Cognition and emotion: Global overview

Lesson 1: What is cognition?

3 levels of analysis

- Functional level: Moderators, can be observed
- Algorithmic level: Mediators/mechanisms, hypothetical
- Implementational level: Brain level

Emotion = "automatic, embodied, poorly encapsulated" => But many exceptions

Definition and taxonomies

Automaticity (feature based => you can have MIXES) => CONTINUÜM

Algorithmic level: features of mechanisms

- Automatic processes vs non-automatic processes
    - **UNCONTROLLED (UNINTENTIONAL) VS CONTROLLED (INTENTIONAL)**
        - (1) GOAL (2) CAUSES the desired (3) EFFECT
            - If at least one of these 3 is missing => uncontrolled
        - 2 controlled **subtypes**
            - **Promoting type** (intentional): goal to engage in a process
                => process occurs (goal is achieved)
            - **Counteracting type:** goal to stop/alter/avoid the process
                => process is stopped/altered/avoided (goal is achieved)
    - **UNAWARE VS AWARE**
        - (un)aware of the… (!!Functional level, can't be aware of mechanisms)
            - (1) Stimulus-input
            - (2) Output
            - (3) Process itself
                - Unaware when you're unaware of at least 1
    - **EFFICIENT VS NON-EFFICIENT**
        - Efficient: Consumes little or no attentional capacity
            - Attention => (1) quantity and (2) direction
                - Directed at (1) input, (2) output or (3) process
    - **FAST VS SLOW**
        - Depends on **process** duration, NOT duration of S presentation!

Functional level: Under which conditions can a certain process take place?

- Automatic processes: Suboptimal conditions
- Non-automatic processes: Optimal conditions

Rule based vs associative (algorithmic level)

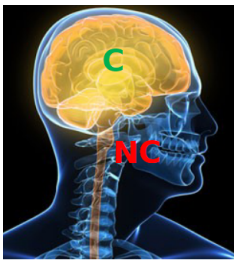
- Rule based: Inferential, premises + conclusion
- Associative: Simple, spreading of activation

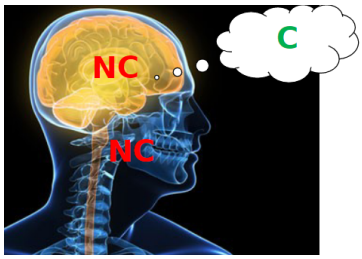
Aboutness and qualia

- Aboutness: Intentional content, cognition is always about something
- Qualia: Phenomenal aspect, consciousness, subjective experience/quality
    - 'not all knowledge is physical knowledge'

Cognition vs non-cognition: Different views

- Topological account vs mentalist account (C = mental representation)





Lesson 2: Emotion causation (what is emotion?)

What is an emotion?

- **(1) SHORT DURATION, INTENSE, CLEAR TARGET,**
- **(2) EVOKED BY A STIMULUS,**
    - Internal or external stimulus
- **(3) EXISTS OF MULTIPLE COMPONENTS**
    - Cognitive component: Goal relevance, (in)congruence
        - Function: Stimulus evaluation, appraisal
    - Motivational component: Action tendencies (=/= action!)
        - Function: Preparation and support of action
    - Somatic component: Physiological responses
        - Function: Support of all other components
    - Motor component: Behaviour
        - Function: Action execution
    - Subjective component: Experience/feelings (qualia)
- **ADDITIONAL COMPONENTS (DEPENDS ON MODEL/AUTHOR)**
    - (4) Importance, (5) Control precedence ('urgence'), (6) Synchronicity (of the components), (7) Affect program (emotion specific?), ~~(8) spontaneous/irrational,~~ (9) valence (but surprise?), (10) Subjective criteria? (constructivists: Emotions are too broad, can't be grasped in one model)

Emotion causation: Theories (main focus: Functional level)

- 3 steps for emotion:
  - (1) Elicitation: S => Emotion vs no emotion (why this S?)
  - (2) Differentiation: S => Emotion 1 vs emotion 2
  - (3) Intensity: S => Weak vs strong emotion

Theory of James

S => PHYSIOLOGICAL RESPONSES AND EXPRESSIVE BEHAVIOUR (SERVES AS FEEDBACK) => EMOTION

- ~~Elicitation~~
- Differentiation: f(Unique pattern of physiological response/expressive behaviour)
- Intensity: f(Intensity of phys. response/expressive behaviour)

Evidence/debate

- Consensus that there are **no specific physiological response patterns** for every emotion, but still a **debate whether there are specific facial expressions** for each emotion
- Separation peripheral/central => Reduced emotional experience?
  - Mixed results, we have to show that pp w/o peripheral feedback have no emotions

⇨ **Facial feedback hypothesis**, but unsuccessful replication and indirect measure of happiness

Theory of Schachter: C before E

S => PHYSIOLOGICAL RESPONSES (UN-SPECIFIC AROUSAL, SETS INTENSITY) => ATTRIBUTION (C) => EMOTION

- ~~Elicitation~~
- Differentiation: f(CONSCIOUS (+ non-automatic) cognitive attribution (cognition))
- Intensity: f(Intensity of unspecific phys. response (arousal))

- Criticism: Does cognition precede emotion? (Zajonc: 'affect can precede cognition, not full blown emotion')
  - Mere exposure effect (is about valence though…): Emotion in the absence of cognition
    - BUT criticism diminishes if we assume that cognition can be automatic!

Evidence

- Bridge experiment
- Epinephrine experiment
  - Criticism: 'Idealised' results pattern, failed replication, influence of cognition on emotion has its limits

Appraisal theories (Arnold, Scherer, Frijda,…): C before E

S => APPRAISAL => FIXATES ACTION TENDENCIES => PHYS. RESPONSES => EXPR. BEHAVIOUR => EMOTION

⇨ **EXPERIENCE/FEELINGS (QUALIA) = REFLECTION OF ALL COMPONENTS IN CONSCIOUSNESS**

Elicitation, differentiation, intensity: f(Appraisal)

Appraisal process at the functional level (S input and output)

- Appraisal is an assessment of…

  - Goal relevance: ELICITATION
  - Goal congruence: DIFFERENTIATION (Valence)
  - Expectancy: INTENSITY
  - Control: DIFFERENTIATION (Anger vs fear)
  - Agency: Source of (in)congruence, internal (self-agency) vs external
    - If external, important whether mismatch is intentional or not!
- Lots of other taxonomies of different emotions

Appraisal process at the algorithmic level

- Rule based: Assign value to appraisal-components => Combine into pattern, **infer** reaction
  - Flexible, but not automatic
- Associative/learned
  - Less flexible, but automatic

Network theories (Bower, Leventhal, Lang)

ASSOCIATIVE NETWORK OF REPRESENTATIONS, NO FIXED ORDER BETWEEN COMPONENTS => EMOTION

⇨ **DIFFERENT WAYS TO START EMOTIONAL EPISODE, NOT ALWAYS EVOKED BY S, AWARE OR UNAWARE**

Affect program theories/Basic emotion theories (Ekman)

PERCEPTUAL FEATURES (S) ACTIVATE AN EMOTION-SPECIFIC PROGRAM (NEURAL CIRCUIT) THAT FIXATES THE ACTION TENDENCY

Basic emotions (Ekman,…) vs Non-basic emotions

- Basic emotions: No consensus about set of basic emotions and basis for inclusion
- Non-basic emotions: Combo's or extensions of basic emotions

Lesson 3: Big emotions: Fear

Fear on the functional level

PROCEDURE => EFFECT

Environment causes change in behaviour

vs on the algorithmic level

PROCESS/MEDIATING MECHANISM

Problem of underdetermination

Association formation models (e.g. Rescorla-Wagner): Cognition => Emotion

ASSOCIATION (COGNITIVE, STORED IN MEMORY) AS MEDIATING MECHANISM

Assumptions (shaky)

- Hidden assumption: **Monotonicity:**
  - Monotonic relationship between associative strength (determined by activation of memory representations) and response strength
  - Criticism: Other determinants and form of responding not considered

