BOSTON UNIVERSITY

Constant Therapy

Understanding how big data analyses can inform theories of rehabilitation

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Disclosure

- Co-founder of Constant Therapy (now- The Learning Corporation), ownership stock

- **Funding for initial work from Wallace Coulter Foundation for Translational Research**

Aphasia rehabilitation- where do things stand?

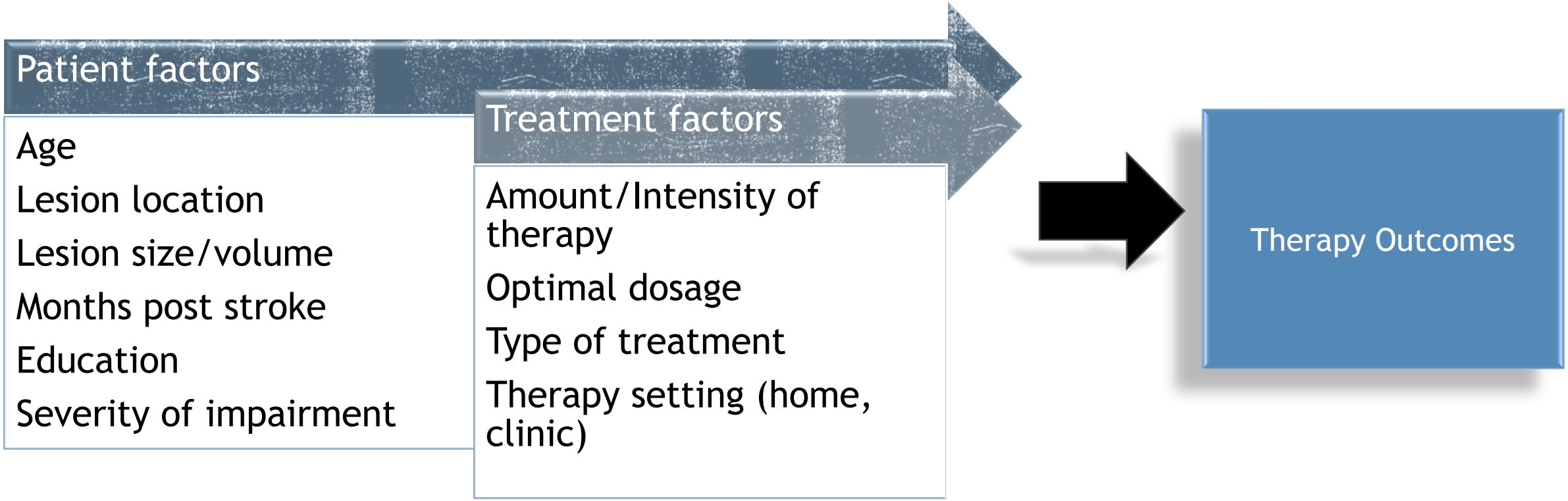
Treatment works at the individual patient level and for specific impairments-

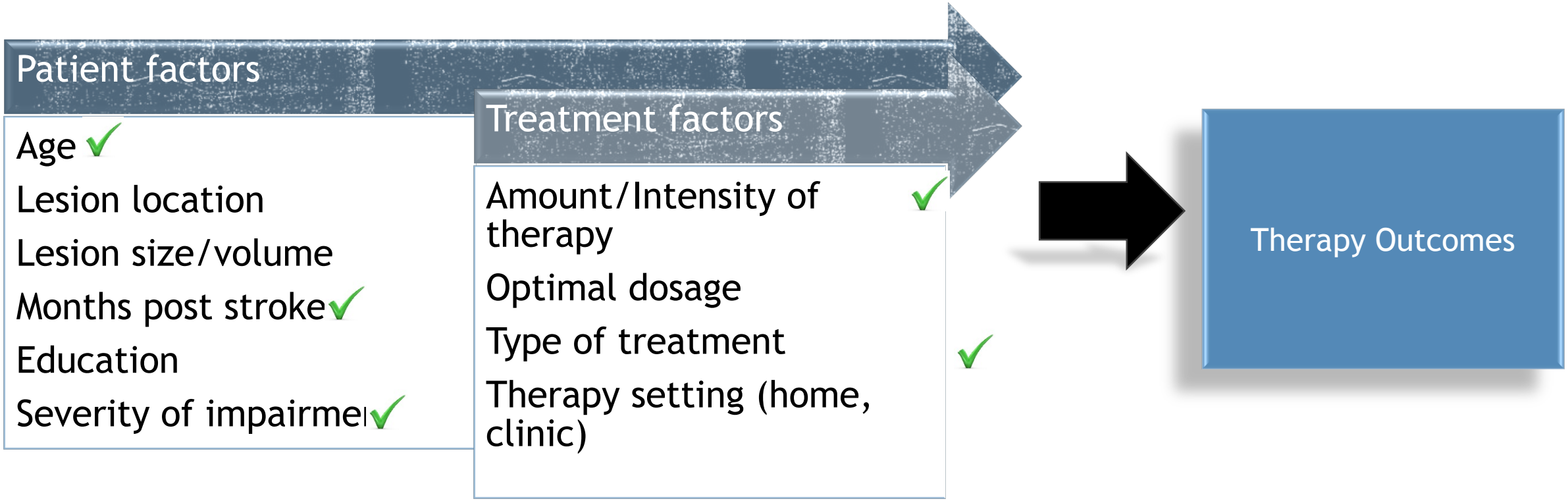
- Semantic feature analysis (SFA) (Boyle, 2004; Boyle & Coehlo, 1995; Coelho et al., 2000; Hashimoto & Frome, 2011; Kiran & Bassetto, 2008),
- Phonological component analysis (Leonard et al., 2008; van Hees et al., 2013; Wambaugh, 2003),
- Phonomotor therapy (Kendall et al., 2015),
- Verb network strengthening treatment (VNeST) (Edmonds et al., 2014a),
- Treatment of underlying forms (TUF) (Dickey & Thompson, 2007; Thompson et al., 2010a; Thompson et al., 2010b; Thompson & Shapiro, 2005),
- Orthographic impairment approaches (Beeson & Egnor, 2006; Kiran, 2005; Orjada & Beeson, 2005),
- Constraint induced language therapy (Breier et al., 2011; Maher et al., 2006; Pulvermuller et al., 2001),
- Melodic intonation therapy (MIT) (Hough, 2010; Morrow-Odom & Swann, 2013; Norton et al., 2009; van der Meulen et al., 2012), and
- Multimodal aphasia therapy (Boo & Rose, 2011; Rose & Douglas, 2008; Rose et al., 2013).

Moreover, many of these impairment-based approaches have been found to facilitate changes in functional communication skills (Berthier et al., 2009; Edmonds et al., 2014a; Hough, 2010; Kendall et al., 2015; Martins et al., 2013; Milman et al., 2014; Pulvermuller et al., 2001; van der Meulen et al., 2014; Wilssens et al., 2015).

What we don’t yet know is-

When a patient walks into the clinic, can we accurately prescribe the right therapy and dosage for the patient and make some predictions about how much improvement he/she will show ?


Patient factors
Age
Lesion location
Lesion size/volume
Months post stroke
Education
Severity of impairment
Treatment factors
Amount/Intensity of therapy
Optimal dosage
Type of treatment
Therapy setting (home, clinic)
Therapy Outcomes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What can big data tell us?

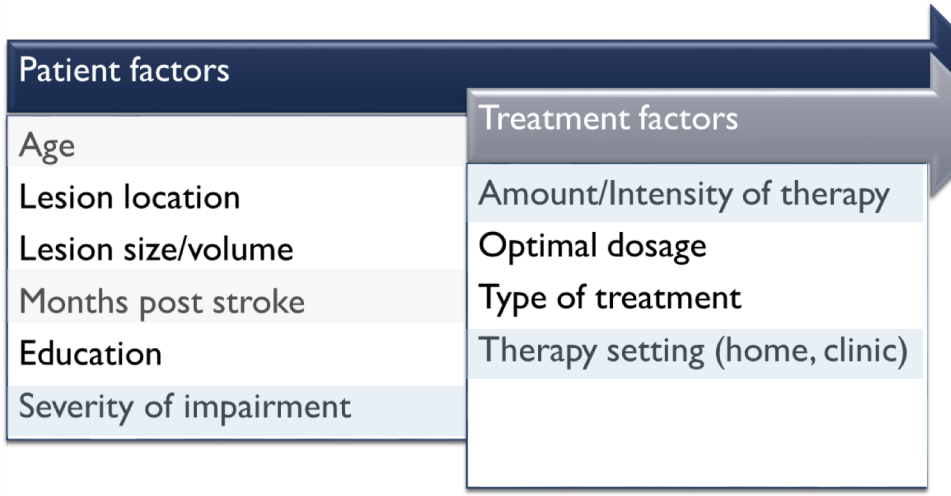
Can large scale data be used to answer questions about the effectiveness of aphasia rehabilitation

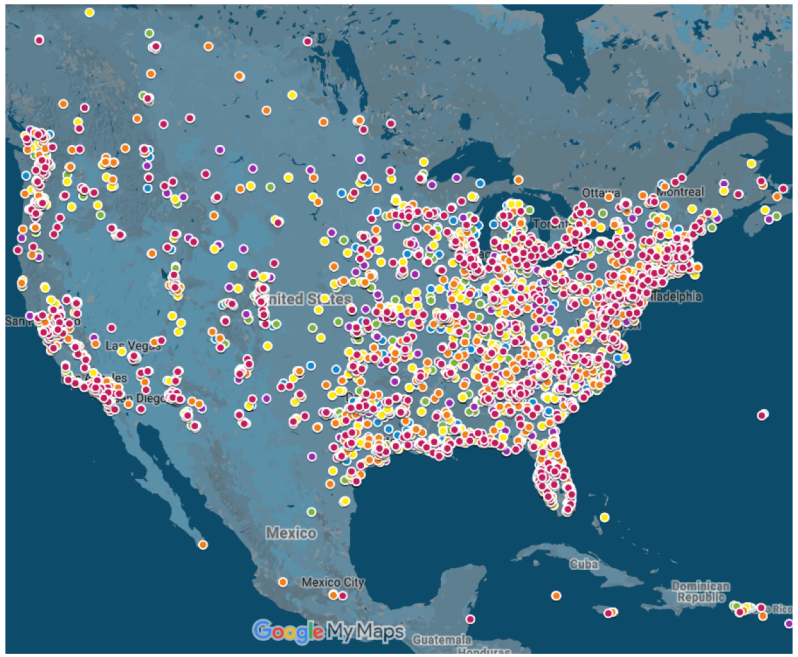
Three questions:

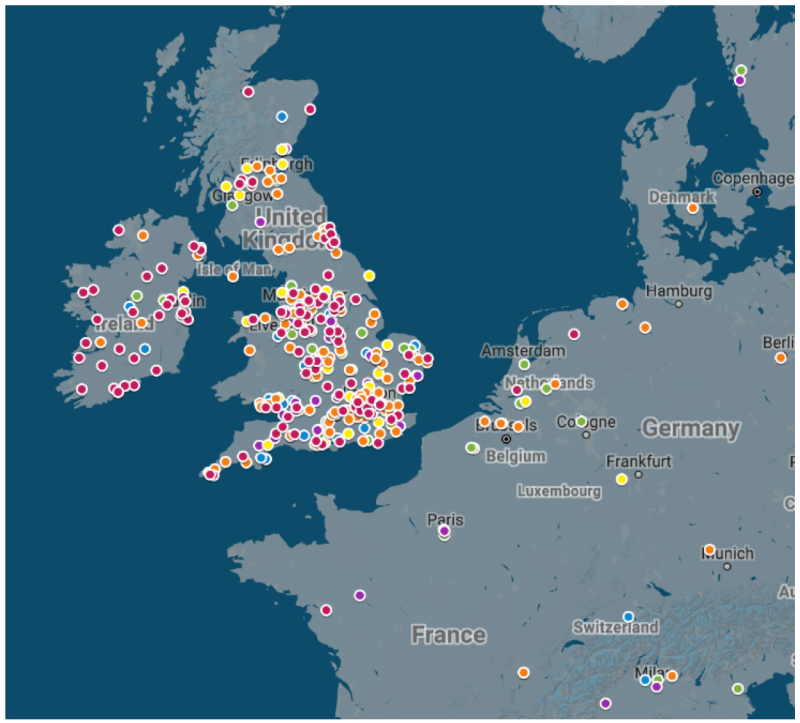
1. How does therapy at home compare to therapy in the clinic?

