Understanding Working Memory

Robyn Milligan

(Adapted from Professor Susan E. Gathercole &
Prof. Tracy Packiam Alloway)

What is working memory?

Working memory describes the ability we have to **hold in mind and mentally manipulate information over short periods of time.** Working memory is often thought of as a mental workspace that we can use to store important information in the course of our mental activities. A good example of an activity that uses working memory is mental maths.

When do we use working memory?

Mental maths is just one example of an activity that relies on working memory. Other examples from everyday life include:

- Remembering a new telephone number, a PIN number, web address or a vehicle registration number while we are trying to find a pen and paper to write it down or to use it in some other way
- Following spoken directions such as 'Go straight over at the traffic circle, take the second left and the building is on the right opposite the shops'
- Calculating how much the bill will be at the Pick 'n Pay checkout for the items we have in our basket.
- Remembering the unfamiliar foreign name of a person who has just been introduced to you for long enough to enable you to introduce them to someone else
- Measuring and combining the correct amounts of ingredients (e.g. rub in 50g of margarine and 100g of flour, and then add 75g of sugar) when you have just read the recipe but are no longer looking at the page.

Why is working memory important in classroom learning?

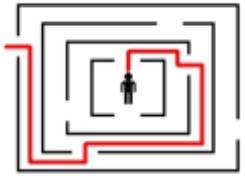
Many of the learning activities that children are engaged with in the classroom, whether related to reading, mathematics, science, or other areas of the curriculum, impose quite considerable burdens on working memory.

3. Visual Working Memory

This refers to the visual parts of working memory. It is your child's mental 'notebook' where they store temporary information that they can see. To improve your child's visual working memory, play the following games

a. Mazes in the sand

Encourage your child to take 'mental' photographs of designs that you draw, and then get them to copy them after a delay of a few seconds. Make the designs more complicated as they get better.



b. Magic Cup Game

Hide different objects under cups and after switching them around, get your child to remember what object was in what position.

c. Follow the Leader

Encourage your child to copy you as you point out a sequence of dots/bricks/tiles/stones. Make the length of the sequence longer and longer as your child gets better and better at it.

d. Memory Games

Place a few household items on a tray, and cover them with a cloth (pillow case, dishcloth). Give your child 30 seconds to have a look under the cloth. After that, cover it up again, and get your child to remember what the objects were (i.e. bottle top, soap, cell phone, spoon, pen). As he gets good at this, increase the number of objects that he has to remember. Later, get him to remember both the name of the object and its location on the tray (two processes at the same time).

Activities often require the child to hold in mind some information (for example, a sentence to be written down) while doing something that for them is mentally challenging (such as spelling the individual words in the sentence). These are the kinds of activities on which children with poor working memory struggle with most, and often fail to complete them properly because they have lost from working memory the crucial information needed to guide their actions. As a result, the children may not get the learning benefit of successfully completing an activity, and this slows down their rates of learning.

Working memory is also needed to **help us remember where we have got to in a complicated mental activity.** Consider the case of a child with low working memory capacity attempting to follow the teacher's instructions to write down a sentence she has just spoken. The child not only needs to **hold the sentence in working memory for sufficiently long** to guide his or her attempts to write the individual words, but needs **to remember how far they have got** in this attempt, and to **find the next word** in working memory. Although to skilled writers this seems like an easy task, children with poor working memory capacities find this extremely difficult, and often either skip or repeat words and letters as they lose their place in this demanding mental activity.

What can you do to improve your child's working memory capacity?

1. **Monitor your child's working memory load.**
    a. After giving an instruction, ask your child to repeat it to you, or tell you in what order they will carry out the task.
    b. If they have forgotten the instruction, repeat the information
    c. Break down tasks and instructions into smaller parts to minimise memory load
    d. Encourage your child to ask the teacher more information when they have forgotten

2. **Verbal Working Memory**
    This refers to the language and hearing parts of working memory, and includes tasks like remembering and carrying out two auditory instructions at the same time.

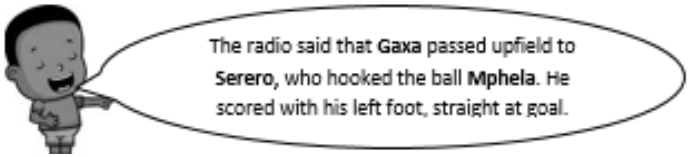
To improve your child's verbal working memory, play the following games with them:

Play Copy-Cat

- Get your child to repeat after you as you say more and more complex sentences, or lists of words.
- Ask your child to listen to a list of names that you call out, and get them to remember them in order. Make the lists longer and longer each time your child masters a level. Start with related objects (apple, banana, orange, pear), and then make it more complicated by including unrelated objects (one, frog, hat, seven, run, pink, cheese).
- You can also increase their numerical skills by using lists of numbers to improve their abilities (i.e. one, five, seven, three). Make the task more complicated by asking your child to remember the number sequence backwards (I.e. You say '1, 5, 7' and your child says '7, 5, 1').

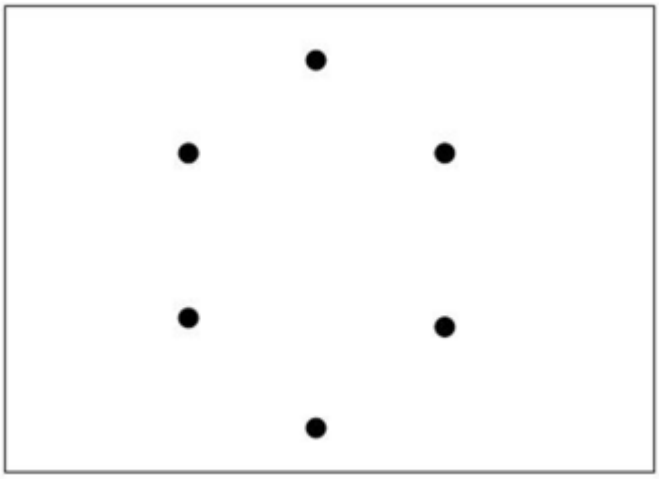
Memory Story Games

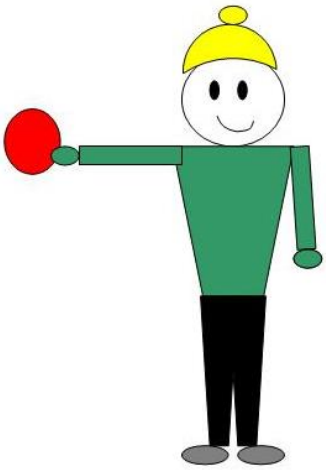
Read or tell your child stories. Ask them to remember the names of the characters, and get them to tell them to you at the end. Later, ask them to keep track of two components in the story (i.e. the types of animals in the story, and what they each did). This requires your child to keep track of two mental processes at the same time. This skill can be developed while listening to the radio, watching soccer or listening to the commentary. The aim to get the child to remember details that they hear, and then remember them long enough to say them back to you.

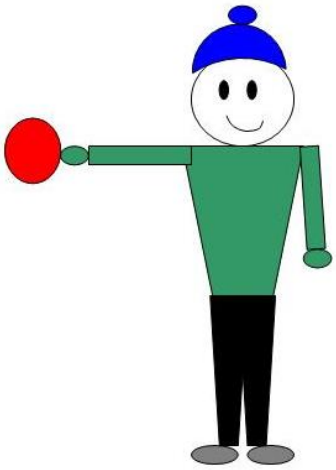


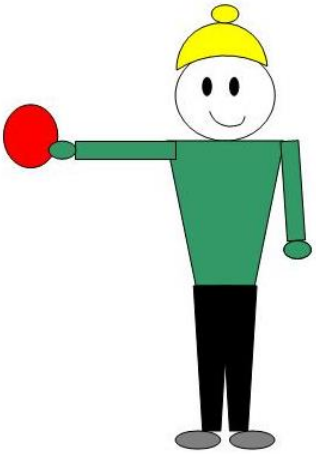
Appendix B

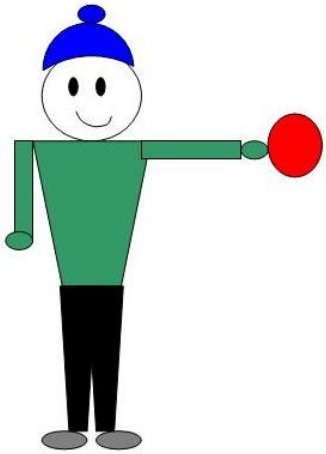
Small Laminated Cards of Mr X and Spatial Recall

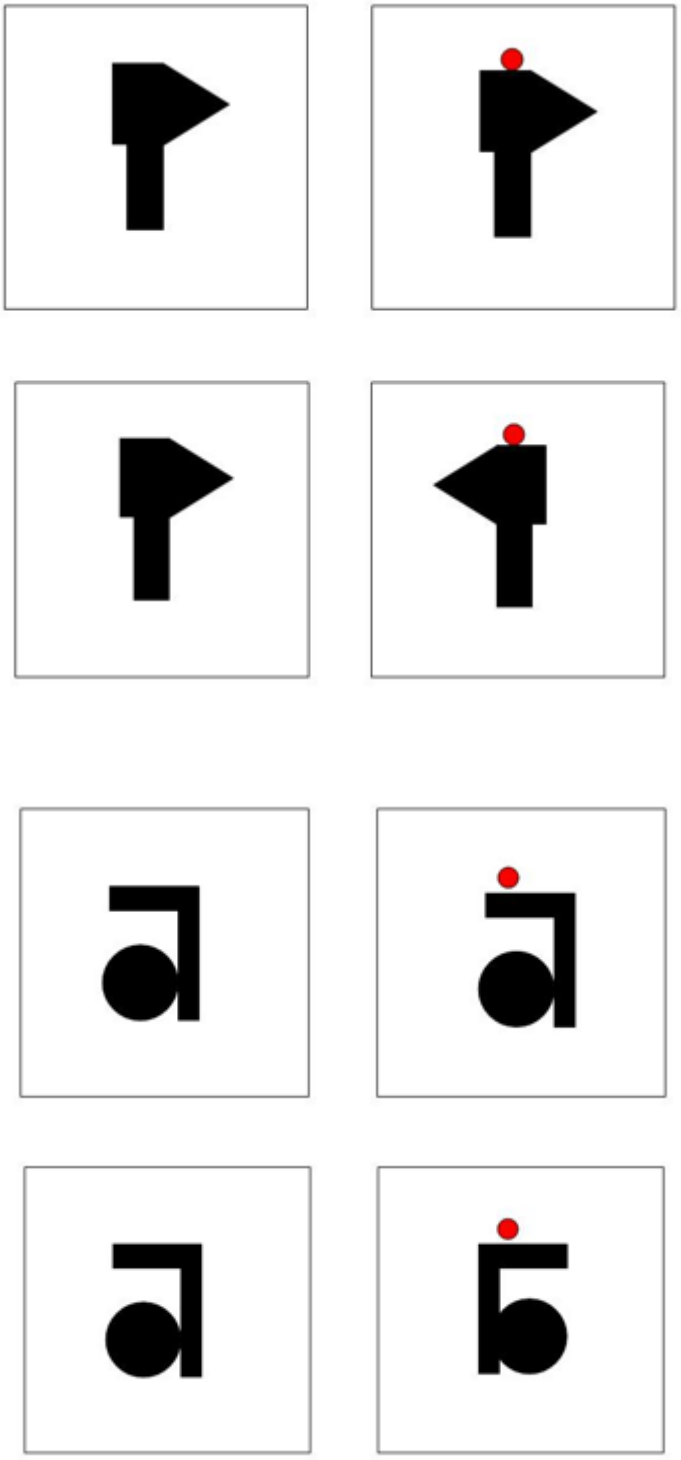












Appendix C

Standardised Testing Procedure

Inviting participation:

- Approach individuals, explain the study and invite them to participate.
- Please remember to make a big fuss of the parents by thanking them, and give them very broad feedback on their child's performance from the report.
- Also, let's be more vigilant about doing referrals for speech etc as they happen. We are ethically liable for missed referrals.

Testing

AWMA

1. Administer all the practice items in all subtests, except Listening Recall, Mr X and Spatial Recall.
2. Then if the child aces the practice items, jump them up to start at level 2 or 3 (use your discretion) to preserve their attentional resources and interest for longer. You can always jump down if it's too advanced.
3. In the case of Listening Recall, Mr X and Spatial Recall, administer all practice items if the child has the capacity to understand what is going on. Please use the visual aids that we piloted for this process. If they do not understand the multiple processes, and you feel like you are hitting your head against a brick wall, skip the two-part section of the practice round and just start at level 1. If they pass level one, you can re-explain how they can manage the second level.

RCPM

1. Let's make a rule that in the case of poor language comprehension, you offer the child the corrected version in the first three attempts of each set. i.e. they make their choice, but you explain why it is correct or not for the first three. This allows them to self-correct if they don't understand the instructions.
2. Discontinuation Rule: The book says that in order for the subtest to be valid, they must get the first 5 correct. I think we stretch this to 8. If they have got the first 8 incorrect, discontinue and start the next set. We will score it properly, but for now, just record the raw scores in each subtest.

Sentence Repetition

1. Because of the conflation of auditory memory for a foreign language and English proficiency, let's agree that each sentence can be said twice in order to try and compensate for memory.
2. Accuracy in scoring is very important to create variance, so that this can be used statistically.

Demographic Questionnaire

1. Let's try note handedness on the form (R, L or U). Let's try make sure that the computer is in the centre of the child's visual screen. Take note of incongruencies between pointing and writing of name.
2. Please try and remember also to ask mom where she gets her medication from in order to gain access to her file.
3. Try and fill in child's HAART scores while you have the file.

Appendix D

Age matching comparisons of NEPSY-II subsample

Table D1

Age matching comparisons of NEPSY-II subsample

Trio	Gender	HIV-I	HIV-EU	HIV-UU
1	Male	7 years, 6 months	7 years, 5 months	7 years, 6 months
2	Female	7 years, 9 months	7 years, 8 months	7 years, 8 months
3	Female	7 years, 6 months	7 years, 5 months	7 years, 2 months
4	Male	6 years, 3 months	6 years, 3 months	6 years, 4 months
5	Male	8 years, 2 months	8 years, 3 months	8 years, 2 months
6	Female	8 years, 5 months	8 years, 4 months	8 years, 5 months
7	Female	7 years, 6 months	7 years, 6 months	7 years, 5 months
8	Male	8 years, 1 month	8 years, 1 month	8 years, 1 months
9	Female	6 years, 2 months	6 years, 2 months	6 years, 3 months
10	Female	6 years, 2 months	6 years, 0 months	6 years, 3 months
11	Male	8 years, 2 months	8 years, 3 months	8 years, 4 months
12	Male	6 years, 7 months	6 years, 6 months	6 years, 6 months
13	Female	8 years, 2 months	8 years, 1 month	8 years 0 months
14	Female	6 years, 9 months	6 years, 9 months	6 years, 8 months
15	Female	6 years, 1 month	6 years, 3 months	6 years, 3 months
16	Male	6 years, 4 months	6 years, 3 months	6 years, 4 months
17	Female	4 years, 6 months	4 years, 6 months	4 years, 5 months
18	Female	7 years, 3 months	7 years, 3 months	6 years, 11 months
19	Female	6 years, 0 months	6 years, 0 months	5 years, 11 months
20	Female	8 years, 4 months	8 years, 0 months	8 years, 2 months
21	Female	8 years, 7 months	8 years, 8 months	8 years, 6 months
22	Male	7 years, 8 months	7 years, 9 months	7 years, 9 months
23	Female	8 years, 3 months	8 years, 2 months	8 years, 2 months
24	Male	8 years, 7 months	8 years, 7 months	8 years, 6 months
25	Male	7 years, 2 months	7 years, 2 months	6 years, 11 months
26	Female	6 years, 1 month	6 years, 0 months	5 years, 11 months
27	Female	7 years, 11 months	7 years, 11 months	7 years, 11 months
28	Female	6 years, 4 months	6 years, 5 months	6 years, 6 months
29	Female	7 years, 5 months	7 years, 5 months	7 years, 5 months
30	Female	7 years, 3 months	7 years, 3 months	7 years, 4 months

Appendix E

Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ms Robyn Milligan

CLEARANCE CERTIFICATE **M120902**

PROJECT A Comparison of Working Memory Profiles in HIV Positive and HIV Exposed Uninfected Unexposed Children

INVESTIGATORS Ms Robyn Milligan.