Non-trivial

- **Abstraction assumption** (<-> episodic memory)
  - You abstract over multiple episodes, more episodes => stronger association & R
- **Reproduction assumption**
  - Stored in memory (cognition) as 'ready to use'-units, comes out when relevant

Fear conditioning

One association stored in memory has to be tackled to remediate fear=> Different theories

1: Inhibitory learning theory: Install inhibitory association

- Functional level: Extinction procedure + effect (fear + CR ↓)
- Algorithmic level: Excitatory and inhibitory association cancel eachother out

⇨ US representation does not get activated => absence of fear (monotonocity assumption)

- Exposure therapy

⇨ **Non-permanent amnesia:** Not or barely thinking about the US (inactive representation)

- Criticism: People still remember the US/being scared

2: Reconsolidation interference: Remove association

- Functional level: Elicit fear => Propanolol/…. => Test one week later: Fear is gone!
- Algorithmic level: Fear memory reactivation => Active state => Reconsolidation
  - Propanolol interferes with reconsolidation => Memory vanishes
  - Criticism:
    - Replication issues
    - We don't know what happens in the brain (underdetermination)
    - **Skin conductance and US-expectancy stay intact**
      - Problem for monotonicity assumption: Association should be gone but people still think about US?

⇨ Solution: Multiple memory systems: Not about memory erasure but about **emotional memory erasure** (demarcation criteria?)

Towards a propositional model

- Criticism on associative models:
  - Fear is not only about an association:
    - There are different **types of relations** between CS and US
      - Predict, cause, prevent,…
      - Explains that fear presupposes an **expectancy**

⇨ Dual system-approach? (lower-level associations vs higher-level propositions)

⇨ **SINGLE-PROCESS PROPOSITIONAL THEORIES:** Info is encoded propositionally right away

BUT still no explanation for different **forms of responding**: Fear presupposes next to expectancy also a **goal** => motivational model

Towards a motivational model

UTILITY ASSESSMENT: U = E (EXPECTANCY) * V (VALUE) => PEOPLE COMPARE ACTION OPTIONS~GOAL

⇨ Fear as the subjective component of an action (tendency) to secure the "safety goal"

⇨ Other goals => Goal conflicts

⇨ **Treatment**: Play around with E and V (exposure as goal directed task)

Limitation: Doesn't account for HOW people learn about contingencies

Lesson 4: Big emotions: Love

Learning and emotion theories to better understand complicated grief

= INTENSE CRAVING OR LONGING FOR THE DECEASED, AS WELL AS BEING CONSTANTLY REMINDED OF THE DECEASED (> 6 OR 12 MONTHS)

Effects of non-contingent stimulus presentations (Solomon): Grief

Habituation

- A - B-process
    - First contacts with loved one: Strong excitement, little withdrawal
    - After long contact: Little excitement, strong withdrawal = **grief**
- Criticism: Leaves many aspects of grief unexplained

Effects of contingent stimulus presentations: Longing, visiting specific places

Appetitive conditioning

- During life together, many **cues co-occur** with presence of the loved one (appetitive S) => **Cues can trigger longing** (LONGING as cardinal "emotion"/"symptom" of complicated grief)
    - Internal or external cues
    - Positive valence
    - **U = E * V** => Action tendency to reunite and searching behavior (goal = reunion)
        - Why still high? 2 explanations:
            - (1) If value is high, as long as expectancy =/= 0, there's still utility
            - (2) Expectancy depends on context: Some contexts are "not updated" yet

Extinction: Why does longing persist?

- Losing a loved one forces you in an extinction situation => Expected effect: CR ↓
    - BUT longing extinguishes slowly
- ~ Appetitive conditioning theory of grief:
    - Longing can even temporarily **INCREASE** (triggers **craving,** similar to addiction)
    - **Frustration** due to non-delivery of appetitive outcome
- ~ Appraisal model
    - **Frustration** due to obstruction of goal attainment

Generalization: Why is longing experienced frequently?

A CHANGE OF BEHAVIOUR (1) DUE TO A REGULARITY IN THE OCCURRENCE OF (TWO) S THAT (2) THE TEST S DID NOT FEATURE IN

⇨ NOT ONLY CO-OCCURRING, BUT ALSO RELATED CUES CAN BE TRIGGERS

- Related cue: Perceptual or conceptual overlap
- 2 phenomena:
    - (1) More generalization in case of outcome deprivation (absence of loved one triggers generalization)

- (2) Poor generalization of extinction

⇨ Helps to explain why grieving is harder after long-lasting relationship

Evaluative conditioning (subtype of classical conditioning): Cherishing behaviour

- Expl. 1: Co-occurrence with loved one => Cherish pillow
  - Fairly resistant to extinction training
- Expl. 2: **Sign-tracking:**
  - Tendency to behaviourally engage with cue that has been paired with desired outcome

Effects of regularities in the presence of stimuli and behaviour: Revisiting places

NEXT TO CUES, ONE'S OWN BEHAVIOUR CAN ALSO CO-OCCUR WITH THE PRESENCE OF A LOVED ONE

⇨ **INSTRUMENTAL BEHAVIOUR**

Instrumental conditioning

CHANGE OF BEHAVIOUR DUE TO A REGULARITY BETWEEN THE PRESENCE OF A BEHAVIOUR AND OF A S

- What was first goal-driven/instrumental behaviour could now be **habitual behaviour:**
  - No longer driven by the outcome that originally installed it
    - = non-goal directed, S-R?
  - NOT NECESSARILY: **A new goal** might be involved!!!

Avoidance?

- **Cues that had contingency** might change affect (positive to negative) after decease (change in contingency)

⇨ Cause AVOIDANCE

- **Cues that had contiguity (relation) w/o contingency,** mere referential relation to loved one

⇨ Cause APPROACH

Pavlovian-instrumental transfer

Classical conditioning: Cue-Outcome Instrumental conditioning: Response-Outcome	Cue:Response↑

Classical conditioning increases probability that instrumental behaviour is present

Heuristic and predictive value of invoking these learning principles?

- Explain variety of topographically different behaviours with only 2 requirements:
  - (1) Loved one
  - (2) Shared life together
- !! Importance of learning history

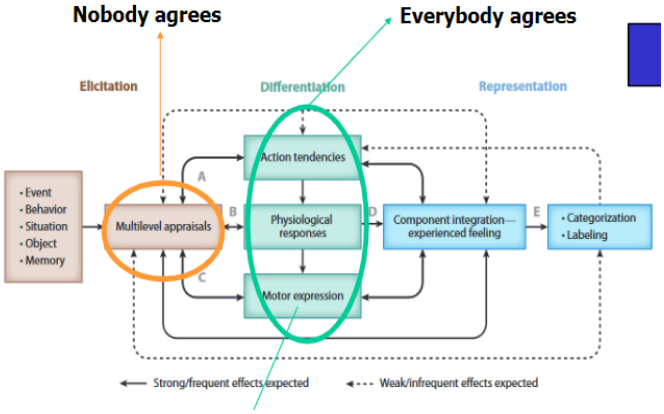
⇨ Insights can help in bettering clinical treatments

Lesson 5: Emotional processing

Introduction

- Emotion = caused by **evaluations** of events or people in relation to concerns/goals, the link between S-R
    - Based on external/internal S features, made in relation with goal, or norms/concerns

⇨ Goal adaptive behaviour



Not much agreement on specifics of appraisal

Three theories for elicitation and differentiation (motor expression of face):

- Basic emotion theories: Ekman, behaviourism
- Constructivist emotion theories: Russell, constructivism
- Appraisal theories of emotion: Scherer, cognitivism

Emotion theories

Basic emotion theory: Ekman

S => APPRAISAL (UNSPECIFIC) => AFFECT PROGRAM (SPECIFIC!) => ACTION TENDENCIES, PHYS. RESPONSES, SUBJ. FEELINGS, EXPRESSIVE BEHAVIOUR (ALL SPECIFIC)

