Reflection in (and on) Cognitive Remediation

Dame Til Wykes
Institute of Psychiatry, Psychology and Neuroscience

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Creator: CIRCuiTS
1. What is cognitive remediation and why do we need it?
Developmental lag from age 7

6-18 months behind typical development between 8-21yrs
Higher symptom severity related to more cognitive impact
Gur et al 2014, JAMA Psychiatry

Seidman et al., 2013, Psy.Med.

Delayed milestones increases risk of Sz
Stochle et al, 2019 online
“I was looking at A or B for some subjects now I’m looking at C or D if I’m lucky.”

“Memory loss is the new thing that’s bothering me.”

“I have low concentration”

“I’m coming to terms with the fact that I have got a learning difficulty.”

Michael, Aged 16 years
“My concentration is very poor. I jump from one thing to another. If I am talking to someone they only need to cross their legs or scratch their head and I am distracted and forget what I was saying.”

McGhie and Chapman, 1961
**Independence**
“Living in my own flat”

**Life Skills**
“Being able to cook when I want to”

**WORK**
“Having a little job”

**Fulfilling Relationships**
“Having a girlfriend”

Rethink 2010
Predicting dependence on care
The Netherne Series

Wykes, Katz, Hemsley, Dunn & Sturt, 1990 -1994

Positive symptoms

Negative symptoms

Length of illness
Previous skills

Thinking flexibility

Dependence on psychiatric services
Predicting dependence on care
The Netherne Series

Wykes, Katz, Hemsley, Dunn & Sturt, 1990 -1994

Positive symptoms

Negative symptoms

Thinking flexibility

60%

Dependence on psychiatric services

Length of illness

Previous skills
Predicting the costs of care

Cognition difficulties predict cost

*Significant at the 0.05 level

Patel, A. et al., 2006 Sz Res
How much data is enough?
New Schizophrenia Data 2014 -2018

• 87 trial reports
  • Multiple methods
  • Different ages, symptom profiles, stage of illness

▪ 20 meta-analyses
  ▪ 18 found significant cognition and/or functioning improvement
  ▪ 15 found symptom improvement

"cognitive" OR "cognition") AND ("training" OR "remediation" OR "rehabilitation" OR "enhancement") AND ("random" OR "randomised control" OR "randomized control" OR "randomised controlled" OR "randomized controlled" OR "trial"
What is Cognitive Remediation?

“is an intervention targeting cognitive deficit* using scientific principles of learning with the ultimate goal of improving functional outcomes. Its effectiveness is enhanced when provided in a context (formal or informal) that provides support and opportunity for extending everyday functioning.”

*(attention, memory, executive function, social cognition or meta cognition)

Cognitive Remediation Expert Working Group 2012
Multi-Outcome Meta-Analysis (MOMA) of Cognitive Remediation in Schizophrenia:

- 67 studies
- 4067 participants

Lana Kambeitz-Illankovic et al, Dec 2019 Neuroscience and Biobehavioral Reviews
Differentiating cognitive remediation
Differentiating cognitive remediation

- Drill & Practice vs Drill & Strategy
- General vs Specific Cognitive domains
- “Top down” versus “bottom up”
  - What does this mean? Attention vs Executive functioning training?
- Compensation vs Restorative
  - Strategies vs Rebuilding Cognitive Networks
Cognitive outcomes

Drill+Practice vs Drill+Strategy

NO DIFFERENCES

Wykes et al 2011
Differentiating cognitive remediation

- Drill & Practice vs Drill & Strategy
- General vs Specific Cognitive domains

- “Top down” versus “bottom up”
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  - Strategies vs Rebuilding Cognitive Networks
Specific versus General CRT?

- 138 participants
  - 65 to CRT (general)
  - 73 to RECOS (personalised)

- No differences between the arms
  - Cognition
  - Functioning

Franck et al 2013
Differentiating cognitive remediation

• Drill & Practice vs Drill and Strategy
• “Top down” versus “bottom up”
  • What does this mean? Attention vs Executive functioning training?
• Compensation vs Restorative
  • Strategies vs Rebuilding Cognitive Networks

• Neural plasticity informed training
  • Restorative? Compensation?
2. Plasticity
Plasticity – what is it?

