mental disorders

- Two established systems:
  - International Classification of Diseases (**ICD-10**)  
World Health Organization (WHO)
  - Diagnostic and Statistical Manual of Mental Disorders (**DSM-IV**)  
American Psychiatric Association (APA)
- Clinical symptoms are the essential elements of classification
- But...
  - Cognitive dysfunctions also play an important role in the pathophysiology of mental disorders (schizophrenia, specific phobia)

# Cognitive psychopathology

## Definition of a Mental Disorder

- **DSM-5:**

“A Mental Disorder is a health condition characterized by **significant dysfunction** in an individual’s **cognitions, emotions, or behaviors** that reflects a **disturbance** in the **psychological, biological, or developmental processes** underlying mental functioning. Some disorders may not be diagnosable until they have caused clinically significant distress or impairment of performance.”

- **DSM-IV:**

- A clinically significant behavioral or psychological syndrome or pattern that occurs in an individual
- A manifestation of a behavioral, psychological, or biological dysfunction in the individual

# Cognitive psychopathology

## Cognitive dysfunction underlying mental disorders (I)

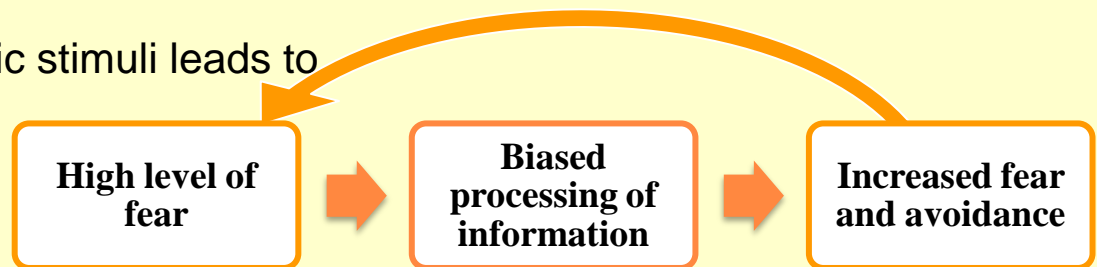
### Example 1: Specific phobia and cognitive biases

- **Spider phobia & visual perception**

- Participants provided spider size estimates

**Results:**

- Significant positive correlation between
  - Size estimates
  - Self-reported fear while encountering spiders
- High level of fear is associated with the biased processing of perceptual information
- Tendency to magnify phobic stimuli leads to
  - Increased fear
  - Subsequent avoidance



# Cognitive psychopathology

## Cognitive dysfunction underlying mental disorders (II)

### Example 2: Schizophrenia and cognitive impairments

- **MATRICES –**

Measurement and treatment research to improve cognition in schizophrenia

- **MCCB –**

MATRICES Consensus Cognitive Battery

- Seven cognitive domains in MCCB

Cognitive Domain	Test
Speed of processing	<i>Brief Assessment of Cognition in Schizophrenia (BACS)</i> : Symbol-Coding <i>Category Fluency</i> : Animal Naming  Trail Making Test: Part A
Attention/Vigilance	<i>Continuous Performance Test—Identical Pairs (CPT-IP)*</i>
Working memory (nonverbal) (verbal)	<i>Wechsler Memory Scale®—3rd Ed. (WMS®-III)</i> : Spatial Span  <i>Letter-Number Span</i>
Verbal learning	<i>Hopkins Verbal Learning Test—Revised™ (HVLT-R™)</i>
Visual learning	<i>Brief Visuospatial Memory Test—Revised (BVMTR™)</i>
Reasoning and problem solving	<i>Neuropsychological Assessment Battery® (NAB®)</i> : Mazes
Social cognition	<i>Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT™)</i> : Managing Emotions

<http://www.matricsinc.org/MCCB.htm>

Nuechterlein KH et al. *Am.J.Psychiatry.* 2008; 165:203-213.

# Cognitive psychopathology

## Cognitive dysfunction underlying mental disorders (III)

### Example 3: Schizophrenia and sense of agency

- **Sense of agency is...**

- “The registration that we are the initiators of our own actions”

Synofzik M. et al. *Conscious Cogn.* 2008;17(1):219-39.