- **Affect program** links S and R (6 layers/affect programs, one for each basic emotion)
    - Innate (debated), quick, universal, specific neural networks in brain, shared with animals, automatic (debated) and **modular**
    - Appraisal sets off chain of specific action tendencies, phys. responses, subj. feelings and expressive behaviour for a specific basic emotion
        - => You can discriminate emo from non-emo and between emotions
            - No overlap
- **Categorial perception**

Facial Action coding System (FACS)

- 44 action units, combo/sum of AU at the same time = emotion
    - **=> 6 basic emotions:** Happy, sad, fearful, angry, disgust, surprise
        - Universal: Shared across cultures, but small differences
            - Asia: Confuse fear and disgust (they are shown differently there)
    - Code and measure AU (and suppressed emotion) with Facial EMG
- **Unique combo of muscles for each action unit:**
    - Frontalis: Surprise
    - Corrugator supercilli: Negative emotions
    - Orbicularis oculi: Duchenne smile
    - Zygomaticus (minor and major): Positive emotions
        - Upper and lower part face: Controlled by different parts of motor cortex,

        - which is influenced by the **amygdala** (gets info of visceral (bodily) reactions)
- We don't use the whole face to identify emotion: **Bubble technique**
- Emotions have a **function:**
    - Fear increases sensory processing (visual field, airflow in nose), disgust lowers it

Strengths	Weaknesses
Theory linked with specific method (FACS)	Developed mostly with/for (static) facial expression
Clear hypotheses formulated	Problems with complex emotions, or blend
Enhanced validity	Based on artificial facial expressions
Cross-cultural and cross-species approach	Innate an automaticity criteria are debated

Constructivist emotion theory: Russel, emotion as psychological construct

S => CORE AFFECT AND CATEGORISATION => SPECIFIC FEELINGS/EMOTION

- **Dimension theory:** CORE AFFECT (universal) drives evaluation of S:
    - Circumplex model with 2 axes: Valence and Arousal
        - No clear cut categorization (<-> Ekman)
        - **Interindividual differences!** You construct core affect: Different for everyone
- Core affect connects to **action tendencies**
- Theory is also validated using words

- Criticism: 3rd axe "dominance vs submissive" needed to differentiate between fear & anger?

Self-assessment Manikin (SAM)

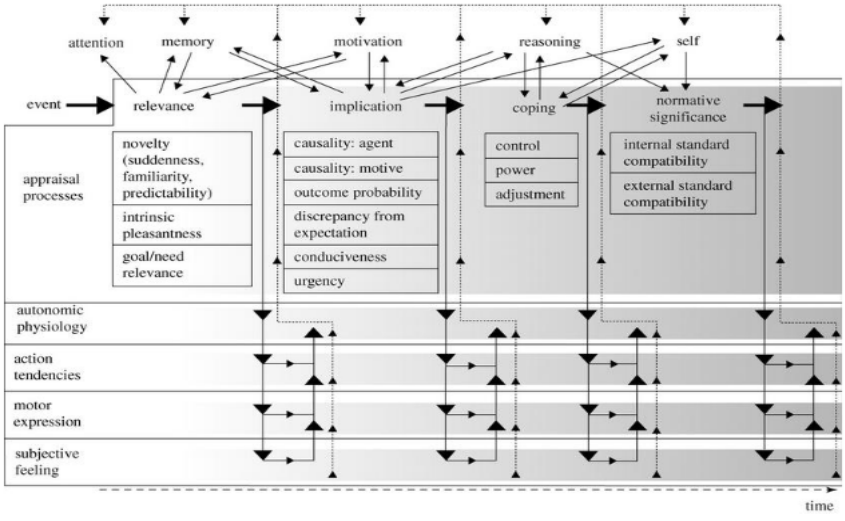
- Measures core affect (3 axes) => Plot on circumplex model (arousal and valence)

Strengths	Weaknesses
Simple theory plus method (SAM)	Definition of 'arousal' is often unspecified
Clear hypotheses formulated	Orthogonality of two main dimensions
Well-supported	More dimensions and order of dimensions
Works equally well for non-verbal as verbal information	
Inter-individual + inter-cultural differences considered	

Appraisal theory: Scherer, multi level and multi sequence

S => APPRAISAL => R

- Appraisal/analysis of S happens following a specific **sequence**



- Sequence is also visible in the face (measure AU at specific time points)

Strengths	Weaknesses
Appraisal dissected	Sequence makes it hard to test it (in lab conditions)
Can explain dynamic/changing effects	Fixed sequence (novelty precedes valence and goal)
Sequence → time-course	Not very well supported by the existing data (focus on theory rather than data)
Subject-specific and situation specific effects	
Link to motivation/goals	
Complex emotions	

Lesson 6 and 7: Emotion and attention (= a process)

Introduction

Biased – competition

Psychological Refractory Period (PRP)

= THE PERIOD OF TIME DURING WHICH THE RESPONSE TO A SECOND STIMULUS IS SIGNIFICANTLY SLOWED BECAUSE A FIRST STIMULUS IS STILL BEING PROCESSED (WHY? => BOTTLENECK (LIMITED CAPACITY))

⇨ **DEPENDS ON STIMULUS ONSET ASYNCHRONY**

Competition - selection - bottleneck

- Attention **selects** relevant information at the cost of inhibiting irrelevant information, using the mechanism **gain-control** => Competition!
  - Rich input => Filter (attention, biases competition) => Simple output
- **Where is the filter operating?**
  - Early: Broadbent
  - Late: Treisman

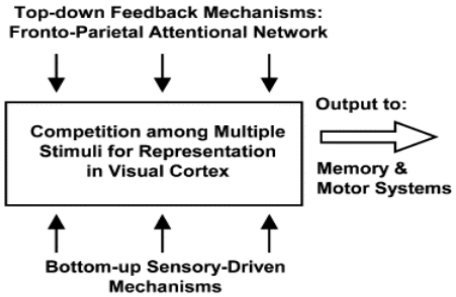
⇨ Both, filter is DYNAMIC

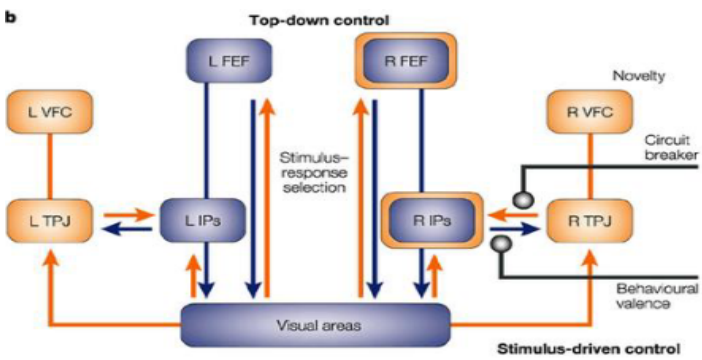
Biased competition model

- 2 consequences of filter:
  - (1) Enhancement of attended S (GAIN)
  - (2) Suppression of unattended S (COST)
- **Neurophysiological level**: Less activity in brain because competition, very early after stimulus onset (100ms), goal-directed

Dual-system (dissociation): Stimulus driven (B-U) vs goal directed (T-D)

- Competition/filter biased by emotion: Emo is hard to suppress
- B-U (orange, ventral) and T-D (blue, dorsal) are driven by separate mechanisms





- Overlap => Both circuits influence each other and have to be damaged to have neglect, mostly Rhem (circuit breaker is there)

Applications/Paradigms: Where does emotion bias competition?

Hard to say whether emotion is B-U or T-D

Emotional (counting) Stroop: Cognitive control (rather than attention) and conflict

SLOWER RT WHEN DISTRACTING WORD(S) IS EMOTIONAL

- Emotional word creates conflict/influences CC: You have to inhibit emotion and activate relevant info
- WHY?
    - Emotional S => Arousal ↑ (NOT Valence or appraisal!)

