Introduction to Decision Making Studies 03

Balloon Analog Risk Task (BART) 02

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Balloon Analog Risk Task (BART)

- BART is the most sensitive task to detect alcohol users' risk-taking behavior.
- Sensation seeking trait
  - “nonimpulsive, socialized mode of sensation seeking,” – personality characteristic, taking types of risk motivated by the need for stimulation (e.g., bungee jumping).
  - “impulsive, unsocialized mode of sensation seeking,” resulting from ignoring stop signals in dangerous reward-seeking behaviors (e.g., gambling).
- Hypothetical gambles and economic games administered in laboratory settings often lack any element of arousal, and this might account for inconsistent results when relating personality to such risky decisions.
  - Modern escalating risk tasks seem to provide some elements of arousal.
  - Impulsivity theory: impulsive risk taking is likely due to failure to inhibiting dangerous reward-seeking behaviors, such as making a sequence of risk-disadvantageous choices.

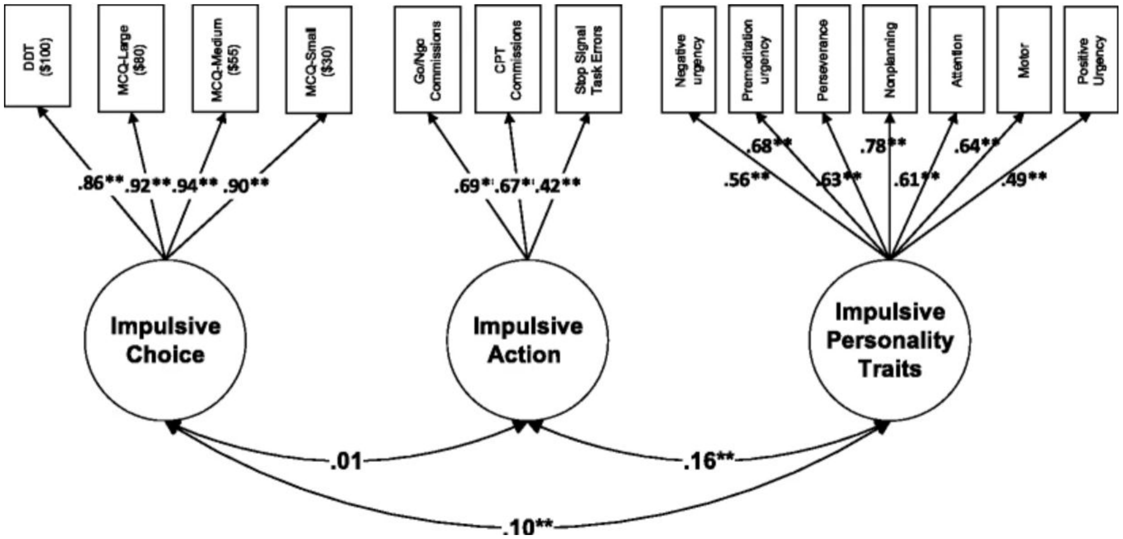
Impulsivity Structure

Impulsive choice: discounting of delayed rewards; e.g. Delay Discounting, investment

Impulsive action: ability to inhibit a prepotent motor response; e.g., Go Nogo, Stop Signal

Impulsive personality traits: self-reported attributions of self-regulatory capacity. e.g., UPPS

sensation seeking has low loadings



Discussion: What does BART measure?

- BART:
    - reward + risk preference (decision) + impulsive action, motor response (response time)
    - ambiguous decisions/context
    - Physiological and emotional (e.g., fear) arousal
- Sensation seeking:
    - emotion regulation method?
    - Moderation of impulsivity
    - ADHD or ASD population
        - sensitive to sensation
    - Substance use

BART and Impulsivity

- Average number of pumps on unexploded balloons, whether the sensation seeking and the impulsivity relations with risk taking were statistically different
- effect size for the relation of sensation seeking with risk taking was in the small–moderate range, whereas the effect size for impulsivity was just around the small effect size threshold.
- Inconsistencies in personality–risk research were mostly due to random fluctuations of specific effect sizes (sampling variability, sample size, and low statistical power), rather than to lack of theoretical ties or to measurement unreliability.
- sensation seeking and impulsivity, not statistically different, but qualitatively different.
    - a consistent tendency for sensation seeking to systematically result in slightly higher estimates than impulsivity.
    - effect size was more empirically robust when publication bias was taken into account.