DEPARTMENT Department of Psychology

DATE CONSIDERED 28/09/2012

DECISION OF THE COMMITTEE* Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 24/10/2012 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Prof Kate Cockcroft

DECLARATION OF INVESTIGATOR(S)
To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix F

Demographic Questionnaire

Demographic Questionnaire

CODE: | | | | | | | | | | | *(to be filled in by researcher)*

The following sections to be filled in by the parent/guardian of the participant

Child's Name: _____

Home Language: _____ School Language: _____

Gender: M F Date of Birth: D D M M Y Y Y Y

Current Grade: _____ Current School: _____

Has the child started formal schooling (i.e. grade 0)? YES NO

Did the child attend pre-primary school? YES NO

How many years of pre-primary school attended? _____

How many children in the child's class currently? _____

Does the child attend a school for learners with special needs? YES NO

Are there family members with special needs? YES NO

If so, please provide details:_____

Living Amenities & Caregiving

Who lives with the child? _____

_____

Please indicate the type of place where the child lives

Flat House Shack Shelter Number of bedrooms: _____

Which suburb do you live in? _____

Does the child receive a grant? YES NO Monthly Amount: _____

Living Standards Measure:

Question	Answer	
1. I have the following in my household:		
TV set	TRUE	FALSE
VCR	TRUE	FALSE
DVD player	TRUE	FALSE
M-Net/DStv subscription	TRUE	FALSE
Hi-fi/music centre	TRUE	FALSE
Computer / Laptop	TRUE	FALSE
Vacuum cleaner/floor polisher	TRUE	FALSE
Dishwashing machine	TRUE	FALSE
Washing machine	TRUE	FALSE
Tumble dryer	TRUE	FALSE
Home telephone (excluding a cell)	TRUE	FALSE
Deep freezer	TRUE	FALSE
Fridge/freezer (combination)	TRUE	FALSE
Electric stove	TRUE	FALSE
Microwave oven	TRUE	FALSE
Built-in kitchen sink	TRUE	FALSE
Home security service	TRUE	FALSE
3 or more cell phones in household	TRUE	FALSE
2 cell phones in household	TRUE	FALSE
Home theatre system	TRUE	FALSE
2. I have the following amenities in my home or on the plot:		
Tap water in house/on plot	TRUE	FALSE
Hot running water from a geyser	TRUE	FALSE
Flush toilet inside house	TRUE	FALSE
3. There is a motor vehicle in our household	TRUE	FALSE
4. I am a city dweller	TRUE	FALSE
5. I live in a house, cluster or town house	TRUE	FALSE
6. I live in a rural area outside Gauteng	TRUE	FALSE
7. There are no radios, or only one radio (excluding car radios) in my household	TRUE	FALSE
8. There is no domestic workers or household helpers in household (both live-in & part time)	TRUE	FALSE

Mother: Level of Education		**Father: Level of Education**	
No schooling		No schooling	
Less than primary school completed		Less than primary school completed	
Primary school completed		Primary school completed	
Secondary school not completed		Secondary school not completed	
Secondary school completed		Secondary school completed	
Tertiary education completed		Tertiary education completed	
Other		Other	
Current occupation:		Current occupation:	

Mother

What was the highest school grade passed? _____

Did the mother study after school? YES NO What? _____

Is the mother literate? YES NO

Mother's current occupation: _____

Father

What was the highest school grade passed? _____

Did the father study after school? YES NO What? _____

Is the father literate?

Father's current occupation: _____

1.	Gestational age at which maternal HAART was initiated	
2.	Maternal WHO stage of HIV at diagnosis	
3.	Maternal CD4 count at time of HAART initiation	
4.	Maternal Viral load at time of HAART initiation	
5.	Maternal PMTCT regimen	
6.	Child's Current CD4 Count	
7.	Child's Current Viral Load	
8.	Child's Current ARV regimen	
9.	Age at which ARV regimen began	
10.	History of Regimen (drug name and duration)	Reason for change/non-adherence
11.	Total number of months on treatment	
12.	Any other chronic medication (e.g. Ritalin etc.)	
13.	Additional Notes	

Informed Consent for child and access to child's and mother's medical records

CODE: | | | | | | | | | | | *(to be filled in by researcher)*

The following sections to be filled in by the parent/guardian of the participant

By filling in and signing this document I,

_____

(parents/guardians's name)

give permission for my child,

_____ (child's name)

to participate in the study. I also allow the researchers access to my child's medical records in my hospital file. I understand that I can remove my child from the process at any time without any negative consequences. I allow the researchers to use the data confidentially.

I also give permission for the researchers to access my hospital file (where applicable) to find out information regarding my child's health while I was pregnant with him/her. I am guaranteed that this information will remain confidential at all times.

Mother's name: _____

Mother date of birth: | D | D | | M | M | | Y | Y | Y | Y |

Signed: _____(parent/guardian) Date: _____

University of the Witwatersrand

Psychology Department

Research Ethics Committee

011 274 9278/9/80

Dear Parent/Guardian,

I am a counselling psychologist currently completing a PhD at the University of the Witwatersrand and am conducting research into the effect of HIV and anti-retroviral therapy on the development of thinking and learning. This will help us to know if there are things that can be done to children affected by the disease to learn better at school. In order to understand whether these differences are due to the disease and its treatment, we need to measure them against children who are *not* infected or exposed to the virus. This is why you have been asked if you would like to participate in the study, as you will form what we call a control group.

What is required of participants?

If you would like to be a part of this research, I would need, with your permission, access to your child's and their mother's hospital file to see your child's medical history, and their health while they were not yet born. Part of this research also requires your responses on the questionnaire below, as well as allowing your child to undergo three brief psychometric tests. The Ravens Coloured Progressive Matrices (10 minutes) asks the child to identify 36 missing puzzle pieces from coloured pictures. The Automated Working Memory Assessment (60 minutes) is a computer programme that asks children to move and think about characters, shapes and words. Thirdly, the Sentence Repetition Test (10 minutes) requires children to repeat 16 English sentences after me. Testing should take no longer than an hour and a half of your time. The questionnaire can be filled in by yourself, or with my help, either before, during or after the assessment. *This study does not require you or your child to have blood tests of any kind.* I would therefore like to invite you to participate in this research, and give permission for your child to participate in the study.

What you can expect from the researcher:

Your responses, results and medical information will remain confidential, and no-one other than myself will be able to link your name to your results. Should the psychometric tests identify severe academic problems in your child, you will be referred to the local psychology department for further assistance, should you wish. Your child will also receive light refreshments during the assessment. Completion and return of the questionnaire will be considered to indicate permission for me to use your responses for the research project. Participation of both you and your child is voluntary. Should you choose not to participate, this will not be held against you in any way, and

you will not be treated differently at the clinic when you next come to get your medication. You and your child are also allowed to withdraw from the study at any time, and will not experience any negative consequences. The results of the study will be given to the doctors at the unit, and you are welcome to talk to them about what they mean. I will also be available to discuss the general results should you wish to see me about them.

If you have any further questions or require feedback on the progress of the research, feel free to contact me. My contact details appear below my signature.

Thank you for considering taking part in the research project. Please detach and keep this sheet.

Kind Regards,

Robyn Milligan

Brittany McKillop

Fatima Duarte

083 956 1545

milligan.robyn@gmail.com

University of the Witwatersrand

Psychology Department

Research Ethics Committee

011 274 9278/9/80

Dear Parent/Guardian,

We are a group of three researchers at the University of the Witwatersrand conducting research into the effect of HIV and anti-retroviral therapy on the development of thinking and learning. This will help us to know if there are things that can be done to children infected with the disease to learn better at school.

What is required of participants?

If you would like to be a part of this research, we would need, with your permission, access to your child's and your child's mother's hospital files to see your child's medical history, and their health while they were not yet born. Part of this research also requires your responses on the questionnaire below, as well as allowing your child to undergo three brief psychometric tests. The Ravens Coloured Progressive Matrices (10 minutes) asks the child to identify 36 missing puzzle pieces from coloured pictures. The Automated Working Memory Assessment (60 minutes) is a computer programme that asks children to move and think about characters, shapes and words. Thirdly, the Sentence Repetition Test (10 minutes) requires children to repeat 16 English sentences after me. Testing should take no longer than an hour and a half of your time. The questionnaire can be filled in by yourself, or with our help, either before, during or after the assessment. *This study does not require you or your child to have blood tests of any kind.* We would therefore like to invite you to participate in this research, and give permission for your child to participate in the study.

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Psychology Department

Research Ethics Committee

011 274 9278/9/80

Dear Parent/Guardian,

We are a group of researchers at the University of the Witwatersrand and are conducting research into the effect of HIV and anti-retroviral therapy on the development of thinking and learning. This will help us to know if being exposed to the disease and its treatment before being born has an impact on thinking and learning, and whether or not there are things that can be done to help these children learn better at school.

What is required of participants?

If you would like to be a part of this research, we would need, with your permission, access to your and your child's hospital file to see your child's medical history, and their health while they were not yet born. Part of this research also requires your responses on the questionnaire below, as well as allowing your child to undergo three brief psychometric tests. The Ravens Coloured Progressive Matrices (10 minutes) asks the child to identify 36 missing puzzle pieces from coloured pictures. The Automated Working Memory Assessment (60 minutes) is a computer programme that asks children to move and think about characters, shapes and words. Thirdly, the Sentence Repetition Test (10 minutes) requires children to repeat 16 English sentences after me. Testing should take no longer than an hour and a half of your time. The questionnaire can be filled in by yourself, or with our help, either before, during or after the assessment. *This study does not require you or your child to have blood tests of any kind.* We would therefore like to invite you to participate in this research, and give permission for your child to participate in the study.

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Kind Regards,

Robyn Milligan

Brittany McKillop

Fatima Duarte

083 956 1545

milligan.robyn@gmail.com

Hello,

My name is (Robyn/Brittany/Fatima), and I am studying at university. I am trying to find out some things about the way children think and learn. I would like to invite you to join me in finding these things out.

If your decide that you would like to be a part of this, you will need to do three jobs. The first job is a book of coloured puzzles where you need to find the missing puzzle piece. The second one is a job on my computer where we will look and listen to different words and pictures together. The last job is where you and I play copy-cat with 16 English sentences.

It's your choice to do these jobs or not. If you decide that you will do them, you can have as many breaks as you like, and I also have a little snack for you half-way through so you don't get tired. If you decide in the middle of the jobs that you don't want to carry on, that is OK. Nothing bad will happen and you will be free to leave the hospital and go home.

Are you happy to help me with my study and do these three jobs with me?

Yes: _____ No: _____

Can you write your name over here?

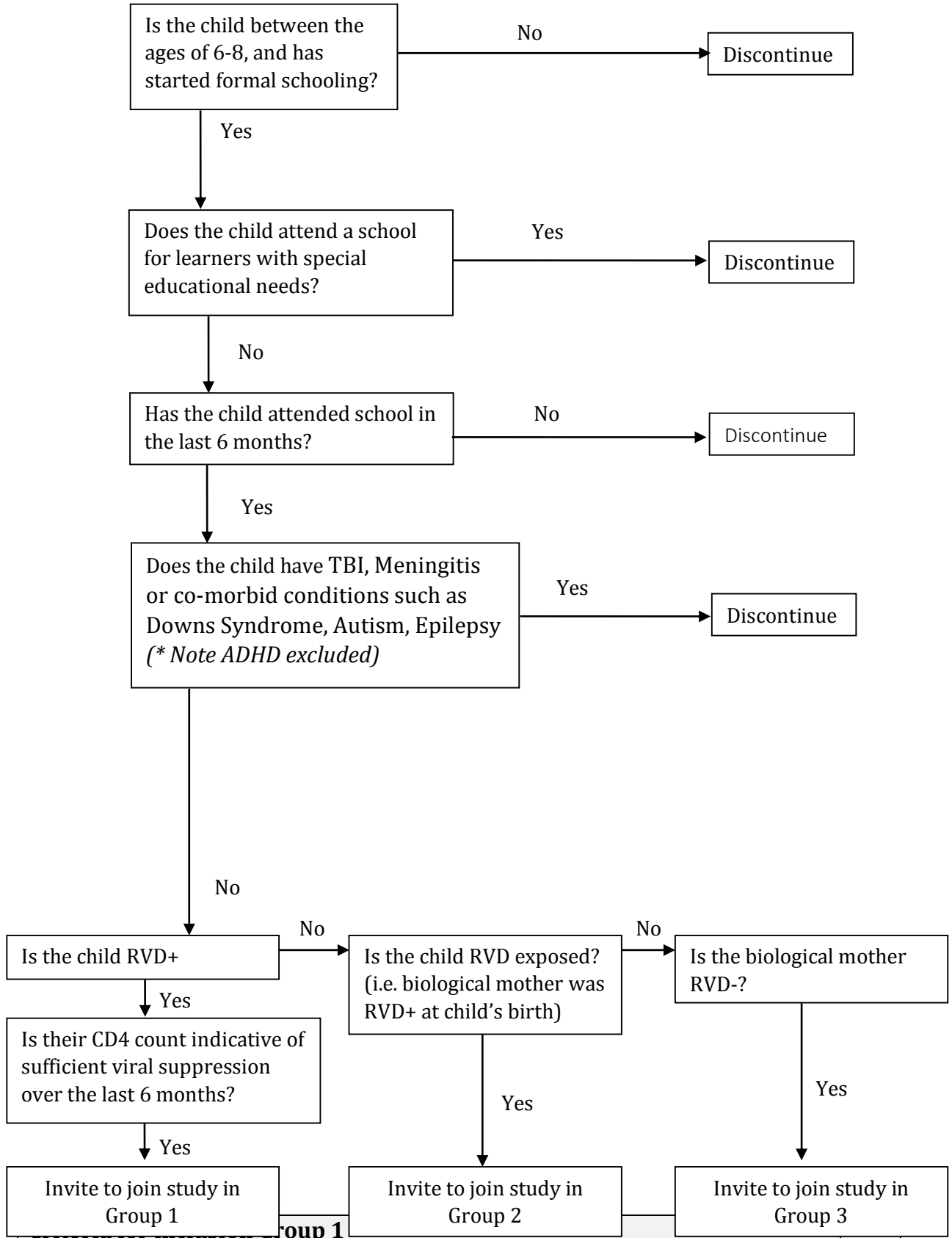
_____

Researchers signature in place of child's if can't yet write their name to indicate verbal consent:

_____

Date: _____

Staff checklist for participation



roup 1	
In Grade 1 at school	
Vertically acquired RVD+ status	
Sufficiently virally suppressed (i.e.)	

No TBI, Meningitis or co-morbid conditions such as Downs Syndrome, Autism, Epilepsy *(* Note ADHD **not** excluded)*	
Not in special needs schools	
Has attended school in the last 6 months	

Criteria for inclusion Group 2	
In Grade 1 at school	
Mother was RVD+ prior to giving birth	
Is currently RVD-	
No TBI, Meningitis or co-morbid conditions such as Downs Syndrome, Autism, Epilepsy *(* Note ADHD **not** excluded)*	
Not in special needs schools	
Has attended school in the last 6 months	

Criteria for inclusion Group 3	
In Grade 1 at school	
Mother and child are RVD-	
No TBI, Meningitis or co-morbid conditions such as Downs Syndrome, Autism, Epilepsy *(* Note ADHD **not** excluded)*	
Not in special needs schools	
Has attended school in the last 6 months	

Appendix G

Formula for NEPSY-II Domain Creation

Table G1

Formulae for Proportional Distribution of Subtest Weighting into Domain Categories (Attention & Executive Functioning)

Attention & Executive Functioning				100
Auditory Attention & Response Set				25
	Auditory Attention Scaled Score	19	6.25	
	Errors of Commission	7	6.25	
	Errors of Omission	7	6.25	
	Errors of Inhibition	7	6.25	
Design Fluency				25
	Total Scaled Score	19	25	
Inhibition				25
	Naming Scaled Score	19	12.5	
	Inhibition Scaled Score	19	12.5	
Statue				25
	Raw Score (15 time units at 2 points each)	30	25	

Table G2

Formulae for Proportional Distribution of Subtest Weighting into Domain Categories (Language)

Language				100
Comprehension of Instructions				20
	Scaled Score	19	20	
Oromotor Sequences				20
	Scaled Score	19	20	
Repetition of Nonsense Words				20
	Scaled Score	19	20	
Speeded Naming				20
	Scaled Score	19	20	
Word Generation				20
	Semantic	19	10	
	Initial Letter	19	10	

Table G3

Formulae for Proportional Distribution of Subtest Weighting into Domain Categories (Memory & Learning)

Memory & Learning				100
Memory for Faces			20	20
	Scaled Score	19		
Memory for Faces Delayed			20	20
	Scaled Score	19		
Memory for Names			20	20
	Scaled Score	19		
Memory for Names Delayed			20	20
	Scaled Score	19		
Sentence Repetition			20	20
	Scaled Score	19		

Table G4
Formulae for Proportional Distribution of Subtest Weighting into Domain Categories (Sensorimotor Abilities)

Sensorimotor Abilities				100
Fingertip Tapping				25
	Dominant Hand Scaled Score	19	6.25	
	Non-Dominant Hand Scaled Score	19	6.25	
	Repetitions Scaled Score	19	6.25	
	Sequences Scaled Score	19	6.25	
Imitating Hand Positions				25
	Scaled Score	19	25	
Manual Motor Sequences				25
	Percentile Conversion	19	25	
Visuospatial Processing				25
	Scaled Score	19	25	

Table G5
Formulae for Proportional Distribution of Subtest Weighting into Domain Categories (Social Perception)