- Ability “to distinguish actions that are self-generated from those generated by others”

Balconi M. *Neuropsychology of the sense of agency.* Milan: Springer Publ., 2010.

- **Distorted sense of agency in patients with schizophrenia**

- Tendency to misattribute actions to an external agent

- May be associated with:

- Ego-disturbances
- Hallucinations
- Delusions

**E.g., distinction between self- and other-generated sounds is impaired in schizophrenia compared to controls**

Hauser M et al. *Psychiatry Research.* 2011;186:170–176.

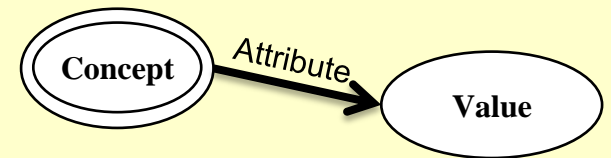


# Cognitive psychopathology

## Frame-based representation of mental disorders

- **Frame Theory (Barsalou, 1992)**
  - Approach to defining and classifying mental disorders
- **Novel approach to represent the concepts using recursive attribute-value structures**

- **Attributes** are aspects of a described concept
- **Values** are subordinate concepts of attributes



- **Frame – based representation of mental disorders provides a more systematic, explicit and clearly structured basis for**
  - Classification of mental disorders
  - Descriptive representation of
    - Psychopathology
    - Etiological causes
    - Pathophysiological consequences
    - Cognitive dysfunctions

# Cognitive psychopathology

## Frame-based representation of mental disorders

### SFB 991, B06: Frames in Psychiatric Classification

#### Principal Investigators

- **Professor Gottfried Vosgerau**, Department of Philosophy, Heinrich-Heine-University, Düsseldorf
- **Priv.-Doz. Jürgen Zielasek**, Department of Psychiatry and Psychotherapy, Heinrich-Heine-University, LVR-Klinikum Düsseldorf

#### Staff

- **Professor Wolfgang Gaebel**, Department of Psychiatry and Psychotherapy, Heinrich-Heine-University, LVR- Klinikum Düsseldorf
- **Dr. Patrice Soom**, Department of Philosophy, Heinrich-Heine-University, Düsseldorf
- **Dipl.-Psych. Olga Beldanova**, Department of Psychiatry and Psychotherapy, Heinrich-Heine-University, LVR-Klinikum Düsseldorf

- **Research aims:**
  - Analysis of mental disorders and of their classification by means of frame analysis
  - Frame-based representation of mental disorders
- **We chose specific phobias as an example of mental disorders for representation in frames**
  - Fixed stimulus-reaction relation
  - Comparably well-known pathomechanisms