Visual search

= SPATIAL ATTENTION (BUT ALSO POSSIBLE IN TIME), SHIFT ATTENTION (OVERT OR COVERT) IN SPACE

2 emotional effects found: Search (Top-down) and capture (Bottom-up)

Search (T-D, goal-related): During selection/identification?

- Different stages: Preparation => Guidance => Selection => Identification
    - **When does emotion play a role?** => Late stage: Selection/identification

- Parallel, pre-attentive search: single feature easy to search even when many objects, automatic and fast, no competition (exception!)
    - Features that drive attention
        - **B-U features**: low level features: color, motion, orientation, size
            - Biases during **GUIDANCE**

- Serial, attentive search: conjunction of features, harder to search, more time needed in function of distractors, lots of competition
    - No target in the group? => **Serial exhaustive** <-> **Self-terminating**
    - Features that drive attention
        - **T-D features**: complex: intersection, color change, faces, 3D, optic flow
            - Biases during later stages

⇨ **Context-dependent!**

Face in the crowd: Anger superiority effect

- Angry in happy crowd => ~Parallel search (but no pre-attentive search for emotional S)
- Happy in angry crowd => ~Serial search
    - **Not a T-D bias but B-U (during guidance)!**
        - V-shape associated with –

High quality pictures: Happy superiority effect

- Happy face in neutral crowd = faster!

  - BUT: Driven by **state/trait:** Anxious/clinical groups => Larger benefit for – emotions (compatible w/ mood)
- Question remains: Effect of emotion on selection or identification?

Capture (B-U): During guidance? Can also be explained using CC or WM

Value-driven attentional capture (fear): B-U, automatic

- Logic: **Conflict between goal and saliency of distractor**
  - Monotonic increase in RT COST depending on value of stimulus
    - Larger cost for threat related than safe distractor
  - **Early effect:** Short latency saccades (< 200ms) curve toward a distractor, whereas long latency saccades (>200 ms) curve away from a distractor
    - Bias during **guidance**
      - Driven by – emotion
    - Quick subcortical route for emotional info via amygdala
      - Longer route: Retina => Thalamus

Value-driven attentional capture (reward): Motivational

- Logic: **S with reward-related value grabs attention because it's important to you**
  - Even after training, effect remains
  - Role amygdala (not just for – S) and basal ganglia/striatum (dopamine)
- Effects ≠ only attention effect (works together with CC)
  - Also **cognitive control** (visual WM capacity => lower = larger capture effect, can't process many S at once)

Visual search: Conclusions

- External validity
- 2 effects of emotion: Search vs capture
  - Search effect is probably post-perceptual/ late effect (T-D)
    - More consistently found with negative than positive emotion
  - Capture is early and perceptual (guidance?) (B-U)
    - Works equally will with positive emotion (reward) and threat

Attentional blink (measures PRP, bottle neck): Temporal attention

- Attention shifts in time, sometimes we have gains (easy selection) and sometimes costs ~PRP

RSVP: Rapid Serial Visual Presentation

- Attentional blink when lag/ISI (Inter Stimulus Interval) is too short

Boost and bounce model (attention as modulator) (T-D: Task instructions/goal)

- You amplify fist S (boost, FC and PC) => You pull less weight to second S (bounce) and miss it
  - Only with short ISI/lag
  - Model to explain this effect: **2 competing processes**
    - (1) Bottom-Up guidance of attention: Salient S => Easy to allocate attention (gain for emotional stimuli)
    - (2) Top-Down guidance of attention: ~goal or task instructions

Emotion-induced attentional blink (Driven by AROUSAL, valence only => smaller gains) B-U?

- Seeing emotional S creates larger blink than control condition (you boost important S)
  - Only with short ISI/lag
  - Emotionality goes via amygdala

⇨ **Cost** of emotion on temporal attention when emo S comes 1st

⇨ **Gain** of emotion on temporal attention when emo S comes 2nd (you overcome bottleneck)

- **Influences of state/trait:**
  - High anxious people have a gain for fearful faces compared with happy
    - Low anxious people => Same effect for happy and fearful
  - => Effect is not purely B-U!

- **Reduce attentional blink by adding WM task:**
  - Divide attention (remember picture) => less attention to T1 (less boost) => less bounce effect => overcome bottleneck
    - Why? => More optimal allocation of temporal attention
  - Positive emotion broadens attention, negative emotion narrows attention
    - => larger WMT effect on positive emotion

Cueing (unilateral cue)/Dot probe (bilateral cue): Spatial attention

Posner cueing task (exogenous attention: attention not driven by E but by luminance,…)

- Unpredictive cue
- Bottom-up
- Valid vs invalid trials (valid: cue and target = same position)

Orienting: Short interval/SOA (Stimulus Onset Asynchrony)

= CUEING EFFECT: FASTER RT FOR VALID TRIALS = POSNER EFFECT

- **Emotional cues** (happy, sad, neutral or scrambled), **valid or invalid**:
  - Irrespective of conditions, always cueing effect for valid trials
    - Pp do best for fearful cues (also small gain for happy)
  - No effects of state or trait
- B-U? (fear facilitates orienting, early effect)

Inhibition of return/disengagement: Longer interval/SOA

= WHEN SOA IS LONGER, FASTER ON INVALID TRIALS

⇨ WHY? YOU DISENGAGE AFTER A WHILE IF YOU ATTEND A LOCATION AND INHIBIT IT

- **Emotional cues** (happy, sad, neutral or scrambled), **valid or invalid**:
  - High anxious people: No inhibition of return for angry and jumbled cues!
  - Low anxious people: Little gain for angry cues (faster on angry invalid trials)
- T-D? (anxiety delays disengagement)
  - Attention bias modification (ABM)

General conclusions

- Common grounds for VS, AB and cueing:
    - Driven by **AROUSAL**
    - Often late T-D effects (interaction between T-D and B-U for VS and AB)
        - During selection or identification
        - Exception during guidance: CAPTURE

⇨ Alternative model to T-D (goal-directed) vs B-U (S-driven) competition:

⇨ **Priority map:** 3 layers**:** Top-down + bottom-up + value

- Bottle neck => Set priorities, organized by attention
- Cooperation (>< competition)
- Multiple systems work together
- Additive effect (no competition) of different S weights
    - **3 systems together decide which S will be selected in time**

⇨ Priority map at each moment in time, determines where attention will go

Lesson 8: Influence of motivation on cognitive control

⇨ CC depends on attentional control, depends on motivation to overcome challenges/conflict

"Pure" cognitive control (no effect of emotion): Conflict => Attention

Dominant framework

- **Cognitive control... (uniquely human!)**
    - Is an ability to pursue goal-directed behaviour (<-> habitual behaviour)
    - Can modulate large spectrum of cognitive processes
    - Comes whenever you need to adapt
    - Can be depleted

⇨ We will examine CC indirectly via **conflict processing** (Conflict => Slower RT and more errors)

- **2 Processes during CC:**
    - (1) Detect conflict/challenge
    - (2) Adapt and increase control (engage attention) to overcome conflict

⇨ Attention solves conflict **(conflict monitoring and cognitive control model)**

⇨ Explains slower RT and increased error rate when conflict is involved

- **Sequence of 4 processes:** 3 this lecture(1-2 conflict detection, 3 adaptation), (4) next
    - (1) Activation of 2 units in VC (competition, **upstream effect**, b-u)
    - (2) Activate corresponding task process/bias to task-relevant representations
    - (3) Bias the system/select (**downstream effect**, t-d)/organise competition
    - (4) Evaluate the response = cascade effect

CC

- **ACC**: Overlap between – affect, pain and CC
    - Probably where conflict is detected or engaged

Two processes: Conflict detection and adaptation (attention)

ATTENTION AND CC ARE RELATED TO EACHOTHER: CONFLICT => ATTENTION ↑ (INHIBITION AND FACILITATION)

Posner's attention model (cueing task): 3 independent systems that interact

- (1) Alerting system: When aroused, more attention abilities
- (2) Orienting system: Shifts attention in space/time
- (3) Conflict relating system: CC

Influence of positive emotion on conflict processing

- Reward
  - **Main effect:** Gain in RT for all conditions
  - **Interaction effect:** Better accuracy for rewarded incongruent trials

Conflict adaptation model (Gratton effect/congruency sequence effect)

BETTER PERFORMANCE FOR 2ND CONFLICT AFTER A 1ST CONFLICT CAN'T BE EXPLAINED WITH POSNER'S MODEL

⇨ **WHY? BOOST ATTENTION CONTROL, FLUCTUATIONS OF CONTROL ACROSS TIME**

Consequences at the methodological level: Sequence effect!