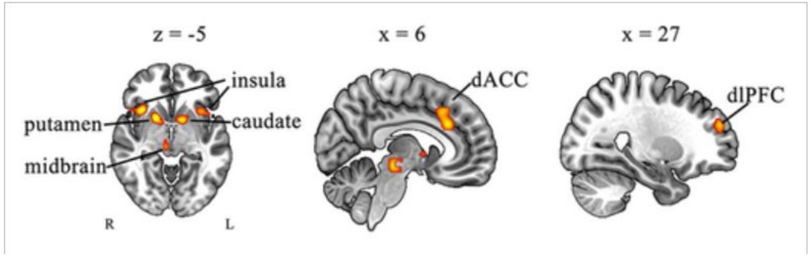
BART and Impulsivity: Sex and Age Differences

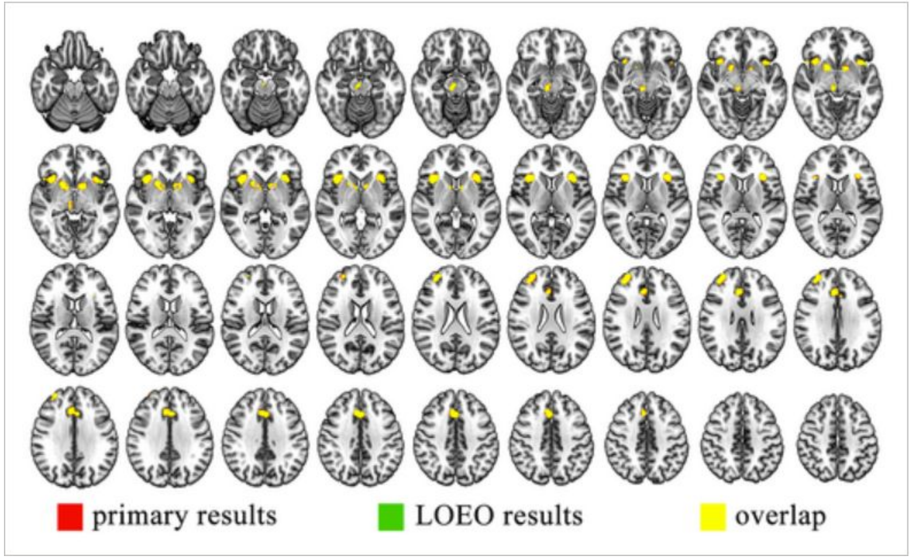
- Only significantly larger effect sizes for the **older adolescents and young adults** instead of during early adolescence or preadolescence
- Impulsive tendencies tend to decline linearly from childhood to the adult age.
  - Thus, whereas during early adolescence, there is relatively lower sensation seeking and relatively higher impulsivity, during middle adolescence, <u>both impulsivity and sensation seeking are relatively higher compared with later ages</u>, thereby increasing one's vulnerability to risk.
  - *Longitudinal studies? profile differences?*
- That people <u>develop more mature or stable risk (or arousal) preferences over time</u> is widely documented by personality studies of recreational risks
- No sex differences.

BART fMRI

ACC, bilateral insula, right putamen, left caudate, right dlPFC, and midbrain.

