TECHNICAL COMMENTARY

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Decision making

Introduction

Decision making requires the use of knowledge and experience of a context in order to choose a course of action. The ability to autonomously make decisions is referred to as their decisional capacity. Effective decision-making aims to increase the likelihood of a favourable outcome in the relevant context, selecting responses that avoid unfavourable or harmful outcomes.

An experimental tool used to examine decision-making is the Iowa Gambling Task. On each trial, participants choose a card from one of four decks and receive a monetary gain or loss. Two decks (A, B) are disadvantageous and two decks (C, D) are advantageous. The decks also differ according to the amount of immediate gain, the relative frequency of gains vs. losses and the relative number of net losses. The goal is to maximize monetary outcome through adaptive decision-making across many trials.

Another experimental tool is the MacArthur Competence Assessment Tool, which assesses the ability to understand the relevant information, the ability to reason rationally, the ability to appreciate a situation and its consequences, and the ability to communicate a choice.

Method

We have included only systematic reviews with detailed literature search, methodology, and inclusion/exclusion criteria that were published in full text, in English, from the year 2000. Reviews were identified by searching the databases MEDLINE, EMBASE, and PsycINFO. Reviews with pooled data are prioritized for inclusion. Reviews reporting fewer than 50% of items on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA[1]) checklist have been excluded from the library. The evidence was graded guided by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group approach[2]. The resulting table represents an objective summary of the available evidence, although the conclusions are solely the opinion of staff of NeuRA (Neuroscience Research Australia).

Results

We found five systematic reviews that met our inclusion criteria[3-7].

- High quality evidence finds medium to large impairments in understanding, appreciation and reasoning decision-making and a small impairment in expression of a choice decision making. Effect sizes were smaller in studies using enhanced informed consent for people with schizophrenia.
- Moderate to high quality evidence finds people with schizophrenia also have lower performance scores on the Iowa Gambling Task, with more A and B deck choices and fewer D deck choices. There were also fewer C deck choices, although this was not significantly different to controls.
- Moderate quality evidence finds more severe psychotic symptoms and poorer verbal cognitive functioning are associated with reduced decision-making ability about treatment (small to medium-sized effects).

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Betz LT, Brambilla P, Ilankovic A, Premkumar P, Kim MS, Raffard S, Bayard S, Hori H, Lee KU, Lee SJ, Koutsouleris N, Kambeitz J

Deciphering reward-based decision-making in schizophrenia: A meta-analysis and behavioral modeling of the Iowa Gambling Task

Schizophrenia Research 2019; 204: 7-15

View review abstract online

Comparison	**Reward-based decision-making in people with schizophrenia vs. controls.**
Summary of evidence	**Moderate to high quality evidence (large samples, inconsistent, precise, direct) finds people with schizophrenia have overall lower performance scores on the Iowa Gambling Task, with more A and B deck choices and fewer D deck choices.**

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Measured by Iowa Gambling Task – net scores

25 samples, N = 1,886

Significant, medium to large reductions in net scores in people with schizophrenia in;

Block 2: d = -0.34, 95%CI -0.51 to -0.18, $p < 0.001$, I^2 = 66%

Block 3: d = -0.70, 95%CI -0.96 to -0.44, $p < 0.001$, I^2 = 85%

Block 4: d = -0.94, 95%CI -1.25 to -0.63, $p < 0.001$, I^2 = 89%

Block 5: d = -1.06, 95%CI -1.50 to -0.63, $p < 0.001$, I^2 = 94%

There were no significant differences in;

Block 1: d = 0.09, 95%CI -0.04 to 0.23, $p = 0.154$, I^2 = 45%

Authors report possible publication bias in block 5 results and adjusting for this reduced the effect size to -0.58, which remained significant.

