Assessing Psychiatric and Learning Disorders:
A Dual-Tiered Perspective

Deborah Budding, Ph.D, ABPdN, ABN

509 N. Sepulveda Blvd., Ste 102

Manhattan Beach, CA 90266

(310) 318-8436

debudding@verizon.net

www.deborahbudding.com

Topics Part I

- Review of Dual-Tiered Cognitive Model

- Language and Language-Related Learning Disorders

- Social Cognition and Psychiatric Disorders

Topics Part II

- Assessment Considerations: Neuropsychological tests in a dual-tiered context.

- Proposed tests/methodologies
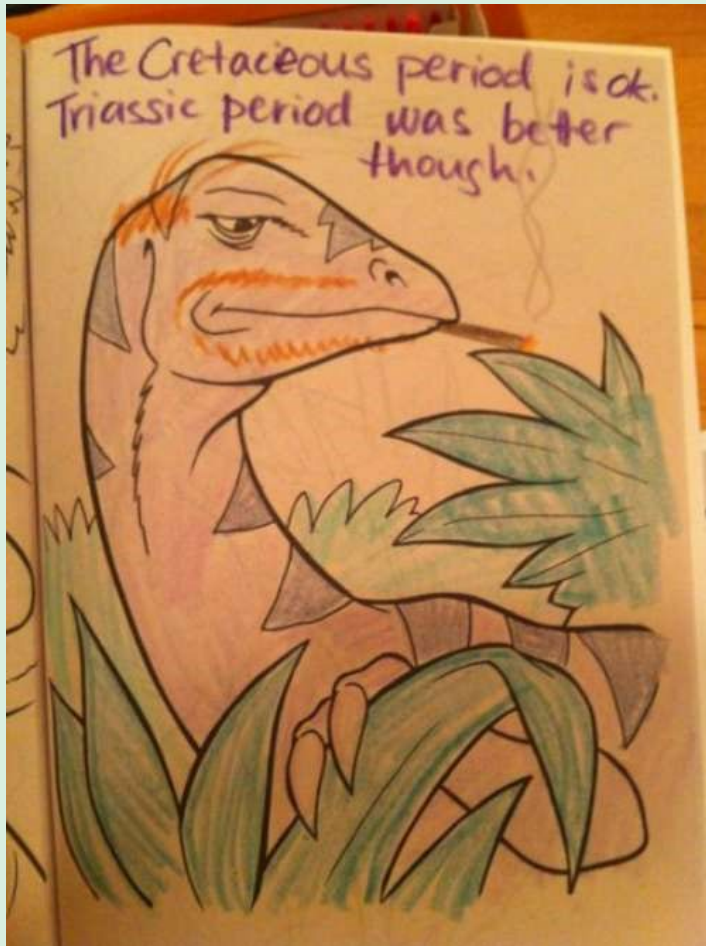
Part I

Review of Dual-Tiered Model

- The main purpose of any living organism is survival.
- In order to survive we must interact with our environment.
- Successful interaction with the environment is called…
- ADAPTATION

Unsuccessful =
EXTINCTION

Predictable vs. Unpredictable

- Some aspects of the environment are very predictable and benefit from a fixed, routine, automatic response.

- Some aspects of the environment are novel and require flexible response.

- Hence, we need both a "habit" and a "thinking" system.

Automatic v. Effortful Processing

- How Is Behavior Generated?
  - Internally (self-generated)
    - From a thought
    - From a feeling
    - From a memory
  - Externally (environmentally prompted)
    - From another's directions
    - When outer circumstances shift

Stimulus-Based Processing

- Advantages:

  - Quick, consistent responses to familiar circumstances and predictable features.
  - Conserves resources.
  - Always works under proper circumstances.

Disadvantages:

- Limitations to number of "trigger stimuli."
- Cannot create new behaviors under novel conditions,not flexible.
- No ability to "move in order to perceive."