# Cognitive psychopathology

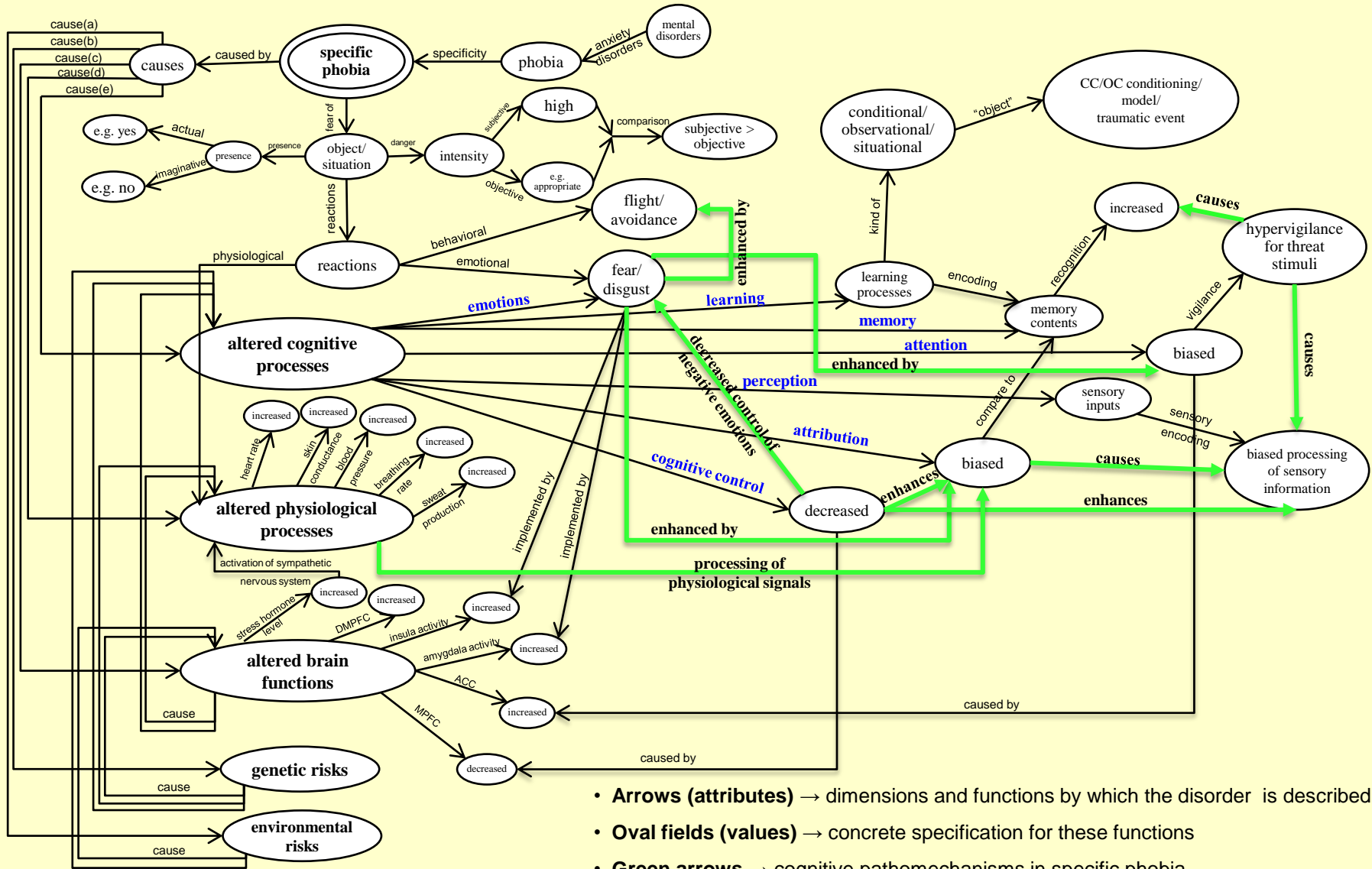
## What is specific phobia?

- **Specific phobia is...**
  - Extreme fear of specific objects or situations
  - Out of proportion to the actual danger
  - Significant emotional distress
  - Significant daily life interference
  - Symptoms are restricted to the feared situation:
    - when encountering feared object,
    - or when thinking about it
- **Types of specific phobia (ICD10):**
  - **Animal type** (e.g. insects, dogs)
  - **Nature-forces type** (e.g. storms, water)
  - **Blood, injection and injury type**
  - **Situational type** (e.g. elevators, tunnels)
  - **Other type**
- **Lifetime prevalence of 12.5%**



