

# APPROACHES TO HUMAN COGNITION (1)

- COGNITIVE PSYCHOLOGY: BEHAVIOR OF BRAIN ON A SPECIFIC AREA

- NEURO PSYCHOLOGY: BRAIN DAMAGED PATIENTS

- VS NON-BRAIN DAMAGED PATIENTS

- NEUROSCIENCE: MEASURE BRAIN ACTIVITY

- COMPUTATIONAL SCIENCE: USING COMPUTATIONAL MODELS

- REPPLICATION CRISIS

- DOUBLE DISSOCIATION

- CASE STUDIES VS CASE STUDIES

- FMRI: ANALYSE A FUNCTION OF AN AREA

- TMS: SIMULATE A LESION BY CREATING INTERFERENCE

# BASIC PROCESSES IN VISUAL PERCEPTION (2)

- PERCEPTION: HOW SENSORY INFORMATION IS PROCESSED IN PERCEPTUAL EXPERIENCE. GEST IN 20 ms

- DEPTH PERCEPTION: RECONSTRUCT 3D FROM 2D

- STEREOPSIS: BASED ON A SLIGHT DIFFERENCE OF DISPARITY OF TWO RETINAL IMAGE

- VISUAL CLUES

- MONOCULAR: REQUIRE 1 EYE (STATIC/DYNAMIC)

- BINOCULAR: REQUIRE BOTH EYE

- TEXTURE GRADIENT
- BLUR
- INTERPOSITION
- FAMILIAR SIZE
- MOTION PARALLAX

- ZEKI FUNCTIONAL SPECIALIZATION THEORY

- V1-V2: BASIC VISUAL PROCESSING
- V3-V3A: FORM PERCEPTION
- V4: COLOR PERCEPTION
- VS (MT FOR HUMAN): MOTION PERCEPTION

## EYE

- LATERAL INHIBITION

- CONES: COLOR AND DETAILED PERCEPTION, CENTRE OF THE RETINA, PARVOCELLULAR (P-PATHWAY) GO TO V4

3 CONES (BLUE, RED, GREEN)  
TRICROMACY THEORY + OPPONENT PROCESS  
THEORY = DUAL PROCESS THEORY  
IMITATION

- RODS: VISION IN DIM LIGHT AND MOTION, PERIPHERY OF THE RETINA. CAN BE ACTIVE BY JUST ONE PHOTON  
MAGNOCELLULAR (M-PATHWAY) GO TO VS

- COMPLEX INTERACTION BETWEEN CHANNELS
- ARRANGEMENT OF CONES IS KINDA RANDOM

- LAND EFFECT: DISCOUNT LUMINANCE TO PERCEIVE COLOR OF OBJECTS. (COLOR CONSTANCY)

## VENTRO DORSAL STREAM

- WHAT PATHWAY
- VISION FOR PERCEPTION
- ALLOCENTRIC

## DORSO DORSAL STREAM

- HOW PATHWAY
- VISION FOR ACTION
- EGOCENTRIC

# OBJECT RECOGNITION (3)

- PATTERN RECOGNITION EXTREMELY FLEXIBLE

- PERCEPTUAL ORGANIZATION: INNATE (PROXIMITY, GOOD CONTINUATION, SIMILARITY, COMMON FAITH)

- VISUAL IMAGERY ≠ ACCUMULATION

- PERCEPTUAL ANTICIPATION THEORY (KOSSLYN): PERCEPTION = IMAGERY

- ONLY DIFFERENCE WHERE THE SIGNAL COME FROM

- PROPOSITIONAL THEORY (PHYSICK): PERCEPTION ≠ IMAGERY

- BUILD STATEMENT THAT IS SAVED IN MEMORY

## OBJECT RECOGNITION

- RECOGNITION BY COMPONENTS (BIEDERMANN)

- 36 GEONS

- VIEWPOINT INVARIANT

- BUILD 3D REPRESENTATION OF THE OBJECT IN THE BRAIN

### LIMITATION:

- FOCUS ON BOTTOM-UP
- TOO INFLEXIBLE
- CLOUDS EXAMPLE

## GRIBBLE (TARR)

- VIEWPOINT DEPENDENT

## COMPUTATIONAL THEORY (MARR)

- PURE BOTTOM-UP

- 2D PRIMARY SKETCH: OBSERVER CENTRE, 2D DESCRIPTION

- 2D 1/2 SKETCH: ADD DEPTH. OBSERVER CENTRE

- 3D MODEL REPRESENTATION: VIEWPOINT INDEPENDENT, REPRESENT FULL 3D STRUCTURE IN THE BRAIN

## BAR MODEL

- EMPHASIS ON TOP-DOWN

- TOP-DOWN WHEN YOU DON'T HAVE ENOUGH INFORMATION

- USE PRIMING AND BLURRING AS EXPERIMENTS

- FAST PROCESSING OF THE LIST OF A SCENE

# FACE RECOGNITION

## HOLISTIC FACE PROCESSING (EVEN IN YOUNG CHILDREN)

- INVERSION EFFECT: INVERTED FACES HARDER TO RECOGNISE
- PART WHOLE EFFECT: EASIER TO RECOGNISE A FACE PART WHEN PRESENTED WITHIN A WHOLE FACE RATHER THAN ISOLATION
- COMPOSITE EFFECT: HALF FACE MORE DIFFICULT WHEN IT APPEARS AGAINST A DIFFERENT HALF

## PROSOPAGNOSIA (FACE BLINDNESS)

- ACQUIRED PROSOPAGNOSIA: CAUSED BY BRAIN DAMAGE
- DEVELOPMENTAL PROSOPAGNOSIA: NO OBVIOUS DAMAGE

IMAGERY: NOTHING REALLY IN FRONT OF US

- HALLUCINATION: PERCEPTION-LIKE EXPERIENCE OCCURS WITHOUT STIMULUS

- ANTON'S SYNDROME: BLIND INDIVIDUAL MISINTERPRETS VISUAL IMAGERY AS VISUAL PERCEPTION

## BRUCE-YOUNG THEORETICAL APPROACH

- MOST INFLUENTIAL THEORETICAL APPROACH
- 1) STRUCTURAL CODING: MENTAL REPRESENTATION OF THE FACE
- 2) EXPRESSION ANALYSIS: EMOTIONAL STATES OF PEOPLE INFERRRED FROM THE SPATIAL EXPRESSION
- 3) FACIAL SPEECH ANALYSIS: SPEECH PERCEPTION ASSISTED BY LIP-READING
- 4) DIRECT VISUAL PROCESSING: RECOGNITION OF FEATURES BUT NOT THE IDENTITY
- 5) FACE RECOGNITION UNITS: STORE EVERY FACE WE HAVE LEARNED
- 6) PERSON IDENTITY NODES: PROVIDES INFORMATION ABOUT INDIVIDUALS (OCCUPATION)
- 7) NAME GENERATION: PERSON NAME IS STORED SEPARATELY
- 8) COGNITIVE SYSTEM: CONTAINS ADDITIONAL INFORMATION

## LIMITATIONS

- FACIAL IDENTITY AND FACIAL EXPRESSION NOT COMPLETELY SEPARATE
- FACIAL EXPRESSION COMPLEXITY IS OVERSIMPLIFIED

VISUAL IMAGERY: → ABILITY TO RECALL IMAGES FROM THE BRAIN W/OUT ANY STIMULUS FROM THE ENVIRONMENT

### KOSSYLN ANTICIPATION THEORY

- VISUAL IMAGES ARE DEPICTIVE REPRESENTATIONS
- VISUAL PERCEPTION: BOTTOM-UP
- VISUAL IMAGERY: TOP-DOWN
- IMAGERY = PERCEPTION