Social Perception			100
Affect Recognition			100
	Scaled Score	19	
	Happy Error Percentile Conversion	19	
	Sad Error Percentile Conversion	19	
	Neutral Error Percentile Conversion	19	
	Fear Error Percentile Conversion	19	
	Angry Error Percentile Conversion	19	
	Disgust Error Percentile Conversion	19	

Table G6
Formulae for Proportional Distribution of Subtest Weighting into Domain Categories (Visuospatial Processing)

Visuospatial Processing				100
Arrows				20
	Scaled Score	19	20	
Block Construction				20
	Scaled Score	19	20	
Design Copying				20
	Scaled Score	19	20	
Geometric Puzzles				20
	Scaled Score	19	20	
Picture Puzzles				20
	Scaled Score	19	20	
Route Finding				20
	Percentile Conversion	19	20	

Appendix H

Descriptive Statistics for Normality of AWMA and NEPSY-II Performance

Table H1
Descriptive Statistics for HIV-I Group (z-scores)

							Skewness			Kurtosis		
		N	Mean (SD)	Std Dev.	Std Error	Min.	Max.	Statistic	Std. Error	Z Score	Statistic	Std. Error	Z Score
Age in months		95	88.98	10.15	1.04	71	107	-0.68	0.247	-2.753	-1.207	0.49	-2.463
No. years in preschool		91	2.37	1.48	0.16	0	6	0.603	0.253	2.383	-0.339	0.5	-0.678
Class size		55	31.96	9.58	1.29	11	50	-0.109	0.322	-0.339	-0.24	0.634	-0.379
LSM		95	6.55	1.77	0.18	2	10	-0.146	0.247	-0.591	0.181	0.49	0.369
SRT		95	7.91	6.95	0.71	0	30	0.77	0.247	3.117	0.129	0.49	0.263
RCPM		95	13.79	5.09	0.52	2	26	0.525	0.247	2.12	-0.249	0.49	-0.509
Digit Recall		95											
	Raw		20.55	4.43	0.45	11	30	-0.293	0.247	-1.184	-0.204	0.49	-0.416
	Scaled		86.21	14.11	1.45	64	120	0.396	0.247	1.602	-0.333	0.49	-0.68
	Percentile		24.99	24.53	2.52	1	91	1.184	0.247	4.784	0.605	0.49	1.234
Word Recall		95											
	Raw		13.03	4.89	0.5	1	23	-0.54	0.247	-2.182	-0.247	0.49	-0.504
	Scaled		77.54	13.32	1.37	30	127	0.574	0.247	2.318	2.529	0.49	5.16
	Percentile		13.08	18.22	1.87	1	96	2.35	0.247	9.498	5.904	0.49	12.046
Nonword Recall		95											
	Raw		10.76	4.32	0.44	0	20	-0.239	0.247	-0.966	0.3	0.49	0.611
	Scaled		100.97	17.87	1.83	59	145	-0.162	0.247	-0.653	0.269	0.49	0.55
	Percentile		52.63	30.6	3.14	0	100	-0.164	0.247	-0.661	-1.167	0.49	-2.381
Verbal Short Term Memory		95											
	Scaled		85.6	14.62	1.5	59	131	0.329	0.247	1.328	0.093	0.49	0.19
	Percentile		24.25	23.97	2.46	0	98	1.134	0.247	4.584	0.576	0.49	1.175
Listening Recall		95											
	Raw		2.31	3.24	0.33	0	15	1.482	0.247	5.988	1.701	0.49	3.469
	Scaled		73.13	15.31	1.57	2	109	-0.173	0.247	-0.701	4.358	0.49	8.89
	Percentile		10.83	18.25	1.87	1	73	2.146	0.247	8.671	4.102	0.49	8.369
Listening Recall Processing		95											
	Raw		5.18	5.63	0.58	0	34	2.493	0.247	10.075	8.267	0.49	16.865
	Scaled		77.88	9.18	0.94	66	114	1.681	0.247	6.794	3.186	0.49	6.5

	Percentile		10.44	14.59	1.5	1	82	2.953	0.247	11.932	9.774	0.49	19.94
Counting Recall		95											
	Raw		10.34	3.67	0.38	0	21	-0.011	0.247	-0.043	0.382	0.49	0.78
	Scaled		87.85	13.65	1.4	55	129	0.187	0.247	0.756	0.319	0.49	0.651
	Percentile		27.05	23.3	2.39	0	97	0.989	0.247	3.997	0.522	0.49	1.065
Counting Recall Processing		95											
	Raw		23.08	10.76	1.1	0	59	0.62	0.247	2.506	0.801	0.49	1.634
	Scaled		89.05	11.17	1.15	71	128	1.133	0.247	4.577	2.26	0.49	4.611
	Percentile		27.08	21.23	2.18	3	97	1.367	0.247	5.523	2.084	0.49	4.252
Backwards Digit Recall		95											
	Raw		4.91	3.43	0.35	0	13	0.246	0.247	0.996	-0.358	0.49	-0.731
	Scaled		80.57	13.3	1.36	58	119	0.291	0.247	1.178	-0.289	0.49	-0.59
	Percentile		16.69	18.91	1.94	0	90	1.716	0.247	6.933	3.055	0.49	6.233
Verbal Working Memory		95											
	Scaled		77.18	11.13	1.14	61	107	0.692	0.247	2.798	-0.456	0.49	-0.931
	Percentile		11.49	14.88	1.53	0	68	1.748	0.247	7.062	2.526	0.49	5.152
Dot Matrix		95											
	Raw		14.15	4.67	0.48	1	29	0.088	0.247	0.355	1.088	0.49	2.221
	Scaled		86.61	16.72	1.72	61	148	0.592	0.247	2.391	0.564	0.49	1.15
	Percentile		27.26	27.22	2.79	1	100	0.895	0.247	3.618	-0.344	0.49	-0.702
Mazes Memory		95											
	Raw		11.59	5.06	0.52	1	24	-0.05	0.247	-0.202	-0.272	0.49	-0.555
	Scaled		83.51	15.81	1.62	48	133	-0.224	0.247	-0.905	0.681	0.49	1.389
	Percentile		22.05	21.84	2.24	0	100	1.252	0.247	5.061	1.272	0.49	2.595
Block Recall		95											
	Raw		14.33	3.51	0.36	7	24	0.391	0.247	1.58	0.181	0.49	0.368
	Scaled		85.94	13.57	1.39	47	120	-0.193	0.247	-0.78	-0.043	0.49	-0.087
	Percentile		25.17	21.79	2.24	1	91	0.907	0.247	3.667	0.334	0.49	0.681
Visuospatial Short Term Memory		95											
	Scaled		82.76	15.85	1.63	2	131	-0.925	0.247	-3.738	6.541	0.49	13.344
	Percentile		20.89	22.28	2.29	1	98	1.374	0.247	5.551	1.255	0.49	2.56
Odd One Out		95											
	Raw		10.24	5.01	0.51	0	24	0.423	0.247	1.708	-0.431	0.49	-0.879
	Scaled		88.73	17.53	1.8	59	130	0.44	0.247	1.776	-0.819	0.49	-1.671
	Percentile		31	31.47	3.23	0	98	0.801	0.247	3.237	-0.887	0.49	-1.81
Odd One Out Processing		95											
	Raw		23.78	16.76	1.72	1	75	0.766	0.247	3.094	-0.349	0.49	-0.713

	Scaled		90.15	15.36	1.58	71	130	0.704	0.247	2.845	-0.714	0.49	-1.457
	Percentile		31.26	30.53	3.13	0	98	0.821	0.247	3.319	-0.873	0.49	-1.78
Mister X		95											
	Raw		5.6	3.63	0.37	0	13	0.172	0.247	0.697	-0.806	0.49	-1.645
	Scaled		92.33	15.92	1.63	62	144	0.558	0.247	2.257	0.373	0.49	0.76
	Percentile		35.26	28.71	2.95	1	100	0.599	0.247	2.42	-0.749	0.49	-1.529
Mister X Processing		95											
	Raw		8.01	6.59	0.68	0	30	1.129	0.247	4.561	1.138	0.49	2.322
	Scaled		88.02	9.8	1.01	71	125	1.395	0.247	5.638	3.487	0.49	7.114
	Percentile												
Spatial Recall		95											
	Raw		7.66	4.81	0.49	0	19	0.2	0.247	0.809	-0.415	0.49	-0.847
	Scaled		87.65	15.43	1.58	60	126	0.169	0.247	0.684	-0.638	0.49	-1.301
	Percentile		28.43	26.62	2.73	0	96	0.87	0.247	3.516	-0.331	0.49	-0.676
Spatial Recall Processing		95											
	Raw		11.47	10.49	1.08	0	51	1.777	0.247	7.18	3.609	0.49	7.362
	Scaled		87.94	11.27	1.16	70	142	1.734	0.247	7.007	5.43	0.49	11.077
	Percentile		24.03	20.73	2.13	2	100	1.802	0.247	7.283	3.186	0.49	6.499
Visuospatial Working Memory		95											
	Scaled		87.21	16.38	1.68	61	132	0.424	0.247	1.715	-0.314	0.49	-0.64
	Percentile		27.84	27.52	2.82	0	98	0.933	0.247	3.772	-0.131	0.49	-0.267

Table H2
Descriptive Statistics for HIV-EU Group (z-scores)

							Skewness			Kurtosis		
	N	Mean (SD)	Std Dev.	Std Error	Min.	Max.	Statistic	Std. Error	Z Score	Statistic	Std. Error	Z Score
Age in months	88	88.28	10.51	1.12	67	106	-0.116	0.257	-0.451	-1.156	0.508	-2.274
No. years in preschool	79	2.51	1.62	0.18	0	7	1.091	0.271	4.034	0.875	0.535	1.635
Class size	65	35.42	10.78	1.34	5	81	1.488	0.297	5.01	5.854	0.586	9.986
LSM	88	5.88	1.13	0.12	2	10	-0.482	0.257	-1.877	3.071	0.508	6.041
SRT	88	10.69	7.46	0.8	0	30	0.51	0.257	1.986	-0.351	0.508	-0.69
RCPM	88	15.72	6.01	0.64	3	29	0.399	0.257	1.552	-0.642	0.508	-1.262
Digit Recall												
Raw	86	21.35	5.34	0.58	7	32	-0.224	0.26	-0.864	-0.053	0.514	-0.103
Scaled	86	90.47	17	1.83	60	125	0.16	0.26	0.616	-0.88	0.514	-1.712
Percentile	86	34.3	30.29	3.27	0	95	0.597	0.26	2.298	-0.914	0.514	-1.778
Word Recall												
Raw	86	11.41	5.66	0.61	1	26	0.494	0.26	1.902	-0.381	0.514	-0.742
Scaled	86	76.15	14.2	1.53	63	120	1.498	0.26	5.767	1.781	0.514	3.466
Percentile	86	12.55	21.65	2.33	1	91	2.514	0.26	9.679	5.835	0.514	11.354
Nonword Recall												
Raw	86	8.65	4.27	0.46	1	18	0.279	0.26	1.075	-0.403	0.514	-0.784
Scaled	86	95.18	17.15	1.85	59	137	0.141	0.26	0.541	-0.318	0.514	-0.618
Percentile	86	41.41	30.94	3.34	0	99	0.354	0.26	1.363	-1.199	0.514	-2.333
Verbal Short Term Memory												
Scaled	86	84.44	16.41	1.77	59	129	0.767	0.26	2.954	0.333	0.514	0.649
Percentile	86	23.06	26.27	2.83	0	97	1.476	0.26	5.685	1.536	0.514	2.989
Listening Recall												
Raw	86	4.4	4.86	0.52	0	25	2.106	0.26	8.11	5.334	0.514	10.38
Scaled	86	84.56	17.58	1.9	62	139	1.148	0.26	4.419	1.266	0.514	2.464
Percentile	86	22.55	27.2	2.93	1	100	1.579	0.26	6.079	1.703	0.514	3.315
Listening Recall Processing												
Raw	86	7.72	8.16	0.88	0	50	2.689	0.26	10.355	9.239	0.514	17.979
Scaled	86	83.13	13.25	1.43	66	134	1.831	0.26	7.052	4.031	0.514	7.844
Percentile	86	17.93	22.61	2.44	1	99	2.214	0.26	8.527	4.498	0.514	8.753
Counting Recall												
Raw	86	11.42	3.98	0.43	6	24	0.662	0.26	2.549	0.586	0.514	1.14

	Scaled	86	93.44	13.74	1.48	70	130	0.55	0.26	2.117	0.274	0.514	0.534
	Percentile	86	36.16	26.47	2.85	2	98	0.7	0.26	2.696	-0.351	0.514	-0.683
Counting Recall Processing													
	Raw	86	26.66	13.36	1.44	6	75	1.213	0.26	4.671	2.457	0.514	4.781
	Scaled	86	93.94	12.57	1.36	75	131	1.1	0.26	4.237	1.347	0.514	2.621
	Percentile	86	36.01	25.72	2.77	5	98	0.986	0.26	3.798	0.192	0.514	0.375
Backwards Digit Recall													
	Raw	86	5.43	4.05	0.44	0	20	0.72	0.26	2.773	1.179	0.514	2.294
	Scaled	86	84.56	14.76	1.59	58	136	0.481	0.26	1.854	0.568	0.514	1.106
	Percentile	86	22.53	23.11	2.49	0	99	1.294	0.26	4.982	1.155	0.514	2.247
Verbal Working Memory													
	Scaled	86	85.13	14.13	1.52	61	121	0.676	0.26	2.602	-0.17	0.514	-0.332
	Percentile	86	23.01	25.19	2.72	0	92	1.346	0.26	5.184	0.742	0.514	1.443
Dot Matrix													
	Raw	86	15.53	3.91	0.42	0	24	-0.629	0.26	-2.421	1.958	0.514	3.811
	Scaled	86	93.22	14.71	1.59	64	132	0.159	0.26	0.614	-0.232	0.514	-0.452
	Percentile	86	37.07	27.55	2.97	1	98	0.526	0.26	2.025	-0.722	0.514	-1.406
Mazes Memory													
	Raw	86	11.27	5.8	0.63	0	24	0.155	0.26	0.597	-0.517	0.514	-1.006
	Scaled	86	86.94	17.91	1.93	48	129	0.269	0.26	1.035	-0.648	0.514	-1.262
	Percentile	86	29.07	29.54	3.18	0	97	0.793	0.26	3.056	-0.634	0.514	-1.234
Block Recall													
	Raw	86	14.99	4.13	0.45	7	26	0.498	0.26	1.919	0.023	0.514	0.045
	Scaled	86	90.87	13.02	1.4	61	120	-0.065	0.26	-0.25	-0.479	0.514	-0.932
	Percentile	86	32.51	24.75	2.67	1	91	0.604	0.26	2.324	-0.64	0.514	-1.245
Visuospatial Short Term Memory													
	Scaled	86	88.74	15.21	1.64	63	126	0.469	0.26	1.807	-0.545	0.514	-1.061
	Percentile	86	29.5	27.98	3.02	1	94	0.853	0.26	3.286	-0.493	0.514	-0.96
Odd One Out													
	Raw	86	12.8	4.61	0.5	0	25	0.11	0.26	0.423	0.071	0.514	0.139
	Scaled	86	98.9	15.93	1.72	62	133	0.009	0.26	0.033	-0.555	0.514	-1.081
	Percentile	86	48.36	30.97	3.34	1	99	0.023	0.26	0.089	-1.313	0.514	-2.555
Odd One Out Processing													
	Raw	86	30.63	15.52	1.67	3	80	0.771	0.26	2.971	0.659	0.514	1.283
	Scaled	86	97.86	14.55	1.57	71	144	0.565	0.26	2.176	0.365	0.514	0.71

	Percentile	86	44.11	28.8	3.11	3	100	0.299	0.26	1.153	-1.122	0.514	-2.183
Mister X													
	Raw	86	6.81	3.35	0.36	0	17	0.252	0.26	0.97	0.488	0.514	0.95
	Scaled	86	99	13.62	1.47	71	133	0.131	0.26	0.503	-0.272	0.514	-0.53
	Percentile	86	48.22	27.43	2.96	3	99	0.091	0.26	0.351	-1.069	0.514	-2.081
Mister X Processing													
	Raw	86	11.21	8.18	0.88	0	42	1.565	0.26	6.026	3.577	0.514	6.961
	Scaled	86	92.53	13.2	1.42	11	121	-2.335	0.26	-8.992	16.561	0.514	32.225
	Percentile	86	35.53	21.89	2.36	7	92	0.969	0.26	3.73	0.231	0.514	0.45
Spatial Recall													
	Raw	86	9.63	4.55	0.49	0	21	0.241	0.26	0.927	0.133	0.514	0.258
	Scaled	86	95.56	14.1	1.52	64	135	0.548	0.26	2.109	0.57	0.514	1.109
	Percentile	86	39.75	27.54	2.97	1	99	0.689	0.26	2.654	-0.537	0.514	-1.045
Spatial Recall Processing													
	Raw	86	16.77	11.83	1.28	0	58	1.564	0.26	6.022	3.007	0.514	5.851
	Scaled	86	94.79	13.05	1.41	75	142	1.694	0.26	6.523	3.215	0.514	6.256
	Percentile	86	36.37	24.44	2.64	5	100	1.229	0.26	4.732	0.805	0.514	1.567
Visuospatial Working Memory													
	Scaled	86	97.23	14.14	1.52	65	132	0.061	0.26	0.234	-0.006	0.514	-0.013
	Percentile	86	44.91	27.85	3	1	98	0.175	0.26	0.675	-1.03	0.514	-2.005