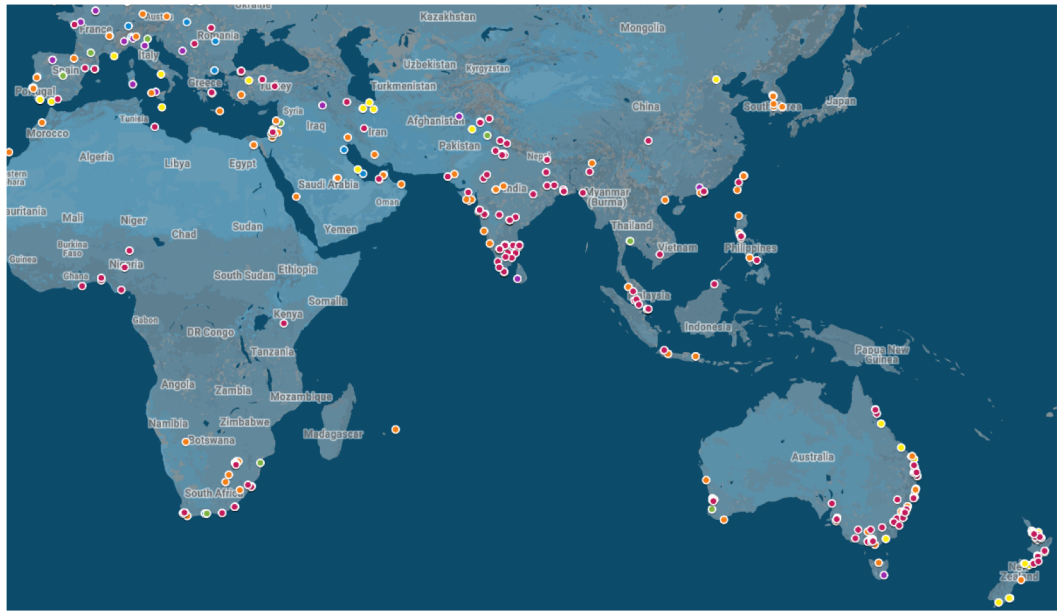
2. How does severity of impairment influence outcomes?

3. What is the optimal dosage of treatment?

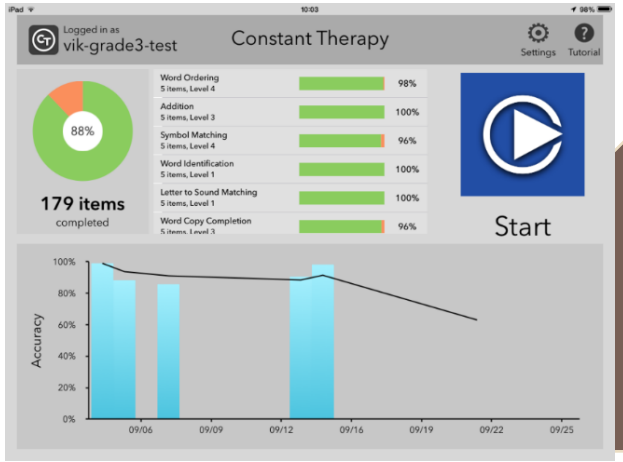






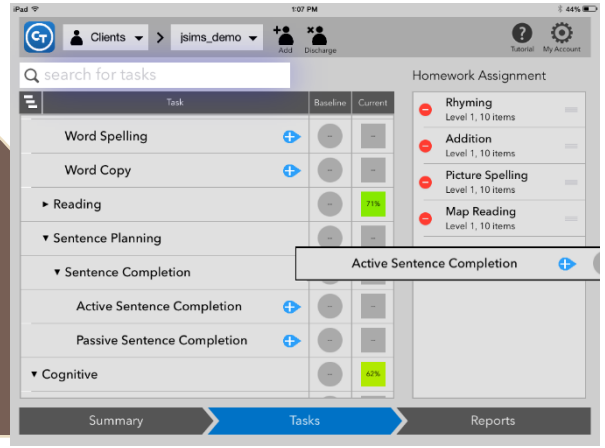


- 20,000 individuals with post-stroke aphasia who used Constant Therapy program (2013-2016)
- Retrospective analysis



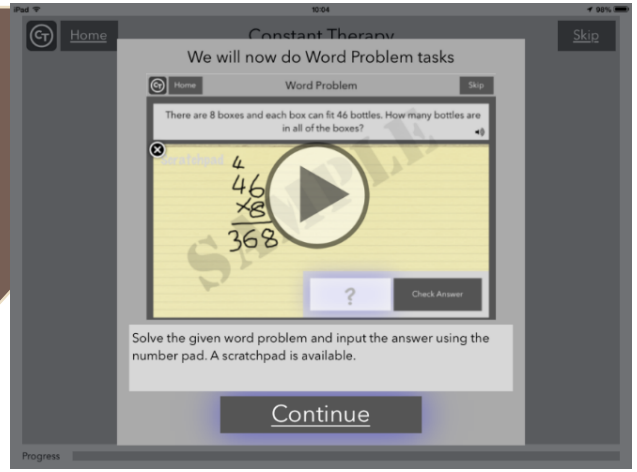
Clinician signs up for constant therapy and enrolls patients

Patients are assigned specific therapy tasks

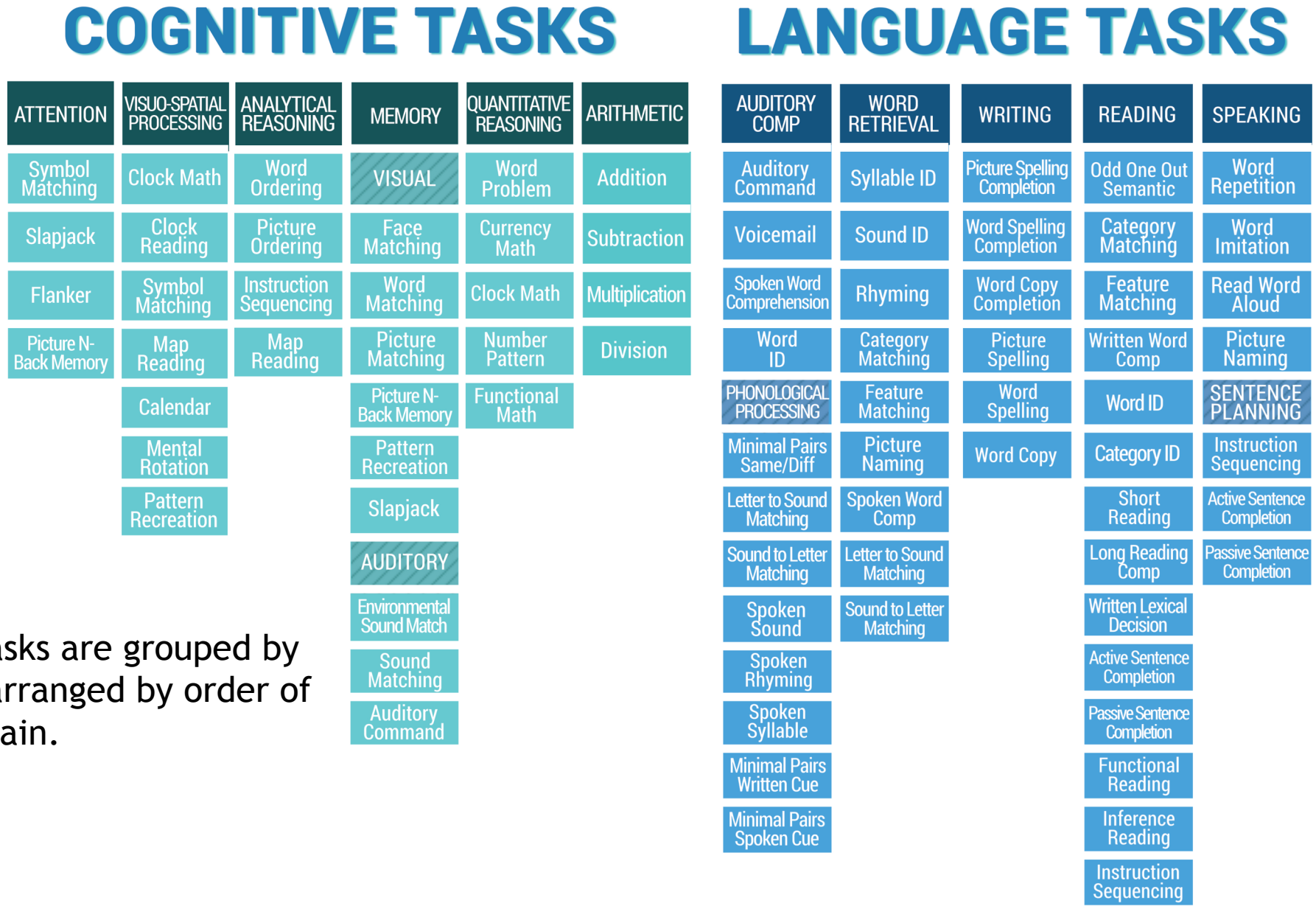


Clinician Analyzes Data on usage and performance

Patient completes CT program

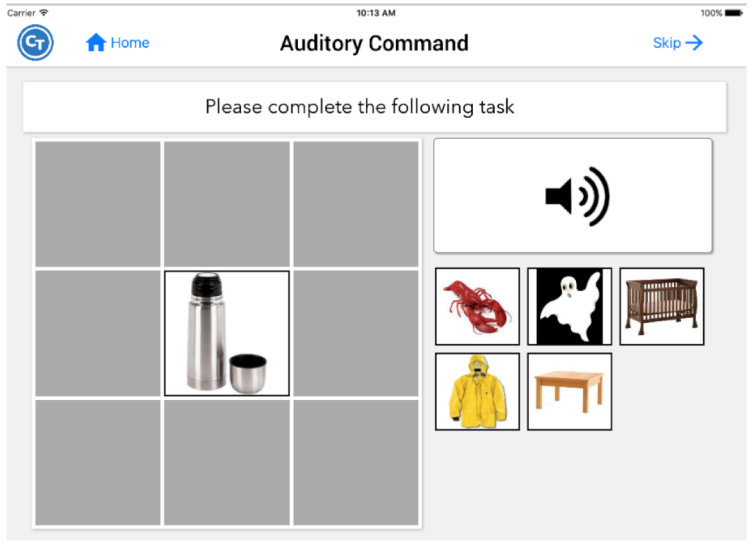


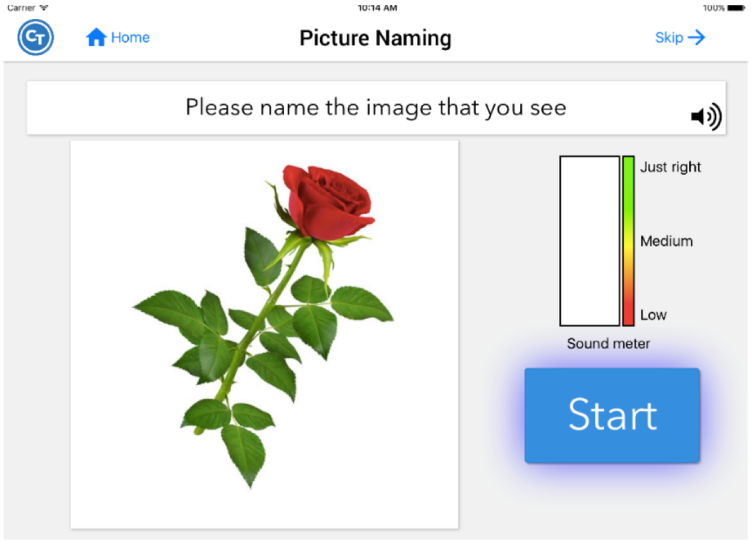
Methods



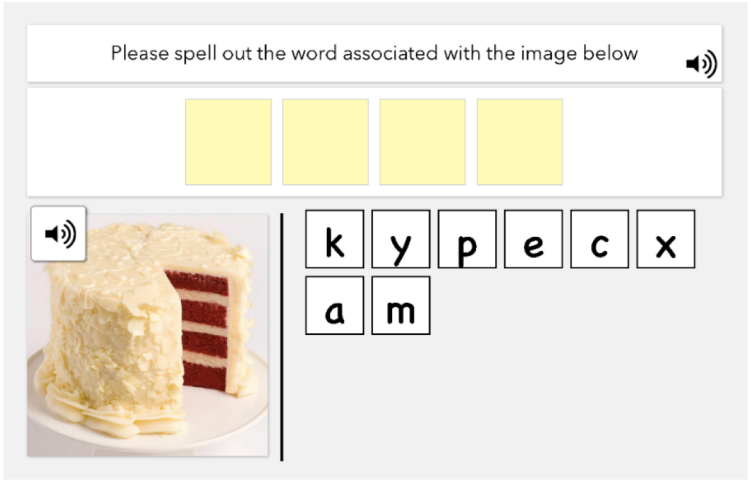
Constant Therapy's 70+ tasks are grouped by functional skill area and arranged by order of difficulty within that domain.