### PYLYSHYN PROPOSITIONAL THEORY

- IMAGERY IS A TACIT AND IMPLICIT PROPOSITIONAL KNOWLEDGE
- PERCEPTION ≠ IMAGERY

# MOTION PERCEPTION AND ACTION (4<sup>th</sup>)

## DIRECT PERCEPTION (GIBSON)

- NO NEED TO DO ALL THE COMPUTATION
- THE LIGHT REACHING THE EYE CONTAIN ALL THE VISUAL INFORMATION
- OPTIC FLOW: CHANGES IN THE PATTERN OF LIGHT  
↓  
• FOCUS OF EXPANSION: MOTIONLESS CENTERED POINT

### LIMITATIONS:

- PERCEPTION PROCESS MORE COMPLICATED
- UNDERESTIMATE TOP-DOWN IMPORTANCE
- OVERSIMPLIFIED ROLE OF MOTION ON PERCEPTION

— X —

## VISUALLY GUIDED MOVEMENT

- DRIVERS DO NOT CONSTANTLY FIXATE ANY GIVEN FEATURE (TANGENT POINT)

### LIMITATIONS

- SEVERAL OTHER INFO ARE USED (BINOCULAR DISPARITY...)
- FUTURE PATH MORE USED THAN TANGENT POINT

## TIME TO CONTACT (LEE)

$$\bullet \text{TTA} = \frac{\text{SIZE OF AN OBJECT RETINAL IMAGE}}{\text{RATE OF EXPANSION}}$$

- ASSUMED OBJECT VELOCITY IS CONSTANT
- TTA-DOT: RATE OF DECLINE OF TTA OVER TIME WHEN BRAKING

### LIMITATIONS:

- NOT WORKING IF THE OBJECT ACCELERATING
- IGNORE FAMILIARITY SIZE AND BINOCULAR DISPARITY

## PLANNING CONTROL MODEL (GLOVER)

WE USE PLANNING SYSTEM AND THEN CONTROL SYSTEM

- TAKE TIME
- DEPENDS ON VISUAL REPRESENTATION IN THE INFERIOR PARITAL LOBE
- FAIRLY FAST

- SELECT A TARGET, HOW TO GRASP IT AND HOW TO USE IT
- INFLUENCED BY INDIVIDUAL GOALS
- CREATE MULTIPLE PLANS

### LIMITATIONS

- CONTROL NOT NECESSARILY AT THE END

## BRAIN PATHWAYS

### DORSO DORSAL STREAM

- HAND CENTERED
- GRASP SYSTEM

### VENTRAL-DORSAL STREAM

- OBJECT CENTRED

## CHANGE BLINDNESS

- THE SYSTEM DOES NOT ALWAYS RESPOND TO CHANGES
- DEPENDS ON PERCEPTION AND ON ATTENTION
- VERY DIFFICULT TO AVOID
- PRE AND POST CHANGE MUST BE COMPARED

## INATTENTIONAL BLINDNESS

- GORILLA AND BALL
- UNDETECTED STIMULI ARE PROCESSED
- DEPENDS ON SIMILARITY OF THE TASK STIMULI AND THE UNEXPECTED OBJECT

UNCLEAR ABOUT INTERACTIONS OF BOTTOM-UP AND TOP-DOWN PROCESSES

TWO EXPLANATION ON WHY WE HAVE CHANGE BLINDNESS

1. SELECTIVE ATTENTION: DUE TO FAILURE OF FOCUSED OR SELECTIVE ATTENTION

### 2. PERIPHERAL VISION APPROACH:

NOT CODED CORRECTLY. NO PERFECT CORRESPONDENCE BETWEEN WHAT WE ARE LOOKING AND WHAT THERE IS IN THE PERIPHERY

## BIOLOGICAL MOTION (4<sup>th</sup>)

MOTION OF ANIMALS AND PEOPLE

### MIRROR NEURONS

- ON MONKEYS
- ACTIVE WHEN ANIMALS PERFORM AN ACTION AND WHEN SEEING ANOTHER ANIMAL PERFORM AN ACTION
- ALSO IN HUMANS (CAN NOT DEEP AS MUCH AS MONKEY) ARE REGIONS
- DON'T PROVIDE EXACT MOTORIC CODING OF OBSERVED ACTIONS

- HELP US PERFORMING CERTAIN ACTIONS

- CODING OF HUMAN STRUCTURE IS SPONTANEOUS AND INNATE (IS BOTTOM-UP)

### HUMAN MOTION PERCEPTION IS SPECIAL

- MORE SENSITIVE
- SPECIFIC AREA ACTIVE
- CAN BE PERCEIVED AND REPRODUCED
- WE HAVE TO DEAL WITH IT A LOT

- EXPERIENCE MATTERS: CAN DETECT MOTION IN INDIVIDUALS WE HAVE VIEWED OVER TIME

# ATTENTION AND PERFORMANCE (S)

ATTENTION SELECT SOME TYPE OF INFORMATION IN THE ENVIRONMENT

- ACTIVE MODE CONTROLLED TOP-DOWN WAY BY THE INDIVIDUAL'S GOALS OR EXPECTATIONS
- PASSIVE MODE CONTROLLED BOTTOM-UP WAY BY THE EXTERNAL STIMULI

- EXTERNAL ATTENTION: SELECT SENSORY INFORMATION, MOST STUDIED ONE (n)
- INTERNAL ATTENTION: SELECT INTERNALLY GENERATED INFORMATION.

## FOCUSED VISUAL ATTENTION:

- DISTRIBUTED ATTENTION: ATTENTION DISTRIBUTED COMPLETELY IN THE VISUAL FIELD
- FOCAL/Spatial ATTENTION: ATTENTION ON A RESTRICTED AREA

## HOW TO EXPLORE SPACE:

- OVERT ORIENTATION: BODY MOVEMENT TOWARD THE OBJECT/AREA OF INTEREST
- COVER ORIENTATION: ALIGN AN INTERNAL MECHANISM, MOVING ATTENTION W/OUT VISIBLE BEHAVIOURAL CHANGE

ATTENTION AND GAZE MOVE TOGETHER TO THE SAME SPATIAL POSITION, BUT POSSIBLE TO SEPARATE THEM

## LOAD THEORY: HOW WE DEAL WITH DISTRACTION EFFECT

- PERCEPTUAL LOAD: HIGH PERCEPTUAL LOAD REQUIRES NEARLY ALL OUR PERCEPTUAL CAPACITY → LOW DISTRACTABILITY
- COGNITIVE LOAD: HIGH COGNITIVE LOAD → HIGH DISTRACTABILITY

## LIMITATIONS

- PERCEPTUAL LOADS EFFECTS ON ATTENTIONAL PROCESSES ARE AUTOMATIC, COGNITIVE LOAD NON-AUTOMATIC
- DE-EMPHASIZED VARIOUS FACTORS
- PERCEPTUAL LOAD AND COGNITIVE LOAD ARE VAGUE

- RESEMBLE A SPOTLIGHT
- IS FLEXIBLE
- CAN BE:
  - OBJECT-BASED
  - SPACE-BASED
  - FEATURE-BASED

## LIMITATIONS:

- SPACE- OBJECT- AND FEATURE-BASED ATTENTION OFTEN INTERACT w/ EACHOTHER TO ENHANCE OBJECT PROCESSING

- UNATTENDED VISUAL STIMULI RECEIVE LESS PROCESSING THAN ATTENDED ONE
- FIRST 75 MS COMPUTATION THE SAME

FOCUSSED AUDITORY ATTENTION: COCKTAIL PARTY PROBLEM (FOCUS ON 1 CONVERSATION WHEN SEVERAL PEOPLE ARE TALKING) 2 STEPS

1. SOUND SEGREGATION: DECIDE WHICH SOUND GO TOGETHER
2. SOURCE SEGREGATION: SELECT DIRECT ATTENTION TO THE SOURCE OF INTEREST AND IGNORE THE OTHERS

USUALLY MORE PROCESSING OF UNATTENDED WORD THAT HAVE SPECIAL MEANING FOR LISTENERS (DETECT YOUR NAME ON THE UNATTENDED MESSAGE)