Table H3

Descriptive Statistics for HIV-UU Group (z scores)

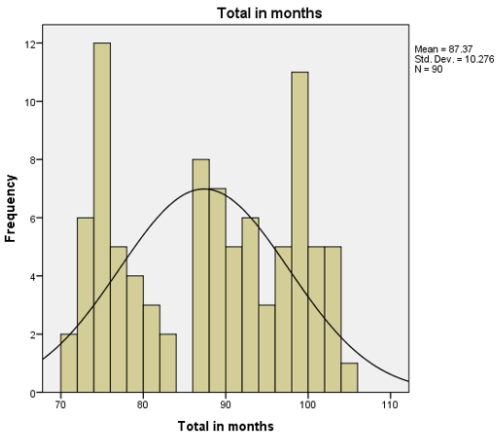
							Skewness			Kurtosis		
	N	Mean (SD)	Std Dev.	Std Error	Min.	Max.	Statistic	Std. Error	Z Score	Statistic	Std. Error	Z Score
Age in months	92	84.54	10.35	1.08	60	106	-0.065	0.251	-0.259	-0.789	0.498	-1.586
No. years in preschool	82	2.15	1.52	0.17	0	6	0.475	0.266	1.789	-0.771	0.526	-1.467
Class size	74	33.08	9.99	1.16	15	76	0.844	0.279	3.024	3.508	0.552	6.359
LSM	92	6.95	1.65	0.17	2	10	0.166	0.251	0.662	0.134	0.498	0.27
SRT	92	17.15	9.83	1.03	0	32	-0.077	0.251	-0.307	-1.056	0.498	-2.121
RCPM	92	19.5	5.79	0.6	9	32	-0.063	0.251	-0.251	-0.755	0.498	-1.517
Digit Recall												
Raw	92	23.93	5.19	0.54	11	37	-0.288	0.251	-1.146	0.091	0.498	0.183
Scaled	92	100.21	17.05	1.78	11	126	-1.656	0.251	-6.589	6.915	0.498	13.893
Percentile	92	52.86	29.19	3.04	2	96	-0.232	0.251	-0.924	-1.161	0.498	-2.334
Word Recall												
Raw	92	16.68	6	0.63	1	26	-0.4	0.251	-1.592	-0.693	0.498	-1.392
Scaled	92	94.43	18.46	1.92	63	129	-0.066	0.251	-0.263	-1.185	0.498	-2.381
Percentile	92	41.88	33.64	3.51	1	97	0.217	0.251	0.865	-1.464	0.498	-2.941
Nonword Recall												
Raw	92	12	5.03	0.52	1	21	-0.296	0.251	-1.179	-0.512	0.498	-1.028
Scaled	92	110.62	18.03	1.88	69	137	-0.312	0.251	-1.243	-0.682	0.498	-1.369
Percentile	92	68.04	30.65	3.2	2	100	-0.82	0.251	-3.263	-0.632	0.498	-1.269
Verbal Short Term Memory												
Scaled	92	102.41	16.97	1.77	69	129	-0.224	0.251	-0.891	-0.82	0.498	-1.648
Percentile	92	55.11	32.02	3.34	2	97	-0.271	0.251	-1.078	-1.296	0.498	-2.604
Listening Recall												
Raw	92	5.98	4.01	0.42	0	18	0.126	0.251	0.5	-0.48	0.498	-0.964
Scaled	92	95.57	16.89	1.76	63	131	0.008	0.251	0.031	-0.686	0.498	-1.379
Percentile	92	42.86	31.08	3.24	1	98	0.14	0.251	0.558	-1.335	0.498	-2.682
Listening Recall Processing												
Raw	92	9.71	7.28	0.76	0	40	1.291	0.251	5.135	2.548	0.498	5.12

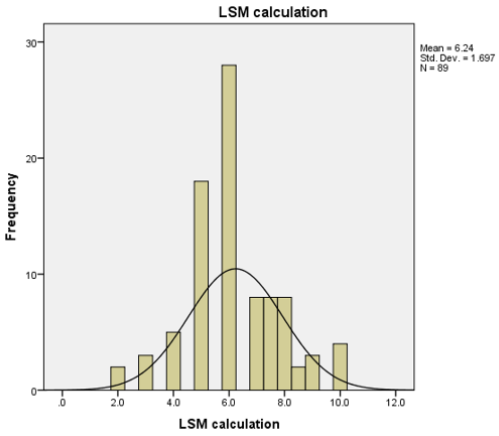
	Scaled	92	90.13	12.77	1.33	73	135	0.809	0.251	3.22	0.773	0.498	1.553
	Percentile	92	29.43	24.64	2.57	4	99	0.986	0.251	3.924	0.114	0.498	0.229
Counting Recall													
	Raw	92	13.57	5.87	0.61	0	25	0.239	0.251	0.953	-0.567	0.498	-1.138
	Scaled	92	103.37	20.36	2.12	14	141	-0.766	0.251	-3.046	3.162	0.498	6.354
	Percentile	92	56.25	31.25	3.26	0	100	-0.011	0.251	-0.043	-1.299	0.498	-2.611
Counting Recall Processing													
	Raw	92	35.03	20.42	2.13	0	80	0.654	0.251	2.603	-0.536	0.498	-1.076
	Scaled	92	104.22	16.32	1.7	74	133	0.412	0.251	1.639	-0.931	0.498	-1.87
	Percentile	92	55.34	30.35	3.16	4	99	0.144	0.251	0.571	-1.36	0.498	-2.733
Backwards Digit Recall													
	Raw	92	8.25	4.3	0.45	0	23	0.464	0.251	1.846	1.422	0.498	2.857
	Scaled	92	99.42	16.34	1.7	64	143	0.238	0.251	0.945	0.093	0.498	0.187
	Percentile	92	48.16	29.95	3.12	1	100	0.202	0.251	0.805	-1.226	0.498	-2.463
Verbal Working Memory													
	Scaled	92	99.7	16.26	1.7	66	131	0.352	0.251	1.4	-0.618	0.498	-1.241
	Percentile	92	47.85	30.94	3.23	1	98	0.29	0.251	1.154	-1.223	0.498	-2.457
Dot Matrix													
	Raw	92	16.08	4.7	0.49	2	31	0.464	0.251	1.847	1.162	0.498	2.335
	Scaled	92	99.3	17.17	1.79	65	148	0.681	0.251	2.709	0.183	0.498	0.368
	Percentile	92	46.46	31.4	3.27	1	100	0.361	0.251	1.437	-1.231	0.498	-2.474
Mazes Memory													
	Raw	92	13.5	6.78	0.71	0	30	0.088	0.251	0.352	-0.668	0.498	-1.343
	Scaled	92	97.09	16.44	1.71	59	133	0.1	0.251	0.396	-0.459	0.498	-0.923
	Percentile	92	44.53	30.99	3.23	0	99	0.215	0.251	0.856	-1.291	0.498	-2.594
Block Recall													
	Raw	92	16.04	5.64	0.59	5	30	0.431	0.251	1.714	0.171	0.498	0.343
	Scaled	92	97.46	16.08	1.68	70	131	0.461	0.251	1.832	-0.561	0.498	-1.128
	Percentile	92	43.54	30.78	3.21	2	98	0.493	0.251	1.96	-1.007	0.498	-2.024
Visuospatial Short Term Memory													
	Scaled	92	97.29	17.6	1.83	63	139	0.503	0.251	2	-0.45	0.498	-0.905

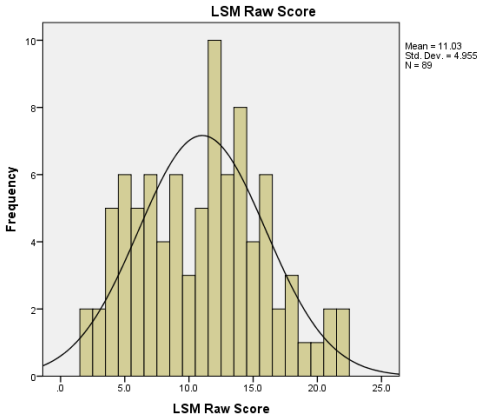
	Percentile	92	43.29	32.45	3.38	1	99	0.447	0.251	1.777	-1.213	0.498	-2.437
Odd One Out													
	Raw	92	14.6	5.51	0.57	1	26	-0.408	0.251	-1.622	-0.358	0.498	-0.718
	Scaled	92	108	17.36	1.81	71	133	-0.496	0.251	-1.973	-0.7	0.498	-1.407
	Percentile	92	64.68	31.9	3.33	3	99	-0.658	0.251	-2.619	-0.995	0.498	-2
Odd One Out Processing													
	Raw	92	37.91	18.99	1.98	3	85	0.154	0.251	0.612	-0.127	0.498	-0.256
	Scaled	92	107.55	16.6	1.73	75	144	-0.038	0.251	-0.151	-0.541	0.498	-1.086
	Percentile	92	63.16	30.58	3.19	5	100	-0.511	0.251	-2.033	-1.16	0.498	-2.33
Mister X													
	Raw	92	7.74	4.49	0.47	0	20	0.484	0.251	1.926	-0.502	0.498	-1.008
	Scaled	92	107.11	19.42	2.03	71	155	0.294	0.251	1.169	-0.555	0.498	-1.116
	Percentile	92	60.05	32.4	3.38	3	100	-0.33	0.251	-1.314	-1.284	0.498	-2.58
Mister X Processing													
	Raw	92	16.02	12.28	1.28	1	48	0.817	0.251	3.251	-0.4	0.498	-0.804
	Scaled	92	103.09	19.58	2.04	30	139	-0.074	0.251	-0.295	0.715	0.498	1.437
	Percentile	92	53.08	32.8	3.42	10	100	0.203	0.251	0.809	-1.542	0.498	-3.099
Spatial Recall													
	Raw	92	10.59	5.34	0.56	0	23	0.288	0.251	1.145	-0.512	0.498	-1.028
	Scaled	92	102.32	15.01	1.56	70	135	0.083	0.251	0.33	-0.46	0.498	-0.924
	Percentile	92	53.88	29.44	3.07	2	99	-0.117	0.251	-0.465	-1.25	0.498	-2.512
Spatial Recall Processing													
	Raw	92	20.7	15.21	1.59	1	71	0.984	0.251	3.916	0.581	0.498	1.167
	Scaled	92	101.8	15.04	1.57	80	148	0.684	0.251	2.722	-0.165	0.498	-0.332
	Percentile	92	51.13	29.63	3.09	9	100	0.254	0.251	1.01	-1.385	0.498	-2.782
Visuospatial Working Memory													
	Scaled	92	107.25	17.98	1.87	71	139	0.091	0.251	0.36	-0.988	0.498	-1.985
	Percentile	92	60.79	31.7	3.31	3	99	-0.297	0.251	-1.18	-1.3	0.498	-2.611

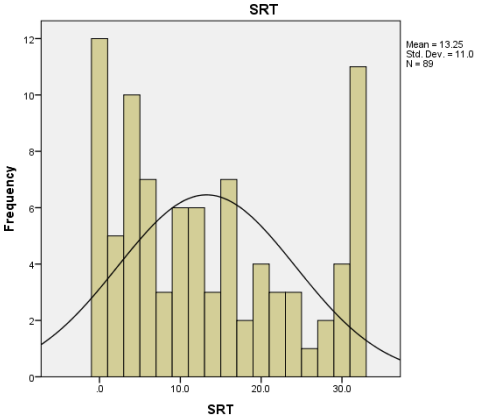
Appendix I

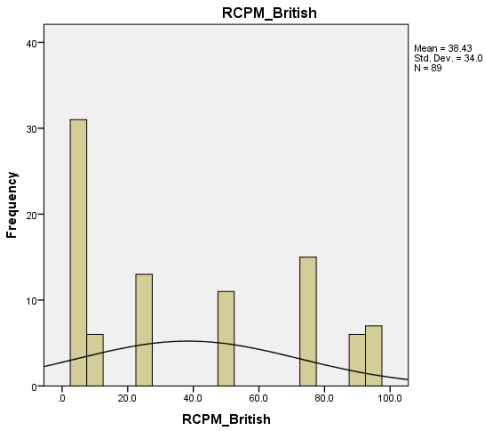
Histogram Normality Plots for NEPSY-II Continuous Variables

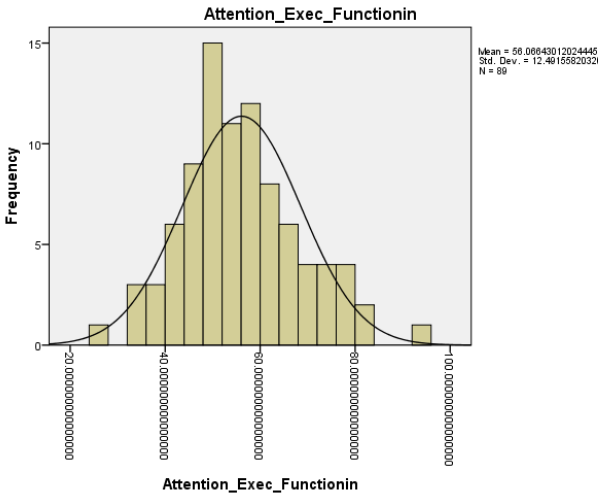


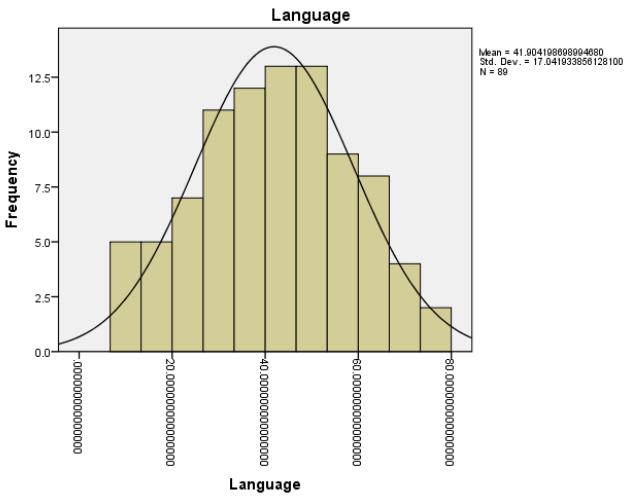


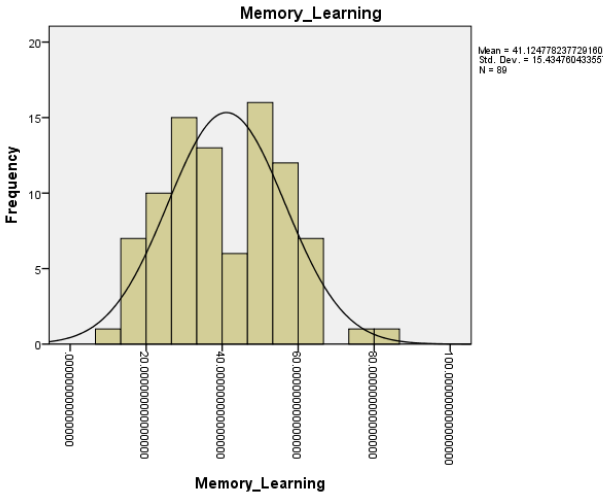


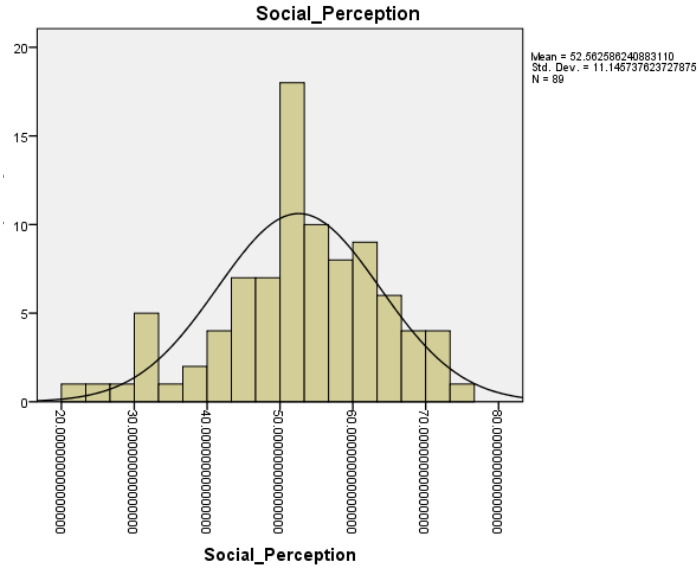


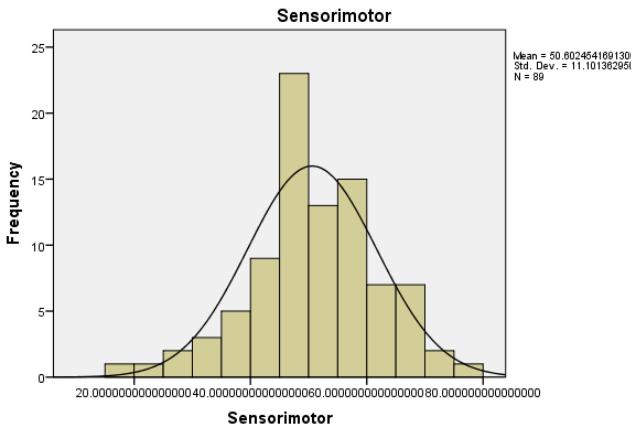


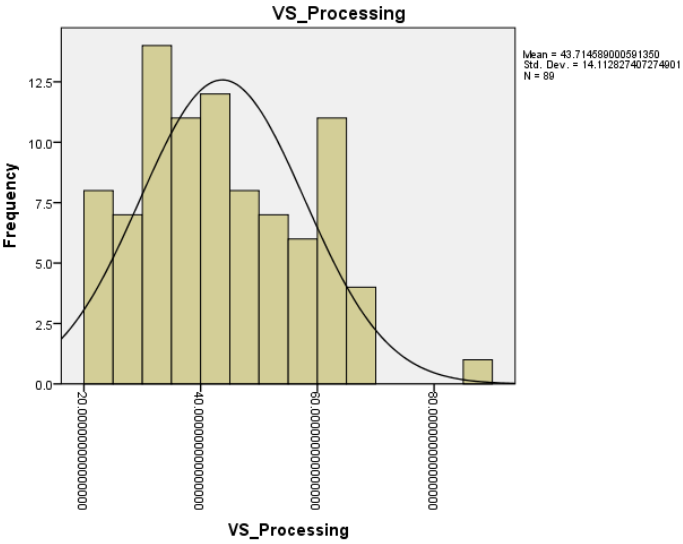

Attention_Exec_Functionin
Mean = 56.06643012024445
Std. Dev. = 12.4915582032
N = 89
Frequency
Attention_Exec_Functionin


