Decision making under risky and uncertain conditions in typical and pathological adult samples

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Anno Accademico 2022/2023
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Abbreviations

ACC: anterior cingulate cortex
BART: Balloon Analogue Risk-Taking Task
BG: basal ganglia
BPs: bad performers
CFC: Consideration of Future Consequences-14 Scale
COMTI: Catechol O-methyltransferase inhibitors
CR: cognitive reserve
CRIq: Cognitive Reserve Index questionnaire
DA: dopamine agonists
dACC: dorsal anterior cingulate cortex
DASS: Depression Anxiety Stress Scale
DBS: deep brain stimulation
DII: Dickman Impulsivity Inventory
dLPFC: dorsolateral prefrontal cortex
DLT: Drawn Lots Task
DM: decision making
DOSPERT: Domain-Specific Risk-Taking
EDRs: electrodermal responses
EFs: executive functions
GDT: Game of Dice Task
GPs: good performers
HC: healthy control
ICDs: impulse control disorders
IGT: Iowa Gambling Task
LBs: Lewy bodies
LCB: Locus of Control of Behavior
LEDD: levodopa-equivalent daily dose
LOT-R: Life Orientation Test- Revised
lPFC: lateral prefrontal cortex
MAO-BI: monoamine oxidase-B inhibitors
MCQ-30: Metacognitions Questionnaire (CC: cognitive confidence; CSC: cognitive self-consciousness; POS: positive beliefs about worry; NEG: negative beliefs about uncontrollability and danger; NC: need to control thoughts)
MCST: Modified Card Sorting Test
MMSE: MiniMental State Examination
mPFC: medial prefrontal cortex
MRI: magnetic resonance imaging
NIRS: near-infrared spectroscopy
OAs: older adults
OFC: orbitofrontal cortex
PD: Parkinson’s disease
PFC: prefrontal cortex
PRISMA: Preferred reporting of items for systematic reviews and meta-analyses
QUIP-RS: Impulsive-Compulsive Disorders in Parkinson’s Disease – Rating Scale
RME: Reading the Mind in the Eyes Test
RPs: risky performers
SCRs: skin conductance responses
SPs: safe performers
TAS-20: Toronto Alexithymia Scale (F1 subscal: difficulty in identifying feelings; F2 subscale: difficulty in describing feelings; F3 subscale: cognitive style externally oriented)
TMT: Trail Making Test
ToM: Theory of Mind
UPDRS: Unified Parkinson's Disease Rating Scale
vIPFC: ventrolateral prefrontal cortex
vmPFC: ventromedial prefrontal cortex
vPFC: ventral prefrontal cortex
WCST: Wisconsin Card Sorting Test
YAs: younger adults
Decision making (DM) has been receiving increased attention throughout the last decades, due to its pervasiveness in everyday life and its support for individual wellbeing and autonomy (Mather, 2006; Salthouse, 2012; Iannello et al., 2017). Considering the current historical period, people are called to face uncertain and risky decisions in manifold fields, such as the economic and medical ones. Gaining a deeper understanding of the neurocognitive mechanisms underlying DM under these particular conditions – namely, under uncertainty and risk – is crucial, especially considering the complex nature of the decisional processes, which encompass several cognitive and affective abilities (Schiebener & Brand, 2015).

In the present dissertation a particular focus was kept on the relationships between decisional performances and cognition, in particular cold executive functions (EFs), which are pivotal abilities in most goal-directed behaviors and also in DM. As well, we explored possible individual traits affecting decisional processes.

We considered two specific targets that literature highlighted as at risk of developing decisional impairments leading to risky decisions: healthy older adults (OAs) and patients affected by Parkinson’s disease (PD) (e.g., Denburg & Hedgcock, 2015; Colautti et al., 2021; Cool et al., 2022; Iannello & Colautti, 2022). As life expectancy is increasing and the global population over 65 years is growing faster than any other age group, it appears crucial to promote active aging (Chai et al., 2022); In this way, cognitive functioning, among which DM, covers a central role in preserving autonomy (Oschwald et al., 2019). Moreover, it appears essential to better understand the mechanisms underlying the cognitive elaboration of positive and negative consequences of a choice under conditions of uncertainty and risk, and the processes that lead the selection of a choice option over another. Dopamine is assumed to play an important role in such processes and PD – which is the second most common neurodegenerative disorder usually occurring around 60 years (Chen et al., 2022) – deserves attention. It allows both to delve into the neurocognitive DM mechanisms and to promote PD patients’ wellbeing.

Thus, findings in such a field can support both (i) the prevention of possible negative results derived from poor choices and (ii) the cognitive enhancement and rehabilitation of these capacities by avoiding situations of fragility, which can be critical during the lifespan, and especially during aging, when consequences derived from bad decisions become more blatant and impacting the quality of life (Finucane and Lees, 2005; Denburg et al., 2007).
Chapter 1 presents a scoping review that aimed at providing a comprehensive overview of the relationships between DM under uncertainty and risk and cold EFs in healthy adults during the lifespan – with a focus on OAs – highlighting the main results from literature and identifying possible gaps. Similarly, Chapter 2 reports a scoping review aimed to delve into DM under uncertainty and risk and the relationships with cold EFs in patients affected by PD, as evidence highlighted the tendency toward risky choices in this disorder. In this Chapter, the neural mechanisms involved in DM are thoroughly analyzed, as PD affects most of the neural structures pivotal in decisional processes under uncertainty and risk. Basing on the main findings from Chapter 1 and the identified gaps to date present in literature, Chapter 3 reports a research study that investigated DM processes in a sample composed of healthy older adults, highlighting how cold EFs can support DM under uncertainty and risk during aging. As well, basing on results and suggestions of possible knowledge gaps present in the literature as stressed in Chapter 2, Chapter 4 concerns an in-depth research study aimed at deepening the cognitive and neural mechanisms implied in PD patients’ decisional process. Possible relationships of DM performances with cold EFs, individual traits, and dopaminergic medications were discussed, to shed light on possible factors which can lead patients to suboptimal and risky choices. In both Chapters 3 and 4 practical implications derived from findings were considered, and future research directions were suggested.