## CHERRY DICHOTIC LISTENING TASK (COCKTAIL PARTY)

2 DIFFERENT AUDITORY MESSAGE TO BOTH EAR. SOLVED WITH PHYSICAL DIFFERENCE

## BOTTLENECK

TOO LIMITED

- BROADBAND: BOTTLENECK IN EARLY PROCESSING. OTHER INPUT (UNATTENDED ONE) REMAINS BRIEFLY IN A SENSORY BUFFER WITH LITTLE OR NO PROCESSES

- TREISMAN (ATTENTION THEORY): BOTTLENECK LOCATION MORE FLEXIBLE. IMPORTANT ROLE OF TOP-DOWN PROCESS. UNATTENDED STIMULI FLEXIBILITY OF PROCESSING

- DEUTSCH AND DEUTSCH: ALL STIMULI FULLY ANALYSED. MOST IMPORTANT STIMULUS DETERMINE THE RESPONSE. BOTTLENECK MUCH LATER. UNATTENDED STIMULI ALL THROUGH PROCESSING

## ROSNER PARADIGM

• ENDOGENOUS ATTENTION: CONTROLLED BY INDIVIDUAL INTENTION. USED WHEN CENTRAL CUES ARE PRESENTED. DEPENDS ON YOU AND TAKE TIME

• EXOGENOUS ATTENTION: AUTOMATICALLY SHIFT ATTENTION. INVOLVED WHEN UNINFORMATIVE PERIPHERAL CUES ARE PRESENTED

- ASSOCIATED WITH 2 BRAIN AREAS
- INTERACT IN FRONTAL AND PARIETAL REGIONS

## LIMITATIONS:

- ADDITIONAL BRAIN NETWORKS ARE ALSO RELEVANT TO ATTENTION

## DISORDERS OF VISUAL ATTENTION

- NEGLECT: LACK OF AWARENESS OF STIMULI ON THE OPPOSITE SIDE OF THE BRAIN DAMAGE (USUALLY DAMAGE ON RIGHT SIDE)

- EXTINCTION: FAILURE TO DETECT A STIMULUS ON THE SIDE OPPOSITE OF THE BRAIN DAMAGE WHEN A STIMULUS IS PRESENTED ON THE SAME SIDE OF THE BRAIN DAMAGE

## TWO TYPES

- SPACEBASE/EGOCENTRIC NEGLECT: NO AWARENESS OF STIMULI ON THE LEFT SIDE OF THE VISUAL FIELD

- OBJECT CENTERED/ALLOCENTRIC NEGLECT: LACK OF AWARENESS OF THE LEFT SIDE OF OBJECTS

## LIMITATIONS

- HARD TO PRODUCE THEORETICAL ACCOUNT APPLICABLE TO ALL PATIENTS. HUGE INDIVIDUAL DIFFERENCES IN SYMPTOMS AND DAMAGED REGIONS

- UNCLEAR RELATIONSHIP BETWEEN NEGLECT AND EXTINCTION

## VISUAL SEARCH FOCUSING ON RESEARCH

OF OBJECT DETECTING ASAP

### RELAY A LOT ON ATTENTION

#### FEATURE INTEGRATION THEORY (TREISMAN)

TWO STAGES

- 1. PRE-ATTENTIVE STAGE: PROCESS IN //, REACTION TIME DOES NOT DEPENDS ON THE NUMBER OF DISTRACTORS TARGET DIFFER FOR ONLY ONE CHARACTERISTIC

- 2. ATTENTIVE STAGE COMBINES: USE WHEN THE TARGET IS DEFINED BY A COMBINATION OF FEATURES. REQUIRES ATTENTION (IS SLOWER)

**LIMITATIONS:** TARGET DISTRACTION SIMILARITY ARE

- NOT CONSIDERED (MORE SIMILAR → HARDER)
- MUCH MORE VISUAL PROCESSING THAN IMPLIED
- VISUAL SEARCH IS NOT RANDOM. USE KNOWLEDGE TO SELECT AN AREA WHEN THE TARGET IS MORE LIKELY TO BE

#### THREADED COGNITION MODEL

- EACH TASK IS ASSOCIATED TO A STREAM OF THOUGHT
- MULTIPLE THREADS CAN BE ACTIVE AT THE SAME TIME (IF NO OVERLAP OF COGNITIVE RESOURCES). WHEN REQUIRE SAME RESOURCE ONE MUST WAIT ONE TASK AT THE TIME
- DIFFERENT RESOURCES CAN BE USED IN PARALLEL
- NO CENTRAL EXECUTIVE ALLOCATING PROCESSING RESOURCES

##### LIMITATIONS

- NO CENTRAL EXECUTIVE ⇒ HARD TO ACCOUNT FOR COORDINATION OF PROCESSING ACROSS TASK
- LESS SUCCESSFUL MODEL WHEN ACCOUNTING FOR PERFORMANCE ON COMPLEX TASK

#### DUAL PATH THEORY (WOLFE)

TWO PATHWAY

- **SELECTIVE PATHWAY:** LIMITED CAPACITY, ANALYSE 1 (OR A LITTLE MORE) ITEMS AT THE TIME
- **NON-SELECTIVE PATHWAY:** FOR THE LIST OF A SCENE. GENERAL AND VERY FAST INFORMATION CODING

↳ WORK TOGETHER

##### LIMITATIONS:

- UNCLEAR HOW WE USE THE LIST OF KNOWLEDGE TO REDUCE SEARCH AREA
- DEPENDS ON PARALLEL PROCESS (NOT CONSIDERED IN THE MODEL)

#### AUTOMATIC PROCESSING

- SOME PROCESS BECOME AUTOMATIC THROUGH PROLONGED PRACTICE

#### • TRADITIONAL APPROACH (SNIFFIN)

- PROCESS IS CONTROLLED OR AUTOMATIC (NO BETWEEN)

##### LIMITATIONS

- OVERSIMPLIFIED DISTINCTION BETWEEN AUTOMATIC AND CONTROLLED PROCESSED

#### • THEORETICAL APPROACH (MOORS)

- 4 FEATURES OF AUTOMATICITY

- 1) UNCONSCIOUS: DO THE TASK W/OUT THINKING

- 2) EFFICIENT: CAN DO IT WHILE DOING SOMETHING ELSE

- 3) FAST

- 4) GOAL-UNRELATED: UNINFLUENCE BY INDIVIDUAL CURRENT GOAL

- **LIMITATIONS:** 4 FEATURES DON'T HAPPEN TOGETHER

#### ATTENTION AND PERCEPTION

##### TEXTURE TILING MODEL (ROSENHOLTZ)

- VISUAL PERCEPTION WORKS IN //
- WHEN I AM LOOKING TO A SPECIFIC OBJECT I AM SELECTING AN AREA AROUND IT

##### LIMITATIONS:

- NOT SPECIFY HOW OBSERVER DECIDES NO TARGET IS PRESENT
- DE-EMPHASIZE THE ROLE OF ATTENTION

#### ON VIDEO ATTENTION

- HIGH MULTITASKER: MORE SUSCEPTIBLE TO DISTRACTION THAN LOW-MULTITASKER, PERFORM WORST ON TASK REQUIRING WORKING MEMORY
- LOW MULTITASKER: GOOD TOP-DOWN ATTENTIONAL CONTROL
- INTERFERENCE WHEN BOTH TASK HAVE SAME MODALITY

#### • CONTROLLED PROCESSING

- LIMITED CAPACITY
- REQUIRE ATTENTION
- IS FLEXIBLE
- ONE PROCESS AT THE TIME

#### • AUTOMATIC PROCESSING

- NO CAPACITY LIMITATIONS
- NOT REQUIRE ATTENTION
- NOT FLEXIBLE (HARD TO MODIFY ONCE LEARNED)
- MANY PROCESS AT THE TIME