Language
Mean = 41.90419868994680
Std. Dev. = 17.04193385612810
N = 89
Frequency
Language

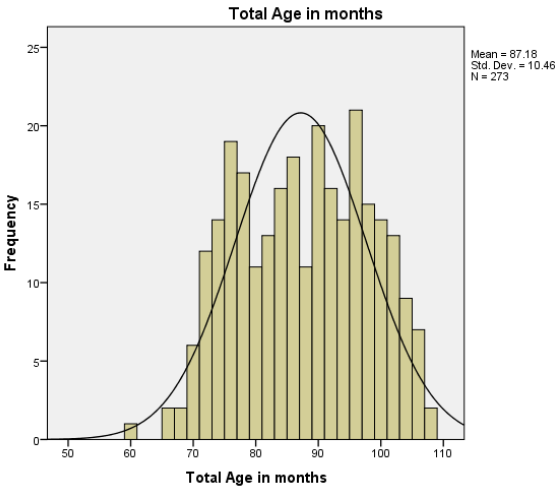

Memory_Learning
Mean = 41.12477823772916
Std. Dev. = 15.43476043355723
N = 89
Frequency
Memory_Learning

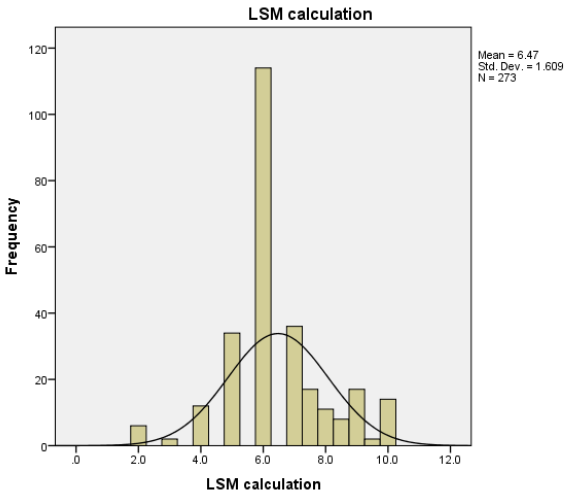

Social_Perception
Mean = 52.56258624088311
Std. Dev. = 11.14573762372787
N = 89
Social_Perception

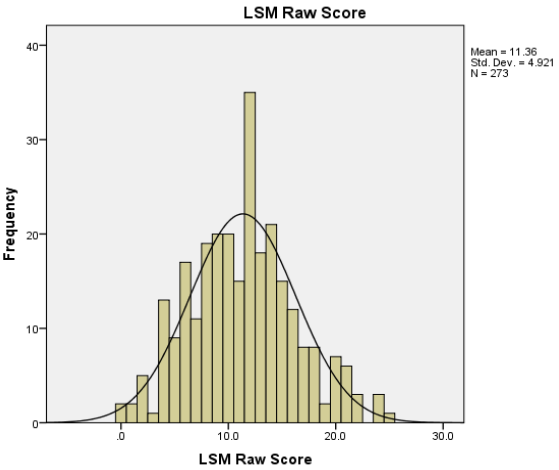

Sensorimotor
Mean = 50.60245416913
Std. Dev. = 11.10138295
N = 89
Frequency
Sensorimotor

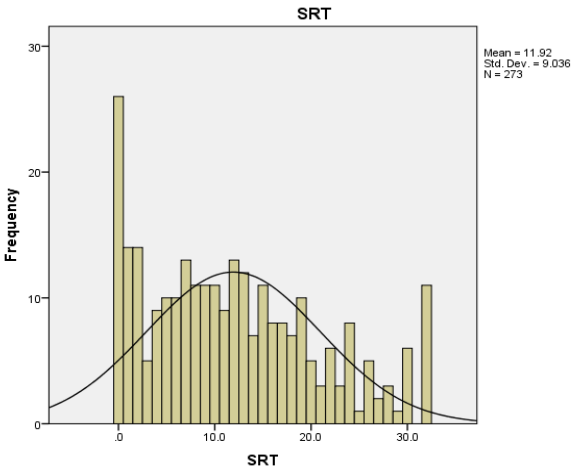

VS_Processing
Mean = 43.71458900059135
Std. Dev. = 14.11282740727490
N = 89
Frequency
VS_Processing

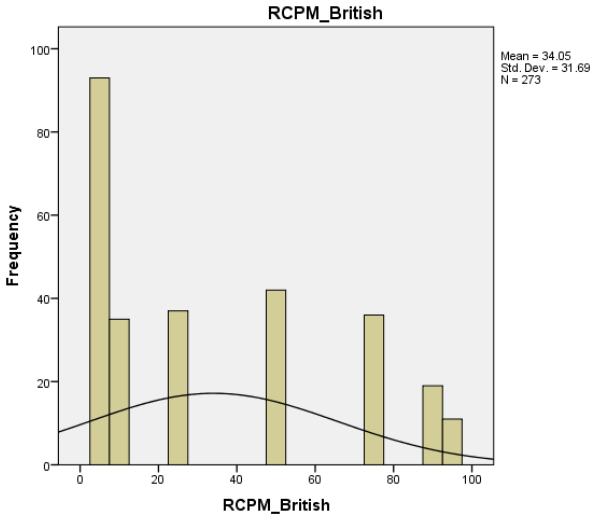
Histogram Normality Plots for AWMA Continuous Variables

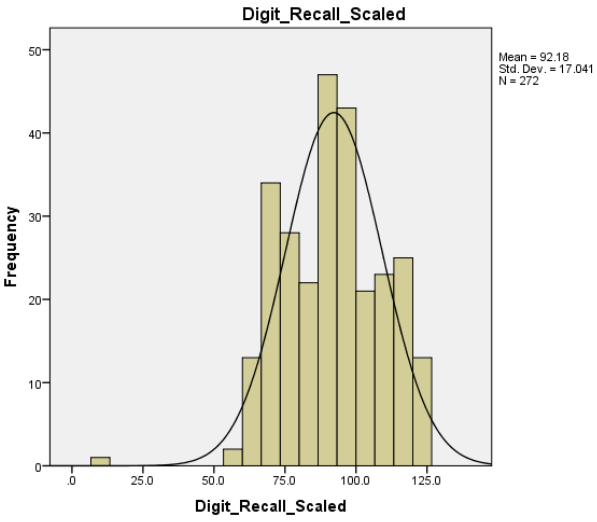


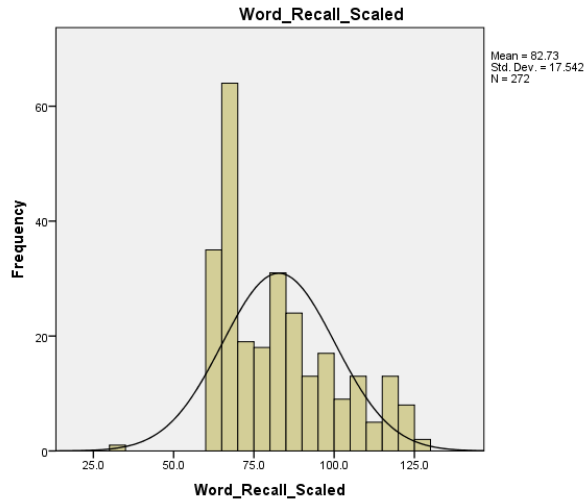


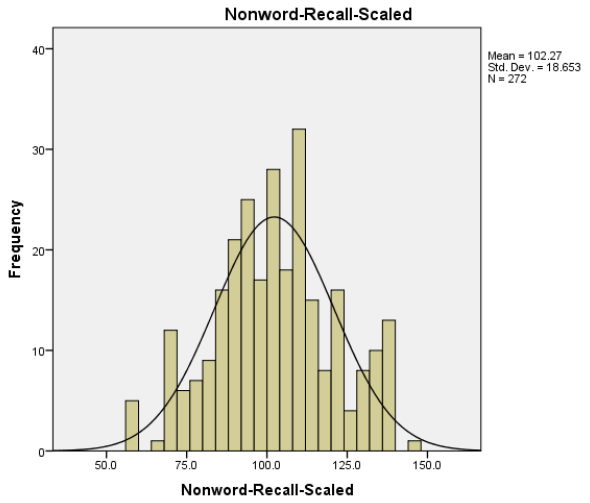


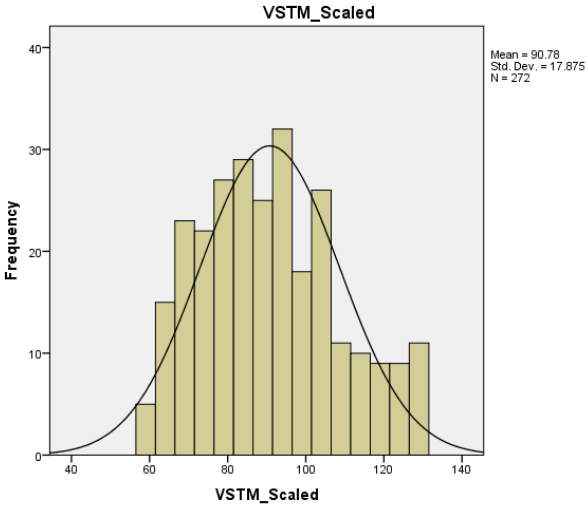


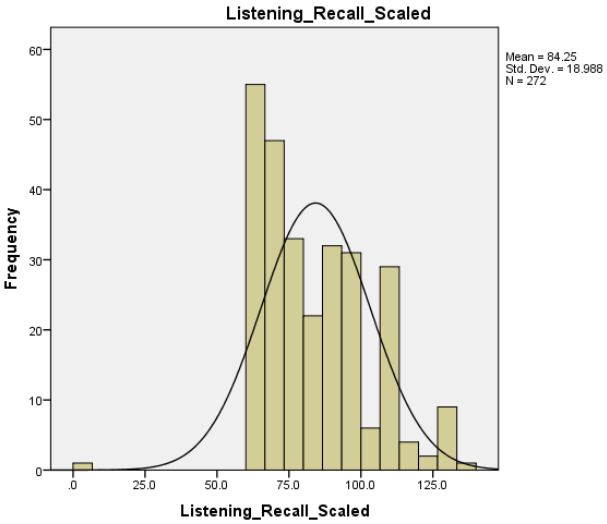


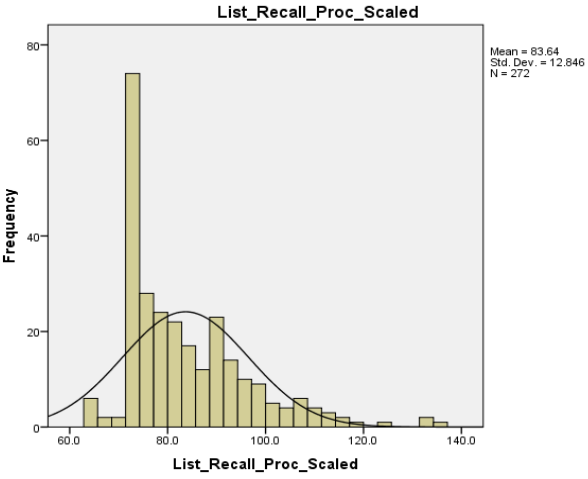


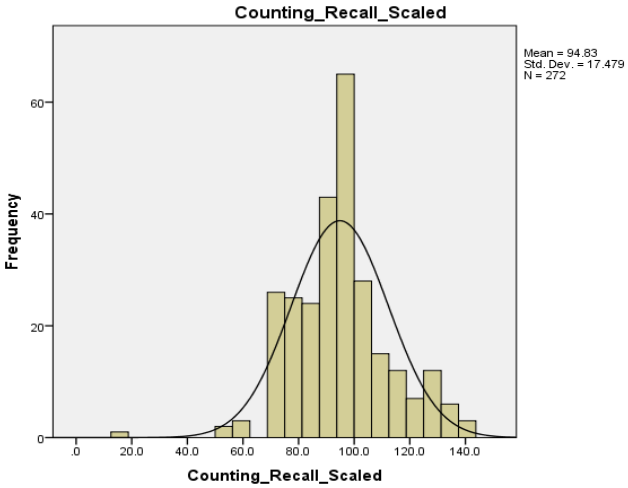

Word_Recall_Scaled
Mean = 82.73
Std. Dev. = 17.542
N = 272
Frequency
Word_Recall_Scaled

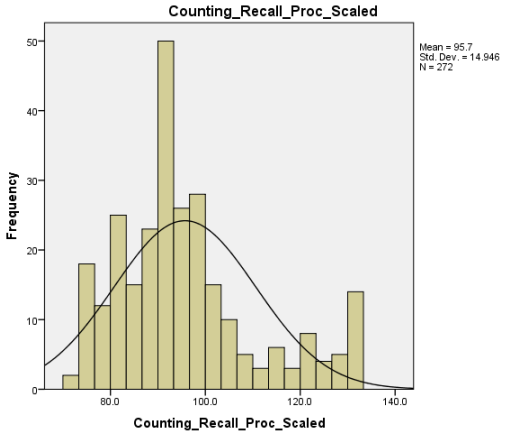

Nonword-Recall-Scaled
Mean = 102.27
Std. Dev. = 18.653
N = 272
Frequency
Nonword-Recall-Scaled

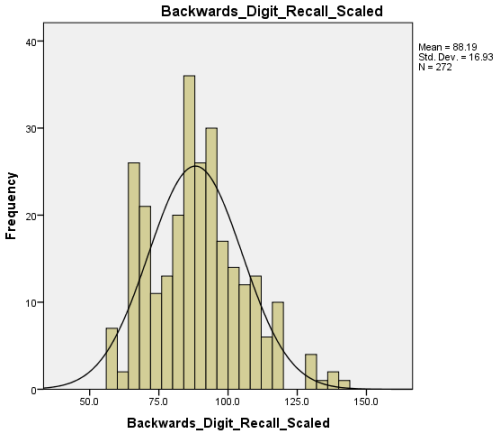

VSTM_Scaled
Mean = 90.78
Std. Dev. = 17.875
N = 272
Frequency
VSTM_Scaled

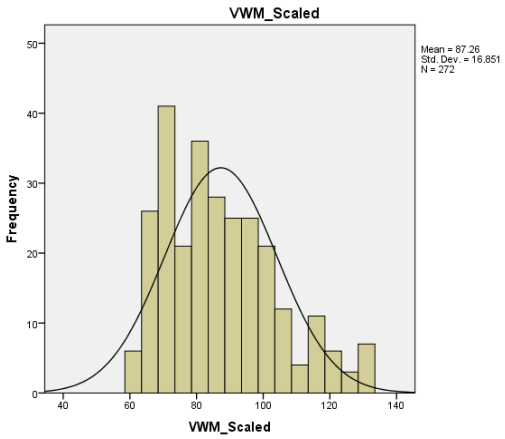

Listening_Recall_Scaled
Mean = 84.25
Std. Dev. = 18.988
N = 272
Frequency
Listening_Recall_Scaled