“Dynamic organisation of the brain”

(Brown and Sherrington, 1912)

Definition

“the ability of the central nervous system (CNS) to adapt in response to changes in the environment or lesions”

(Sharma et al 2016)
May involve

- “modifications in overall cognitive strategies to successfully cope with new challenges (i.e., attention, behavioural compensation)”

  Bury and Jones, 2002

- “recruitment of new/different neural networks”

  Lotze et al, 2006

- “changes in strength of such connections or specific brain areas in charge of carrying out a particular task (i.e., movement, language, vision, hearing)”

  Cohen et al 1997
What is neural plasticity?
Morishita and Vinogradov, Schiz Res May 2019

- Reduced or excessive unregulated plasticity (Voss et al 2019) in auditory system
- Hyper- or hypo- plasticity phenotypes (Smith et al, 2019) using transcriptomics
Can biology tell us about whether CR changes plasticity?
### Neural Plasticity

#### Brain imaging studies
- Activation ✓
- Activation modulation ✓
- Structural changes ✓
- Connectivity ✓
- Predict treatment outcome ✓

#### Other potential indicators
- BDNF
- Genes
D’oh!
Brain changes

Neurocognition

Hepatocognition

Nephrocognition
The Brain

Blobs

Nodes and Edges
Specific or Generalised networks

Default Mode Network vs Extrinsic Mode Network

Activate same network whatever the task

Fedorenko, Duncan & Kanwisher 2013  Hugdahl, Raichle, Mitra & Specht 2015
3. Is cognition enough?
What is Cognitive Remediation?

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Cognitive Remediation Expert Working Group 2012
So far

Cognition

Therapy

Cognition

Rehabilitation or Recovery programmes

Functioning
Multi-Outcome Meta-Analysis (MOMA) of Cognitive Remediation in Schizophrenia:

- 3 outcomes
  - cognitive,
  - clinical,
  - functioning
- CR training vs Active control
- Schizophrenia diagnosis

Lana Kambeitz-Ilankovic et al, Dec 2019 Neuroscience and Biobehavioral Reviews

67 studies
4067 participants
Causal interventionist approach

Peña et al, 2018, Psy Res

- Verbal memory improvement partially mediates improved UPSA

- Processing speed improvement partially mediates GAF improvement

- No effects for social cognition or negative symptoms

Wykes, Reeder, Huddy, et al
Schizophrenia Research 2012
Mediating effects
Working memory on negative symptoms using DOCTRS database

Multiple group path analysis standardised beta coefficients

Cella, Stahl, Keefe, Bell, Morris, and Wykes Psych Med Nov 2017
Is cognition enough?

- Regular exercise - like a muscle it becomes stronger
- Muscle power is not sufficient – need skill too
- Need to develop metacognition, representations and cognitive strategies for stronger cognitive control

Wykes and Reeder, 2005; Taatgen, 2013
What about metacognition?
The role of metacognition?
Applies to content and strategies

- **Declarative knowledge**
  - information that one knows e.g. equation for a calculation

- **Procedural knowledge**
  - knowledge about how to do something e.g. an object’s mass, its speed and how to do the calculation

- **Conditional knowledge**
  - knowledge about when to use a procedure, skill, or strategy and when not to use it; why a procedure works and under what conditions;
Why metacognition? Predicting Attenuated Symptoms

- Attenuated psychosis problems with cognition & metacognition
- APS vs Healthy controls
  - Using metacognition plus neurocognition and & interactions (saturated model) more predictive
- APS vs Treatment seeking
  - saturated model better than cognition alone

Koren et al Schiz Res, August 2019
Relationship over time

Metacognition related to cognition improvement

Also related to:
- Social cognition
- Quality of Life factor

Kukla and Lysaker 2020
Meta-analysis
Evidence of metacognition to function link

Mean ES=.24
7 studies
645 participants

Davies and Greenwood 2018
Metacognition partially mediates the relationship of cognition and functional capacity.