Methods


Home
Auditory Command
Skip
Please complete the following task


Home
Picture Naming
Skip
Please name the image that you see
Just right
Medium
Low
Sound meter
Start


Where was the red-tailed hawk injured?
Feathered Friends
A New York City group helps injured birds and other wildlife.
JANUARY 18, 2013
By Jaime Joyce
Red-tailed hawks are powerful birds. But the hawk that lay on an examination table in New York City was weak and helpless. Wildlife rehabilitators kept a gentle grip on the bird as they inspected the injury above its right eye. The hawk had probably been hit by a car while swooping to grab prey.
"The bird was pretty out of it," says Rita McMahon, cofounder of the Wild Bird Fund (WBF). She helped treat the hawk. Each year, the WBF provides emergency care to about 1,500 sick and injured birds and small mammals in New York City. Often, migrating birds get hurt when they fly into tall buildings. The animals get a full exam, X-rays, blood tests and medicine, if needed. Extra help is provided by two nearby veterinary hospitals.
Frequent Fliers
Patients at the WBF have included geese, ducks, swans and hummingbirds. In November, a wild turkey was brought in with a fractured leg. But pigeons are the WBF's most frequent winged patients. The birds are abundant in New York. On a recent TFK visit to the WBF, we saw about 50 pigeons lined up in cages against a wall. At the sink, a volunteer soaped and scrubbed a pigeon whose feathers were coated with cooking oil.
from TIME for Kids
Above its left eye
Under its right eye
Above its right eye

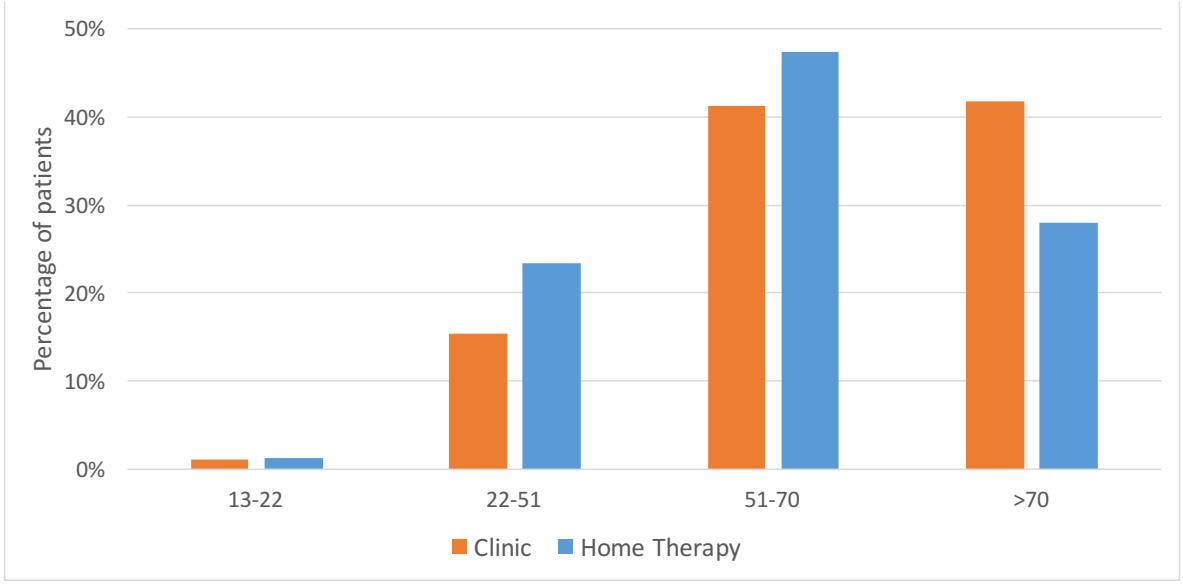

Please spell out the word associated with the image below
k
y
p
e
c
x
a
m

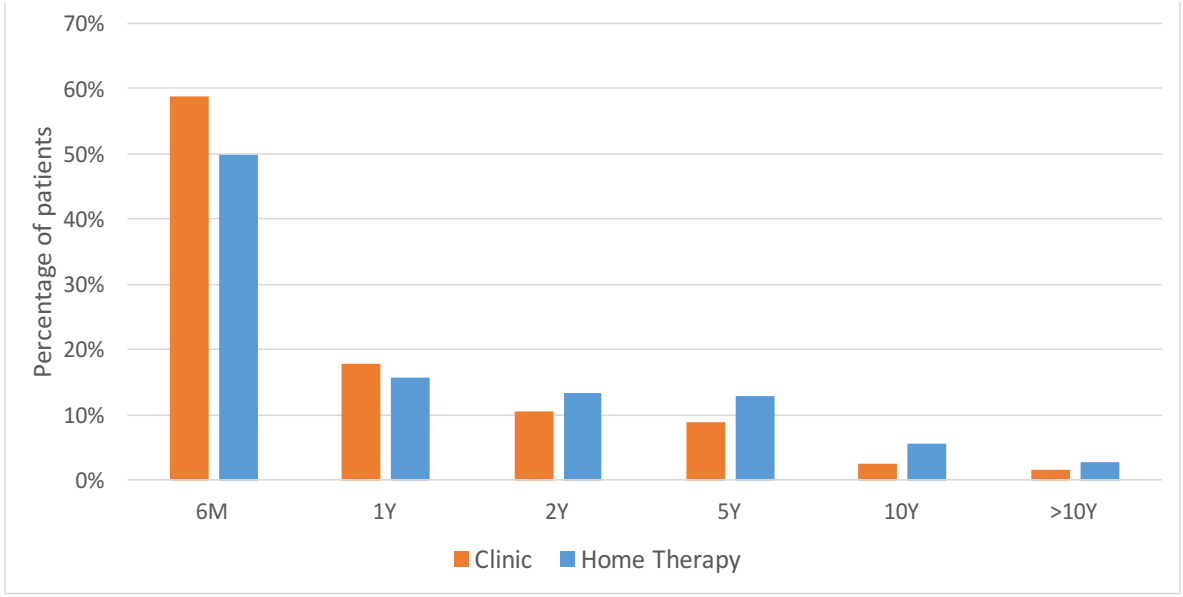
Question #1: How does therapy at home compare to therapy in the clinic?

QUESTION 1

1. How does therapy at home compare to therapy in the clinic?

- 3652 patients
- Clinic patients – 1575 patients (Clinic-only users who only received therapy under the care of a clinician)
- Home therapy patients – 2077 patients (Home-only users with no clinician guidance)





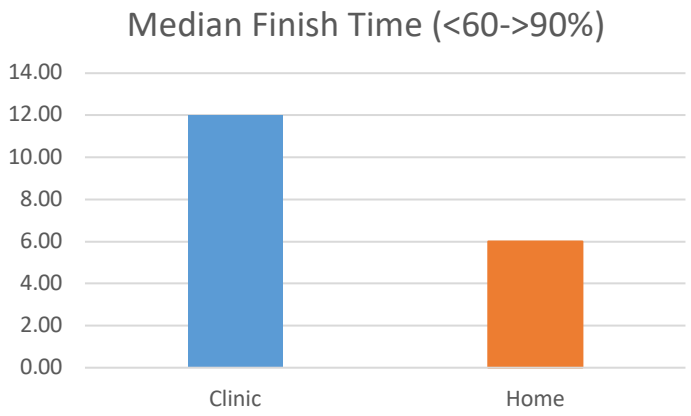
QUESTION 1

How does therapy at home compare to therapy in the clinic?

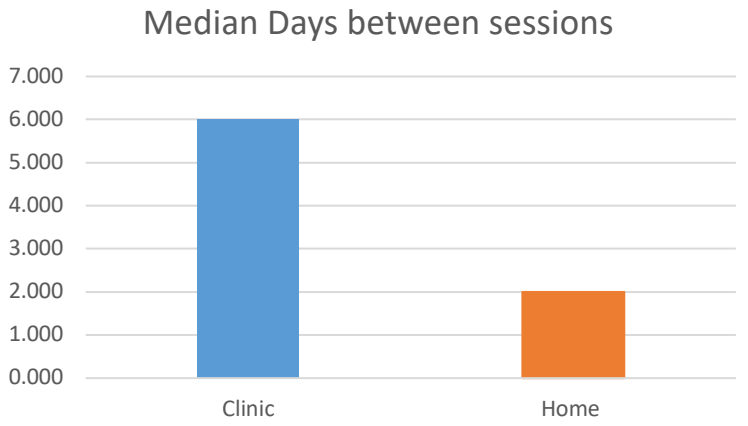
- Effectiveness of therapy was represented by the number of calendar days patients spent between:
  - Struggling at a task (<60% accuracy) to
  - Mastering a task (>90% accuracy)

- Each therapy task was analyzed independently
- 46 out of 244 therapies have at least 20 Clinic-only and 20 Home-only users
- Patients who finished tasks in less than a day or who took more than 60 days to finish the task are not included

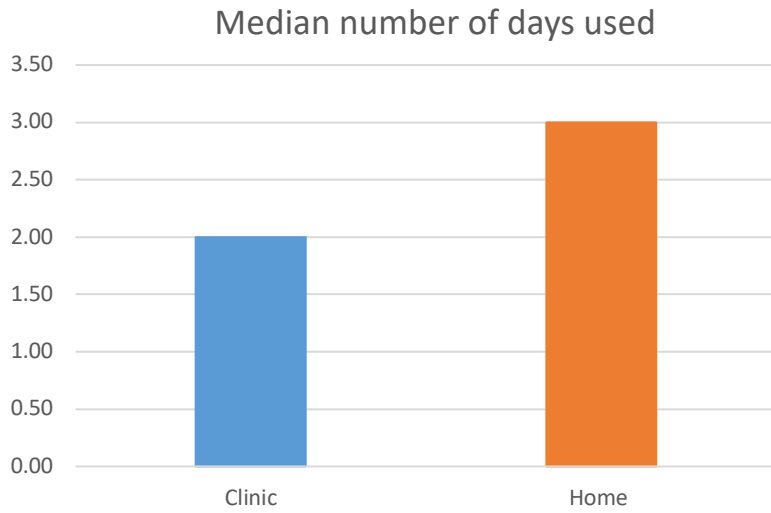
QUESTION 1



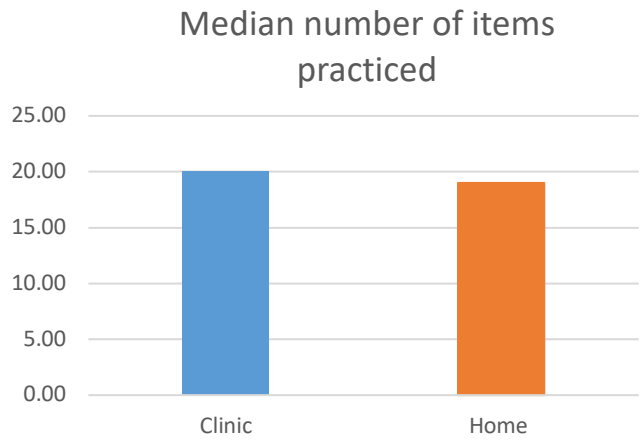
(F(1,7133) = 246.61, p < .001) where clinic users took a higher number of calendar days to reach 90% accuracy than home users

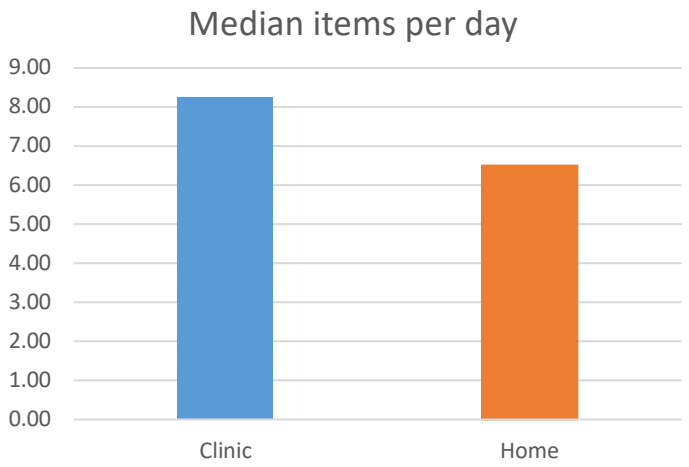


(F(1,7190) = 85.70, p < .001) where clinic users had a greater median numbers of days between sessions than home users



(F(1,7190) = 71.97, p < .001) where overall clinic users took fewer days of therapy to reach 90% accuracy than home users





(F(1,7190) = 13.31, p < .001) where clinic users completed more items per therapy day than home users

QUESTION 1

CLINIC PATIENT

2017	August					
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
31	01	02	03	04	05	06
	START THERAPY TASK					PRACTICE THERAPY TASK
07	08	09	10	11	12	13
					MASTER THERAPY TASK	
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	01	02	03
04	05	Notes:				

HOME PATIENT

2017	August					
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
31	01	02	03	04	05	06
	START THERAPY TASK		PRACTICE THERAPY TASK			MASTER THERAPY TASK
07	08	09	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	01	02	03
04	05	Notes:				

- Main findings
- For patients who improve from 60-90%, both groups require a similar number of therapy sessions to achieve mastery
- Patients practicing only at home can master tasks in a shorter time than patients practicing only in the clinic.