↓  
INCREASING AUTOMATICITY ⇒ REDUCED ACTIVATION IN AREAS ASSOCIATED WITH CONSCIOUS AWARENESS

#### CROSS-MODAL EFFECT

- THE SYSTEM COMBINE INFORMATION COMING FROM SENSES OF THE SAME OBJECT
- WHEN YOU MOVE YOUR ATTENTION YOU MOVE IT FOR BOTH MODALITIES
- BENTIRLOQUISM EFFECT
- THE SYSTEM SELECT THE SENSE THAT GIVE MORE INFORMATION AND THAT WE CAN RELY MORE ON
- TIMING: LISTENING > VIEWING
- LOCALIZING: VIEWING > LISTENING

#### SERIAL VS PARALLEL PROCESSING

- **SERIAL:** SWITCHING ATTENTION BETWEEN 2 TASK AND PROCESS ONLY 1 TASK IN ANY GIVEN MOMENT
- BETTER IN SERIAL BUT ONLY IF WE DON'T SWITCH ACTUALLY EVERY POSSIBLE MOMENT

- **PARALLEL:** PROCESSING BOTH TASK AT THE SAME TIME (REAL MULTITASKING)

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**SPIDER MODEL (FISHER)** DRIVING AND PHONE

- LESS VISUAL SCANNING FOR POTENTIAL DANGERS
- IMPAIRED PREDICTION OF DANGERS
- INATTENTIONAL BLINDNESS

##### LIMITATION

- NO DISTINCTION BETWEEN TEXTING AND SPEAKING ON THE PHONE
- PERFORMANCE CAN ACTUALLY BE IMPROVED BY A SECONDARY TASK (HIGH-MUSIC TEMP)

# LEARNING MEMORY AND FORGETTING (6)

**ENCODING:** TRANSFORM INFORMATION IN A REPRESENTATION THAT CAN BE STORED

↓  
STORAGE

RETRIEVAL: RECOVERY INFORMATION FROM THE MEMORY SYSTEM  
↓  
IF IT FAILS

FORGETTING

- DIFFERENT TYPE OF MEMORY
- **LTM:** UNLIMITED CAPACITY AND CAN LAST FOR DECADES
  - **STM:** SMALL CAPACITY AND LAST FEW SECONDS

DOUBLE DISSOCIATION:  
ARE ≠

- MOST IMPORTANT COMPONENT, NO INFORMATION STORE
- DECIDES WHICH INFORMATION GOES WHERE AND THE SEQUENCE OF OPERATION
- USE IN NON-AUTOMATIC SITUATION
- DAMAGE FRONTAL LOBE → IMPAIRED FUNCTION ORGANIZATION

TEMPORAL STORAGE AND MANIPULATION OF VISUAL PATTERNS AND SPATIAL MOVEMENT

- **VISUAL CACHE:** STORE INFORMATION ABOUT VISUAL FORM AND COLOR (WHAT)

- **INNER SCRIBE:** PROCESS SPATIAL MOVEMENT INFORMATION (WHERE). TRANSFER INFORMATION FROM VISUAL CACHE TO CENTRAL EXECUTIVE

FUNCTION  
FAIRLY  
INDEPENDENT

- HIGHLIGHT**
- **CENTRAL EXECUTIVE:** RESEMBLE ATTENTION AND USE SLAVE SYSTEM. COORDINATES INFORMATION
  - **PHONOLOGICAL LOOP:** PROCESS SPEECH BASE INFORMATION. STORE BRIEFLY
  - **VISUAL-SPATIAL SKETCHPAD:** PROCESS VISUAL AND SPATIAL INFORMATION. STORE BRIEFLY
  - **(EPISODIC BUFFER):** ADDED LATER. PROVIDE TEMPORAL STORE FOR INFORMATION FROM PHONOLOGICAL LOOP AND VISUAL-SPATIAL SKETCHPAD

- 2 TASK W/ SAME COMPONENT ⇒ CAN NOT PERFORM SUCCESSFULLY TOGETHER
- 2 TASK W/ DIFFERENT COMPONENTS ⇒ CAN BE PERFORMED WELL TOGETHER OR SEPARATELY
- **LIMITATIONS:**
  - UNCLEAR HOW INFORMATION FROM PHONOLOGICAL LOOP AND VISUAL SPATIAL SKETCHPAD IS COMBINED
  - CONSIDER ONLY VISION AND HEARING

## MULTI-STORE MODEL

- **SENSORY STORE:** INFINITE CAPACITY, HOLDS INFORMATION VERY BRIEFLY. DIFFERENT STORE FOR EACH MODALITY

→ DIFFERENT MODALITIES  
THAT CODE ≠ INFORMATION

**ICONIC MEMORY (VISION):** MAINTAIN INFORMATION FOR FEW MS. NOT DEPENDS ON ATTENTION

- **SHORT TERM STORE:** WE TRANSFER ONLY SELECTED INFORMATION (VERY LIMITED CAPACITY)
- **LONG TERM STORE:** ONLY FOR INFORMATIONS THAT ARE REHEARS AND REPEATED. OBSERVER CENTRED

→ DIGIT SPAN TEST ↑

- WE CAN USE **CHUNKING** (DEPENDS ON INFORMATION IN LTM AND ABILITY TO IDENTIFY PATTERNS)

• HOW WE LOSE INFORMATION

1. **DISPLACEMENT:** CURRENT OBJECT REPLACED BY NEW ONE

2. **DECAY:** DECAY OVERTIME IN THE ABSENCE OF REHEARSAL

3. **INFERENCE:** COME FROM ITEMS OF PREVIOUS TRIALS

## INDIVIDUAL DIFFERENCES AND EXECUTIVE FUNCTIONS

- PERFORMANCE ON TASK DEPENDS ON INDIVIDUAL DIFFERENCES

- NO: UNITARY CENTRAL EXECUTIVE  
YES: SEVERAL MORE SPECIFIC CENTRAL EXECUTIVE

- **CRYSTALLIZED INTELLIGENCE:** DEPENDS ON KNOWLEDGE, SKILLS AND EXPERIENCE

- **FLUID INTELLIGENCE:** RAPID UNDERSTANDING OF NOVEL RELATIONSHIP

- **HIGH-CAPACITY INDIVIDUALS:** BETTER AT MAINTAINING TASK GOALS AND LESS DISRUPTED BY EXTERNAL DISTRACTION

- **LOW CAPACITY INDIVIDUAL:** POORER ATTENTION CONTROL AND ABILITY TO MAINTAIN GOAL

→ MADE OF 2 PARTS

- **PASSIVE STORE:** FOR SPEECH PERCEPTION
- **ARTICULATORY CONTROL PROCESS:** FOR SPEECH PRODUCTION
- PHONOLOGICAL SIMILAR WORDS → STM WORST THAN DISSIMILAR WORDS

→ WORD-LENGTH EFFECT: WORD SPAN GREATER FOR SHORT WORDS

→ VERY LIMITED CAPACITY, INTERMEDIARY BETWEEN PHONOLOGICAL LOOP AND VISUAL-SPATIAL SKETCHPAD

## UNITY/DIVERSITY FRAMEWORK: 3 EXECUTIVE FUNCTION

ACTIVATION  
IN ≠  
PREFRONTAL  
AREAS

- **INHIBITION FUNCTION:** OVERRIDE DOMINANT RESPONSE (FOR STROOP TASK) AND RESIST DISTRACTION
- **SHIFTING FUNCTION:** SWITCH FLEXIBLY BETWEEN TASK OR MENTAL SETS
- **UPDATING FUNCTION:** RAPID ADDITION OR DELETION OF WORKING MEMORY CONTENTS