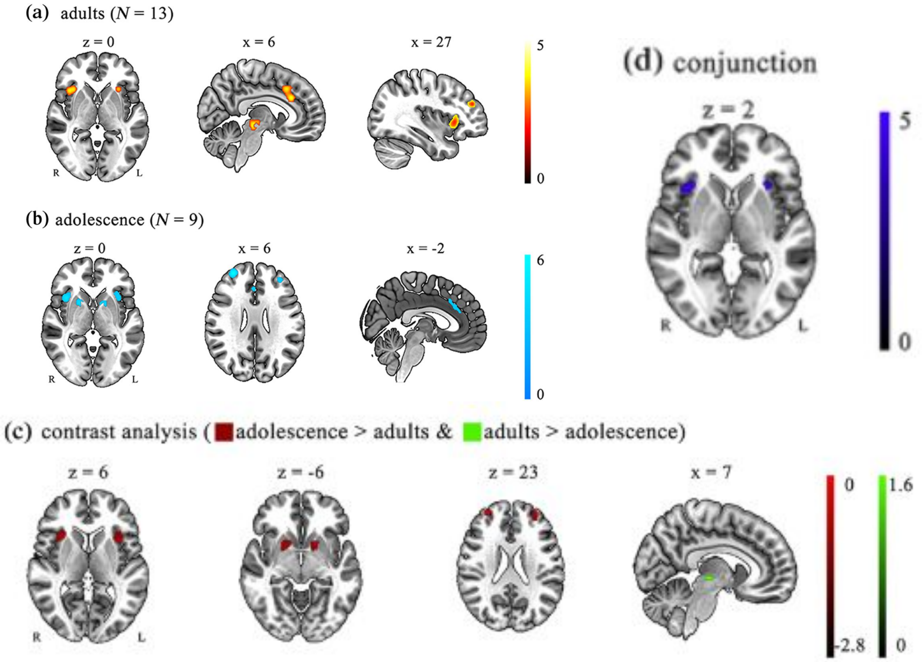
leave-one-experiment-out (LOEO) analysis: bilateral insula, bilateral dlPFC, left caudate, right putamen, and midbrain reached activation maxima





Group Differences: Adults and Adolescents

- **conjunction analysis:** bilateral insula.
- **contrast analysis:**
  - right thalamus/midbrain was more activated in the adult group
  - bilateral insula, bilateral putamen, right dlPFC, and left frontal lobe were more activated in the adolescent groups

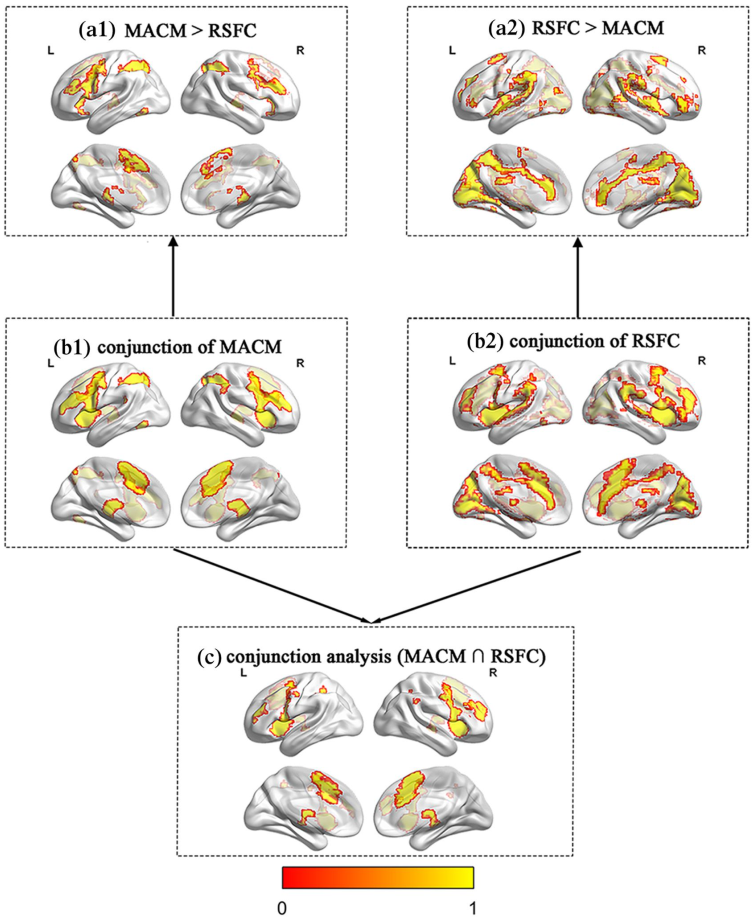


FC by meta-analytic connectivity modeling (MACM)