Higher-Order Processing

- Advantages:
    - Can manage novelty and ambiguity.
    - Can be flexible and set stage for cognitive control.
    - Allows autonomy through ability to program goal-directed behaviors.

- Disadvantage:
  - **SLOW**

Therefore, we have both….

- Stimulus-based control:
  - Fast, accurate, efficient, but "dumb."

- Higher-order control :
  - Smart, flexible and creative, but slow.

- Added bonus: Solutions to "novel" problem-solving situations can be automated for future application

Automatic v. Effortful Processing

- Whether externally prompted or internally generated, behavior falls on a continuum between

Automatic ⟵——————⟶ Controlled

Or, more accurately

Controlled

$\updownarrow$

Automatic

A hierarchically ordered system with different levels of automaticity.

Any adaptive behavior features variously alternating episodes of automatic and controlled function.

Life is Filled with Adaptive Challenges

- We constantly need to adapt ourselves to a changing environment, a fact we tend to take for granted.
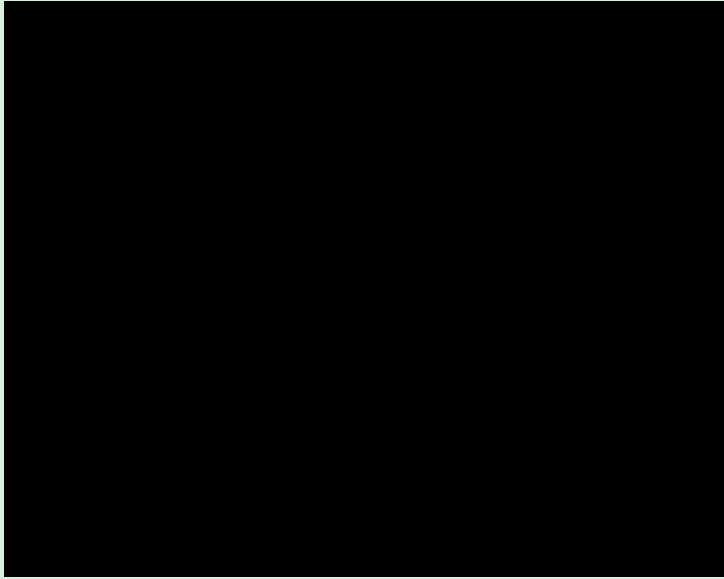
Too much automaticity

- Habitual behaviors/responses are released in situations where they're not adaptive
  - Speed through a page of equations without recognizing signs of operation are different
  - Exit at "your" offramp
  - See your mate as your mother

- Sources of error: The faster we go…..
  - Greater vulnerability to little mistakes
  - Less opportunity to learn from experiences

Not enough automaticity

- Everyday tasks are effortful
    - Morning "routines" are not
    - Physical act of writing requires cognitive effort
    - Social interactions lack fluency/ease
    - The cost of calculating math facts

- Sources of error: The slower we go……
    - Burden working memory &sustained attention
    - More procedural error ("get lost" in the material)
    - The less rewarding the experience and the less the likelihood we will persist

"In theory, there is no difference between theory and practice. In practice there is."

-Yogi Berra

Part I

Language and Learning Disorders

Language and Adaptation

We need to re-orient from:

- Left Hemisphere=Verbal
- Right Hemisphere=Nonverbal/spatial

To:

- Right Hemisphere=Novel
- Left Hemisphere=Routine
  - Podell, Lovell & Goldberg (2001)

At its base, language allows us to categorize our experiences ("eat" vs. "spit out")

Language allows us to take something novel and make it routine.

Link between evolution of language and tool use/development.

Ambrose, 2010

Ullman's Declarative-Procedural Language Model (2005)

- This model links language function specifically to declarative-procedural memory systems.

- Language has rule-based and semantic aspects.

Declarative "Mental Lexicon"

- The brain's dictionary of words.
- The brain's store of idiosyncratic word-specific information
  - (e.g. "dog" or "Boring Seminar")
- The brain's store of unpredictable word forms
  - "thought" vs. "thinked"
  - idioms like "He has a chip on his shoulder."