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Measured by Iowa Gambling Task – deck choices

17 samples, N = 1,214

Significant, medium-sized increased number of cards chosen by people with schizophrenia from;

Deck A: d = 0.35, 95%CI 0.21 to 0.49, $p < 0.001$, I^2 = 25%

Deck B: d = 0.51, 95%CI 0.29 to 0.71, $p < 0.001$, I^2 = 68%

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People with schizophrenia drew significantly fewer cards from; Deck D: *d* = -0.62, 95%CI -0.84 to -0.41, *p* < 0.001, I^2 = 66% *There were no significant differences from;* Deck C: *d* = -0.13, 95%CI -0.37 to 0.11, *p* = 0.278, I^2 = 74%

Consistency in results‡	Inconsistent
Precision in results§	Precise
Directness of results‖	Direct

Hostiuc S, Rusu MC, Negoi I, Drima E

Testing decision-making competency of schizophrenia participants in clinical trials. A meta-analysis and meta-regression

BMC Psychiatry 2018; 18(1): 2

View review abstract online

Comparison	**Decision-making ability in people with schizophrenia vs controls.**
Summary of evidence	**High quality evidence (large sample, consistent, precise, direct) finds medium to large impairments in understanding, appreciation and reasoning decision-making and a small impairment in expression of a choice decision making. Effect sizes were smaller in studies using enhanced informed consent for people with schizophrenia.**

Decision-making ability **Measured by MacArthur Competency Assessment Tool**
Significant, medium to large impairments in decision-making capacity in people with schizophrenia in; Understanding: 13 studies, N = 1,142, OR = 0.18, 95%CI 0.12 to 0.29, *p* < 0.001, I^2 = 10% Appreciation: 13 studies, N = 1,142, OR = 0.20, 95%CI 0.14 to 0.28, *p* < 0.001, I^2 = 6% Reasoning: 13 studies, N = 1,142, OR = 0.27, 95%CI 0.17 to 0.42, *p* < 0.001, I^2 = 11% *Significant, small impairment in decision-making capacity in people with schizophrenia in;* Expression of a choice: 11 studies, N not reported, OR = 0.62, 95%CI 0.48 to 0.80, *p* < 0.001, I^2 =

0% The effect sizes were smaller in studies using enhanced informed consent for people with schizophrenia. There were no moderating effects of age, gender, or inpatient status, apart from studies with more men reported smaller effect sizes for reasoning only.	
Consistency	Consistent
Precision	Precise
Directness	Direct

Larkin A, Hutton P

Systematic review and meta-analysis of factors that help or hinder treatment decision-making capacity in psychosis

British Journal of Psychiatry 2017; 211: 205-215

View review abstract online

Comparison	**Factors associated with decision-making capacity in relation to treatment in people with schizophrenia.**
Summary of evidence	**Moderate quality evidence (medium-sized samples, some inconsistencies, precise, direct) finds more severe psychotic symptoms and poorer verbal cognitive functioning are associated with reduced decision-making ability about treatment (small to medium-sized effects).**
Factors associated with understanding information about treatment decisions	
The following factors were associated with reduced understanding (medium-sized effects); Increased psychotic symptoms: 9 studies, N = 610, r = -0.45, 95%CI -0.55 to -0.34, $p < 0.05$, I^2 = 60% Lower verbal cognitive functioning: 4 studies, N = 203, r = 0.42, 95%CI 0.20 to 0.60, $p < 0.05$, I^2 = 60% Fewer years of education: 3 studies, N = 201, r = 0.46, 95%CI 0.36 to 0.56, $p < 0.05$, I^2 = 0%	
Factors associated with reasoning about treatment decisions	

Decision making

The following factors were associated with reduced reasoning (small effects); Increased psychotic symptoms: 7 studies, N = 528, r = -0.31, 95%CI -0.48 to -0.12, $p < 0.05$, I^2 = 80% Lower verbal cognitive functioning: 3 studies, N = 177, r = 0.39, 95%CI 0.26 to 0.51, $p < 0.05$, I^2 = 0% Fewer years of education: 3 studies, N = 201, r = 0.26, 95%CI 0.12 to 0.38, $p < 0.05$, I^2 = 0%	
Consistency	Consistent, apart from psychotic symptoms and cognitive functioning (understanding)
Precision	Precise
Directness	Direct