QUESTION 1

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- For patients who improve from 60-90%, both groups require a similar number of therapy sessions to achieve mastery
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Question #1: How does therapy at home compare to therapy in the clinic?

Question #2: How does severity of impairment influence treatment outcomes?

Question #3: How does severity and dosage (amount of practice) influence treatment outcomes?

Question #1: How does therapy at home compare to therapy in the clinic?

Question #2: How does severity of impairment influence treatment outcomes?

Question #3: What is the optimal dosage for optimal treatment outcomes?

- In patients with acute aphasia, one randomized control trial showed that patients with mild aphasia improved more than patients with severe aphasia.

- Laska AC, Kahan T, Hellblom A, Murray V, von Arbin M. A randomized controlled trial on very early speech and language therapy in acute stroke patients with aphasia. Cerebrovasc Dis Extra 2011; 1(1):66–74

- Pedersen and colleagues showed that initial aphasia severity predicted language impairment in the chronic stage and was associated with poorer outcomes in the long term.

- Pedersen PM, Vinter K, Olsen TS. Aphasia after stroke: type, severity and prognosis. The Copenhagen aphasia study. Cerebrovasc Dis 2004;17(1):35–43

- One large-scale study examined overall stroke outcomes (not specifically language) and found that greater severity predicted a poorer outcome after rehabilitation.

- van Bragt PJ, van Ginneken BT, Westendorp T, Heijenbrok-Kal MH, Wijffels MP, Ribbers GM. Predicting outcome in a postacute stroke rehabilitation programme. *Int J Rehabil Res.* 2014;37(2):110-117.

- However, another study showed that at even severe patients with aphasia benefited from very early language therapy.

Godecke E, Hird K, Lalor EE, Rai T, Phillips MR Very early post stroke aphasia therapy: a pilot randomized controlled efficacy trial. Int J Stroke 2012;7(8):635-644

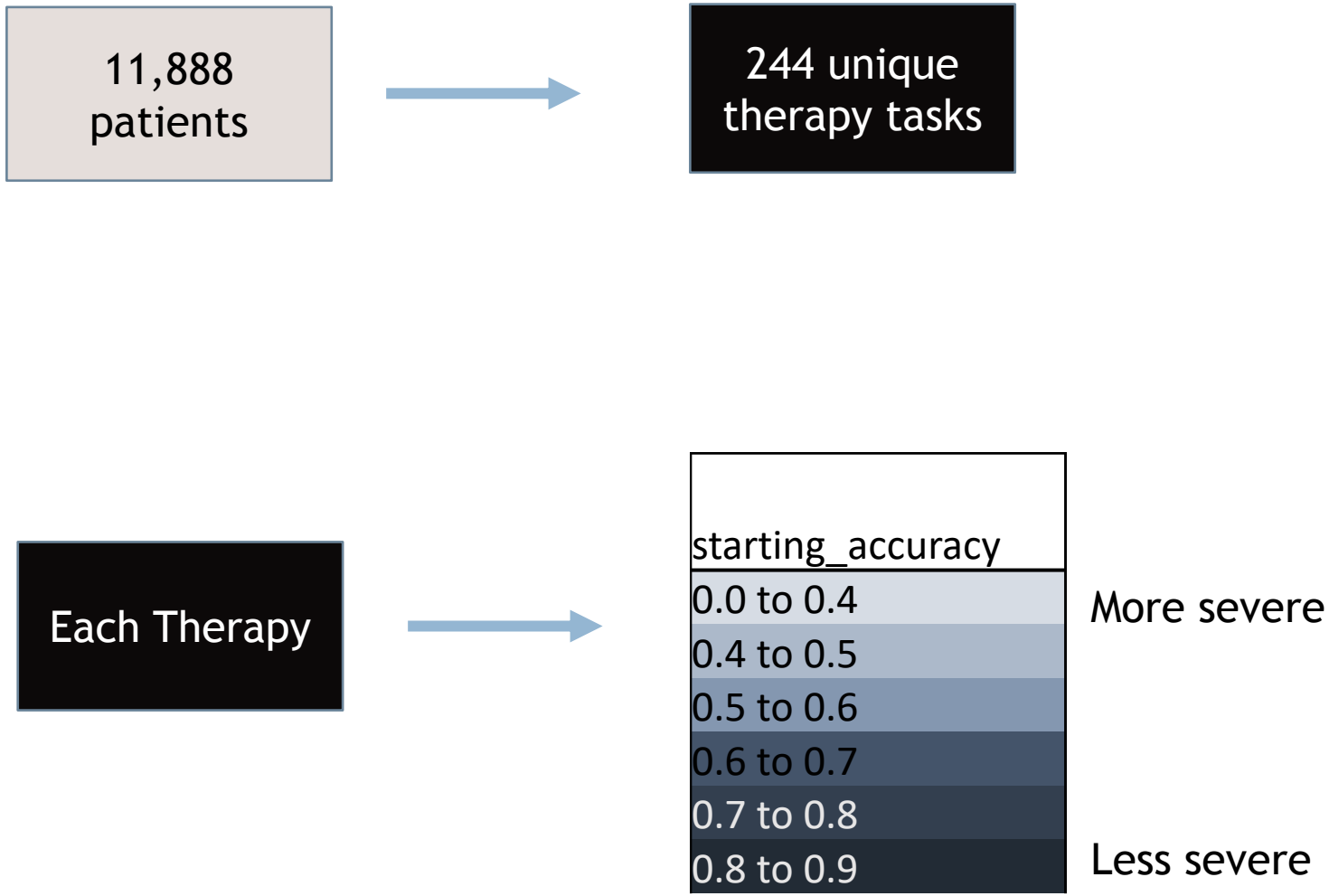
- In a meta-analysis, Robey showed that acute patients with severe aphasia show substantial gains after treatment but chronic patients with moderate and severe aphasia also show substantial gains after rehabilitation.

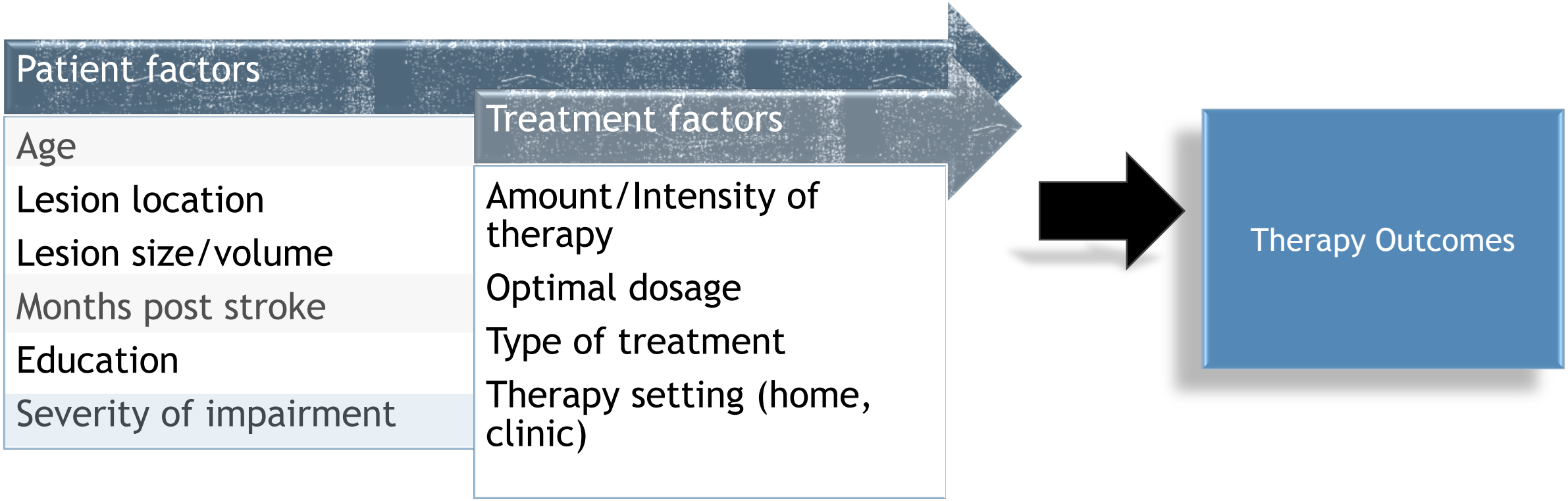
Robey RR. A meta-analysis of clinical outcomes in the treatment of aphasia. *Journal of Speech, Language and Hearing Research*. 1998;41(1):172-187.

- In chronic aphasia, Persad and colleagues reviewed outcomes from rehabilitation centers that provide intensive comprehensive aphasia treatment and found both mild and severe chronic patients with aphasia to benefit from such treatment

Persad C, Wozniak L, Kostopoulos E. Retrospective analysis of outcomes from two intensive comprehensive aphasia programs. *Topics in Stroke Rehabilitation*. 2013;20(5):388-397.

Calculation of Severity of impairment




Patient factors
Age
Lesion location
Lesion size/volume
Months post stroke
Education
Severity of impairment
Treatment factors
Amount/Intensity of therapy
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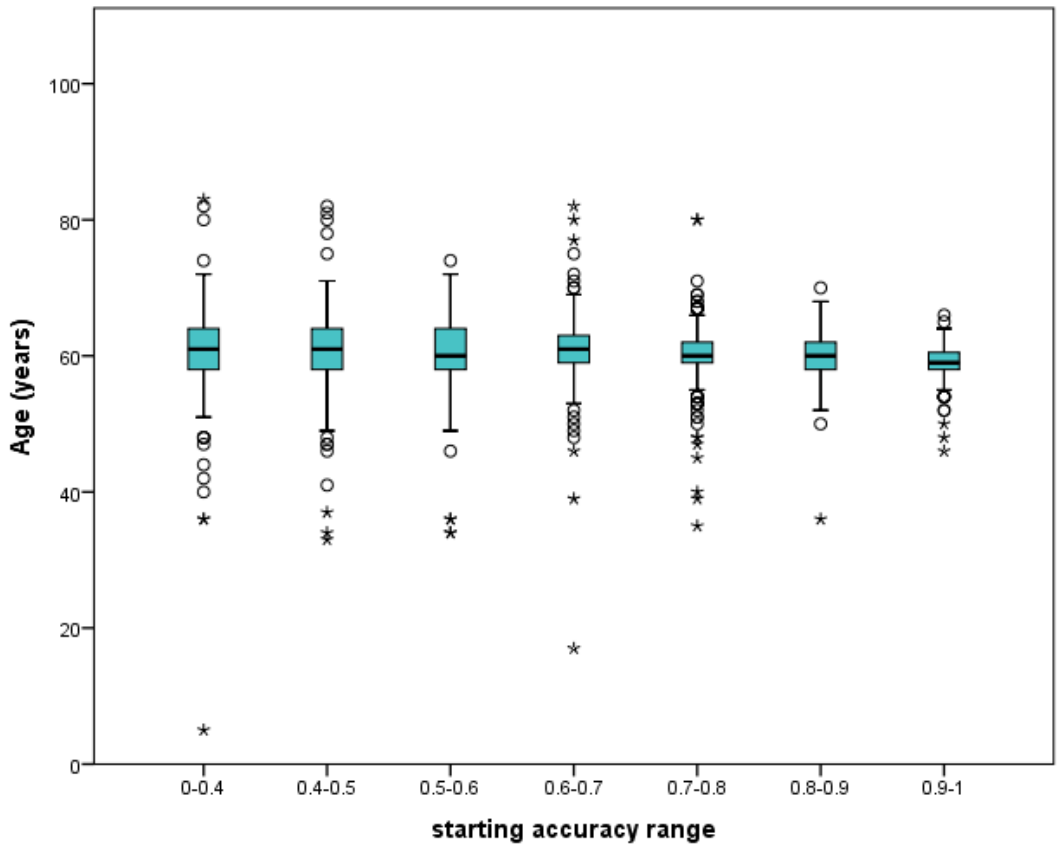
Type of treatment
Therapy setting (home, clinic)
Therapy Outcomes