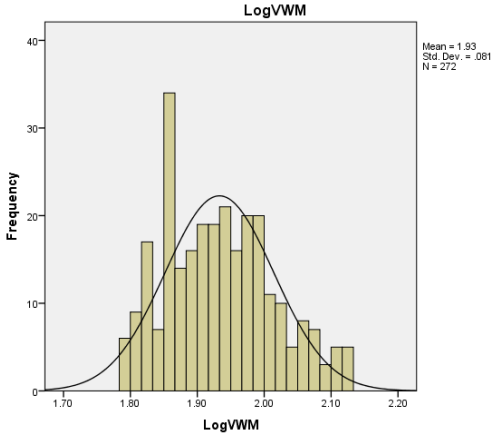

List_Recall_Proc_Scaled
Mean = 83.64
Std. Dev. = 12.846
N = 272
Frequency
List_Recall_Proc_Scaled

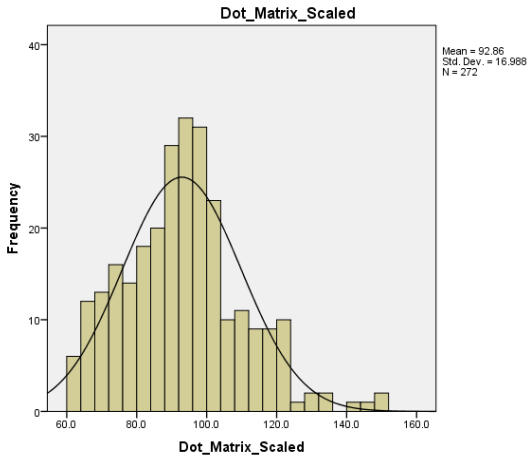

Counting_Recall_Scaled
Mean = 94.83
Std. Dev. = 17.479
N = 272
Frequency
Counting_Recall_Scaled

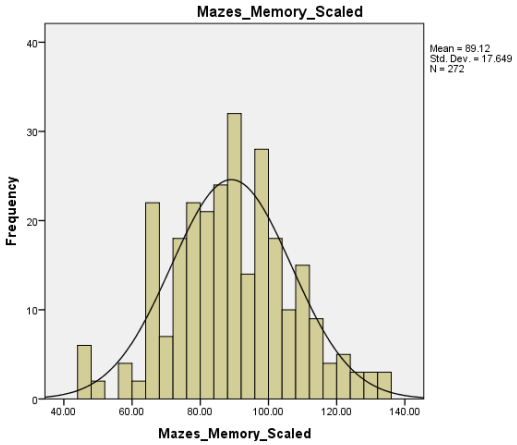

Counting_Recall_Proc_Scaled
Mean = 95.7
Std. Dev. = 14.946
N = 272
Frequency
Counting_Recall_Proc_Scaled

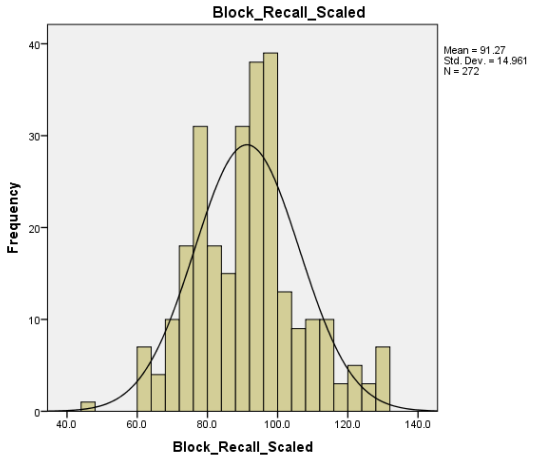

Backwards_Digit_Recall_Scaled
Mean = 88.19
Std. Dev. = 16.93
N = 272
Frequency
Backwards_Digit_Recall_Scaled

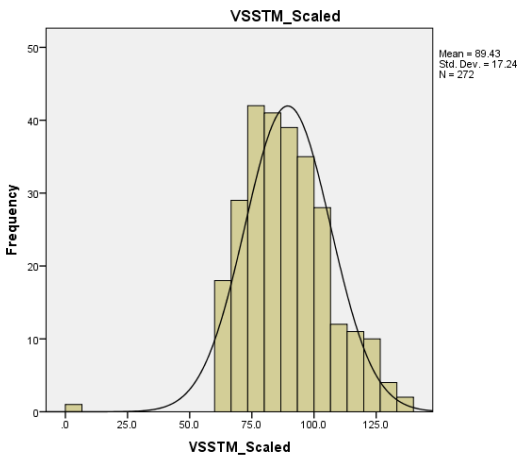

VWM_Scaled
Mean = 87.26
Std. Dev. = 16.851
N = 272
Frequency
VWM_Scaled

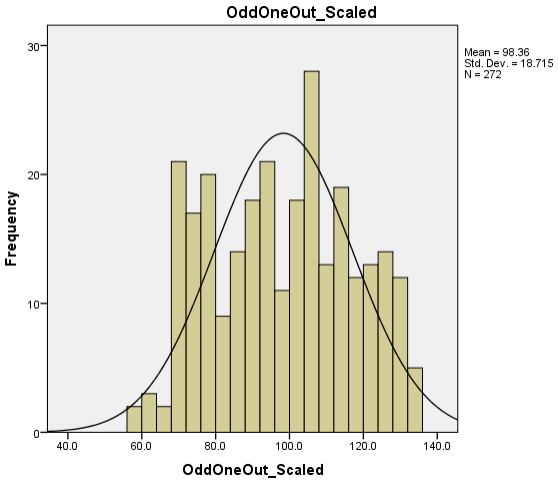

LogVWM
Mean = 1.93
Std. Dev. = .081
N = 272
Frequency
LogVWM

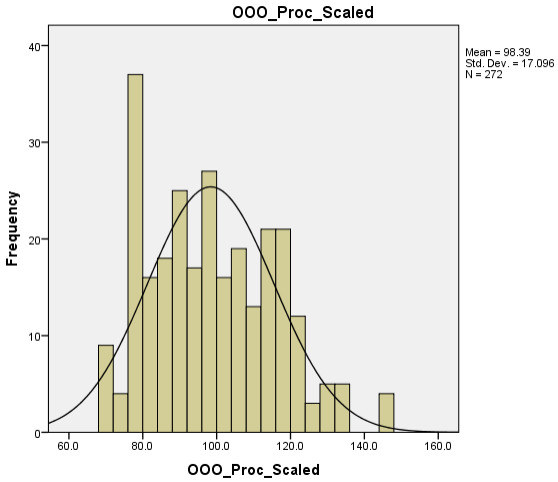

Dot_Matrix_Scaled
Mean = 92.86
Std. Dev. = 16.988
N = 272
Frequency
Dot_Matrix_Scaled

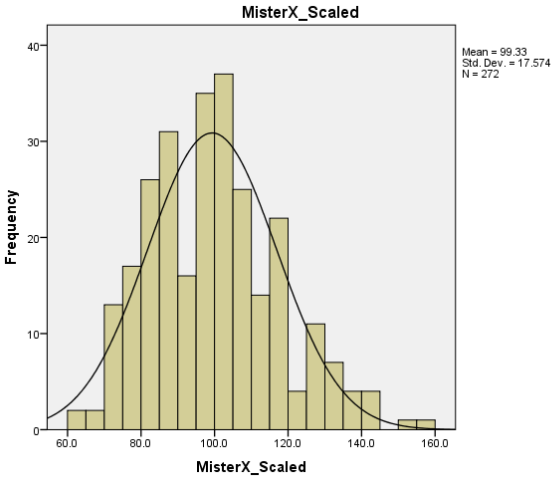

Mazes_Memory_Scaled
Mean = 89.12
Std. Dev. = 17.649
N = 272
Frequency
Mazes_Memory_Scaled

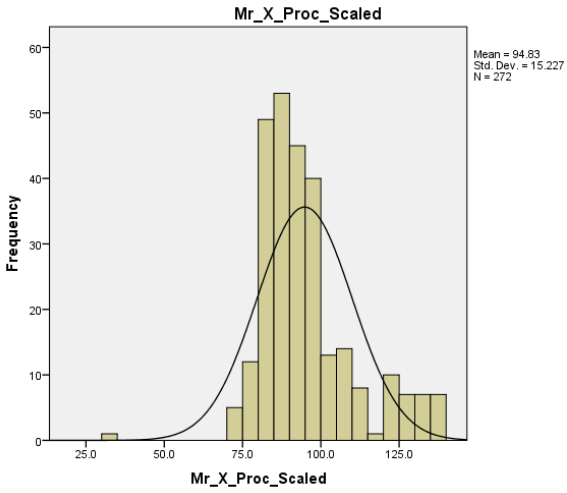

Block_Recall_Scaled
Mean = 91.27
Std. Dev. = 14.961
N = 272
Frequency
Block_Recall_Scaled

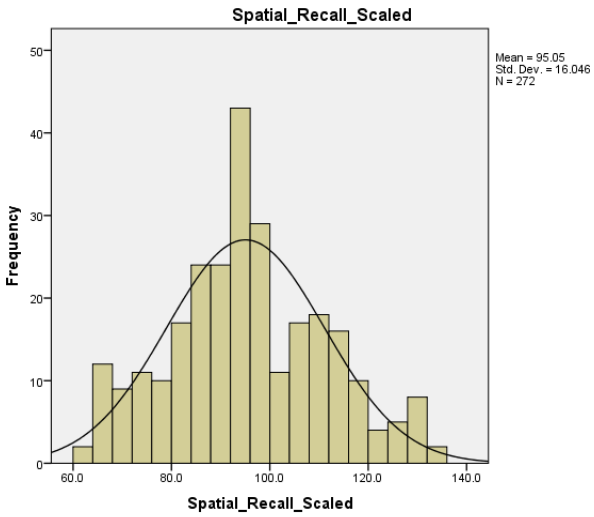

VSSTM_Scaled
Mean = 89.43
Std. Dev. = 17.24
N = 272
Frequency
VSSTM_Scaled

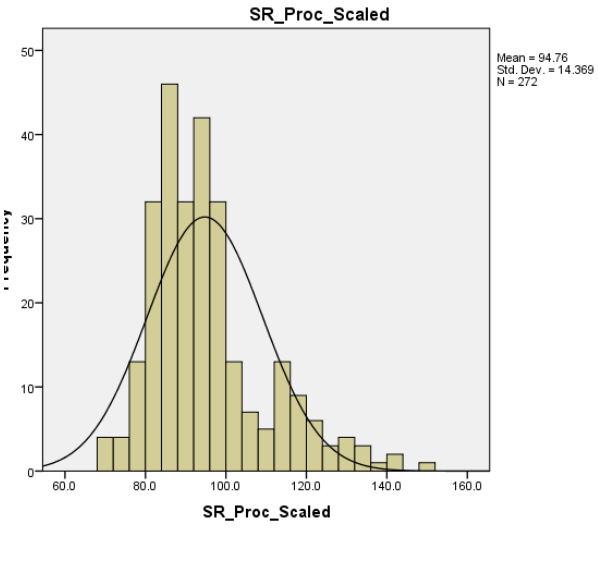

OddOneOut_Scaled
Mean = 98.36
Std. Dev. = 18.715
N = 272
Frequency
OddOneOut_Scaled


OOO_Proc_Scaled
Mean = 98.39
Std. Dev. = 17.096
N = 272
Frequency
OOO_Proc_Scaled


MisterX_Scaled
Mean = 99.33
Std. Dev. = 17.574
N = 272
Frequency
MisterX_Scaled


Mr_X_Proc_Scaled
Mean = 94.83
Std. Dev. = 15.227
N = 272
Frequency
Mr_X_Proc_Scaled


Spatial_Recall_Scaled
Mean = 95.05
Std. Dev. = 16.046
N = 272
Frequency
Spatial_Recall_Scaled


SR_Proc_Scaled
Mean = 94.76
Std. Dev. = 14.369
N = 272
SR_Proc_Scaled

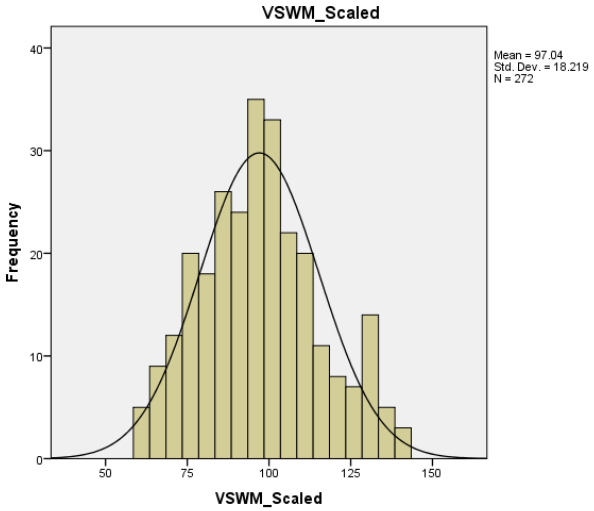

VSWM_Scaled
Mean = 97.04
Std. Dev. = 18.219
N = 272
Frequency
VSWM_Scaled

Table I1

Additional Tests for Homoscedasity for the AWMA and NEPSY-II

	Homoscedasity			
	Levene's Test			
	Statistic	df1	df2	p
AWMA				
Digit Recall	1.453	2	270	0.236
Word Recall	10.088	2	270	<0.001
Non-Word Recall	0.122	2	270	0.885
Verbal Short Term Memory	1.100	2	270	0.334
Listening Recall	1.938	2	270	0.146
Listening Recall Processing	4.462	2	270	0.012
Counting Recall	5.311	2	270	0.005
Counting Recall Processing	11.816	2	270	<0.001
Backwards Digit Recall	1.241	2	270	0.291
Verbal Working Memory	5.103	2	270	0.007
Dot Matrix	1.570	2	270	0.210
Mazes Memory	2.016	2	270	0.135
Block Recall	1.421	2	270	0.243
Visuospatial Short Term Memory	1.893	2	270	0.153
Odd One Out	1.047	2	270	0.352
Odd One Out Processing	1.834	2	270	0.162
Mister X	6.300	2	270	0.002
Mister X Processing	24.680	2	270	<0.001
Spatial Recall	1.382	2	270	0.253
Spatial Recall Processing	7.367	2	270	0.001
Visuospatial Working Memory	4.405	2	270	0.013
NEPSY-II				
Attention & Executive Functioning	0.640	2	86	0.530
Language	1.770	2	86	0.176
Memory & Learning	1.778	2	86	0.175
Sensorimotor Abilities	1.166	2	86	0.317
Social Perception	2.329	2	86	0.103
Visuomotor Processing	0.107	2	86	0.899
AWMA				
Age at Assessment	0.095	2	272	0.909
LSM_{Scaled}	12.716	2	272	0.000
LSM_{Raw}	7.990	2	272	0.000
SRT	9.043	2	272	0.000
RCPM	17.392	2	272	0.000
NEPSY-II				
Age at Assessment	0.056	2	86	0.945
LSM_{Scaled}	1.458	2	86	0.238
LSM_{raw}	1.137	2	86	0.326
SRT	2.153	2	86	0.122
SRTBoxCox	2.017	2	86	0.139
RCPM	0.684	2	86	0.508