MACM identified consistent task-based coactivation with the seed regions of primary ALE results.

To identify the FC patterns corresponding to task fMRI, we used the conjunction analysis between these task-based functional coupling maps.

Coactivation maps for conjunction were significant for left caudate, cingulate gyrus, lateral occipital cortex, supramarginal gyrus, left cerebellum, and planum temporale



Coupling with Rest State fMRI

- Conjunction across MACM and resting-state functional connectivity RSFC analyzes
  - Frontal orbital cortex, right insula, anterior cingulate gyrus, left frontal pole, right frontal pole, precentral gyrus, left superior parietal lobule, left cerebellum, right supramarginal gyrus, left frontal orbital cortex, and right posterior supramarginal gyrus
- Difference between MACM and RSFC analyzes
  - stronger connectivity in task-based FC related to the BART included left insula, frontal orbital cortex, right frontal pole, left lateral occipital cortex, right supramarginal gyrus, brain stem, paracingulate gyrus, right frontal orbital cortex/right insula, left cerebellum, and right temporal pole.
  - RSFC: right insula cortex, left hippocampus, left frontal orbital cortex, right frontal pole, left lateral occipital cortex, posterior cingulate gyrus, postcentral gyrus, right fontal pole, right supramarginal gyrus, left lateral occipital cortex, right inferior temporal gyrus, left putamen, left parahippocampal gyrus, left parahippocampal, and bilateral cerebellum.

Summary

- Primary brain regions:
  - dACC, bilateral insula, right putamen, left caudate, right dlPFC, and midbrain.
  - Right dlPFC is a typical part of the executive control network, which integrates information from the salience network to suppress risky decisions.
  - The putamen and the caudate comprise the striatum. The striatum and the midbrain are the parts of the brain reward system that play a vital role in reward-seeking
  - The dopaminergic projections from the reward system can be released to the salience network

Summary

- Conjunction analysis of age difference:
  - bilateral insula in both adults and adolescents.
  - The insula played an important role in monitoring sensory information and inputs to executive control brain regions.
- Contrast analysis:
  - Right thalamus/midbrain had more activations in the adults
  - <u>Bilateral putamen, right dlPFC, left frontal lobe, and bilateral insula in adolescents.</u>
    - Use more cognition resource to do task than adults

Summary

- Mixed findings
    - Contradictory to the neurodevelopmental imbalance models, a meta-study exploring the age difference did not observe risk-taking differences between early adolescents (11–13 years) and children (5–10 years).
        - Non-linear development of risk-taking, maybe decrease later
- life span wisdom model
    - adolescent risk-taking behavior as a form of adaptive <u>exploratory behavior</u>. More cognitive control and reward network than adult risk-taking.
    - cognitive control system and the reward system rise in tandem during adolescent risk-taking rather than in an imbalanced way.
- The coactive pattern of MACM and RSFC:
    - reward, salience, and frontal–parietal control network.

Summary

- The coactive pattern of MACM and RSFC:
  - reward, salience, and frontal–parietal control network.
  - the risk-taking measured during the BART recruited the frontal–parietal cognitive control network involved in ambiguous decision-making.
- although both the BART and the IGT tasks gauge decision-making under ambiguity, the BART seems to be more sensitive to risky behavior than the IGT
- BART might be prone to engage in measuring both risk-taking and ambiguous decisions.

Reference & Resource

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