Rule-based "Mental Grammar"

- Predictable, and provides rules to combine words in complex ways.

- A system that underlies both linguistic and nonlinguistic aspects of language.

Meaningless, yet Meaningful

"The spong plicked the golb."

Reading, Writing, and Language

Reading and writing are extensions of the language system.

Procedural Deficits in Reading

- Fluent and accurate decoding are foundational skills for reading.

- Fluency depends upon the ability to establish a sight word vocabulary and retrieve sight words quickly.

- Decoding depends upon the ability to automate sound-symbol relationships, so they are robust enough to withstand being stretched and manipulated in the service of sounding out unfamiliar words.

    Nicolson & Fawcett, 2007

Non-disordered reading relies upon well-automated functions for fluent, quick comprehension. We have to slow down in order to access novel or challenging material.

Examples:

- Reading this slide will be quick and easy as the material is simple and the vocabulary is not very complicated.

On the other hand,

- The evidence, provided by experimental data, that the Central Nervous System is able to account for dynamic compensations, led to the hypothesis of the existence of the so-called Internal Models (IM), which implement the neural mechanisms connecting input and output signals of the sensorimotor system in a feedforward fashion. These architectures are considered as the keystone upon which the motor control takes shape and dynamically evolves. They intrinsically contain information about the mechanical properties of the human body in relation both to the environment and to the subject's experience.

Procedural Deficits in Writing

14 year old, Caucasian, right-handed girl comes to clinical attention for school problems (especially writing and math) and homework avoidance.

Secondary problems include limited social interest and avoidance of social settings.

- Case courtesy of Dana Chidekel, Ph.D.

Woodcock Johnson Tests of Achievement, III

Spelling   SS= 97   42nd percentile
Editing   SS= 95   37th percentile
Writing Samples   SS= 103 58th percentile

Test of Written Language, Spontaneous Writing

Contextual Conventions ss= 9   37th percentile
Contextual Language   ss= 8   25th percentile
Story Construction   ss= 11 63rd percentile

How bad could her writing be?

Jon felt the air presser press agenst him from outside his starck white astronat suit. He lifted his hand agien above his head then let it swing down. Bang went the metal as it hit the moon rock the stone cracked then fell away reviling what John had been looking for, evidence.

John put his finger to the talk boton on his radio and sayed into it, Iv got it chief."

He let go of the botton then heard the low and gruff voise of the chief, "well done Tomson im sending the crew."

Jon left his hammer and picked up a brush. He sweeped it over the smoth coloed serface of the rock a few times, then read the word BROTHERS. It was carved into the top of the stone almost like a toumb. he wondered what it stood for and if he was relly neeling on a grave sight.

Procedural Deficits in Writing

- This is what can happen when individual skills are intact and procedures are not automated.

- The student may appear adequate if cognitive effort can be focused on discrete demands, but underlying weaknesses become apparent as soon as demands increase.

Procedural Deficits in Writing

- The same word is misspelled differently in the same passage (or the same sentence).

- Kids who "know" they should capitalize the first word of each sentence, don't do it.

- Punctuation marks are left out, misused and misused different ways in the same composition.

- Letters in words are left out, transposed, reversed, or added.

- There are run-on or fragmentary sentences.

Procedural Deficits in Writing

"scean"   "manshion" "exept"   "coxe"

- The Plot Thikns……..Spelling is phonetically correct and reflects orthographic errors.

- Orthographic errors reflect a lack of automaticity of commonly co-occuring, overlearned (or should be) letter combinations.

Procedural Deficits in Writing

- Writing is slowly and laboriously produced because sequences guiding letter production are not automated

  - Writing can be neat, at great cognitive and motoric expense.

  - Parents decide a child is lazy "because he can write so neatly if I stand over him."