Appendix J

Path Diagrams for Standardised Estimates for Five Models in the Three Subsamples

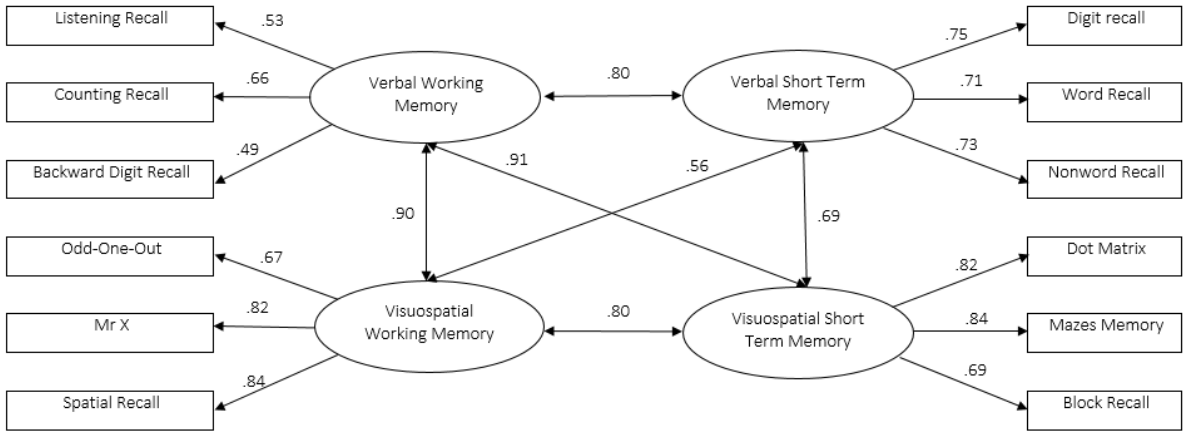


Figure J1. Four Factor Model Standardised Path Estimates for HIV-I Group

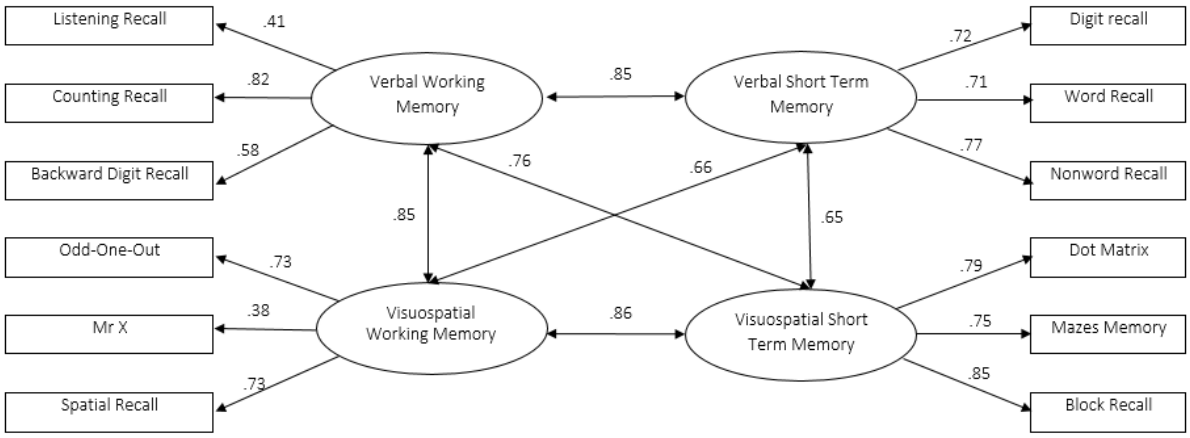


Figure J2: Four Factor Model Standardised Path Estimates for HIV-EU Group

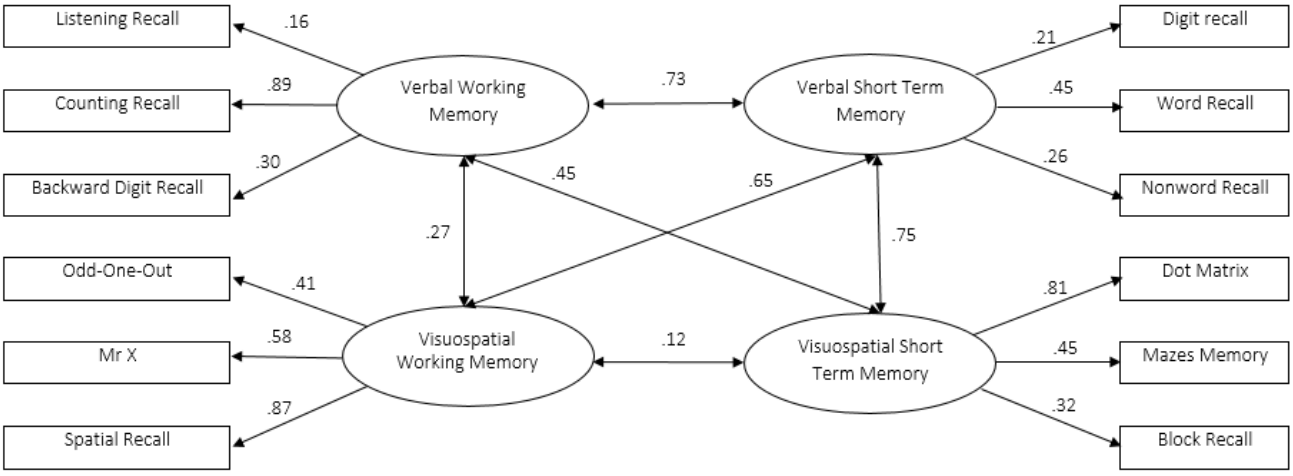


Figure J3. Four Factor Model Standardised Path Estimates for HIV-UU Group

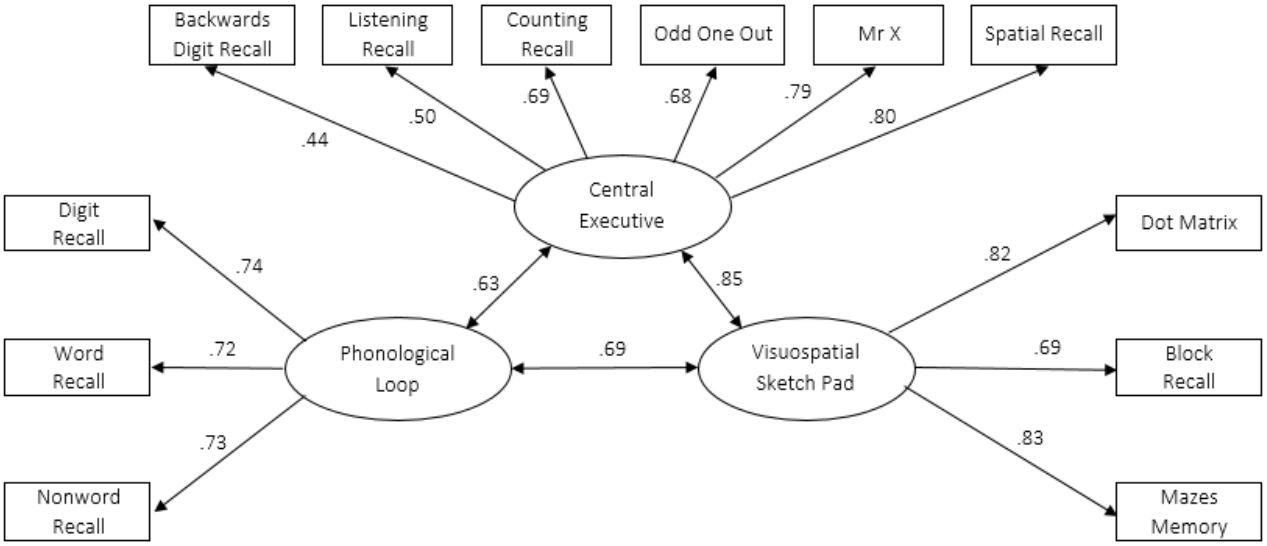


Figure J4. Three Factor Model Standardised Path Estimates for HIV-I Group

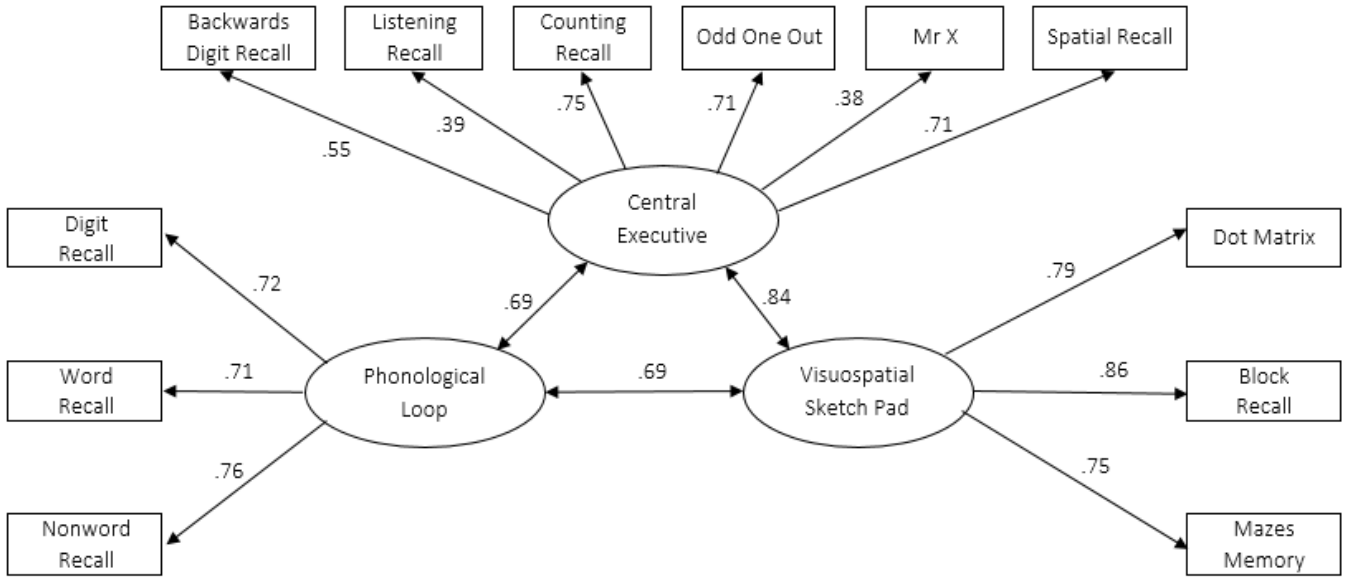


Figure J5. Three Factor Model Standardised Path Estimates for HIV-EU Group

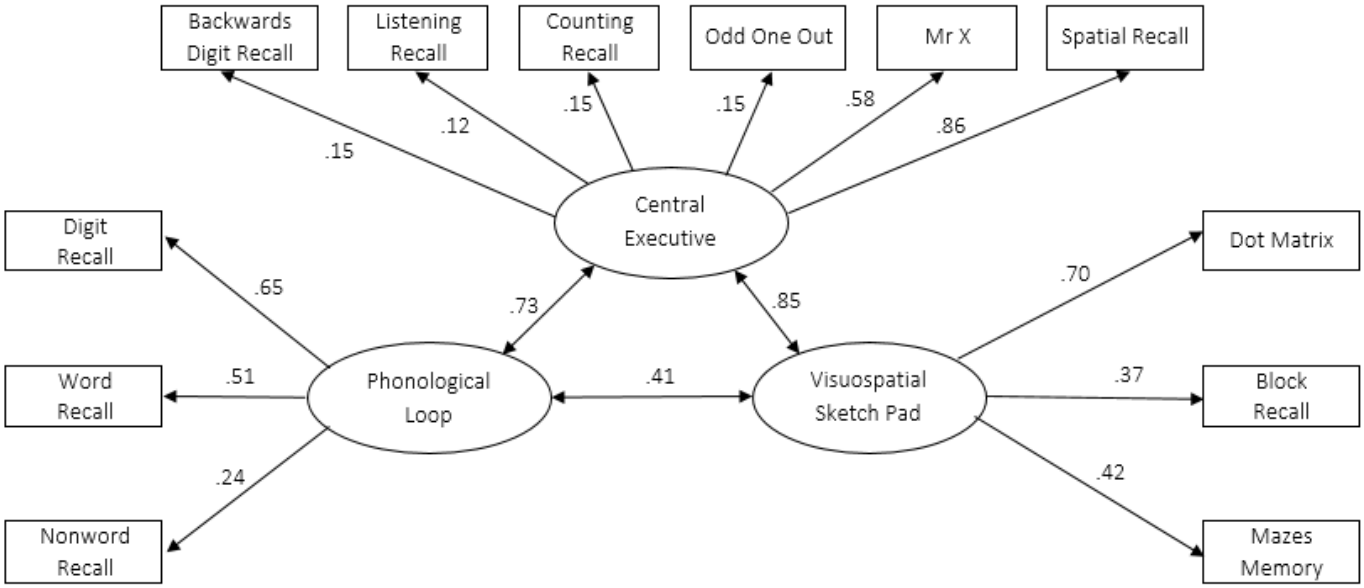


Figure J6. Three Factor Model Standardised Path Estimates for HIV-UU Group

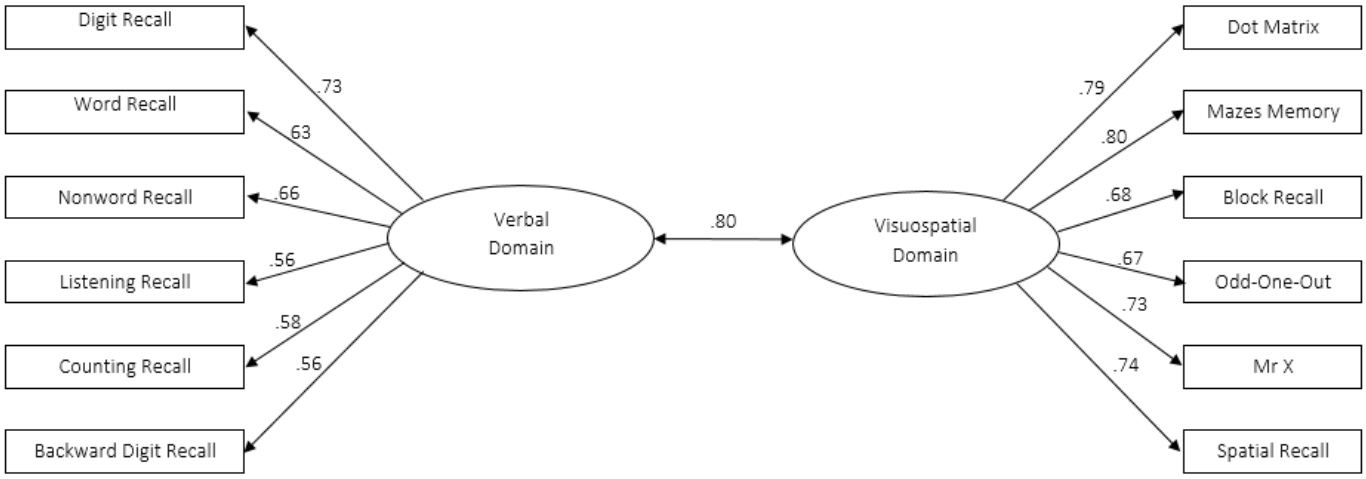


Figure J7. Two Factor Model Standardised Path Estimates for HIV-I Group (Domain Representation: Verbal and Visuospatial Skills)

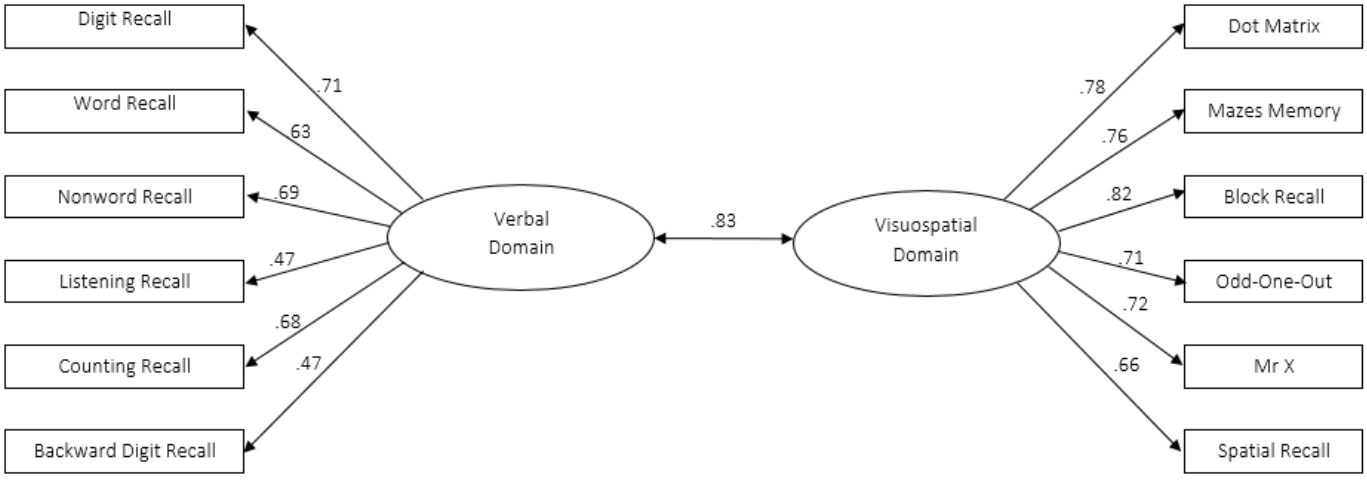


Figure J8. Two Factor Model Standardised Path Estimates for HIV-EU Group (Domain Representation: Verbal and Visuospatial Skills)