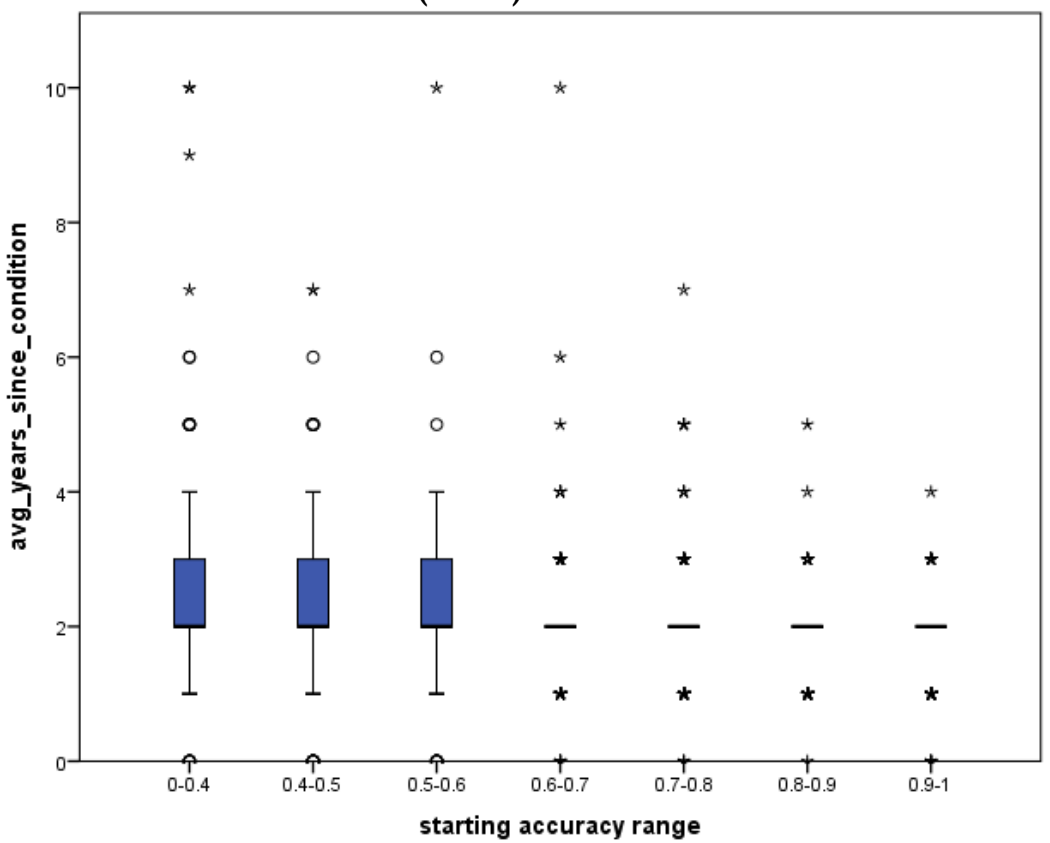
Question # 2:

MEAN PATIENT AGE



Severe patients older (60.7 years) than less severe patients (59 years), though mean age = 60 years, Main effect of group: (F (1749)= 3.6, p <.001)

MEAN TIME (YRS) SINCE CONDITION

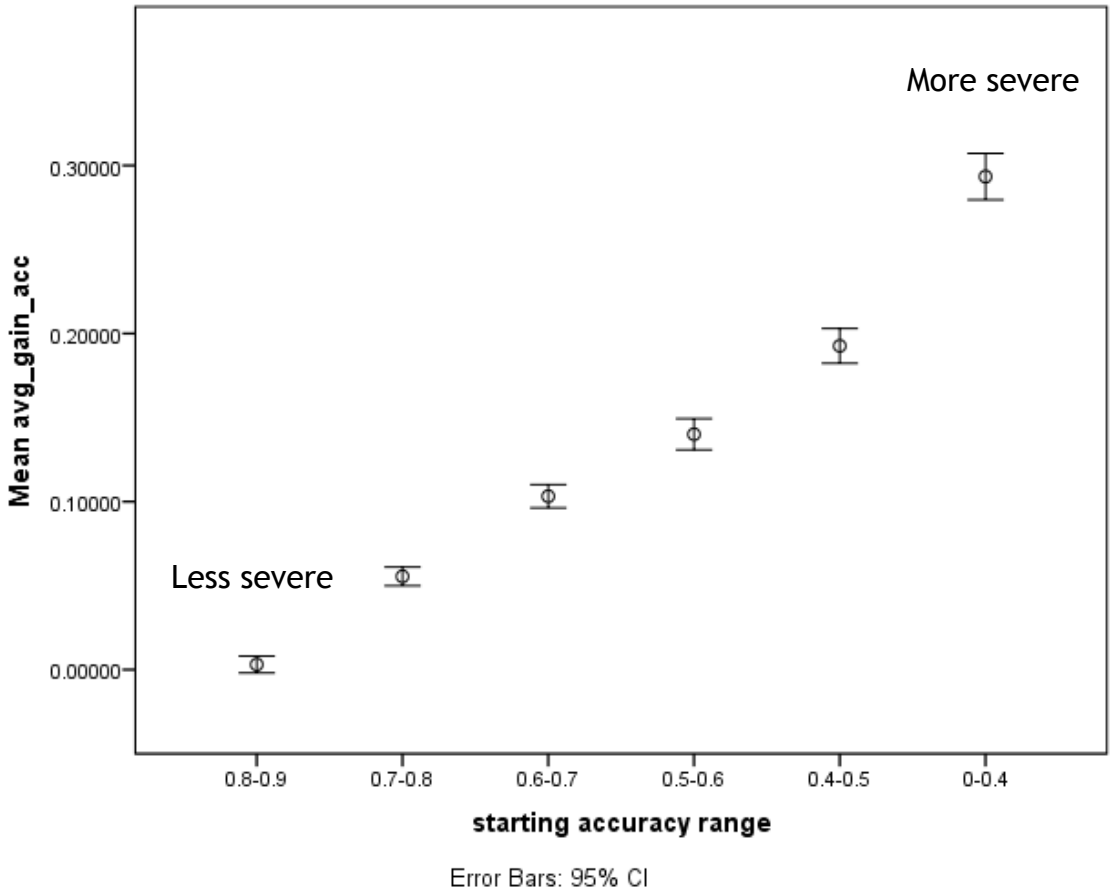


Severe patients slightly more chronic (2.3 years) than less severe patients (1.8 years), though all patients mostly chronic, Main effect of group: (F (1749)= 7.7, p <.00001)

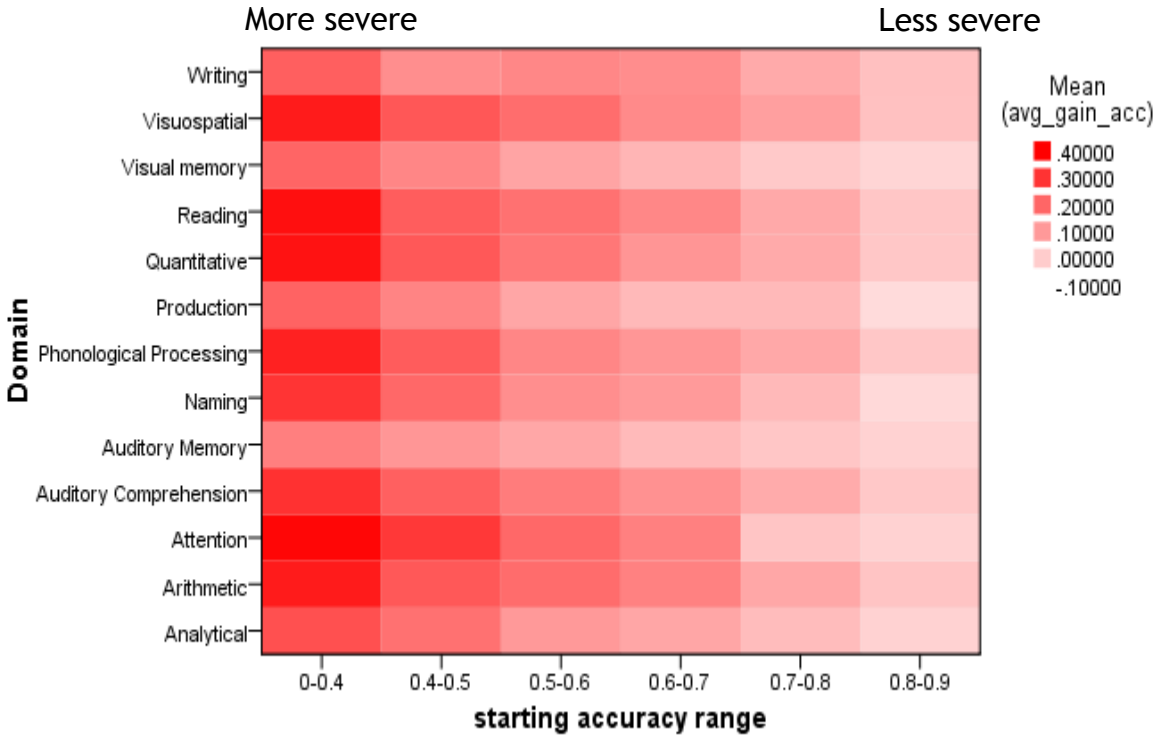
Analysis

- Based on an initial baseline assessment, a given task is assigned as long as its performance is less than 90% accuracy and below average latency.
- For each subject fitting the cohort selected, the accuracy and latency of the first and last 10 items are compared to determine improvement
- To account for familiarity effects, the first 3 items patients did were ignored.
- 2-tailed Paired T-Tests were used to identify significant improvements in accuracy and latency. Due to the logarithmic distribution of the latency, log(latency) were compared to normalize the distribution

Question # 2:

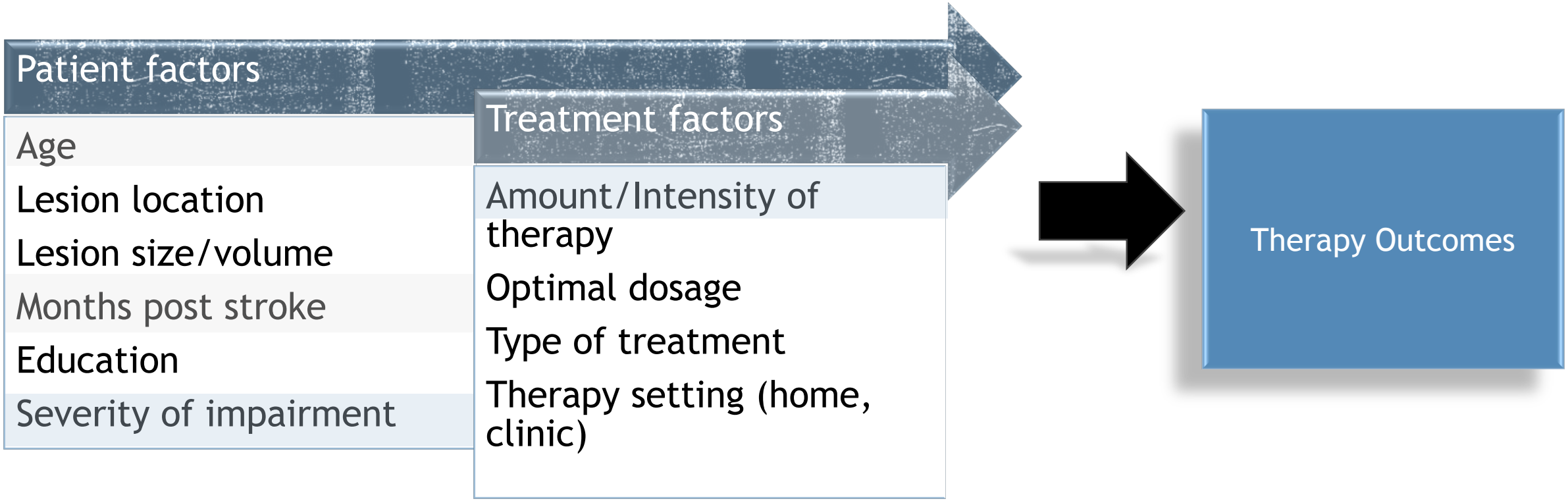


1. More severe patients show more gains (F (5, 6942)= 477.1, p <.00001) than less severe patients.



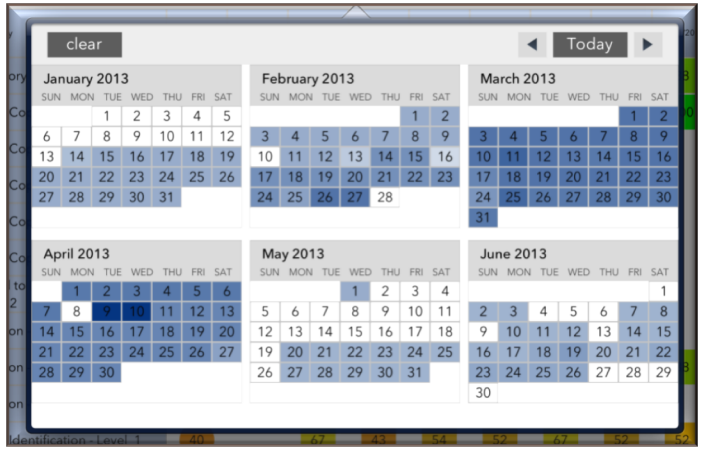
2. The same effect is seen across different domains:
Main effect of domain: (F (12, 6942)= 30.09, p <.00001)
Main effect of severity: (F (5, 1694)= 336, p <.0001)
Significant interaction: (F (60, 1694)= 2.4, p <.0001)

Question # 3: How does severity and amount of treatment influence treatment outcomes?