Wang SB, Wang YY, Ungvari GS, Ng CH, Wu RR, Wang J, Xiang YT

The MacArthur Competence Assessment Tools for assessing decision-making capacity in schizophrenia: A meta-analysis

Schizophrenia Research 2017; 183: 56-63

View review abstract online

Comparison	**Decision-making ability in people with schizophrenia vs controls.**
Summary of evidence	**Moderate to high quality evidence (large samples, mostly inconsistent, precise, direct) finds large impairments in understanding and appreciation decision-making, a medium-sized impairment in reasoning decision-making and a small impairment in expression of a choice.**
Decision-making ability **Measured by MacArthur Competency Assessment Tool**	
Significant, large impairments in decision-making capacity in people with schizophrenia in; Understanding: 10 studies, N = 726, SMD = -0.81, 95%CI -1.06 to -0.56, $p < 0.001$, I^2 = 55%, p = 0.02 Appreciation: 7 studies, N = 489, SMD = -0.87, 95%CI -1.20 to -0.53, I^2 = 58%, p = 0.02 *Significant, medium-sized impairment in decision-making capacity in people with schizophrenia in;* Reasoning: 10 studies, N = 726, SMD = -0.57, 95%CI -0.80 to -0.34, $p < 0.001$, I^2 = 50%, p = 0.04	

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Significant, small impairment in decision-making capacity in people with schizophrenia in; Expression of a choice: 7 studies, N = 489, SMD = -0.24, 95%CI -0.43 to -0.05, p = 0.01, I^2 = 0%, p = 0.81 There were no moderating effects of age.

Consistency	Inconsistent, apart from expression of a choice
Precision	Precise
Directness	Direct

Woodrow A, Sparks S, Bobrovskaia V, Paterson C, Murphy P, Hutton P

Decision-making ability in psychosis: A systematic review and meta-analysis of the magnitude, specificity and correlates of impaired performance on the Iowa and Cambridge Gambling Tasks

Psychological Medicine 2019; 49: 32-48

View review abstract online

Comparison	**Decision-making ability in people with schizophrenia vs controls.**
Summary of evidence	**Moderate to high quality evidence (large sample, some inconsistency, precise, direct) finds a medium-sized effect of poor decision-making ability in people with schizophrenia compared to controls.**

Decision-making ability

Measured by Iowa or Cambridge Gambling Tasks

A medium-sized effect of poorer performance on decision-making tasks in people with schizophrenia;

47 studies, N = 4,264, g = -0.57, 95%CI -0.66 to -0.48, p < 0.001, I^2 = 45%

Small associations were found between poor decision-making and more severe negative symptoms, more depression and general symptoms, poor working memory, poor social functioning, lower IQ, low awareness of emotional responses to information, and more attentional bias towards gain.

There were no associations with positive symptoms, education, executive functioning, or overall symptoms.

No significant differences were found between controls and people taking first-generation or low-

dose antipsychotics.	
Consistency	Some inconsistency
Precision	Precise
Directness	Direct

Explanation of acronyms

CI = confidence interval, *d* = Cohen's d standardised mean difference, *g* = Hedge's g standardised mean difference, N = number of participants, I^2 = percentage of variance in results across studies, N = number of participants, OR = odds ratio, *p* = statistical probability of obtaining that result ($p < 0.05$ generally regarded as significant), *r* = correlation coefficient, vs. = versus

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Explanation of technical terms

* Bias has the potential to affect reviews of both RCT and observational studies. Forms of bias include; reporting bias – selective reporting of results; publication bias - trials that are not formally published tend to show less effect than published trials, further if there are statistically significant differences between groups in a trial, these trial results tend to get published before those of trials without significant differences; language bias – only including English language reports; funding bias - source of funding for the primary research with selective reporting of results within primary studies; outcome variable selection bias; database bias - including reports from some databases and not others; citation bias - preferential citation of authors. Trials can also be subject to bias when evaluators are not blind to treatment condition and selection bias of participants if trial samples are small[8].

† Different effect measures are reported by different reviews.