# Cognitive psychopathology

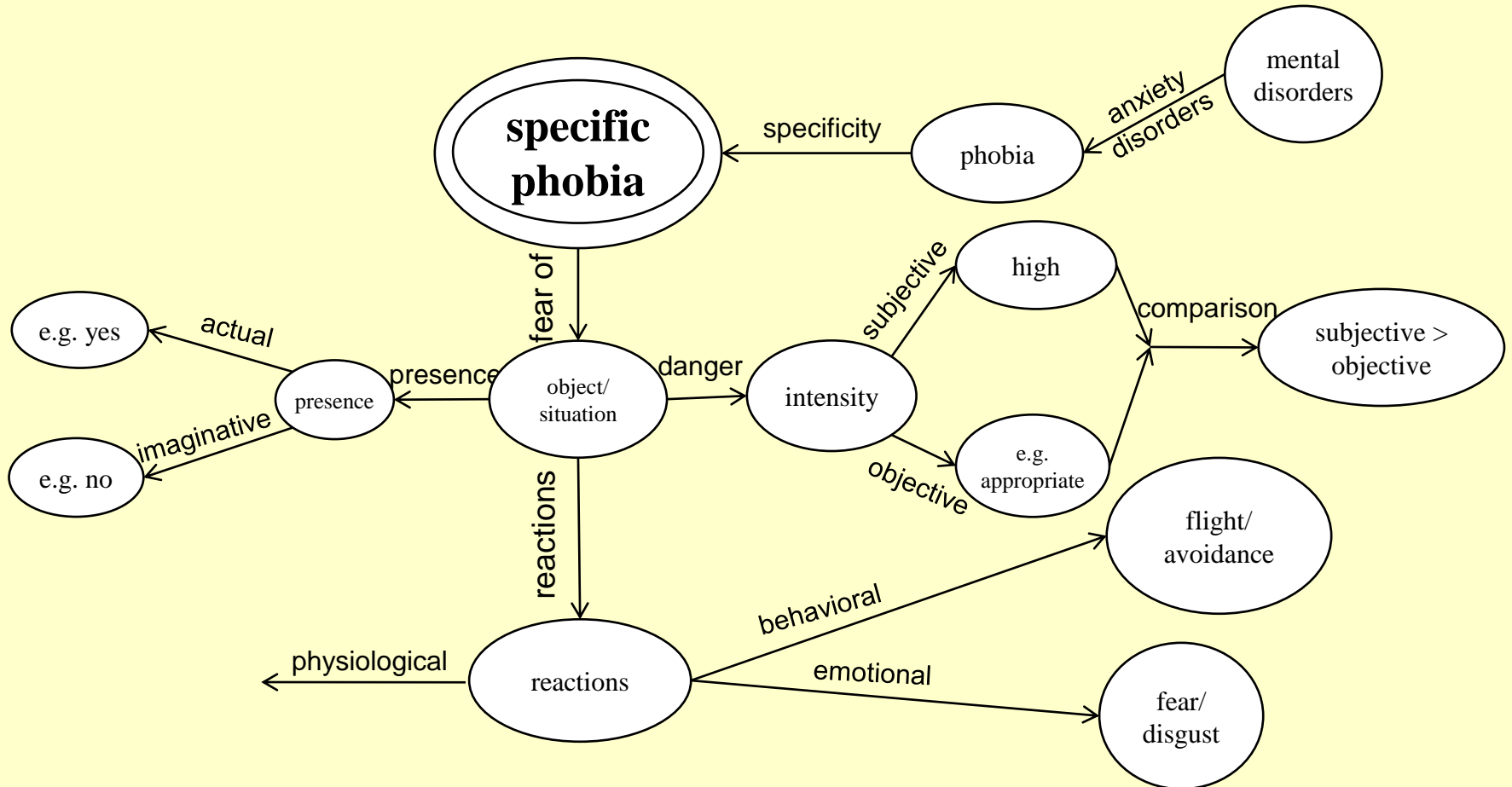
## Frame-based representation of specific phobia