Rate Rhythm & Force in Writing

- Motor
  - Press too hard with a pencil
  - Don't press hard enough
  - Space letters poorly

- Cognitive
  - Write too much for the assignment
  - Write too little for the assignment

- Some kids come up with creative compensatory strategies.

Psychiatric Disorders as Problems in Adaptation

- Social skills feature numerous automatic and controlled features.

- We know to make eye contact, to shake hands, how close to stand.

- Many psychiatric and developmental disorders feature trouble applying these very skills.

Social Cognition- Lieberman

- Matthew Lieberman and colleagues approach social cognition from a well-grounded perspective in functional imaging and cognitive neuroscience.

- The X and C systems represent aspects of automatic and controlled processing.

C-System

- The "C-system" is named for reflective processes that are symbolic, slow, and effortful.

- Activity in the C-system typically feels like self-generated thought and is linguistic.

X-System

- The "X-system" is named for reflexive and intuitive processes that are non-symbolic, fast, and effortless.

- Activity in the X-system, typically feels like reality being directly experienced and is more often perceptual or affective (and sometimes non-conscious).

Research using this model is looking at issues ranging from decision making, to addiction, to prejudice…

Berkman, E. T., Falk, E. B., & Lieberman, M. D. (in press). In the trenches of real-world self-control: Neural correlates of breaking the link between craving and smoking. *Psychological Science*

What Makes a Personality?

- Each of us is wired with a preference for, and relative ease in adapting to, novelty versus routine.

- Some people create procedures more easily than others (whether the activity is interesting or not).

- Some people are better able to change procedures, with or without environmental prompting.

Psychopathology

- Much psychopathology is related to habitual ways of responding in the context of circumstances in which they are not adaptive.

- Most people with (Axis I) psychiatric disorders can recognize their responses are maladaptive, while they can't consciously change their ways of responding.

Automaticity/Control in Psychiatric Problems

- Most psychiatric disorders are diagnosed in relation to symptoms and their impact on functioning.

  - Activities of daily living
  - Ability to respond to social, academic, work demands
  - Ability to love, work and play (Thank you Dr. Freud)

Automaticity/Control in Psychiatric Problems

- Most affect the ability to make - and implement - effective, adaptive decisions about what to do, and when and how to do it.

- Many - if not most - psychiatric disorders interfere with people's ability to bring intentions to fruition constructively.

Automaticity/Control in Psychiatric Problems

- Poor automaticity burdens higher order control.

- Poor automaticity requires you to use "too much of your brain" to perform activities, which necessarily slows down performance.

Automaticity/Control Psychiatric Problems

- With poor automaticity, everyday tasks are effortful.

- May contribute to "vegetative" signs.
  - Getting out of bed and showering
  - Leaving the house to face the world
  - Making eye contact
  - Keeping up with the flow of simple conversation

Automaticity/Control Psychiatric Problems

- Being aware of and respecting boundaries is a central issue in adaptive function.

- Boundaries don't work well in multiple psychiatric disorders

- This can be a procedural problem - e.g. the intuitive (automatic) sense of how far to go is not working.

When Automaticity > Control

- A previously automated belief, behavior or series of behaviors is activated in a circumstance in which it is not adaptive.

  - Transference ("I am not your mother")
  - The same old argument
  - OCD rituals
  - Exiting at "your" offramp when you have an appointment that day further on

Two Ways to Understand Psychiatric Disorders

- As defined by the DSM.

- As a function of dynamic developmental processes.

Limitations of DSM Diagnoses

- They are behavior-based and atheoretical whereas most psychiatric problems (other than those caused by trauma) are neurodevelopmental.

- Many children presenting for NP evaluation will simultaneously meet criteria for up to 5 diagnoses based on this system (Yaryura-Tobias, 2003).

- Most useful to think of symptoms on a continuum.

Developmental Approach

- Biological Contribution
  - Busy fetuses; colicky babies; "He was just different from the beginning"

- Environmental Contribution
  - Socioeconomic issues; parent temperament; culture; trauma

Developmental Approach

- When automaticity and higher order control go awry, problems arise.