Metacognition fully mediates the relationship between capacity and functional outcome.
Why metacognition?

Employment in FEP

Functional Capacity
UPSA

Metacognition

Cognition

In work or not

17.9% OR 1.9

13.7%

Wright et al 2019
Metacognition in therapy
What differences really matter?

Strategic approach only produced a significant functional effect

Drill+Practice = 0.34 (95% CI -0.11, 0.78) Not significant

Drill+Strategy = 0.47 (95% CI 0.22, 0.73) Significant

Wykes et al, 2011
Strategy Training changes the brain
Strategy for Semantic Association Memory (SESAME) training

SESAME

• Two one-hour therapist-led sessions
• Emphasised metacognition (how does memory work, why do we forget information, how can we improve our memory)
• How to use semantic information to improve memory by chunking, use in visual, verbal & auditory tasks
• Homework & Implementation

SESAME:

Tested pre- post training on: Recognition Recall

Self initiated semantic strategies used (items related but cue was “bigger”) and self report of strategy use

SESAME training increases plasticity?

Memory improvements associated with:

• Increased DLPFC activity

• More cortical reserve, more improvement

Executive vs perceptual processing training
(Best et al, AMJ online March 2019)

Executive training = Metacognitive training = Transfer
A metacognitive approach to CRT

1. Set goals

2. Target metacognition
   - Teach new approach to tasks: *metacognitive regulation*
   - Teach *metacognitive knowledge*:
     - Own thinking & what affects it
     - Thinking in general (e.g. strategies)
     - Tasks and goals

3. Integrate into everyday life

Wykes and Reeder, 2005
Metacognition and strategy in cognitive remediation

- Metacognitive support built into therapy
  - Goals, strengths and difficulties, strategies for building knowledge
  - Emphasise selection & evaluation of strategies for building self reflection and metacognitive processing
- Recovery-based, focussed on real-world goals
CIRCuits - Targeting Metacognition

Codes

Well done, you've finished the task!

Score: 50

How difficult did you find this task?

1 2 3 4 5

EASY DIFFICULT

It took you 1 minute 4 seconds.
Your initial estimate was more than 15 minutes.

Strategies Used

How useful were the strategies?

NOT USEFUL VERY USEFUL

ABC
Check that your message makes sense

1 2 3 4 5

123
Cross off each symbol as you translate it

1 2 3 4 5

Use a notepad

1 2 3 4 5

Scan between the image, on to the other

1 2 3 4 5

Divide the text into chunks

1 2 3 4 5

Say your response out loud

1 2 3 4 5

FINISH
Metacognitive improvement over time

RCT
CIRCuiTS vs TAU

Improved metacognition at follow-up

Cella, Edwards, Swan, Elliot, Reeder, Wykes 2019
4. How does CRT work?
What is Cognitive Remediation?

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Cognitive Remediation Expert Working Group 2012
Why is metacognition important?

Pedagogical data

- Mean effect size .71 for teaching reading
  Haller et.al., 1988
- Metacognition and self regulated learning has a high strength of evidence
- Impact - about 8 months of schooling at a cost of £100 per pupil
  Higgins et al, 2012
Neural plasticity learning principles

- Longer massed practice sessions for learning
  - Evidence from mice
- Ordered sequences
  - Train one skill at a time
Some surprising scientific learning principles

- **Storage and retrieval strength (SS, RS)**
  - Learning in different contexts builds SS so more likely to remember

- **Desirable difficulties**
  - Interleaving training more likely to produce better long term recall or mastery (Rohrer & Taylor, 2007)
  - Increasing difficulty of intervening task improved learning (Bjork et al. 2009)
  - Spacing not massing practice (Cepeda et al. 2006)
  - Vary conditions of practice (Cepeda et al. 2006)
Are we missing anything else?
Are therapists important?