- Take trial history into account, look at congruence effect and Gratton effect!

Dual mechanisms framework, conflict monitoring model

- 2 branches of CC:
  - (1) Congruency effect
    - **Proactive**, prepare
    - If you have a cue that tells you the congruency, you'll perform better
  - (2) Gratton effect/Congruency sequence effect/Conflict adaptation
    - **Reactive**, fast, auto, reflexive, **phasic**
    - Can't prepare for this, it automatically pops up (you don't know when you'll get 2 conflict trials right after each other)

⇨ New layer in model

- **Conflict detection**
- Distinguish between reactive and pro-active
  - **Pro-active**: Talk to VC and boost color info at cost of word info
  - **Reactive**: Faster, more automatic, not based on cues => **adaptation**

Emotion: Conflict => - affect => Attention

Conflict is negative/aversive (driving force to allocate attention)

- Emotion and cognitive control are related to each other: Conflict is aversive

Affective priming (for words and pictures): Cues not actively processed

- Systematic facilitation if you pair a – word with conflict related S (and vice versa for +)

Negative bias

- Neutral S paired with conflict related cue are judged as more negative
  - Modulated by SOA: Effect only for small ISI, switches for long ISI

Affective priming (for words and pictures): Cues actively processed

- The cue is also a task
  - After solving conflict cue => becomes POSITIVE cue!
  - => Priming effect swaps!

⇨ Conflict EXPERIENCE matters

NO CONFLICT ADAPTATION WHEN YOU'RE NOT AWARE OF THE CONFLICT

Stronger conflict adaptation with negative emotion (Valence! Reactive and phasic)

- Conflict adaptation depends on **state,** VALENCE-related
  - Sad/anxious: Conflict adaptation effect
  - Happy/calm: Less adaptation

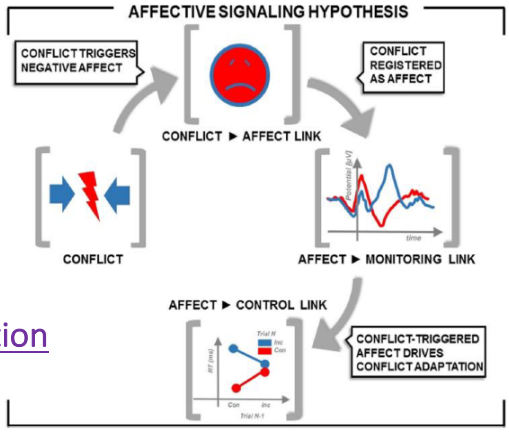
⇨ SINCE THERE'S A LINK BETWEEN CC AND – VALENCE, + VALENCE CAN WEAKEN THIS LINK AND THUS WEAKEN ADAPTATION

- **Punishment** manipulation: Changes motivation => Larger adaptation
  - But effect is not unlimited: Only with short interval
  - Pp in punishment condition also reported more – affect

Conclusions

- Conflict automatically BINDS with - affect
- This affect causes you to increase monitoring
- This facilitates CC and causes adaptation

⇨ Block this chain by adding + affect (state or reward)



Motivation: Conflict => - affect => EVC => Attention

Avoidance of effort

- To overcome conflict is not neutral = effortful
  - **Motivation as driving force** to overcome it (MEDIATING MECHANISM)

⇨ Motivation and cognitive control are related to each other

- The law of least mental effort: Even when you are not aware of it

The cost of exerting control

The expected value of control (EVC) model: Not just conflict but also conflict monitoring process!

- **EVC = difference between outcome values and control costs**
  - Difference between the rewards expected from mobilizing control with a particular direction and intensity & the inherent cost associated with this mobilization

⇨ Determines effort that will be invested, mediated by motivation

CONCLUSION: Conflict => - affect => effort/attention (depends on motivation) => adaptation

Lesson 9: Influence of emotion on action monitoring

"Feedback loop" as key notion for monitoring

- **Cascade:** Every S can lead to response(s), which itself leads to a new S,…
- We constantly monitor our behaviour (input, **ACTOR**) in order to reach our goals/context
    - **Monitoring/Feedback loop/CRITIC:** Compare actual response to S to representation (memory trace of action) of it that's constantly updated by our goals and errors
        - Mismatch? => Adapt response and assign **value** to it (VALENCE)
        - Update representations to sharpen decision making (= Self-regulation) next time
            - Cognition decides whether action is correct or not and thus whether there is a mismatch (accuracy coding) and changes action value
            - C => E

Post-error slowing and Error related negativity (ERN) (Details: see later)

PROOF THAT WE MONITOR OUR BEHAVIOUR => ERROR WE CAN MEASURE

Error-related negativity (ERN) as correlate of monitoring

ERN = Error-Related Negativity

- EEG-signal when mismatch happens, driven by error-signal => **Post error slowing**

ERP = Event-Related Potential

- Stimulus-Locked ERP: EEG-signal time-locked to S, averaged out over multiple signals
- Response-Locked ERP: EEG-signal time-locked to R, averaged out
    - ERN occurs very rapidly after R onset (50ms) (dorsal ACC: Comparison occurs here)
    - Later, PE = Error positivity
- Typical wave: Shows peaks and troughs corresponding to specific activation in the brain
    - => Relate to behaviour

Based on representation of action

- ERN happens early, yet it takes several seconds before you're aware of your mistake
    - => ERN must be caused by internal **representation** of the action
    - => ERN is actually a late signal (reflects dopamine, see later)

- Size ERN depends on instructions
    - Larger when instruction is accuracy (>< speed, neutral)

Flexibility

- No evidence at the response level? => **feedback effect** (ERN during feedback)
    - If we don't know if the action was correct or not, comparison is impossible
    - Shows **flexibility of the monitoring effect**
- 3 Conditions:
    - Deterministic (easy learning): large difference ERN correct-incorrect
    - Probabilistic: Harder to make model => Smaller ERN
    - Random: no ERN
- Feedback: Mirrored ERNs

Awareness not needed

- **ERN without awareness:** Anti-saccade task
    - Perceived and unperceived errors have same ERP

Agency not needed (observation errors)

- Also ERN when observing an error
- Signal is smaller and delayed
- Depends on social relationship

Partial vs full errors

- Partial errors => Also ERN

Parametric coding of error's magnitude (more evidence for FLEXIBILITY)

- ERN signal changes according to severity of the mismatch
- **Prismatic adaptation effect**
- ERN is actually a **late effect:**
    - CRITIC (decision making) monitors your action
    - Mismatch? => We can record ERN, very early!
    - !!! This means the **representation happens before the ERN in the brain**
        - **DOPAMINE** signal in midbrain happens before ERN when there's a mismatch
        - Dopamine is early signal, similar shape as ERN

Negative emotion (see earlier as well)

- Conflict is negative => affective priming
    - Pictures and words: pos faster when congruent, neg when incongruent
    - Same effect for actions: pos word faster said after fast correct hit, neg word faster after error hit = priming effect
    - **Post error slowing**: Slower when error made before => shows monitoring

Priming-effect can be **predicted by ERN** => ERN codes accuracy and emotion! (ERN predicts facilitatory effect of negative words compared to positive words)