Prevalence refers to how many existing cases there are at a particular point in time. Incidence refers to how many new cases there are per population in a specified time period. Incidence is usually reported as the number of new cases per 100,000 people per year. Alternatively some studies present the number of new cases that have accumulated over several years against a person-years denominator. This denominator is the sum of individual units of time that the persons in the population are at risk of becoming a case. It takes into account the size of the underlying population sample and its age structure over the duration of observation.

Reliability and validity refers to how accurate the instrument is. Sensitivity is the proportion of actual positives that are correctly identified (100% sensitivity = correct identification of all actual positives) and specificity is the proportion of negatives that are correctly identified (100% specificity = not identifying anyone as positive if they are truly not).

Weighted mean difference scores refer to mean differences between treatment and comparison groups after treatment (or occasionally pre to post treatment) and in a randomised trial there is an assumption that both groups are comparable on this measure prior to treatment. Standardised mean differences are divided by the pooled standard deviation (or the standard deviation of one group when groups are homogenous) that allows results from different scales to be combined and compared. Each study's mean difference is then given a weighting depending on the size of the sample and the variability in the data. Less than 0.4 represents a small effect, around 0.5 a medium effect, and over 0.8 represents a large effect[8].

Odds ratio (OR) or relative risk (RR) refers to the probability of a reduction (< 1) or an increase (> 1) in a particular outcome in a treatment group, or a group exposed to a risk factor, relative to the comparison group. For example, a RR of 0.75 translates to a reduction in risk of an outcome of 25% relative to those not receiving the treatment or not exposed to the risk factor. Conversely, a RR of 1.25 translates to an increased risk of 25% relative to those not receiving treatment or not having been exposed to a risk factor. A RR or OR of 1.00 means there is no difference between groups. A medium effect is considered if RR > 2 or < 0.5 and a large effect if RR > 5 or < 0.2[9]. lnOR stands for logarithmic OR where a lnOR of 0 shows no difference between groups. Hazard ratios

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measure the effect of an explanatory variable on the hazard or risk of an event.

Correlation coefficients (eg, r) indicate the strength of association or relationship between variables. They can provide an indirect indication of prediction, but do not confirm causality due to possible and often unforseen confounding variables. An r of 0.10 represents a weak association, 0.25 a medium association and 0.40 and over represents a strong association. Unstandardised (*b*) regression coefficients indicate the average change in the dependent variable associated with a 1 unit change in the independent variable, statistically controlling for the other independent variables. Standardised regression coefficients represent the change being in units of standard deviations to allow comparison across different scales.

‡ Inconsistency refers to differing estimates of effect across studies (i.e. heterogeneity or variability in results) that is not explained by subgroup analyses and therefore reduces confidence in the effect estimate. I^2 is the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance) - 0% to 40%: heterogeneity might not be important, 30% to 60%: may represent moderate heterogeneity, 50% to 90%: may represent considerable heterogeneity and over this is considerable heterogeneity. I^2 can be calculated from Q (chi-square) for the test of heterogeneity with the following formula[8];

$$I^2 = \left(\frac{Q - df}{Q}\right) \times 100\%$$

§ Imprecision refers to wide confidence intervals indicating a lack of confidence in the effect estimate. Based on GRADE recommendations, a result for continuous data (standardised mean differences, not weighted mean differences) is considered imprecise if the upper or lower confidence limit crosses an effect size of 0.5 in either direction, and for binary and correlation data, an effect size of 0.25. GRADE also recommends downgrading the evidence when sample size is smaller than 300 (for binary data) and 400 (for continuous data), although for some topics, these criteria should be relaxed[10].

‖ Indirectness of comparison occurs when a comparison of intervention A versus B is not available but A was compared with C and B was compared with C that allows indirect comparisons of the magnitude of effect of A versus B. Indirectness of population, comparator and/or outcome can also occur when the available evidence regarding a particular population, intervention, comparator, or outcome is not available and is therefore inferred from available evidence. These inferred treatment effect sizes are of lower quality than those gained from head-to-head comparisons of A and B.

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