Best & Bowie 2019 SIRS

- Functioning not assessed
- No change in functioning
- Change one functional domain
- Change multiple functional domains
Therapists are important!

Effect size boost with addition of therapist support (supplementary human guidance; SHG)

Working and Verbal memory domains the most influenced

Kambeitz-Illankovic et al, 2019 Dec
Is it a game or a therapy?

- **Therapeutic Alliance**
  - predicts engagement in tasks (Huddy et al, 2012)
  - Strategy use (Cella and Wykes, 2019)

- **Therapist valued** (Rose et al, 2008; Contreras et al, 2016)

- **Perceived treatment usefulness and enjoyment** affects cognitive improvement (Bryce et al, 2018)

- **Engagement in CRT** may predict engagement in other rehabilitation (Thomas et al, 2018)

- **Boost** cognitive effects (Kambeitz-Illankovic et al, 2019)
What do therapists need?
CIRCuiTS website
https://www.circuitstherapyinfo.com/
Training programme

Weekly overview

This online course is structured into weekly topics and is designed to be completed in four weeks. You should ideally aim to follow this structure (two modules in the first week, and three in subsequent weeks), but if you need to work at a slower pace this is fine.

- **Week 1: Introduction**
  - Module 1: Introduction to the Course and CRT
  - Module 2: How to Use CIRCuits

- **Week 2: Targeting Cognition and Metacognition**
  - Module 3: Cognitive Targets
  - Module 4: Metacognitive Knowledge
  - Module 5: Metacognitive Regulation

- **Week 3: Harnessing Motivation**
  - Module 6: Setting Goals and Motivation
  - Module 7: Optimising Learning and Motivation
  - Module 8: Selecting, Assessing, and Formulation

- **Week 4: Transfer to Everyday Living**
  - Module 9: Encouraging Independence and Transfer
  - Module 10: Your Role as a Therapist
  - Module 11: Getting Started with CIRCuits

Module structure

Before we enter the main menu, let’s look at how to work through the pages in these online modules. Below is what each module’s menu page will look like. Most modules follow the same structure and are organised into four sections. You will work through each section one after another, starting with Section 1 on the left. Each section only becomes accessible after the preceding section has been completed.

Select the icons below to learn about the general content of each section.

1. The story so far
2. Get the basics
3. Dig deeper
4. Put it into practice
Introduction: Cognition and mental health

Goals discussion
During a discussion about his shopping goal, in the video below Tom and his therapist touch on the current difficulties he has when he goes shopping.
Learning from our mistakes
Lesson 1: eCaesar trial

- Brain Fitness vs 13 “off the shelf” computer games
  - Brain fitness - ordered, massed practice of domains
  - Active control – varied practice
- Extrinsic motivation (paid completed sessions, game wrapper)
- No therapist

Mahncke et al 2019
Both groups improved
No group differences
Lesson 2: Individual Placement and Support + CR & Work-Focused Social Skills

- **Three groups**
  1. Individual placement & Support (**IPS**)  
  2. Individual placement & Support + CR and Social Skills (**IPSE**)  
  3. Service as usual (**SAU**)  

**RESULT**

- **IPSE >SAU; IPS>SAU**
- **No difference between IPSE and IPS**

*Christensen et al, 2019*
Average 9.6 CR sessions
< third of intended sessions,
57 received 0 sessions)
Potential Mechanisms of Cognitive Remediation Action

Models are not mutually exclusive or exhaustive…

Wykes and Spaulding, 2012; Wykes in preparation
Potential Mechanisms of Cognitive Remediation Action

Models are not mutually exclusive or exhaustive…

Wykes and Spaulding, 2012; Wykes in preparation
Summary of my talk

Mechanism for improvement includes metacognition

Use scientific learning principles to boost metacognition

Strategy implementation (Transfer) needs metacognition

Therapists encourage metacognition changes
All science takes many hands and brains, so thanks to a little help from my friends

In particular the team for the CIRCuiTS trial

Clare Reeder
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Rumina Taylor
Matteo Cella