Variation with internalized-externalized psychopathology

- Internalized, OCD/anxiety = large ERN (Monitoring is increased as default)
    - Role of apprehension component of anxiety: Evaluate context as negative: you expect bad things to happen to you
- Externalized = blunted ERN
- Hypo ERN with alcohol

Conclusions

- System detects error really early and at the same time already codes the value and severity of the error => Really important to GUIDE behaviour

Lesson 10: Emotion regulation

Self-regulation

Self-regulation vs emotion regulation

Self-regulation	Emotion regulation
Development/ motivation (Mischel, Baumeister)	Cognition/ clinical (Gross)
Capacity, resources, effort	Processes
Sequence effect (ego depletion)	Attention, analysis, interpretation
Marshmallow	Reappraisal

Self-regulation strongly related to self-control

Feedback loop for self-regulating behaviour (similar to previous chapter)

- You have a goal in mind and check if current behaviour aligns with that
    - Mismatch between representation and incoming action? => Adapt behaviour
- **2 implications:**
    - (1) Feedback loop has **limited capacity => Ego depletion**
    - (2) Feedback loop can operate imperfectly: What can go wrong?
        - Motivation (decision balance)
        - Setting goals and making commitment (intentions)
        - Ability (internal outcome confidence)
        - Automated data capture
        - Feedback on performance
        - Reinforcement (booster)

"Ego depletion" logic ("resources")

= POOR OR LITTLE SELF-CONTROL, BECAUSE OF USING THE LOOP TOO MUCH OR TOO MUCH NOISE WITHIN LOOP

Expected value of control (EVC) model: Link between motivation and cognitive control/self-regulation

- Model takes costs and outcome values into account, but not possible **depletion**
- Control = effortful and depletes resources => **Less ability to exert control**
    - Marshmallow experiment
    - Radish vs chocolate experiment
    - Watch movie and suppress emotions => Reduced ERN in 2nd task
        - SUPPRESSING EMOTION ALSO DEPLETES SELF-REGULATION! => SELF-REGULATION AND EMOTION REGULATION ARE RELATED/SIMILAR!!!

Emotion regulation

Emotion regulation => Cognition ("processes")

= DEFINED BY BOTH THE INTRINSIC AND EXTRINSIC PROCESSES INVOLVED IN THE MONITORING, EVALUATING AND MODERATING OF EMOTIONAL RESPONSES (TARGET)

⇨ 2 STEPS: (1) SPEC. EMOTION IS UNLOCKED (BY S), (2) WE REGULATE OR NOT

- Emotion vs regulation (2 different things):
    - Regulation influences emotion (not vice versa)
        - Emotion w/o regulation is possible

- Order: 1st emotion, 2nd regulation
- Some models: Emotion less influenced by culture/norms than regulation

- 2 stages of emotion:
  - (1) Primary reaction: Corresponds to emotional response (hard to influence)
  - (2) **Secondary reaction**: Emotion regulation can upregulate/downregulate this!
    - Depends on magnitude of (1)

Emotion regulation at different levels of abstraction: What's the target of regulation? This lesson: (2)

1. **Hedonic needs**: Need-oriented E-R
2. **Goal pursuits:** Goal-oriented E-R (distal or proximal goals)
   a. Distraction through cognitive load
   b. Cognitive reappraisal
   c. Bodily activities such as expressive suppression, response exaggeration and venting
3. **Maintenance of global personality:** Person-oriented E-R

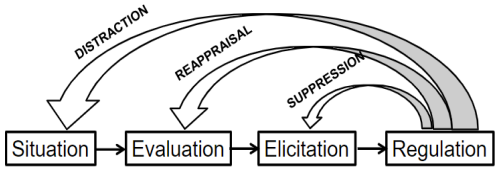
Emotion regulation as goal-directed process: Process model of E-R (Gross)

EMOTION = APPRAISAL OF THE SITUATION => REACTION

⇨ **E-R CHANGES REACTION BY APPLYING A STRATEGY THAT CAN TARGET S, APPRAISAL, PHYSIOLOGY, FEELINGS OR ACTION TENDENCY (OFTEN: FEELINGS)**

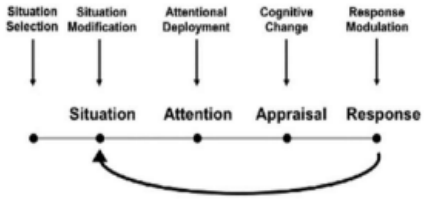
James Gross

- Multiple strategies compete
  - Used strategy depends on specific factors
- Regulation = **Reactive and retrospective**



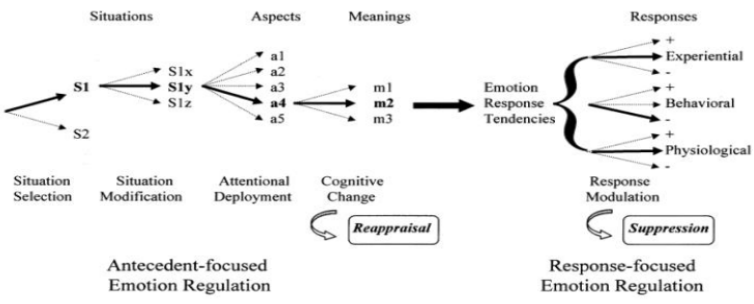
T-D

B-U



- Attention~distraction, appraisal~reappraisal, response ~suppression
- Some strategies can happen BEFORE situation is there (=> prepare, proactive)
- Suppression happens too late => is maladaptive
- Emotion Regulation Questionnaire: Which strategy do you use most? Suppression, appraisal or both?

Most commonly used according to Gross: Reappraisal vs Suppression: The process model of E-R:



Adaptive (+) **Less adaptive (-)**

Sidenote: Always using appraisal isn't good either: If you can anticipate (PROACTIVE), use appraisal, if you can't anticipate (REACTIVE), use suppression (better than nothing, see later)

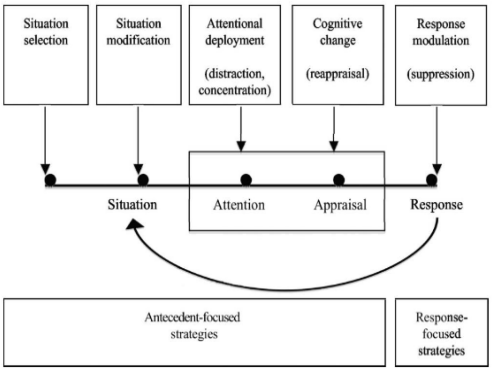
Reasons that suppression is maladaptive and doesn't lead to gain:

- (1)Psychopathology: Anxiety, depression, eating disorder: More suppression than reappraisal
- (2) Psychophysiology:
  - Negative emotions decrease but arousal increases when suppressing
    - Has maladaptive effects on cognitive behaviour

- Blink rate increases: Measure of stress and correlated with arousal
  - Arousal isn't necessarily bad, but often paired with – emotion
- (3) Suppression is energy expensive => When resources are depleted, less control available
  - Ego depletion (reason why E-R and self-regulation are related!!)

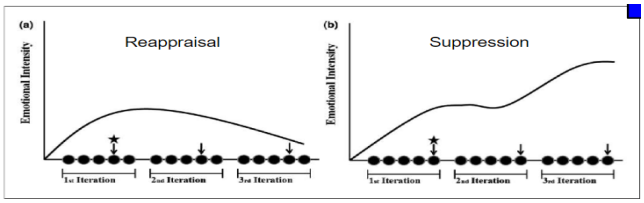
Time matters: Generic time hypothesis

= DEPENDING ON WHEN YOU START TO REGULATE, YOU ACTIVATE SPECIFIC PROCESS



- 2 families of regulation:
  - **Reactive:** Wait until the response to regulate: Suppression
  - **Proactive:** Change situation, attention or evaluation: Situation modification, reappraisal, distraction

- "Down-regulating emotions before they are 'up and running' (reappraisal) is always easier than once they've gathered force (suppression)"



Intensity matters: Process specific timing hypothesis

- Different strategy depending on magnitude of trigger (=> Emotion intensity)
  - **Low magnitude:** Reappraisal (late) vs **High magnitude:** Distraction (early)
  - Reappraisal would be too energy-consuming for high magnitude

Distancing (another strategy, special type of reappraisal/re-interpretation of situation)

= TRYING TO INCREASE THE DISTANCE BETWEEN YOU AND THE SITUATION/TRIGGER

- 4 types/strategies of distancing:

Spatial	The user downregulates an emotional response by taking a perspective that is more spatially distant from the stimulus.
Temporal	The user downregulates an emotional response by taking a perspective in which the stimulus is more distant in time.
Objective	The user downregulates an emotional response by taking an objective perspective. This perspective is often linked to an imagined observer, who may be a generic neutral party or a contextually appropriate professional, such as a clinician, investigator, or reporter.
Hypothetical	The user downregulates an emotional response by taking a perspective in which the stimulus represents a hypothetical scenario as opposed to reality.