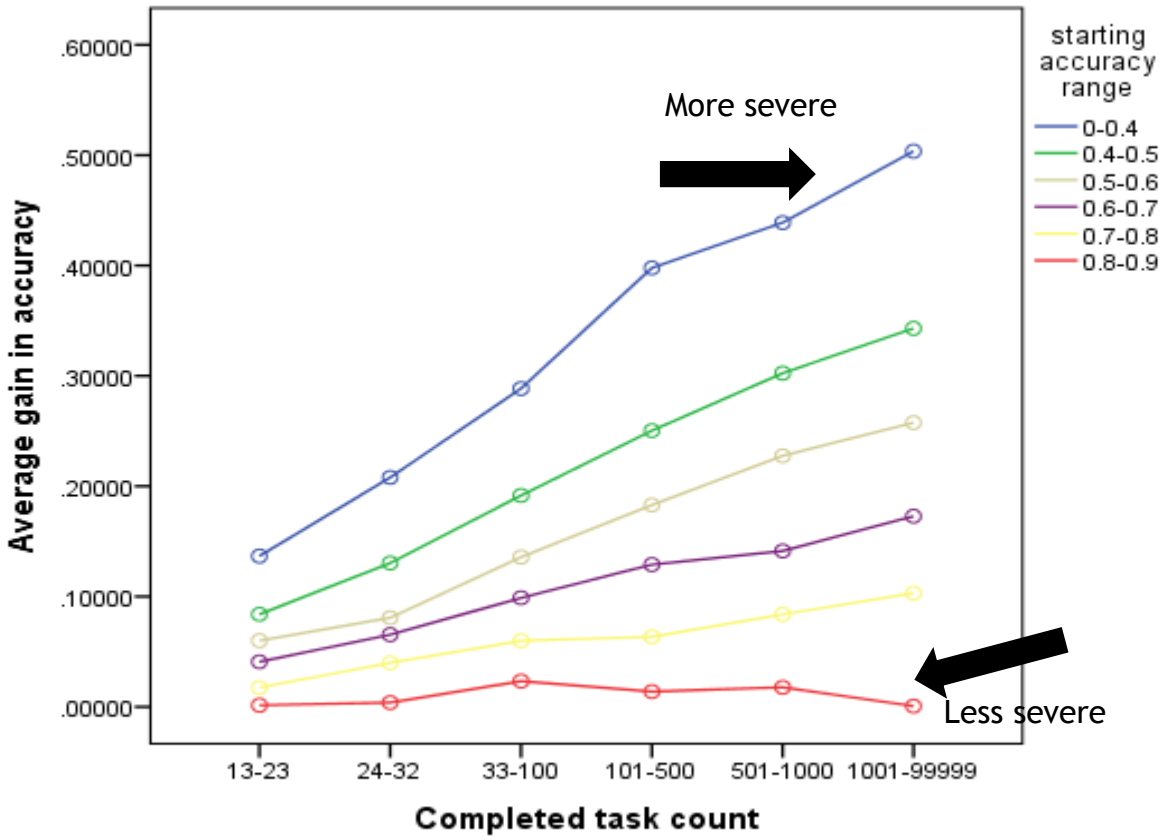
Calculation of Amount of Therapy

- Each item practiced = Trial = Teaching episode (Warren et al., 2007)
- Amount of therapy = Cumulative trials (completed task count) (independent of time/sessions)
- Intervention intensity = dose (number of trials), dose frequency (number of trials per day per week), intervention duration (in months) (Warren et al., 2007)

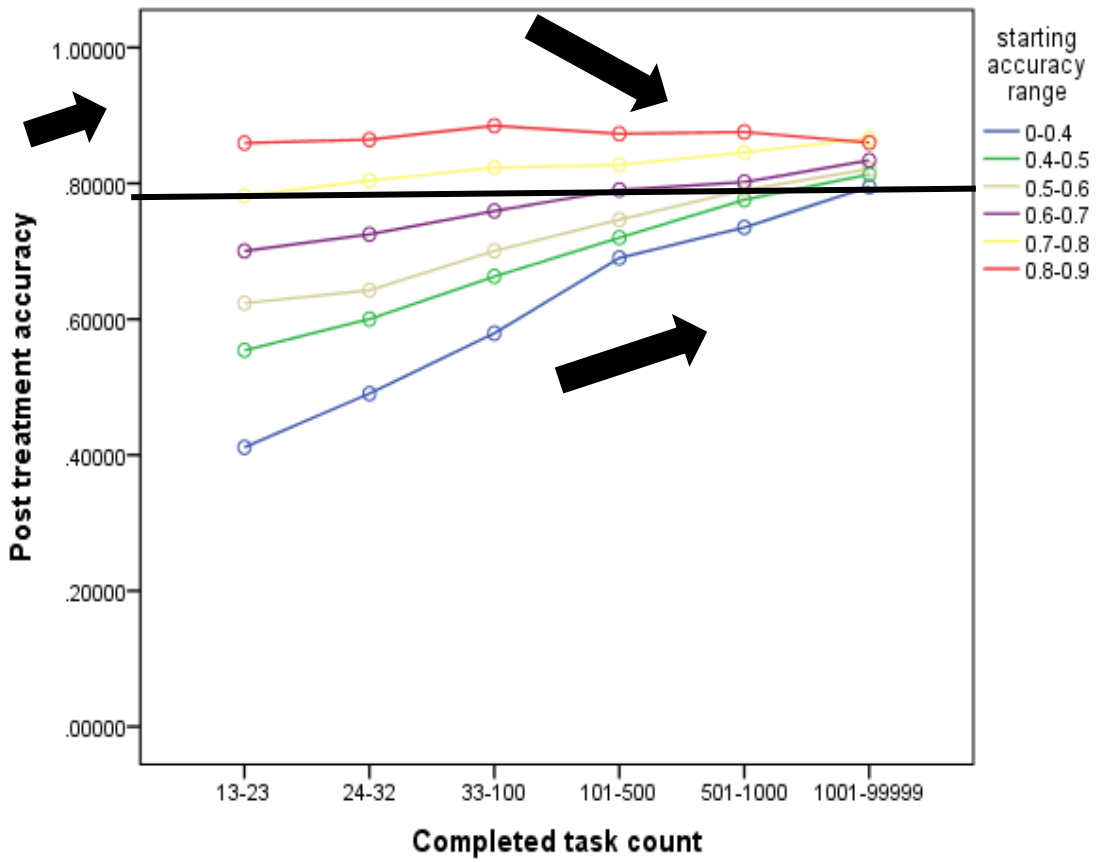


Completed Tasks	
13-23	Fewer items
24-32	
33-100	
101-500	
501-1000	
1001-99999	More items

Question # 2: How does severity and amount of treatment influence treatment outcomes?



1. With more practice, improvements are between 20-50 points for more severe patients, slightly less for less severe patients, (F, (25, 6904) = 24.5 p <.0001)



2. More severe patients can achieve high levels of accuracy (80% or higher) with increased practice; (F, (25, 1724) = 26.5, p <.0001)

SUMMARY

1. When therapy is standardized and individualized, both less severe and more severe patients improve

2. Patients with **lower initial scores** showed more improvements (**20-50 points gains**) than patients with **higher initial scores**

3. These improvements hold at the level of an individual task as well as across different language and cognitive domains

4. Severe patients can achieve success on trained tasks, they need a lot of practice

Why are these results important?

Initial severity an important predictor of recovery; patients with milder aphasia show greater recovery than severe patients (Laska et al., 2001; Pedersen et al., 2004; Plowman et al., 2011)

"All in all, the patient with the most impaired speech function may have the greatest potential recovery during rehabilitation." Laska et al., 2001

- While it is logical to assume that more intensive treatment results in greater outcomes:

-- It has been demonstrated in chronic (Bhogal et al., 2003a; Bhogal, Teasell, & Speechley, 2003b; Cherney et al., 2008) and in acute patients with aphasia (Godecke et al., 2014),

-- Other studies have questioned this premise (Bakheit et al., 2007; Dignam et al., 2015).

- These results suggest that severe patients can achieve success on trained tasks, they need a lot of practice

Question #1: How does therapy at home compare to therapy in the clinic?

Question #2: How does severity of impairment influence treatment outcomes?

Question #3: What is the optimal dosage for optimal treatment outcomes?

Participants

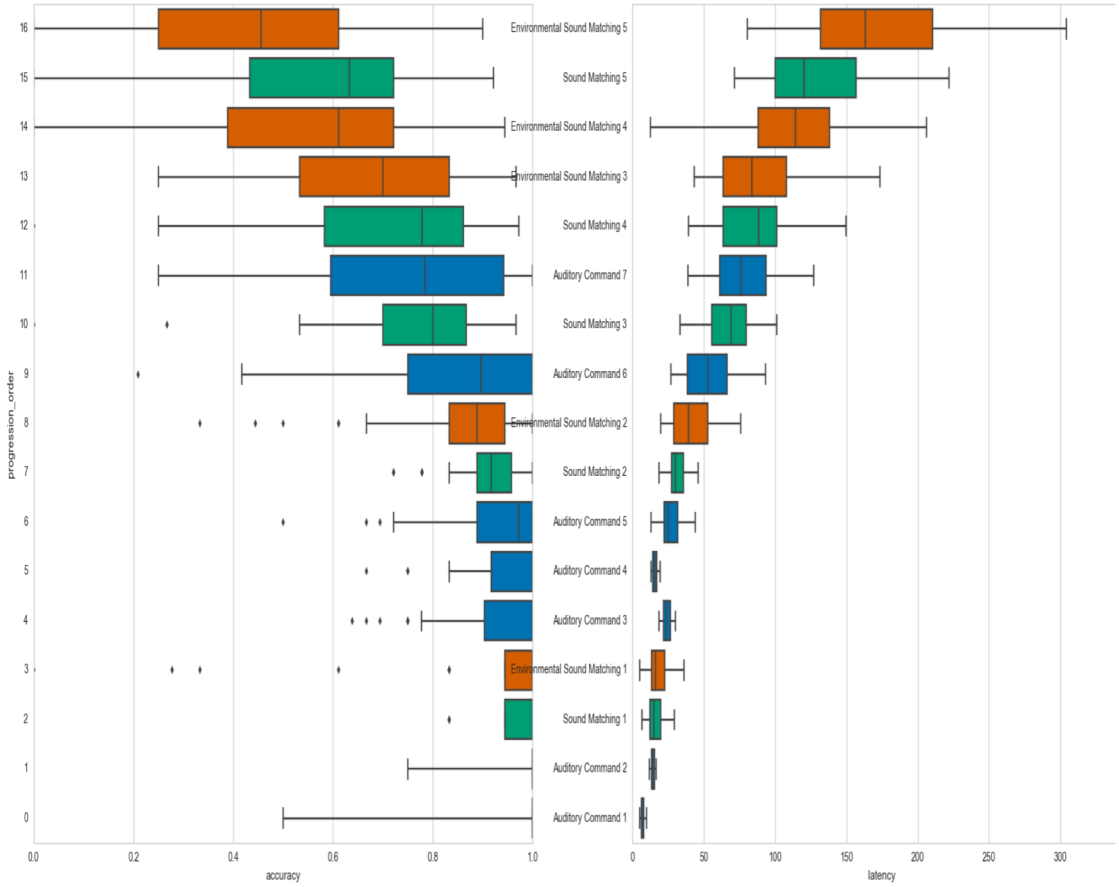
- 2216 individuals with aphasia or stroke with reported deficits in language domains were included in the study
- Participants consented that their data be analyzed for research purposes
- Average age- 64 years
- 1313 patients in the acute stage (<6 months)
- 903 users in the chronic stage (>6 months)
- Participants used CT as much or as little as they desired

Progress through a skill area is represented by a numerical domain score indicating their demonstrated ability level in that skill area.