  - ADHD
  - Autism
  - Mood Disorders
  - Anxiety Disorders
  - Schizophrenia
  - Personality Disorder

ADHD

- Impulsivity: deficits in knowing when not to start a behavior, and knowing when to stop one
  - Interrupting your boss during a meeting
  - Continuing to talk after you have done so
- Inattention: all of the above, plus deficits in knowing when to start a behavior and when to keep it going
  - Continuing to pay attention to this lecture
  - Not thinking about your grocery list during this slide

OCD

- Deficits in knowing when to stop a behavior or thought, and in knowing when not to start one.

- Persistence of a behavior despite conscious recognition that it is maladaptive (e.g. automaticity trumps higher-order thinking).

- ……Or vice versa.

- Inability to assign correct emotional valence to different objects in the environment - paralyzed by equal valence of all choices.

- A disconnect in the circuits between BG and CB that guide selection and refinement.

ADD v OCD/anxiety based attention problems

- Both create different types of attention problems.
- BG are interacting differently with limbic system to make decisions.
- Both can make you vulnerable to paying attention to the wrong information.
- Cerebellum modulates in both.

ADD v OCD/anxiety based attention problems

- ADD: Nothing is interesting enough to merit attention, so attention can be grabbed by extraneous influences
  - Ooh, something shiny!

- OCD/anxiety based attention problems: Everything is interesting enough to merit attention, so attention cannot be disengaged from extraneous influences
  - "What's your favorite color?"
    - Apologies to Monty Python…

Autism

- Core problems in reciprocal relationships and ability to use nonverbal social information.

- Adaptation depends on good procedural models for interaction that are stored in cerebellum.

  - These are compared and selected among in a given circumstance.

- Hence, trouble keeping up with social flow, and then, a propensity to react to the mismatch.

Autism

- Perseverative responses illustrate dysfunction of cerebellar processes that make online adaptations to circumstances and BG processes that guide knowing when to stop.

- "Dysmetria" of cognition, behavior and emotion:
  - Intensity is poorly matched to situation.
  - Undershooting and overshooting a target.

Mood Disorders

- Implied involvement of reward centers, so in a depressed state nothing looks or feels good.

- Chronic depression leads to chronicity of negative associations.

  - Is this why a recurrent disorder is more likely to recur?

  - May play a role in Seasonal Affective Disorder.

Mood Disorders

- Cerebellar involvement can contribute to underreaction to pleasurable features of the environment and overreaction to bad stuff.

- Rate, rhythm and force of reactions is poorly modulated.

Schizophrenia

- Cerebellar component - schizophrenia as cognitive dysmetria (see Nancy Andreasen's work).

- Psychotic thinking and cognitive deficits generate poor mental coordination, including difficulty…
    - Prioritizing
    - Processing
    - Coordinating
    - and Responding to
    - ……information

Schizophrenia

- Basal ganglia play a role in poor selection and interfere with ability to use working memory (see Robert Miller's work).

- Negative symptoms
  - Poor initiation/apathy = not knowing when to start a behavior, lack of sensitivity to rewards to facilitate adaptation/learning.

Schizophrenia

- Positive symptoms

  - Problems with attention and working memory.

  - Source memory problems associated with working memory deficits.

  - Auditory hallucinations a function of misattributing internal speech to external sources.
    - This happens automatically/unconsciously, irrespective of effort to bring a force of will to bear (e..g not under cognitive control)

Personality Disorders

- Axis I versus Axis II disorders can be differentiated on the basis of how much one sees problems residing within the self versus within others.

- A core deficit in self-reflection.

- Hallmark of PD is chronicity, magnitude, and pervasiveness of disruption in a person's life (and in the lives of those he/she knows).

Personality Disorders

- At the core is usually an Axis I disorder that's had a poor or inadequate environmental response.