Effective strategy: Arousal ↓, even when you're not focused on it (<-> suppression), less - emotion

Reappraisal (Proactive: pp are prepared (e.g. Cued))

- Effective for subjective level (less – emotions), but **no effect at physical level** (<-> distancing)

Suppression (Reactive)

- Not very effective for subjective level and **cost at physical level** (Arousal increases)
  - => Overall maladaptive
  - **BUT**: Effectiveness of strategy depends on context
    - Suppression is better than nothing when nothing else is available!

Distraction

- Cognitive load (distractors, e.g. math exercises) after emotional S => Less - emotion

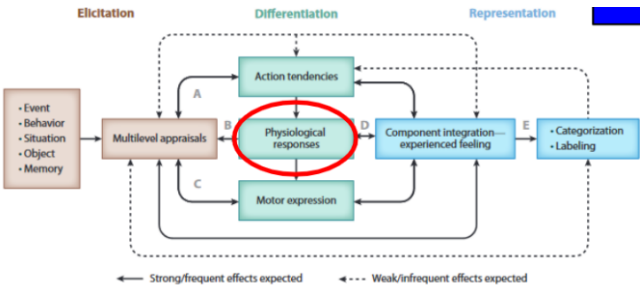
Conclusions

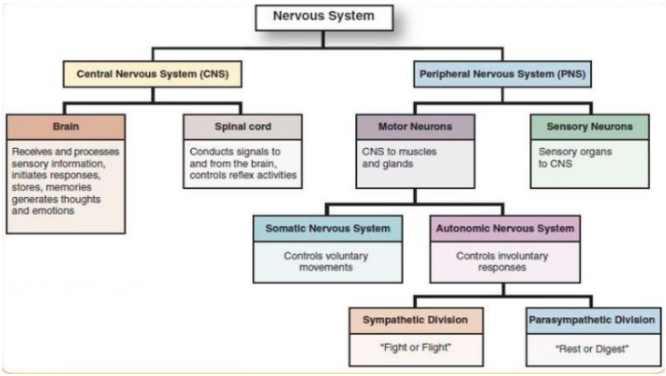
Distancing > Appraisal > Distraction > Suppression (but depends on context, healthy balance!)

Lesson 11: Psychophysiology of emotion

Introduction

- This chapter: Physiological responses (Consequence of appraisal/regulation: **T-D**)
- CNS (Central nervous system) vs PNS/ANS (Peripheral/Autonomic nervous system)
    - For PNS our focus will be on:
        - (Ortho)Sympathetic ns (Fight or flight, SNS)
        - Parasympathetic ns (Rest and digest, PNS)
    - Goal = Homeostasis





Periphery (ANS => PNS vs SNS)

- SNS: Activation of organs (Norepinephrine)
- PNS: Slow down/inhibit organs (Acetylcholine)

- Multitude of measures (some easy to record but lack specificity):
    - Cardiovascular: HR: heart rate, HRV: heart rate variability
    - Respiratory
    - Electrodermal: SCL: skin conductance level, SCR: skin conductance response (amplitude, evoked)

We'll cover a few:

Facial expression: EMG

- **Facial Electro-myography (EMG)**:
    - Sensors (electrodes) placed on specific muscles on the face
- **What does it measure?**

  - VALENCE:
    - Zygomaticus (minor and major) for + emotions
    - Corrugator supercilii for – emotions
    - Frontalis for surprise
  - Difference between real and fake smile: Orbicularis oculi
  - Can also measure suppressed emotion

Electrodermal: SCL

- **Skin conductance level (SCL)**
  - Amount of sweating (measured on hand) changes electrical conductivity of skin
- **What does it measure**?
  - AROUSAL:
    - More sweating => Higher SCL when stressed

- Increase with bodily threat, not with psychosocial threat (Doesn't change your arousal)
- HABITUATION (e.g. with loud noise)

Cardiac: HR, HRV

Heart rate (HR): ECG

- **Electrocardiogram (ECG):**
  - HR = Mean/bpm
- **What does it measure?**
  - HR changes depending on emotion/AROUSAL:
    - Fear bradycardia = Systematic slowing down of the HR in response of negative stimuli, arousal and fear
      - = freezing: parasympathetic effect => to increase sampling info from environment
    - HR increases under stress and negative emotions, probably related to sympathetic effects (longer period): HR ↑ during Trier social stress test (TSST)
    - HABITUATION

Heart rate variability (HRV)

- **HRV**
  - Standard deviation between the mean HR of the different conditions
  - Looks at variability of interbeat interval (R-R distance: Smaller => higher HR)
- **What does it measure?**
  - Adaptability and flexibility (High HRV = Healthy)
    - HRV is predictive of abnormal behaviour!
      - Low, inflexible HRV = maladaptive (constant stress mode)
  - HRV changes during transitions: HRV ↘ when moving from happy to stressed
  - Happy = Regular oscillations/amplitudes of HR across time, constant HRV
  - Stressed = Irregular amplitudes, change in HRV
- Methodological issue: Sometimes contaminated by respiration

Eye-related/Ocular

Pupil dilation

- Dilation caused by: Locus coeruleus-norepinephrine system: More dilation => More norepinephrine/more LC activity: Flexible effect! Activity can change depending on state
    - **Yerkes-Dodson relationship:** Relation between tonic LC activity (arousal) and performance
        - Extremes are not good, optimal is in between
        - Tonic: anxiety, stress vs phasic effects: fear

⇨ Activate LC in phasic/sharp manner (fluctuating): Dilate pupil shortly, then stop dilating and keep going

- **What does it measure?**
    - AROUSAL (Mediated by norepinephrine/LC)
    - Higher EFFORT => More dilation (effect slow in time => Long ISI needed)

Startle effect (blink)

- 2 electrodes placed under the eyelid => Orbicularis oculi activity
    - Startle pp => blink (protective reflex)

- **What does it measure?**
    - VALENCE:
        - Larger reflex for negative emotion/S

Spontaneous eye blink rate (EBR)

- **What does it measure?**
    - Indirect measure of DOPAMINE (basal ganglia)
        - More dopamine => Blink more (dopamine in frontal cortex => motor movements)
        - Suppression => Blink more
    - **Yerkes-Dodson relationship**: Optimal condition is in between (not too much, not too little dopamine)

Conclusion

All measures are related to arousal and/or valence but not emotion => lack of specificity (**clustering**)

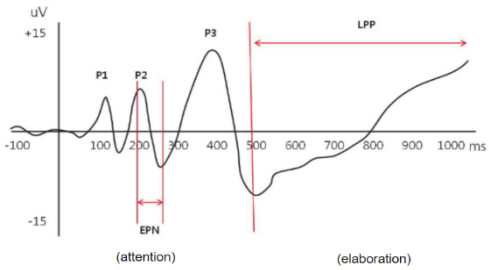
Central (CNS)

- Central nervous system
    - Methods: TMS, MEG, EEG, fMRI, PET, SPECT, …
- **EEG (scalp level):**
    - Evoked potential = averaging => systematic and consistent between trials
    - ERP= event related potential, evoked activity (=> after being averaged out)
    - **Peaks and troughs reflect processes/effects:**
        - Early effects: Sensory effects
        - Later effects: Effects of cognition

- Where does emotion kick in?