## LEVEL OF PROCESSING DEEP PROCESSING > SHALLOW PROCESSING

ALSO DISTINCTNESS  
INFLUENCE LTM

- DEEPER IT IS BETTER YOU ARE IN REMEMBER
- PRODUCE MORE ELABORATE LONGER LASTING AND STRONGER RESULTS

## FORGETTING FROM LTM

- EBBINGHAUS STUDIED FORGETTING ON HIMSELF
- FORGETTING IS USEFUL, MAKES OUR LIFE EASIER
- FORGETTING USELESS AND PAINFUL THINGS
- FORGET DETAILS AND FOCUS ON THE GENERAL MEANING
- WE FORGET MORE EXPLICIT INFORMATION THAN IMPLICIT
- **DECAY:** TRACE LOSES STRENGTH IF IS NOT ACTIVATED, GRADUAL LOSS OF INFORMATION WHEN IS NOT RECODED, LOSE DETAIL
- **INFERENCE:** ABILITY TO REMEMBER DISTURBED BY WHAT WE HAVE LEARNED IN THE PAST (PROACTIVE INFERENCE) OR BY WHAT WE WILL LEARN IN THE FUTURE (RETROACTIVE INTERFERENCE)

- LEARNING NEW LANGUAGE AND FORGET WORDS OF THE FIRST ONE
- REMEMBERS' MEMORY SEARCH IS TOO BROAD AND INCLUDES MATERIAL PREVIOUSLY LEARNED
- LEARNING MATERIAL SIMILAR TO THE ORIGINAL ONE

- **DIRECT FORGETTING:** INVOLVE IMPAIRED LTM TRIGGERED BY INSTRUCTIONS TO FORGET INFORMATION PREVIOUSLY PRESENTED
- **CUE DEPENDENT FORGETTING:** FORGETTING DUE TO LACK OF APPROPRIATE RETRIEVAL CUES
- RECOGNITION MEMORY IS TYPICALLY MUCH BETTER THAN RECALL

## LEARNING THROUGH RETRIEVAL

- **RETRIEVAL:** TRY TO RECOVER INFORMATION THAT WE HAVE STORED
- EVERY TIME I EXTRACT THE MEMORY FROM THE STORE NEXT TIME WILL BE EASIER TO GET IT OUT
- SOME DIFFICULTIES ARE DESIRABLE
- **SPACE VS MASSED TRAINING:**
  - SPACE PERFORM MUCH BETTER
- **MIXED VS BLOCKED PRACTICE:**
  - STUDY THINGS NOT IN BLOCK (BUT MIXED) HELPS YOU PERFORM BETTER. LEARN MUCH BETTER
- PRACTICE HELPS.

## DUAL-MEMORY THEORY

- **RESTUDY:** REINFORCE MEMORY TRACE REUSE MEMORY TRACE CREATE FIRST TIME
- **TESTING:** CREATE ≠ MEMORY TRACE AND YOU CAN CHANGE IT IF YOU DON'T LIKE IT
- **LIMITATION**
  - NOT CLEAR HOW WE CREATE 2<sup>o</sup> MEMORY TRACE

- USEFUL WHEN CIRCUMSTANCES ARE CHANGING
- DUE TO PROBLEM IN RETRIEVAL PROCESS OR TO STRENGTH OF INCORRECT RESPONSE
- COMPETITION BETWEEN CORRECT AND INCORRECT RESPONSE

## BIFURCATION MODEL

- ITEMS RETRIEVED DURING TESTING PRACTICE ARE STRENGTHEN MORE THAN RESTUDIED ITEMS
- WHAT YOU DON'T TEST GET WORST
- TESTING CAN BE INEFFECTIVE IF THE STUDY MATERIAL IS NOT RETRIEVED AND THERE IS NO FEEDBACK

## IMPLICIT LEARNING

- (EXPLICIT = AWARE ABOUT INFORMATION)
- IMPLICIT LEARNING: NOT AWARE OF LEARNING A TASK
- IMPLICIT MEMORY: MEMORY NOT INVOLVING CONSCIOUS RECOLLECTION
- 5 DIFFERENCES BETWEEN IMPLICIT AND EXPLICIT LEARNING
  1. AGE INDEPENDENCE: IMPLICIT NO INFLUENCE ON AGE
  2. IQ INDEPENDENCE: IMPLICIT PERFORMANCE NOT CONNECTED W/ IQ
  3. ROBUSTNESS: IMPLICIT SYSTEM UNAFFECTED BY DISORDERS AFFECTING EXPLICIT SYSTEMS
  4. LOW VARIABILITY: SMALLER INDIVIDUAL DIFFERENCES IN IMPLICIT
  5. COMMONALITY OF PROCESSES: IMPLICIT SYSTEM COMMON TO MOST SPECIES
- SOMETIMES PEOPLE LEARN A SEQUENCE W/ OUT ACTUALLY UNDERSTAND IT
- PARTIAL INDEPENDENCE OF IMPLICIT AND EXPLICIT LEARNING
- COMPLEX MIXTURE OF IMPLICIT AND EXPLICIT LEARNING

## COGNITIVE NEUROSCIENCE

- IMPLICIT: STRIATUM (PART OF BASAL GANGLIA)
- EXPLICIT (AND MEMORY): MEDIAL TEMPORAL LOBES AND HIPPOCAMPUS
- **LIMITATIONS:**
  - NUMEROUS FORMS OF IMPLICIT LEARNING (CAN INVOLVE MORE # BRAIN NETWORKS)
  - LARGE INDIVIDUAL DIFFERENCES

## BRAIN DAMAGED PATIENTS

- AMNESIC: DAMAGE MEDIAL TEMPORAL LOBES. INTACT PERFORMANCE IMPLICIT-MEMORY, IMPAIRED ON EXPLICIT-MEMORY TEST
- PARKINSON: IMPAIRED IMPLICIT AND EXPLICIT LEARNING

## CONSOLIDATION AND RECONSOLIDATION

- **CONSOLIDATION:** PROCESS IN WHICH A TEMPORAL MEMORY IS TRANSFORMED IN A STABLE, LONG LASTING MEMORY
- CONSOLIDATION INVOLVES BIODIRECTIONAL INTERACTION BETWEEN THE HIPPOCAMPUS AND THE CORTEX
- RECENT MEMORIES MORE VULNERABLE THAN OLDER ONES
- LTM IMPAIRED IN INDIVIDUALS WHO DRANK BEFORE LEARNING
- ALCOHOL CONSUMPTION AFTER LEARNING LED TO IMPROVE MEMORY
- CONSOLIDATION INVOLVES PROGRESSIVE TRANSFORMATION OF MEMORY TRACES
- **RECONSOLIDATION** HELPS EXPLAIN HOW MEMORIES ARE UPDATED

## LIMITATIONS

- FORGETTING DOES NOT DEPENDS ON CONSOLIDATION ONLY

- LTM: STORE WHERE WE KEEP ALL THE INFORMATION WE HAVE LEARNED. NOT JUST A STORE. DIFFERENT TYPE OF INFORMATION STORE IN DIFFERENT BRAIN AREAS

- DECLARATIVE MEMORY: WHAT WE CAN ACTUALLY TELL ABOUT WHAT WE KNOW. CONSCIOUS REMEMBER OF EVENTS

- SEMANTIC MEMORY: ABOUT MEANING AND CONCEPTS NOT ASSOCIATED WITH TIME AND SPACE

- EPISODIC MEMORY: RELATED TO A SINGLE MOMENT, INFORMATION ABOUT SPECIFIC EVENTS. UNLINKED TO A SPECIFIC TIME AND PLACE. RECONNECTED TO CONSCIOUSNESS

- NON DECLARATIVE MEMORY: WHAT WE KNOW TO DO BUT NOT CONSCIOUS

ONE CAN BE PROBLEMATIC AND THE OTHER NO

DOUBLE DISSOCIATION, ARE DIFFERENT

### EPISODIC MEMORY

- WANT TO REMEMBER SPECIFIC INFORMATION (TIME AND SPACE)