    - No opportunity to develop a view of one's own role in life circumstances.

- Difficulty navigating between automatic and higher order control makes a person less able to adapt to, or change in response to, environmental demands.

Part II

NP Assessment
in a Dual-Tiered Context

Role of NP assessment in diagnosis/treatment

- Traditionally, NP assessment has been thought to be useful for brain injured people and not for people with psychiatric disorders whose problems were "purely psychological."

- Understanding psychiatric disorders from a neurodevelopmental perspective demonstrates the enormous value of NP assessment for a psychiatric population.

Ecological Validity

- People can look unimpaired on traditional measures….
  - A nearsighted person asked to read something close up will look fine.

- …but cannot function independently outside the office.
  - You can remember a list of words on a test, but you can't remember where you put your keys or whether you turned off the oven.

Interim measures

- NP currently does an excellent job of measuring many aspects of higher-order control.

- However, we lack adequate tools to help measure a person's ability to benefit from interactions with the environment.

Practice Effect

- Not simply a source of error.

- What does it say about a person who does not readily demonstrate practice effect versus someone who does?

- Why not measure it instead of simply trying to avoid it?

Processing Speed

- How might we consider tasks measuring "processing speed" from this perspective?

- Processing speed may represent the degree to which tasks require "effort."

- But not all tasks "the same" in relation to cognitive demands.

- For example, correlation of WISC IV Coding and Symbol Search tasks is .53, despite their placement together into an "Index."

- How might we think about patient data? What about someone who obtains a ss7 on one and ss12 on the other? What about someone who is quick with many errors vs. slow and accurate?

Coding/Digit Symbol   ss7

Symbol Search   ss12

Or

Coding/Digit Symbol ss12

Symbol Search   ss7

What are the cognitive demands of these tasks? What might working memory demands have to do with performance?

Mazes

- Many of us still have our WISC III or WISC R mazes sitting forlornly in files.

- Some of us actively use Mazes to supplement current WISC-IV.

- What if someone performs poorly on it?

Mazes

- How about giving Maze #9 multiple times?

- Five trials seems to be the "magic number" in NP.

- How does the individual do over those five trials?

Each trial measured with both time and number of errors.

Reduction in time and decrease of errors would comprise a rough index of procedural learning on the task.

Alternatively, administer until error-free performance reached.

Presumably, over time, the task would become automated and the subject's hand would appear to "move by itself" to completion.

Failure to learn maze, to improve time, to reduce errors would reflect a failure to benefit from procedural experience.

Trailmaking Tests

- Trail B requires both a search pattern and motor response.

- Fronto-striatal system required to "gate" alternating sequence of numbers and letters.

- In addition to traditional administration of Trails A and B and comparing performance…..

Poor performance on Trails B could be accompanied by repeating multiple times (5) or until reaching a ceiling on time/errors.

Performance would reflect a shift from controlled to automatic processes.

The Procedural-Instrumental Learning Battery (PIL)

- A series of tasks that can be used synergistically in concert with traditional NP measures.

- Will consider cortico-striatal and cerebro-cerebellar contributions to function.

Not organized similarly to traditional NP measures, particularly with regard to psychometrics.

Many of these skills are have/have not, and cannot be forced into a normal distribution.

All measures are currently used for research but not clinical purposes.

Five main components:

- Probabilistic Category Learning
- Serial Reaction Time Task
- Prism Adaptation Task
- Mazes Task
- Trail Making Part B

Important that tasks be very simple, and that they not require much "thinking."

Instrumental/Reinforcement Learning

- **Probabilistic Category Learning**
  - Weather Prediction type task
    - Cards associated with outcomes between 60 to 80 percent of time. Subjects feel they are guessing.
  - These types of "guessing" tasks recruit caudate nucleus.
  - Multiple variations used in research settings to evaluate response to reward.

Probabilistic, cont.

- These tasks have shown differences in responding to positive versus negative reinforcement within the striatum.