2 EFFECTS THAT REFLECT EMOTION: EARLY POSTERIOR NEGATIVITY (EPN) & LATE POSITIVE POTENTIAL (LPP):

Evaluation (EPN): Attention, early effect of emotion



- Early attentional effect to the emotion
  - Increases when pp detect emotional S

What about regulation? => Not really visible at this early stage

Regulation (LPP): Elaboration, late effect of emotion

- Related to elaboration (when you assign a specific value to S), emotion regulation and emotional processing
  - 2 main effects:
    - (1) Emotion: Significant **increase** for emotional compared to neutral S
      - Regardless of the form of S
    - (2) Load: Increasing load **decreases** LPP, interaction with emotionality:
      - Low-load, aversive pictures highest LPP
      - High-load, aversive pictures second highest LPP (High load counteracts emotionality)

What about regulation?

⇨ LPP response ↘ depending on reg. strategy: Nothing > Suppression > Distraction

Cognitive control (Theta waves: FMT)

- **Theta activity is specifically related to control:**
  - Found in situations where you put extra effort in
    - Stimulus level: novelty, conflict, punishment
    - Response level: conflict, errors
    - **Manifestation**: Frontal midline theta (FMT) (4-7 Hz): above frontal cortex
      - = Train of rhythmic waves, induced by certain (control) tasks
- Activation medial cingulate cortex, connected to different regions:
  - Coordinates brain activity to deal with a challenge

Lesson 12: Brain imaging of emotion (implementational level)

Introduction: Amygdala

- Where in the brain can we find the interaction between cognition and emotion?
- **Amygdala vs Hippocampus**
  - Amygdala: Component of limbic system (~emotion?)
  - Hippocampus: Memory (~cognition?)

Properties of the amygdala

Amygdala (hub) broadcasts emotional info to regions far away

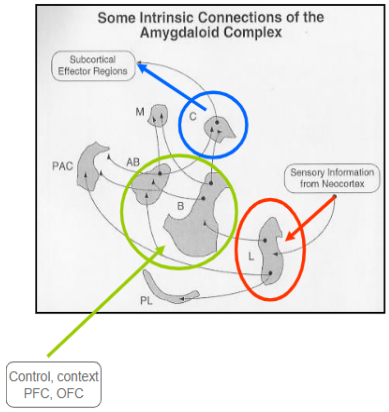
- White matter tract to visual cortex (inferior longitudinal fasciculus)
  - => Amygdala influences visual processing
  - Topographic organization: Different nuclei of amygdala connected to different parts of VC
- Also connection to motor-, auditory- and somatosensory cortex

Amygdala is old (phylogeny) and includes several nuclei

- Conservation across many species w/ same organisation
- 13 different nuclei with different structures, NT, organisations

Ideal anatomy for S-R association, and their modulation

- We'll cover 3 nuclei:
  - (1) Red: Lateral nucleus: Input
  - (2) Green: Basal lateral nucleus: Association processing (competition/evaluation)
  - (3) Blue: Central nucleus: Output (emotional response level)
- **Top-down** modulation possible: Frontal cortex
  - Before (reappraisal) or after (suppression) emotion S onset



Pavlovian conditioning

- Role amygdala during **conditioning phase** (not with habituation and extinction)
  - Link 2 stimuli by means of emotion
- Causal evidence for amygdala involvement in conditioning:
  - No fear responses before conditioning in either group, significant fear responses after conditioning in control group (freezing)
  - !! BUT no fear responses after conditioning in the lesion group (central nucleus)
- No awareness of association needed, still amygdala activation

Amygdala vs VMPFC: Amygdala creates associations, other regions alter them

- Ventromedial prefrontal cortex activates for extinction (overwrite memory trace)
  - Amygdala not needed for extinction
  - The higher VMPFC activation, the better the extinction

Different views on the role of the amygdala ~emotion theory

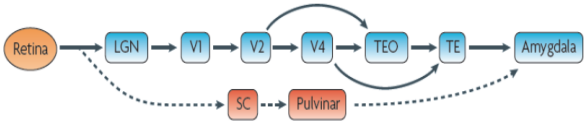
Affect program: Amygdala as fear module – Basic emotion theory => MODULE

"EACH OF THE 6 BASIC EMOTIONS IS RELATED TO A SPECIFIC NEUROANATOMICAL NETWORK"

⇨ **AMYGDALA RESPONSIBLE FOR FEAR ONLY (1 ON 1 MAPPING BETWEEN FEAR AND AMYGDALA ACTIVITY)**

Subcortical fear processing model

- **Shortcut** (VC gets 'skipped') for fear: Retina => Superior colliculus => Pulvinar => Amygdala
  - Fast, automatic, unconscious
  - (still discussion, no clear evidence)



- **Normal route**: Retina => LGN (thalamus) => VC => Amygdala

Urbach-Wiethe disease: patient SM

- Selective bilateral calcification of the amygdala (hard calcium where amygdala should be)
    - Can't process fear, but can recognize all other emotions!
    - Drop in recognizing **surprise**: Shares similarities with fear

Fear module

⇨ **FEAR S => AUTOMATIC, QUICK ACTIVATION OF "FEAR MODULE" (CORE = AMYGDALA)**

- Can't be influenced, you can only influence parts that come after this
- Stimulus awareness not needed, shortcut can still be taken! (only for fear)
- Amygdala is sensitive for specific features: Eyes are important!
    - Fearful eyes alone => Still activity in amygdala

Constructivist: Amygdala for arousal (detection) => DIMENSION

S => CORE AFFECT => SPECIFIC EMOTION

- **Core affect** = valence + arousal, processed in different brain regions:
    - Arousal = amygdala (irrespective of valence)
        - **Fear** often accompanied by a lot of arousal
    - Valence =orbitofrontal cortex (irrespective of arousal)
        - **Increase for positive** valence
- No amygdala, no overcoming of attentional blink for arousing stimuli

Appraisal: Amygdala as relevance detector/processor => APPRAISAL

S => SPECIFIC APPRAISAL (SEQUENCE: IMPORTANT HERE = FIRST STEP: RELEVANCE) => EMOTION

- **Spontaneous evaluation** of ambiguous S (interindividual variability!):
    - Large amygdala activation => Judge S as negative
- **Contextualization**:
    - Rating can be predicted based on context (=> Can bias evaluation)
    - No amygdala activation without face S = **Real value assignment effect**
- **No amygdala, no use of eye info (patient SM):** Eye-tracking
    - When specifically instructed to look at eye region => Can recognize fear!

⇨ Patient uses wrong strategy for emotion recognition!

NO SIMPLE 1-1 MAPPING OF EMOTION AND AMYGDALA, AMYGDALA IS PART OF A NETWORK

General conclusions

- **Emotion is an appraisal of the situation** or event (elicitation): **Discussion (3 theories)**:
    - Is it based on a data base look-up (module)?
    - Based on core affect/dimensions (arousal and valence)?
    - Based on relevance?

- **E => C:** This appraisal **can influence cognition**, and these effects can be revealed using specific tasks or experimental paradigms in psychology:

    - Attention (priority map influenced)
    - Cognitive control (conflict is aversive and effort+ reward needed to process it)
    - Performance/error monitoring (changes of the feedback loop)
- **C => E:** We can reversely use **cognition to alter this appraisal/emotion**
    - Effect of C on E is mostly visible during emotion regulation, by means of:
        - Attention (distraction)
        - Reappraisal
        - Distancing
        - Suppression

- At the psychological level, we can use specific markers to explore this appraisal and how cognition can change it:
    - Peripheral vs Central level of measures

- **Outstanding question**: Are cognition and emotion separate entities during information processing, or instead two sides of the same coin?
    - They work parallel to each other when we process information
    - => Division between them is artificial