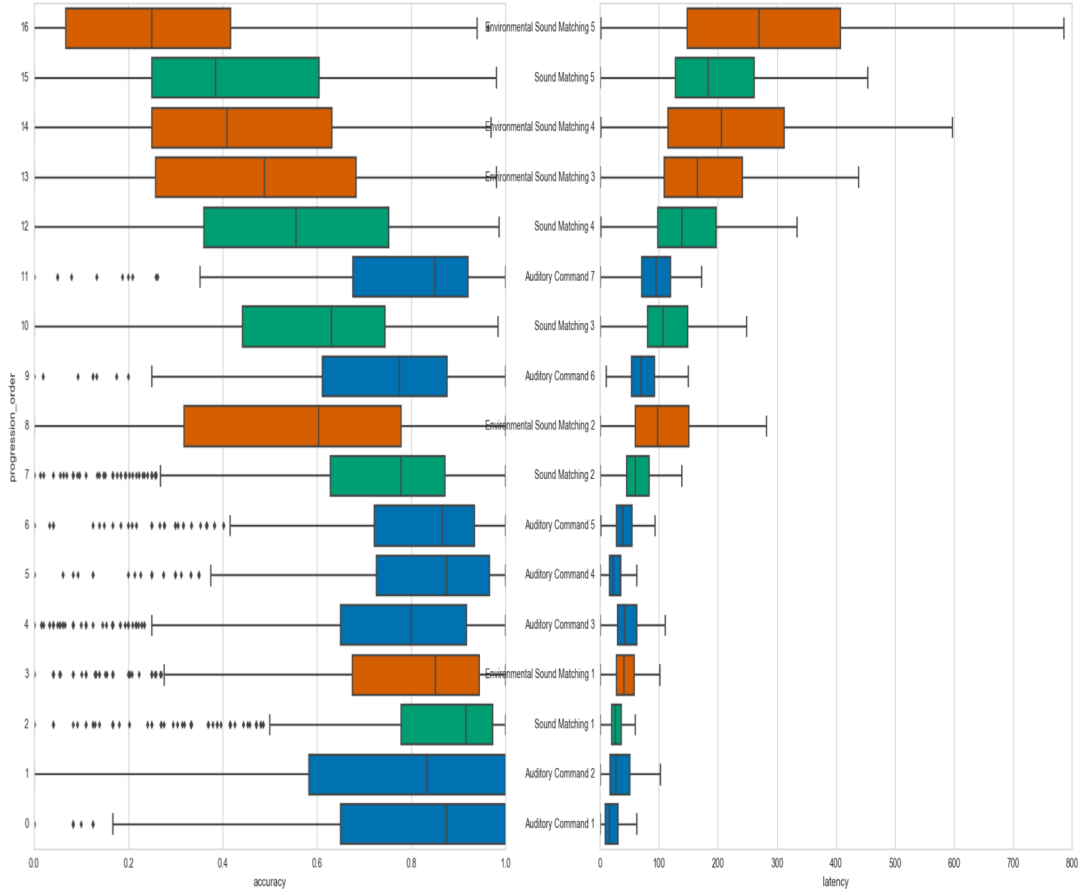
As a user demonstrates recovery by succeeding in exercises they previously struggled with, they are presented with more difficult exercises and their domain score increases.

SAMPLE DOMAIN: Auditory Memory

HEALTHY ADULTS (MTURK)



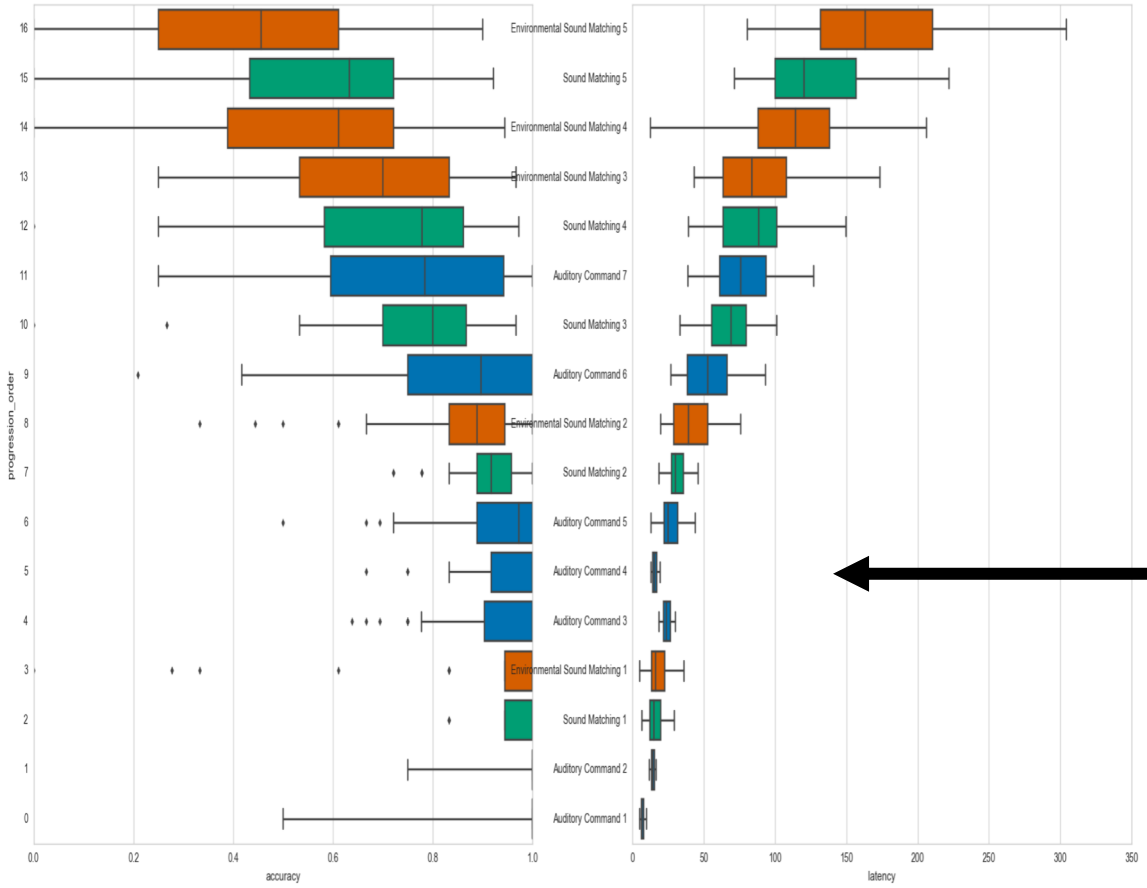
STROKE PERFORMANCE



Methods

SAMPLE DOMAIN: Auditory Memory

HEALTHY ADULTS (MTURK)



Domain Score Formula: $\frac{\text{Highest Task Recently Passed}}{\text{Total Tasks in the Domain}}$

If this is the Highest Task Passed
Domain Score: 6 / 17 = 35% mastered

Analysis

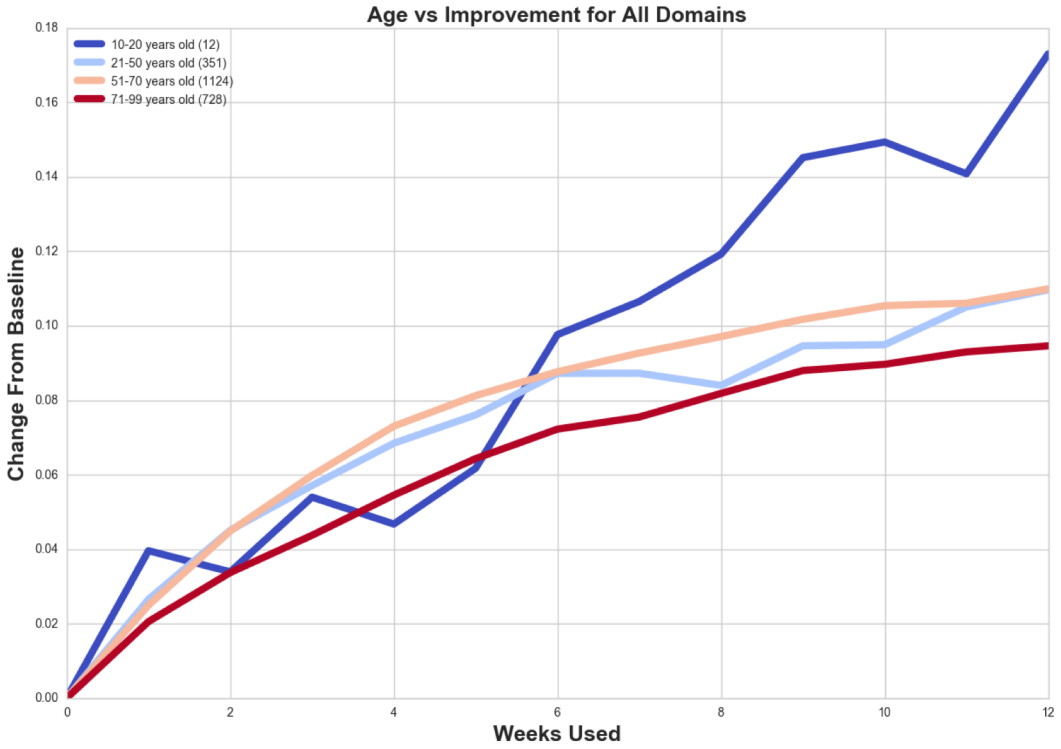
Domain Name	Domains	# data points	# Patients
Analytical	1	15750	1795
Arithmetic	2	7624	961
Attention	3	13219	1663
Auditory Comprehension	4	17853	1888
Auditory Memory	5	17160	1863
Naming	6	15407	1719
Phonological Processing	7	12115	1419
Production	8	8415	1224
Quantitative	9	11648	1368
Reading	10	18094	1909
Sentence Planning	11	12481	1728
Visual Memory	12	15333	1691
Visuospatial	13	16693	1800
Writing	14	12153	1442

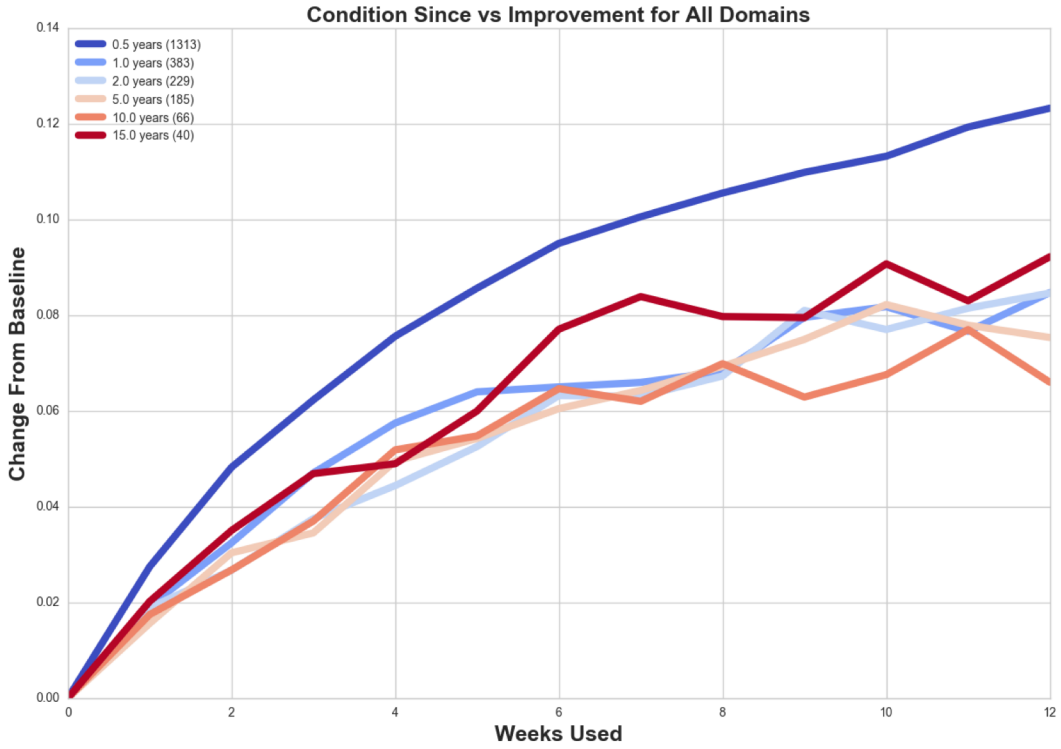
Varying # of patients and data points in each domain