- RECOLLECTION IS SUBJECTIVE

- EPISODIC MEMORY IS ERROR PRONE

- WANT TO ACCESS GIST OF PAST EXPERIENCE FAST AND OMITTING DETAILS

- OFTEN ADDING NON-EXISTING DETAILS

- USE IT TO REMEMBER PAST EVENTS AND IMAGINE WHAT WILL HAPPEN IN THE FUTURE

- IMAGINED FUTURE EVENTS LESS VIVID THAN RECALLED PAST EVENTS

### RECALL

- FREE RECALL: RECALL STUDIED ITEMS IN ANY ORDER

- SERIAL RECALL: RECALL STUDIED ITEMS IN THE ORIGINAL ORDER. MOST DIFFICULT

- CUED RECALL: PRODUCING PREVIOUSLY PRESENTED ITEMS TO RELEVANT CUES

- HIPPOCAMPUS IMPORTANT FOR RECALL

- BRAIN AREAS IN FREE RECALL SIMILAR TO FAMILIARITY AREAS

- OUR SYSTEM NOT MADE FOR REPRODUCING EXACTLY WHAT WE SEEN/HEARD

- NOT SAVE DETAILS BUT MEANING

### RECOGNITION

- FORCED CHOICE RECOGNITION: ASK TO CHOOSE BETWEEN 2 WORDS WHICH ONE YOU STUDIED

- YES-NO RECOGNITION: TELL IF YOU STUDIED OR NOT THAT WORD

- RECOGNITION INVOLVES

USE REMEMBER  
KNOW PROCEDURE  
TO DISTINGUISH

- FAMILIARITY: NOT SURE BUT MIGHT BE THAT THE WORD WAS THERE

- RECOLLECTION: REMEMBER THAT THE WORD WAS THERE, CLEAR REPRESENTATION OF IT

- DIFFERENT BRAIN AREAS ACTIVE IN RECOLLECTION

- PERIRHINAL CORTEX: INFORMATION ABOUT SPECIFIC ITEM

- PARAHIPPOCAMPAL CORTEX: INFORMATION ABOUT CONTEXT

- HIPPOCAMPUS: WHAT AND WHERE INFORMATION

- LIMITATIONS:

- "ITEM" REQUIRE MORE PRECISE DEFINITION

- MORE BRAIN MECHANISM INVOLVED IN RECOGNITION MEMORY

# LONG TERM MEMORY SYSTEM (7)

## INTERDEPENDENCE OF EPISODIC AND SEMANTIC MEMORY

- INTERMEDIATE BRAIN ACTIVITY WHEN YOU INVOLVE A COMBINATION OF EPISODIC AND SEMANTIC MEMORY

## SEMANTICIZATION OF EPISODIC MEMORY:

- WHAT IS EPISODIC CAN BE TRANSFORMED IN SEMANTIC OVER TIME

- AT BEGINNING EPISODIC  $\Rightarrow$  LOSE DETAILS SOONLY  $\Rightarrow$  BECOME SEMANTIC

- MUCH MORE FORGETTING OVER TIME WRT THE GIST

## SEMANTIC MEMORY

- INFORMATION STORED IN THE BRAIN NOT RANDOMLY BUT WITH CRITERIA

- USE IT EVERY TIME WE LEARN SOMETHING NEW

## HIERARCHIES (ORGANIZATION OF INFORMATION)

- SUPERORDINATE CATEGORIES: ON TOP (ITEM OF FURNITURE)

- BASIC LEVEL: MORE INTERESTING, KEEP MORE INFORMATION AND MAKE US ABLE TO DISCRIMINATE BETWEEN OBJECTS (CHAIR)

- SUBORDINATE CATEGORIES: AT THE BOTTOM (EASY CHAIR)

## IMITATION:

- TOO INFLEXIBLE

- EXAGERATE HOW INFORMATION IN SEMANTIC MEMORY IS ORGANIZED

## SEMANTIC DISTANCE (ORGANIZATION OF INFORMATION)

- IS AN EXPANSION OF HIERARCHICAL

- ORGANISED IN DISTANCE BETWEEN CONCEPTS

- ORGANISED FOR WHAT THEY HAVE IN COMMON

- SPREADING ACTIVATION THEORY: A CONCEPT IS A NODE, WHEN I ACTIVATE THE NODE I ACTIVATE ALSO THE CLOSE BY NODES (SPREADING OF ACTIVATION)

- LIMITATION: TOO RIGID

- BARSACAU: THE WAY I PROCESS AN OBJECT DEPENDS ON THE CONTEXT, IS FLEXIBLE AND INFLUENCED BY PERCEPTUAL AND MOTOR SYSTEM. ACTIVATE ≠ CHARACTERISTIC OF THE OBJECT DEPENDING ON THE TASK

- LIMITATIONS: LESS PERCEPTUAL PROCESS ON ABSTRACT THAN CONCRETE CONCEPTS

## HUB-AND-SPOKE MODEL (PATTERSON):

- EACH CONCEPT HAVE AN HUB AND SPOKES

- HUB: CENTRAL UNIT THAT STORE SPECIFIC INFORMATION, ONE FOR CONCEPT SIMILAR TO ENCYCLOPEDIC KNOWLEDGE, STABLE AND UNCHANGING

- SPOKES: DIFFERENT SPOKES CONNECTED TO THE HUB. RELATIVELY SPECIFIC INFORMATION, ACTIVATION DEPENDS ON THE INDIVIDUAL GOALS

- LIMITATION: WE NEED TO CONSIDER RELATIONS BETWEEN CONCEPTS

## SCHEMAS VS CONCEPTS

- SCHEMAS: COMPLEX STRUCTURES THAT WE SAVE NEEDED TO PERFORM DIFFERENT TASK AND TO INTERACT WITH FUTURE. PUT TOGETHER ≠ TYPE OF INFORMATION

- SCRIPT: SPECIFIC TYPE OF SCHEMAS. INFORMATION ABOUT SEQUENCES OF EVENTS. CREATE PROBLEMS SOMETIMES, ADD DETAILS THAT ARE NOT THERE SINCE MEMORY IS RESTRUCTURE

- DOUBLE DISSOCIATION BETWEEN SCHEMA AND CONCEPTS

## NON DECLARATIVE MEMORY

- ABILITY TO LEARN AND SAVE INFORMATION ON WHICH I AM NOT ABLE TO EXTRACT EXPLICITLY FROM MEMORY

## PRIMING & PROCEDURAL MEMORY

- PRIMING OCCURS RAPIDLY. PROCEDURAL MEMORY IS SLOW AND GRADUAL (LEARN NEW TASK)

- PRIMING FOR SPECIFIC STIMULI

- PERCEPTUAL PRIMING: REPEATED PRESENTATION OF STIMULI LEADS TO FACILITATED PROCESSING OF ITS PERCEPTUAL FEATURES

- CONCEPTUAL PRIMING: REPEATED PRESENTATION OF STIMULI LEADS TO FACILITATED PROCESSING OF ITS MEANING

- PRIMING INVOLVES DECLARATIVE AS WELL AS NON-DECLARATIVE MEMORY

## PROCEDURAL MEMORY (SKILL LEARNING)

- NEED TIME TO LEARN A SPECIFIC TASK

- LIMITATIONS: SEQUENTIAL MOTOR SKILL INVOLVES INITIALLY DECLARATIVE MEMORY AND THEN NON-DECLARATIVE

## BEYOND MEMORY SYSTEM AND DECLARATIVE VS NON-DECLARATIVE MEMORY

- HARD TO TEST A SPECIFIC MEMORY (DECLARATIVE, NON-DECLARATIVE) IN ISOLATION
- PROCESSING-BASED THEORETICAL ACCOUNT (HENKE)
  - REPLACE TRADITIONAL APPROACH
  - SEMANTIC KNOWLEDGE CAN BE LEARNED IN ≠ WAYS FOLLOWING 3 PROCESSING NODES
  - RAPID ENCODING OF FLEXIBLE ASSOCIATION: INVOLVE EPISODIC MEMORY, DEPENDS ON HIPPOCAMPUS. FOR WHEN I HAVE TO DO SOMETHING FAST
  - SLOW ENCODING OF RIGID ASSOCIATION: INVOLVE PROCEDURAL MEMORY, DEPENDS ON BASIC CEREBELLUM AND CEREBELLUM
  - RAPID ENCODING OF SINGLE OR UNITIZED ITEMS. INVOLVES PRIMING AND FAMILIARITY IN RECOGNITION MEMORY AND DEPENDS ON PARAHIPPOCAMPUS GYRUS
- EACH TYPE OF MEMORY INVOLVES SEVERAL BRAIN AREAS FORMING ONE OR MORE NETWORKS
- INTERACTION BETWEEN MEMORY SYSTEM (NOT INDEPENDENT)