- Differences between medicated and non-medicated Parkinson's patients have been found.
    - Frank, M.J., 2005

Motor Sequence Learning

Sequence learning involves acquiring a sequence of events over time, motor or cognitive. The Individual acquires a "habit" of responding in a particular sequence.

Serial Reaction Time (SRT)

SRT, continued

- On some blocks the stimuli are presented in a particular sequence.

- On some the stimuli occur in random order.

- Learning is demonstrated by decrease in reaction time.

SRT, cont.

- Supplementary motor area, globus pallidus, putamen demonstrate training-related decrease in reaction time. These decreases were not observed in relation to random trials.
  - Poldrack et al, 2005

Probabilistic vs. SRT

- We can look at these tests in tandem. One recruits the cerebellum (SRT), the other does not.

- Some differentiation might be anticipated.

For example, Foerde and colleagues found Schizophrenic patients to be impaired on a Probabilistic Classification Task compared to normal controls but performed similarly on a SRT task.

   – Foerde et al, 2008

Adapting to Environmental Changes

- **Prism Adaptation**

- Subject learns to respond to a visual stimulus, then to adjust while wearing prism glasses.

- Glasses are removed and subject re-adjusts.

- This task recruits the cerebellum

Prism, cont.

- Patient populations with cerebellar involvement (such as schizophrenia) frequently perform well below level of normal controls.
  - Bigelow et al, 2006

Summary

- Our intention is to "whet the appetite" for improved means of assessing all aspects of patient function.

- Better understanding both declarative and procedural function will help us both more fully illuminate underpinnings of patient difficulties and craft more effective interventions.

References

- An, S.K. et al., (2008). To discard or not to discard: The neural basis of hoarding symptoms in obsessive-compulsive disorder. *Molecular Psychiatry*, doi: 10.1038/sj.mp.4002129.

- Ardila, A. (2008). On the evolutionary origins of executive functions. *Brain and Cognition, 68(1)*, 92-99.

Ambrose, S.H. (2010). Co-evolution of composite-tool technology, constructive memory, and language. *Curr Anthro 51 (1),*S135-147.

Awh,E. & Vogel, E.K. (2008). The bouncer in the brain. *Nature Neuroscience, 11*, 5-6.

References

Bigelow,N.O., Turner,B.M., Andreasen,N.C., Paulsen,J.S., O'Leary,D.S.& Ho,B.C (2006). Prism adaptation in schizophrenia. Brain & Cog, 61, 235-242.

Foerde, K., Poldrack, R.A., Khan, B.J., Sabb, F.W., Bookheimer, S.Y., Bilder, R.M. (2008). Selective Corticostriatal dysfunction in schizophrenia: Examination of motor and cognitive skill learning. N*europsychology,22,*100-119.

Frank, M.J. (2005). Dynamic dopamine modulation in the basal ganglia: A neurocomputational account of cognitive deficits in medicated and nonmedicated Parkinsonism. Journ. Cog. Neurosci, 17, 51-72.

Koziol, L.F. & Budding, D.E. (2009). Subcortical structures and cognition: Implications for neuropsychological assessment. New York: Springer.

References

Levin,F.M. (2009). Emotion and the Psychodynamics of the Cerebellum: A Neuropsychoanalytic Approach. London: Karnac Books.

McNab, F. & Klingberg, T. (2008). Prefrontal cortex and basal ganglia control access to working memory. *Nature Neuroscience, 11*, 103-107.

References

- Pernet, C. et al (2009). Brain classification reveals the right cerebellum as the best biomarker of dyslexia. BMC Neurosci. 2009; 10: 67
- Toates, F. (2006). A model of the hierarchy of behavior, cognition, and consciousness. *Consciousness and Cognition, 15,* 75-118.

References

- Yaryura-Tobias, J.A., et al. (2003). Possible basal ganglia pathology in children with complex symptoms. *Journal of Clinical Psychiatry, 64*, 1495-1501.