# Cognitive psychopathology

## Frame-based representation of specific phobia

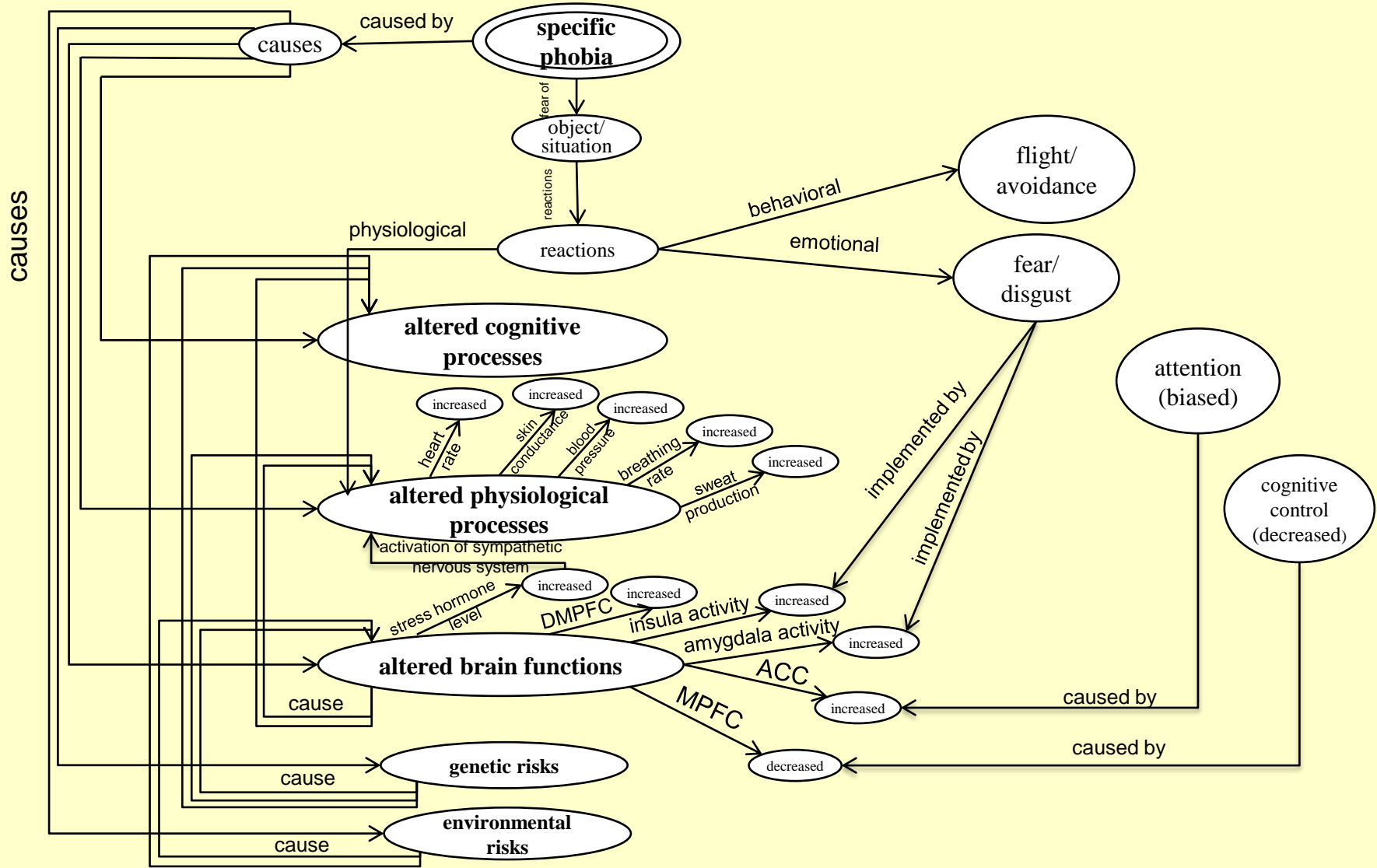
### Definition of specific phobia



# Cognitive psychopathology

## Frame-based representation of specific phobia