## COMPONENT PROCESS MODEL

- SEVERAL NETWORKS CAN BE ACTIVATED DEPENDING ON WHAT WE ARE DOING
  - 3 DIMENSIONS OF 5 BRAIN AREAS
    - COGNITIVE PROCESS: PERCEPTUALLY OR CONCEPTUALLY DRIVEN
    - STIMULUS REPRESENTATION: ITEM OR RELATIONAL
    - LEVEL OF INTENTION: CONTROLLED VS AUTOMATIC
  - IDEA OF FLEXIBILITY IN THE COMBINATION OF PROCESS
  - MOST CONSISTENT APPROACH WITH NEUROIMAGING EVIDENCE
- LIMITATION: NOT A DETAILED MODEL. HARD TO MAKE PREDICTION

## HINTS AND INCUBATION

- FACILITATES INSIGHT
- INCUBATION. NOT THINK ABOUT THE PROBLEM FOR A WHILE. YOU ARE NOT AWARE BUT YOU KEEP THINKING ABOUT THE PROBLEM. STRONGER EFFECTS ON PROBLEM w/ MULTIPLE SOLUTIONS. PROBLEM SOLVING CAN BENEFIT FROM INCUBATION, FIND NEW APPROACH
- HINTS: FACILITATE THE SOLUTION

## FUNCTIONAL FIXEDNESS

- CONVINCED THAT SPECIFIC OBJECT ARE USED ONLY FOR SPECIFIC FUNCTION
- WE CAN OVERCOME IT

## COGNITIVE CONTROL

- COGNITIVE CONTROL: SUPPRESS IRRELEVANT DISTRACTION
- GREATER IN HIGH-WORKING MEMORY INDIVIDUAL
- ASSOCIATED WITH A NARROW FOCUS ON ATTENTION ON GOAL-RELEVANT INFORMATION AND SPECIFIC TASK STRATEGIES

## PAST EXPERIENCE: MENTAL SET

- PAST EXPERIENCE INFLUENCE OUR PROBLEM SOLVING
- CONVINCED FROM PREVIOUS EXPERIENCE TO USE A STRATEGY
- IMPOSES US A SOLUTION EVEN IF IT IS NOT OPTIMAL
- MENTAL SET IS INFLUENCED BY EXPERIENCE
- ABILITY TO BREAK MENTAL SET INVERSELY PROPORTIONAL OF INTELLIGENCE
- HIGH WORKING MEMORY CAPACITY TEND TO CONSIDER COMPLEX PROBLEM SOLUTIONS EVEN WHEN SIMPLE ONES ARE REQUIRED

## PROBLEM SOLVING AND STRATEGIES

- HILL CLIMBING: MORE GENERAL. CHANGING THE PRESENT PROBLEM STATE INTO ONE CLOSER TO THE GOAL. FOCUS ON SHORT-TERM GOALS, OFTEN DOES NOT LEAD TO PROBLEM SOLUTION. USED WHEN THERE IS NO CLEAR UNDERSTANDING OF THE PROBLEM STRUCTURE. OK IF YOU ARE GETTING CLOSER OR NOT
- MEANS-ENDS ANALYSIS: SUBDIVIDE THE PROBLEM IN SUBPROBLEMS. FORM SUBGOALS. VERY USEFUL BUT SOMETIMES DOES NOT WORK

## PROBLEM SOLVING AND EXPERTISE (12\*)

- PROBLEM SOLVING: DIFFERENT PROCESS TO SERVE AN INDIVIDUAL GOAL
- ANALOGICAL PROBLEM SOLVING: USE PAST EXPERIENCE AND KNOWLEDGE TO ASSIST US IN THE CURRENT TASK, DON'T NEED TO BE EXPERT
- EXPERTISE: PEOPLE WITH EXPERTISE HAVE SPECIALIST KNOWLEDGE IN ONE AREA OF DOMAIN
  - WELL DEFINED PROBLEM: I KNOW EXACTLY THE SITUATION I AM IN. ALL ASPECTS ARE CLEARLY SPECIFIED
  - ILL DEFINED PROBLEM: UNSPECIFIED. HARD TO UNDERSTAND IF I AM GOING IN THE RIGHT WAY. MORE COMMON IN DAILY LIFE

## GESTALT APPROACH AND BEYOND:

### INSIGHT AND ROLE EXPERIENCE

- NOT IMPORTANT TO DECOMPOSE THINGS IN THEIR PARTS
- WANT TO UNDERSTAND THE GLOBAL POINT OF VIEW
- REPRODUCTIVE THINKING: REUSE OF PREVIOUS EXPERIENCE THAT I CAN USE IN SIMILAR SITUATION
- PRODUCTIVE THINKING: RESTRUCTURE. MOSTLY ON ILL-DEFINED PROBLEMS

↓  
GESTALT: PRODUCTIVE THINKING PROBLEMS ARE SOLVED WITH INSIGHT. SUDDEN PROBLEM RESTRUCTURING. SUDDEN COMPREHENSION

UNIFICATION: NOT TRUE THAT INSIGHT PRODUCE ALWAYS CORRECT SOLUTION

## META REASONING

- CONTAINS ALL THE PROCESS THAT MONITOR OUR PROCESS DURING PROBLEM SOLVING AND REASONING

## PLANNING

- MOST PEOPLE DO SOME KIND OF PLANNING (IN PRE-FRONTAL CORTEX)
- USUALLY PLAN A LITTLE BIT (NOT THE ENTIRE SEQUENCE)
- CAN BE FORCED TO DO COMPLETE PLANNING

## COGNITIVE MISERNESS

- PEOPLE ARE COGNITIVE MISER: PEOPLE THAT ARE ECONOMICAL WITH TIME AND EFFORT ON TASK REQUIRING THINKING
- SOMETIMES INTUITION IS WRONG BUT WE DON'T TEST IT
- LIMITED PROCESSING CAPACITY FORCE US TO BE HEURISTIC BUT COGNITIVE MISER ARE RELUCTANT TO ENGAGE IN EFFORTFUL PROCESSING
- COGNITIVE REFLECTION TEST

## PROBLEM SOLVING

- GOAL-DIRECTED
  - INVOLVE CONTROLLED PROCESS (NOT TOTALLY AUTOMATIC)
  - A PROBLEM EXIST WHEN SOMEONE LACKS OF RELEVANT KNOWLEDGE TO PRODUCE AN IMMEDIATE SOLUTION
- DIFFERENT TYPE OF PROBLEM

- KNOWLEDGE RICH PROBLEM: CAN BE SOLVED ONLY BY THOSE HAVING RELEVANT SPECIFIC KNOWLEDGE

- KNOWLEDGE LEAN-PROBLEM: INFORMATION TO SOLVE IT IN THE INITIAL STATEMENT

## REPRESENTATIONAL CHANGE THEORY:

- FORM MENTAL REPRESENTATION → ACCESS VARIOUS MENTAL OPERATORS
- RESTRUCTURE: CHANGE THE PROBLEM REPRESENTATION ← BLOCK (IMPASSE) DUE TO WRONG REPRESENTATION  
TO  
• CONSTRAINT RELAXATION: OPEN YOUR MIND FOR MORE OPTIONS
- RE-ENCODING: THINK OF THE PROBLEM IN A COMPLETELY DIFFERENT WAY
- ELABORATION: ADD NEW PROBLEM INFORMATION