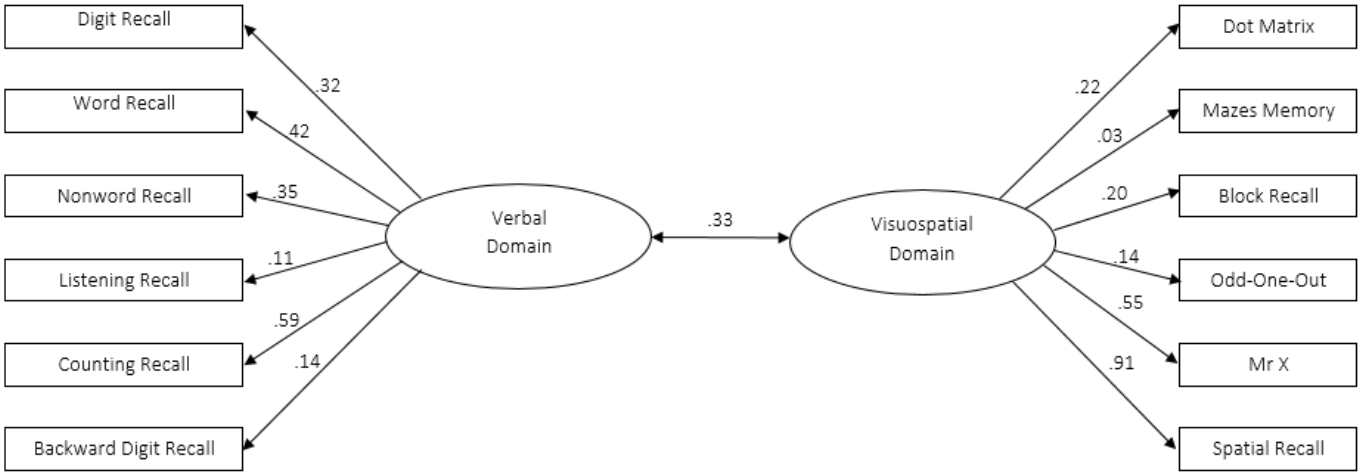


Figure J9. Two Factor Model Standardised Path Estimates for HIV-UU Group (Domain Representation: Verbal and Visuospatial Skills)

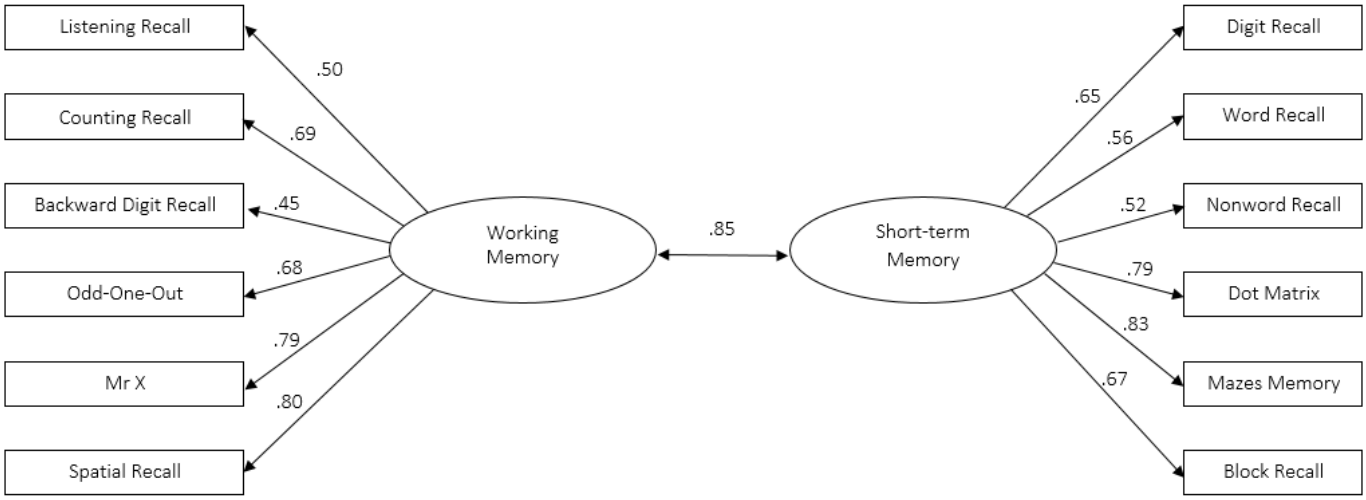


Figure J10. Two Factor Model Standardised Path Estimates for HIV-I Group (Distinction: Short Term Storage (simple) vs. Processing (complex))

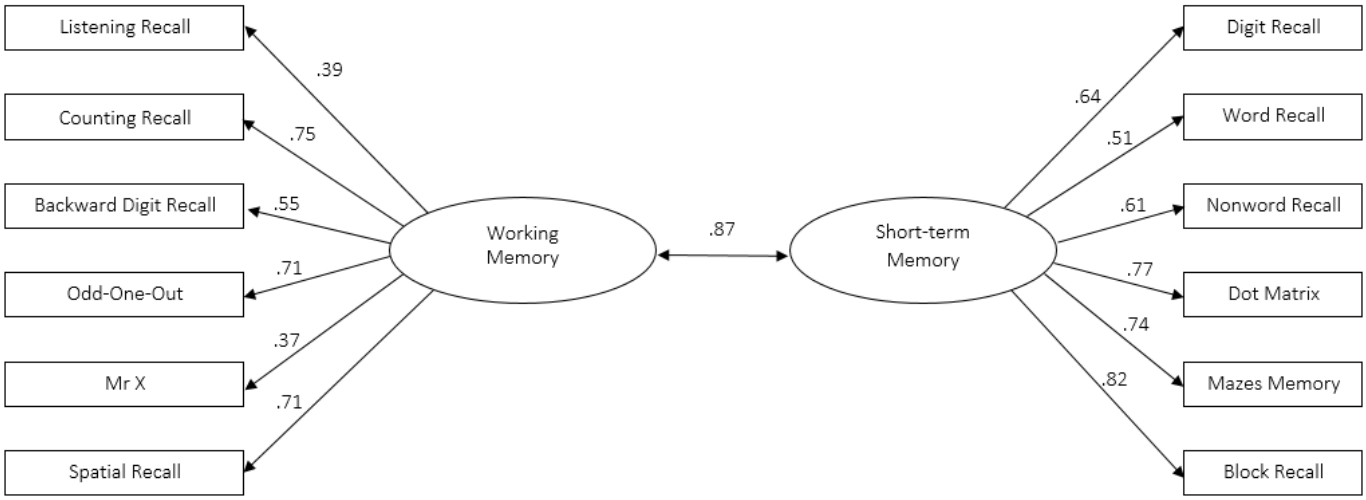


Figure J11. Two Factor Model Standardised Path Estimates for HIV-EU Group (Distinction: Short Term Storage (simple) vs. Processing (complex))

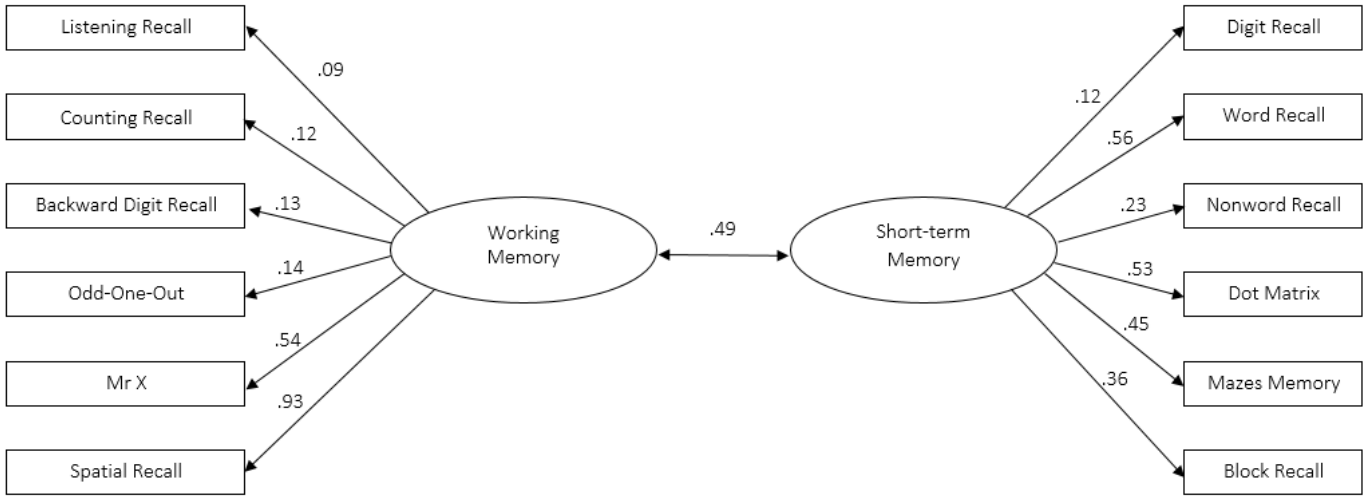


Figure J12. Two Factor Model Standardised Path Estimates for HIV-UU Group (Distinction: Short Term Storage (simple) vs. Processing (complex))

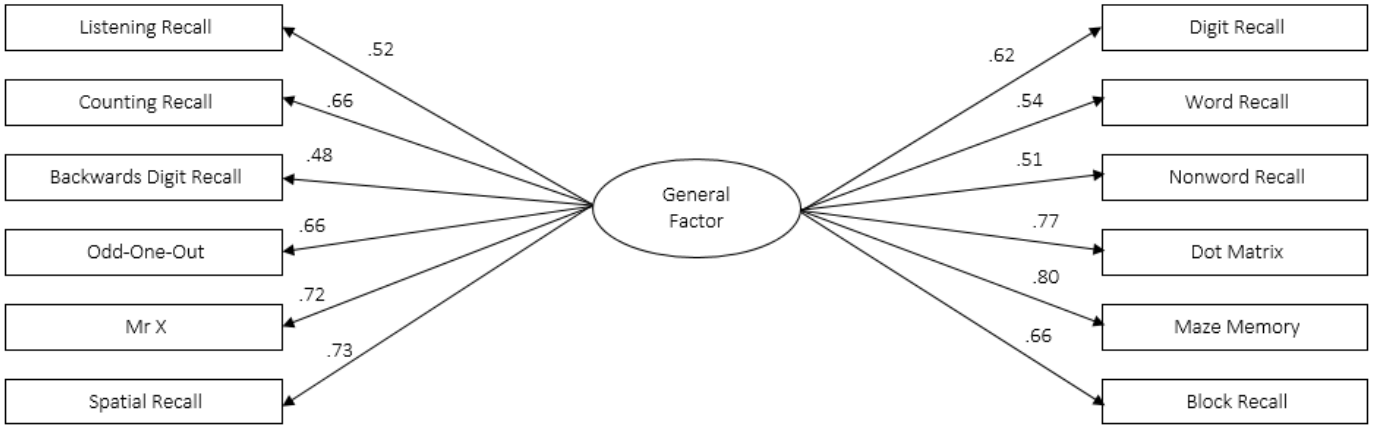


Figure J13. Single Factor Model Standardised Path Estimates for HIV-I Group

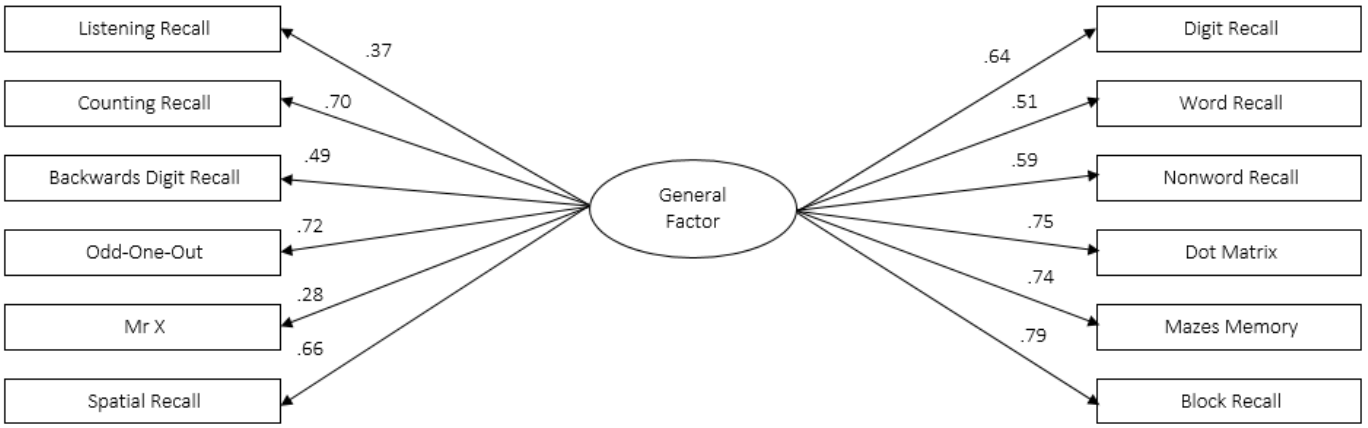


Figure J14. Single Factor Model Standardised Path Estimates for HIV-EU Group

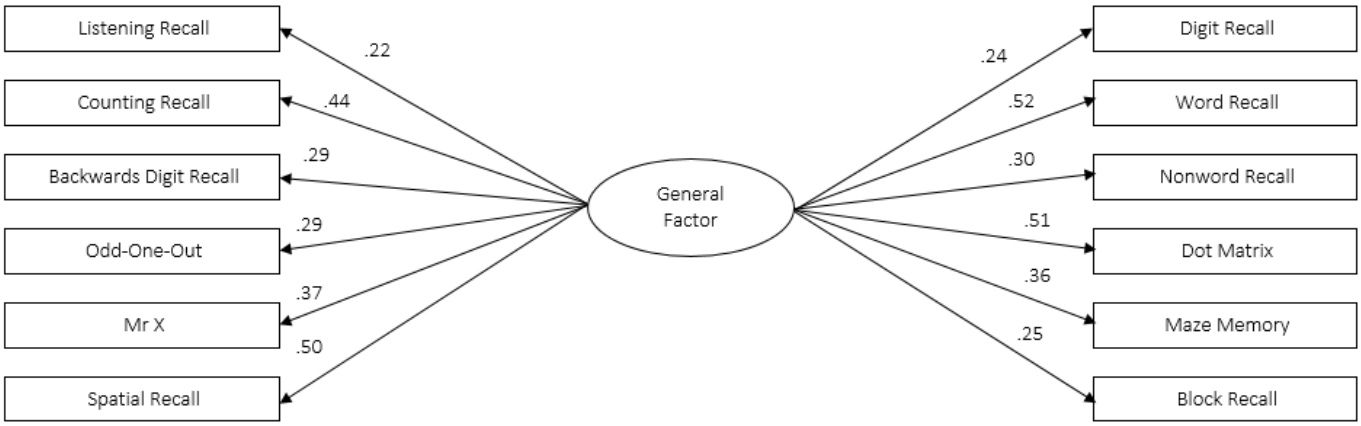


Figure J15. Single Factor Model Standardised Path Estimates for HIV-UU Group

Appendix K

Summary of ARV Drug Safety Side Effects

Table K1

Summary of ARV Drug Safety Side Effects

Antiretroviral Class	Drug Name	Paediatric Indication	Specific Drug Adverse Effects	Class Adverse Effects
NRTI's/NtRTI's	Abacavir (ABC)	>3 months	Serious and sometimes fatal hypersensitivity reactions	Mitochondrial dysfunction including lactic acidosis, hepatic toxicity, pancreatitis, and peripheral neuropathy.
	Didanosine (ddI)	Yes		
	Emtricitabine (FTC)	>3 months	Skin discolouration, fat redistribution	
	Lamivudine (3TC)	Yes	Anaemia, Neutropenia, fat redistribution	
	Stavudine (d4T)	Yes	Fat redistribution	
	Tenofovir (TDF)	No	Osteomalacia and reduced bone density, renal toxicity	
	Zidovudine (ZDV, AZT)	Yes	Bone marrow suppression, myopathy, fat redistribution	
NNRTI's	Efavirenz (EFV)	>3 months	Neuropsychiatric effects	Rare, but potentially life-threatening cases of skin rash, including Stevens-Johnson syndrome and hepatic toxicity.
	Etravirine (ETR)	No		
	Nevirapine (NVP)	Yes		
Protease Inhibitors	Atazanavir (ATV)	>6 years	Elevations in indirect bilirubin, cardiac conduction abnormalities	Metabolic complications including dyslipidemia, fat maldistribution, insulin resistance.
	Darunavir (DRV)	>6 years	Skin rash, elevated hepatic transaminases	
	Fosamprenavir (f-APV)	>2 years	Life-threatening rash, neutropenia, elevated serum creatinine kinase	
	Indinavir (IDV)	No	Hyperbilirubinemia, rash, nephrolithiasis/urolithiasis	
	Lopinavir (LPV)	Yes	Cardiac conduction abnormalities	
	Nelfinavir (NFV)	>2 years		
	Ritonavir (RTV)	>1 month		
	Saquinavir (SQV)	No		
	Tipranavir (TPV)	>2 years	Hepatitis	
Fusion Inhibitors	Enfuvirtide (T-20)	>6 years	Local injection site reactions, local site cellulitis	
Entry Inhibitors	Maraviroc (MVC)	No	Rash, musculoskeletal symptoms	
Integrase Inhibitors	Raltegravir (RGV)	No	Abdominal pain, vomiting, rare systematic allergic reaction, hepatitis	

Maron, G., Gaur, A. & Flynn, P. (2010). Antiretroviral therapy in HIV-infected infants and children. *The Pediatric Infectious Disease Journal, 29,* 360-363.