### Pathogenesis of specific phobia

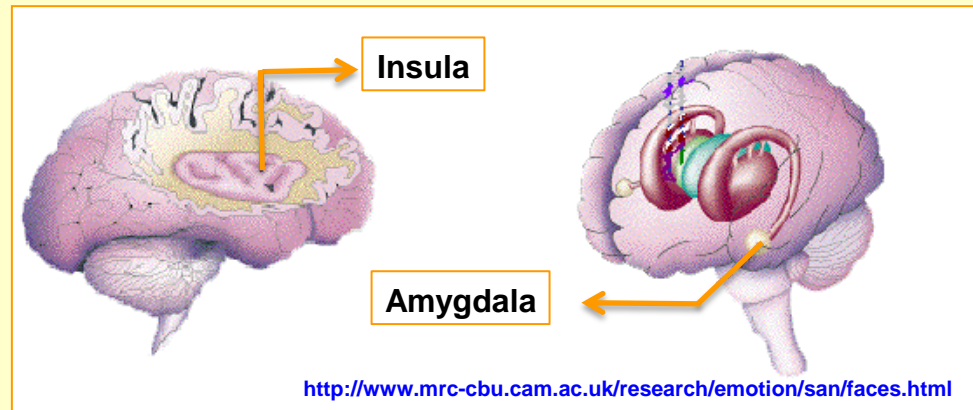
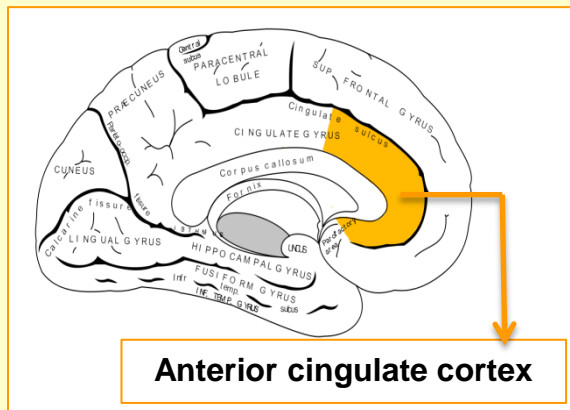
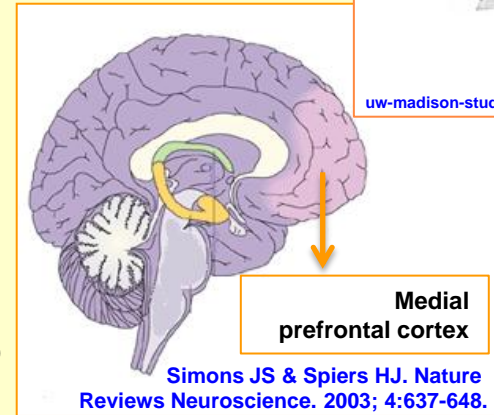
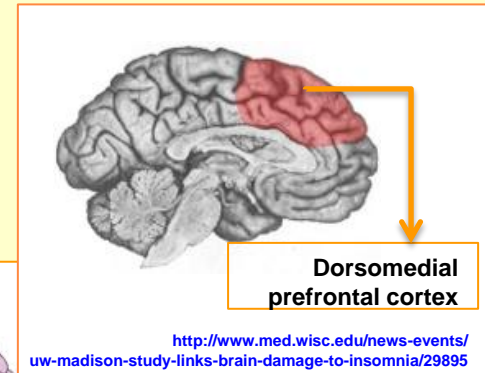
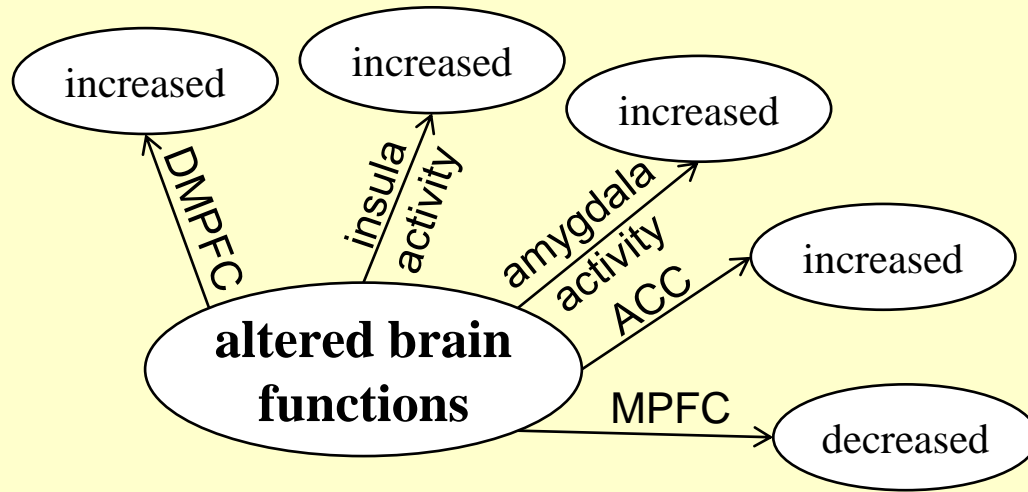