- LIMITATIONS:
  - NOT EXPLAIN INDIVIDUAL DIFFERENCES
  - NOT MUCH EVIDENCE OF RESTRUCTURE

## ANALOGICAL PROBLEM SOLVING AND REASONING

- ANALOGY: COMPARISON BETWEEN 2 OBJECTS
- HELP UNDERSTAND NEW SITUATION
- GOOD IN ANALOGY  $\rightarrow$  GOOD IN FLUID INTELLIGENCE
- RAVEN'S PROGRESSIVE MATRICES: GEOMETRICAL ANALOGIES AND ANALOGICAL REASONING
- 3 TYPE OF ANALOGIES:
  - SUPERFICIAL SIMILARITY: DON'T HELP SOLVING THE PROBLEM SAME ELEMENT IN 2 DIFFERENT PROBLEMS
  - STRUCTURAL SIMILARITY: SAME RELATIONSHIP ABOUT COMPONENTS
  - PROCEDURAL SIMILARITY: SIMILAR WAY TO FIND THE SOLUTION OF A PROBLEM
- NOT GOOD IN RETRIEVE  $\Rightarrow$  CAN'T APPLY SIMILARITY

## ENHANCING ANALOGICAL PROBLEM SOLVING

- USE A LOT OF ANALOGIES
- IMPORTANT TO TRANSFER WHAT WE KNOW TO OTHERS
- MOST INDIVIDUALS RARELY PRODUCE ANALOGIES SPONTANEOUSLY BUT CAN EASILY DO IT

## SEQUENTIAL PROCESSING STAGES

- STEPS FOR ANALOGICAL REASONING
- 4 COMPONENT PROCESS
  - ENCODING: PROCESSING INFORMATION ABOUT PROCESSING STIMULI
  - INFERRING: IDENTIFY A RELATION BETWEEN 2 ITEMS
  - MAPPING: IDENTIFY OVERALL RELATIONAL PATTERN
  - APPLYING: USING OUTCOME OF MAPPING TO SEE IF THE SOLUTION IS CORRECT
- 2 STRATEGIES FOR SOLVING 4 TERM ANALOGY
  - PROJECT-FIRST MODEL: RULE A-B, A-C THEN RULE GENERATING D
  - ALIGNMENT-MAPPING MODEL: RULE A-C, ALIGN B WITH D

## WORKING MEMORY

- COMPARE 2 OBJECTS DONE IN WM
- IMPAIRED PROBLEM SOLVING IF A SECONDARY TASK INVOLVING THE CENTRAL EXECUTIVE IS PERFORMED AT THE SAME TIME

## INDIVIDUAL DIFFERENCES

- MOST COGNITIVE TASK REQUIRE TOP-DOWN, GOAL FOCUSED EXECUTIVE ATTENTION
- FLUID INTELLIGENCE AND WM CAPACITY BOTH INVOLVE EXECUTIVE ATTENTION

## EXPERTISE

- EXPERTISE LINKED w/ EXPERIENCE
- TEST EXPERTISE: USE KNOWLEDGE RICH PROBLEMS THAT REQUIRE MUCH KNOWLEDGE



## MEDICAL EXPERTISE

- USE TWO METHODS
  - EYE-TRACKING: USEFUL INFORMATION ABOUT VISUAL ATTENTION AND SUBCONSCIOUS PROCESS
  - THINK-LOUD
- WHY ABNORMALITIES ARE NOT NOTICE
  - DETECTING ERRORS: NEVER LOOK AT THAT POSITION
  - RECOGNITION ERRORS: LOOK THERE BUT NOT DETECT DIFFERENCE
  - JUDGEMENTAL ERRORS: HAVE DOUBT BUT DON'T CLASSIFY AS TUMOR
- EXPLICIT REASONING: SLOW, DELIBERATE, ASSOCIATED WITH CONSCIOUS AWARENESS
- IMPLICIT REASONING: FAST, AUTOMATIC NOT ASSOCIATED WITH CONSCIOUS AWARENESS

## CHESS-PLAYING EXPERTISE

- STRICT RANKING SYSTEM
- IMPROVE COGNITIVE SKILL
- BRIEF CHESSBOARD PRESENTATION: MASTER VERY ACCURATE AT REPOSITIONING PIECES (IF PIECES AT RANDOM EXPERTISE = NON EXPERT)

## TEMPLATE THEORY

- STORE INFORMATION IN TEMPLATES (ABSTRACT SCHEMATIC STRUCTURE), BUILD OF SMALL MEMORY STRUCTURES (CHUNKS)
- # TEMPLATE EXPERTS = # TEMPLATE NON-EXPERT  $\approx$  2
- MASTER TEMPLATE SIZE  $\gg$
- PERFORMANCE IN OGIZ GAMES DEPENDS ON TEMPLATE BASED KNOWLEDGE

## LIMITATIONS

- NOT ALWAYS THE FIRST MOVE THAT CAME IN MIND IS THE CORRECT ONE
- NOT CLEAR HOW WE USE TEMPLATE-BASED SOLUTION ON NON-FAMILIAR POSITIONS

## MEDICAL EXPERTS VS CHESS EXPERTS

- NEEDED SEVERAL YEARS OF INTENSIVE TRAINING
- CHESS EXPERTS: KNOWLEDGE COMPOSED BY ABSTRACT TEMPLATES
- MEDICAL EXPERTS: LESS ABSTRACT AND MORE VISUAL KNOWLEDGE

## BRAIN PLASTICITY

- PLASTICITY CHANGE IN STRUCTURE AND FUNCTION OF THE BRAIN
- CROSS MODEL: IF BECOME BLIND WHEN YOUNG OCCIPITAL AREA (FOR ANALYSIS OF VISUAL INFORMATION) IS USED FOR NAVIGATION
- EXPERIENCE CHANGE BRAIN STRUCTURE
- TAXI DRIVERS w/ "THE KNOWLEDGE": GREATER VOLUME OF POSTERIOR HIPPOCAMPUS BUT SMALLER OF ANTERIOR HIPPOCAMPUS

## DELIBERATE PRACTICE AND BEYOND

- PRACTICE ESSENTIAL TO BECOME EXPERTS
- ERICKSON AND CHASE
  - TASK DIFFICULTY (NOT TOO HARD AND NOT TOO EASY)
  - NEED TO HAVE PERFORMANCE FEEDBACK
  - ADEQUATE CHANCES TO REPEAT THE TASK
  - OPPORTUNITY TO CORRECT ERRORS
- PRACTICE IS NECESSARY BUT NOT SUFFICIENT

## LIMITATIONS

- HARD TO TEST (VAGUE DEFINITIONS)
- EMPHASIZE LT WM BUT MAYBE NEW FORM OF WM

## EXPERTS VS NOVICES

- EXPERT: DETECT-THEN-SEARCH PROCESS LOOK STRAIGHT AWAY WHERE THE STIMULUS IS
- NOVICES: SEARCH-THEN-DETECT PROCESS. EXTENSIVE VISUAL SEARCH INCLUDING IRRELEVANT INFORMATION AND THEN DETECT RELEVANT THINGS
- NON EXPERT: PERFORM BETTER w/ VERBAL DESCRIPTION + PHOTO.
- EXPERTS: BETTER w/OUT VERBAL DESCRIPTION
- MAKE SOME USE OF SLOW EXPLICIT OR ANALYTIC PROCESS

## Beyond Deliberate Practice

### MULTIFUNCTIONAL GENE-ENVIRONMENT INTERACTION

- EXPERTISE IS MULTIPLY DETERMINED
- THERE ARE INDIVIDUAL DIFFERENCES (INNATE TALENT, IQ DIFFERENCES, GENES AND ENVIRONMENT)