# Cognitive psychopathology

## Frame-based representation of specific phobia

### Pathogenesis of specific phobia

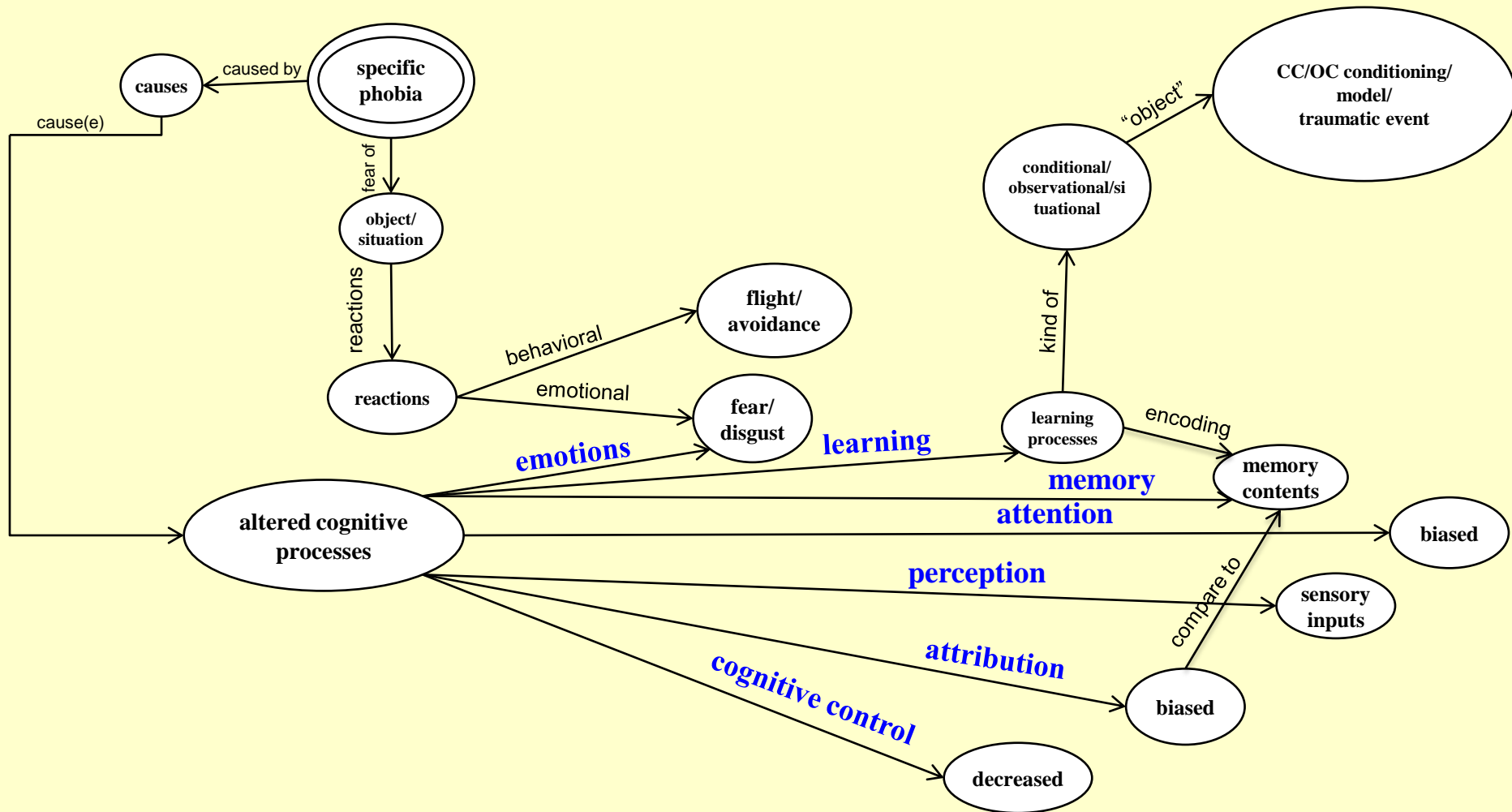
#### Altered brain functions



# Cognitive psychopathology

## Frame-based representation of specific phobia

### Cognitive pathomechanisms of specific phobia







# Conclusion and future direction

## Summary

- Cognitive psychopathology
  - Is an important tool for the description and future classification of mental disorders
  - Is currently under revision in the process of development of DSM-5 and ICD-11
- New concepts are being developed to bridge the gap between neuroscience and psychopathology
  - E.g., frame-based analysis of mental disorders

## Future direction

- Integration of genetic and environmental factors in frame representation of mental disorders
- Frame representation of brain functions in healthy individuals, to be related with the frames describing mental disorders
- Development of classification or diagnostic instruments based on the frame representation of mental disorders
- Experimental psychological study to verify frame structures of mental disorders
- Schizophrenia: complex disorder to be analyzed next

**Thank you for your attention!**