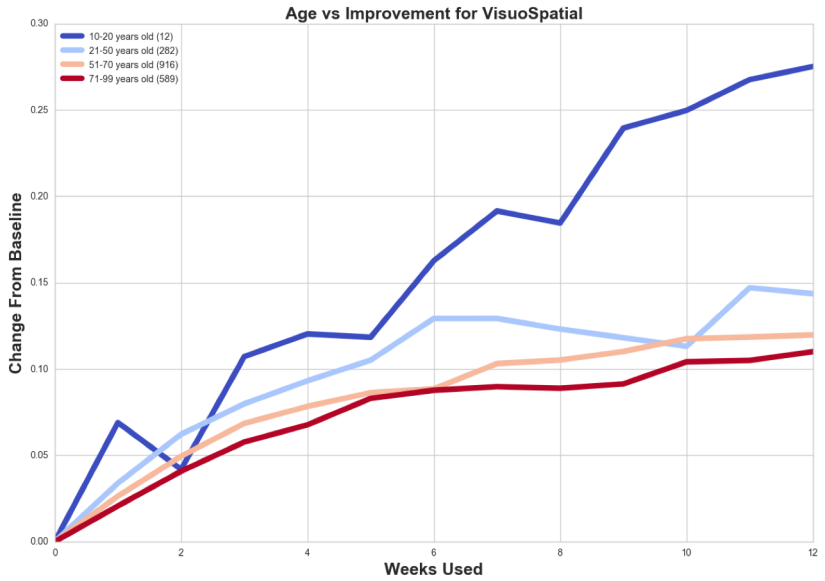
Analysis approach

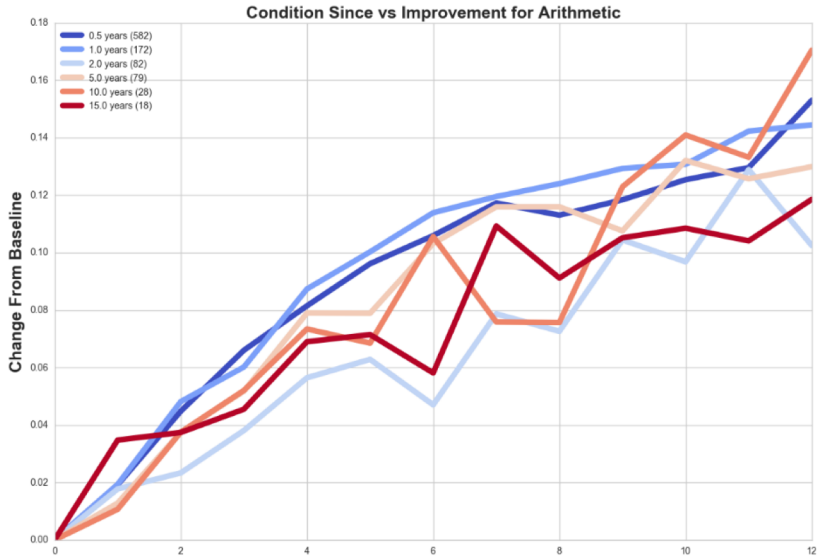
- Users were divided into one of seven groups based on how many average days per week they used CT over a 3-month period (i.e., from 0 times/week to 6 times/week).
- 50% of participants used CT 2 or more days per week.
- Compared the change in domain score over time to their baseline score.
- For each domain, analyze the relation between the rate of improvement and the dosage of therapy per week.
- A linear mixed model was generated for change from baseline domain score with fixed factors of average app usage & domain area and fixed effects of age, time since injury, & weeks used.
- The derived coefficients were compared across usage groups using paired Wald tests, revealing significant differences in the coefficients.

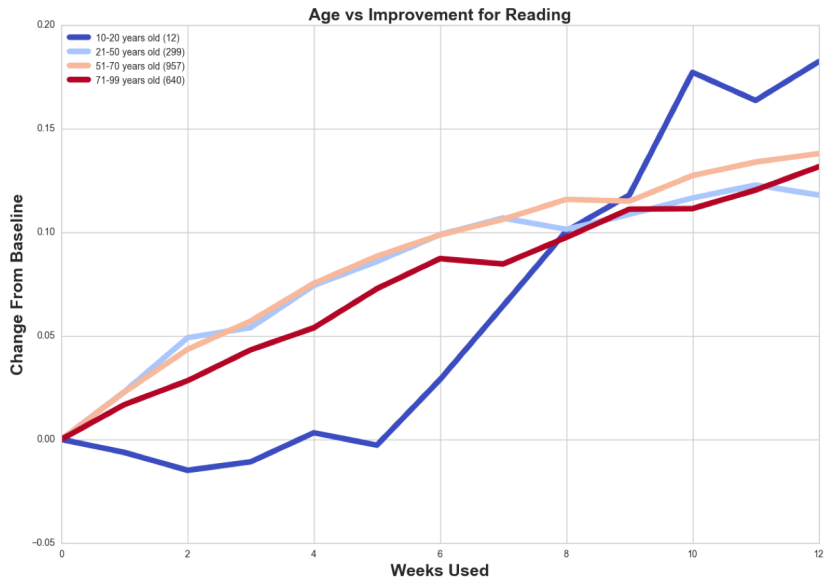
Results: Covariate effects of age and condition since

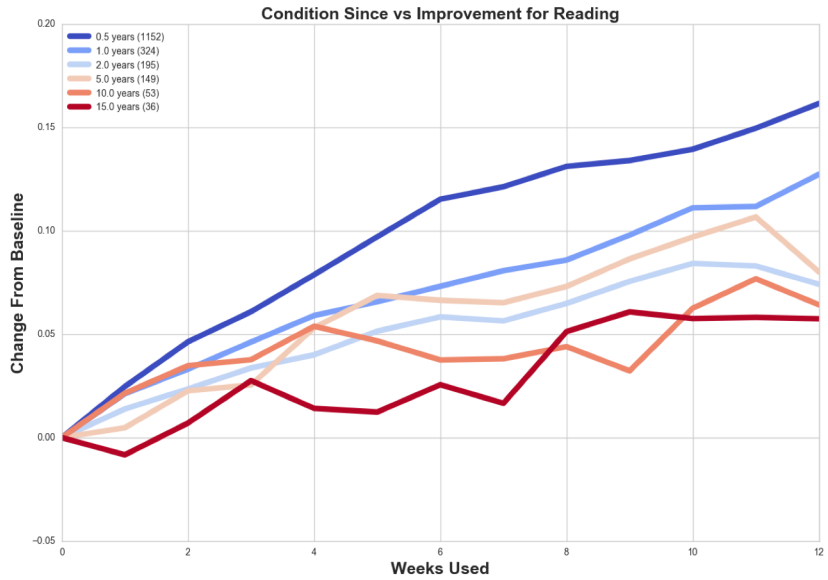


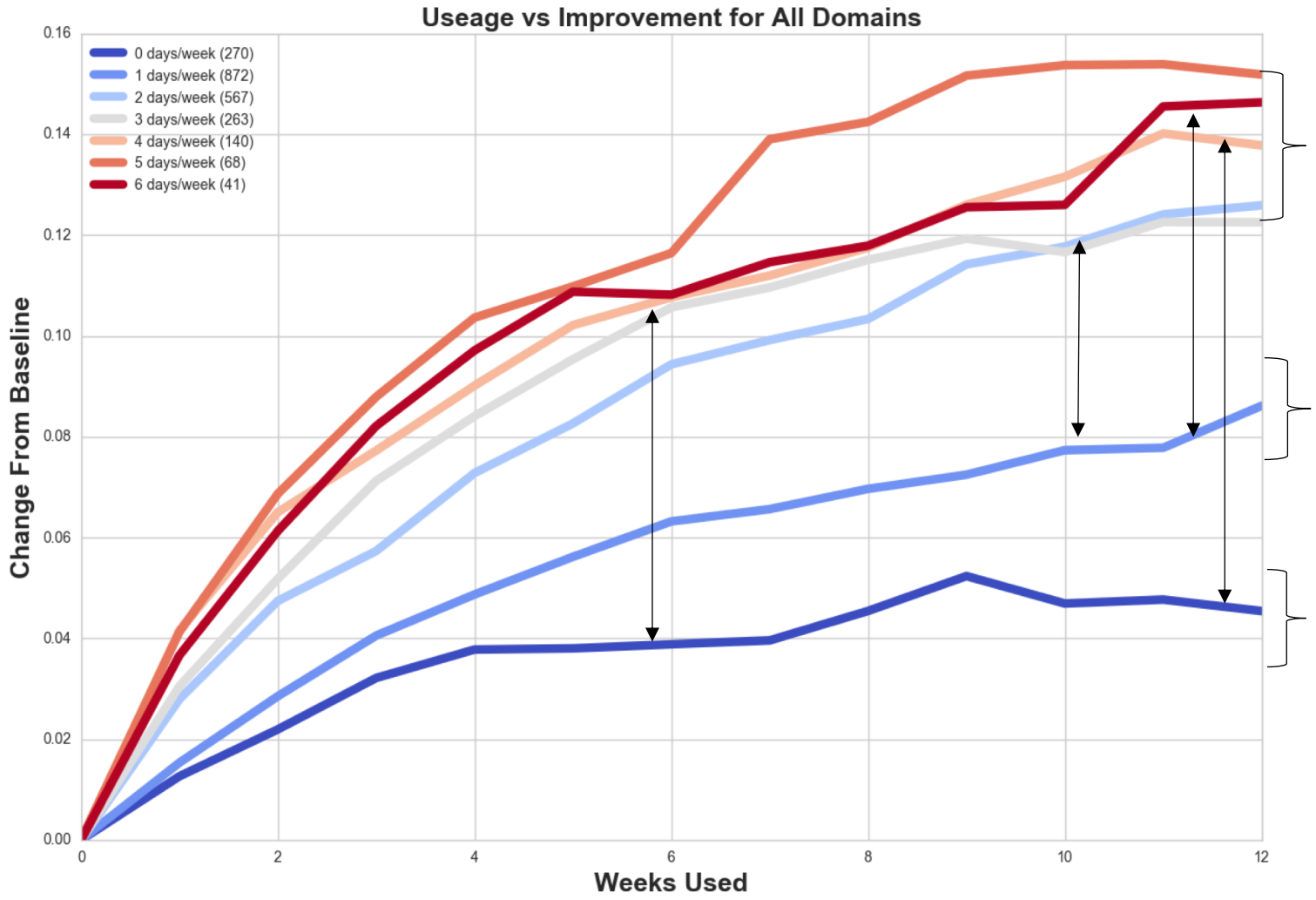



Age vs Improvement for VisuoSpatial
10-20 years old (12)
21-50 years old (282)
51-70 years old (916)
71-99 years old (589)
Change From Baseline
Weeks Used


Condition Since vs Improvement for Arithmetic
0.5 years (582)
1.0 years (172)
2.0 years (82)
5.0 years (79)
10.0 years (28)
15.0 years (18)
Change From Baseline

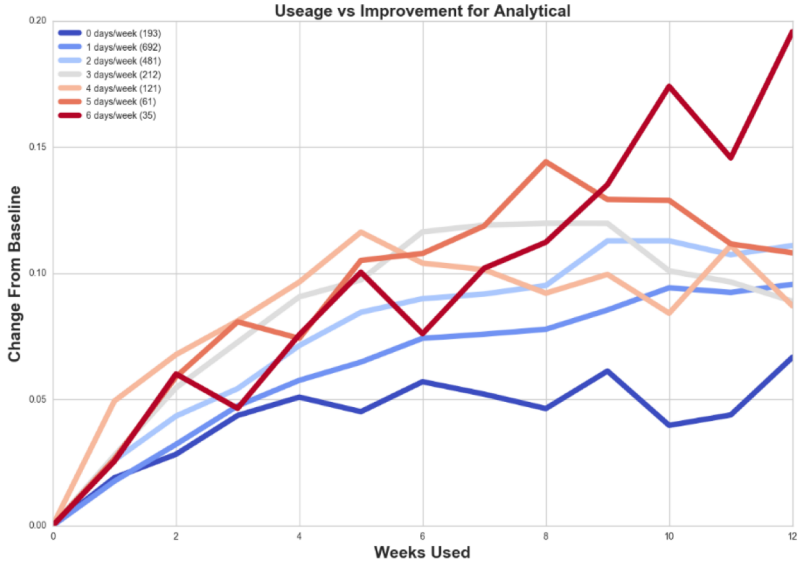

Age vs Improvement for Reading
10-20 years old (12)
21-50 years old (299)
51-70 years old (957)
71-99 years old (640)
Change From Baseline
Weeks Used

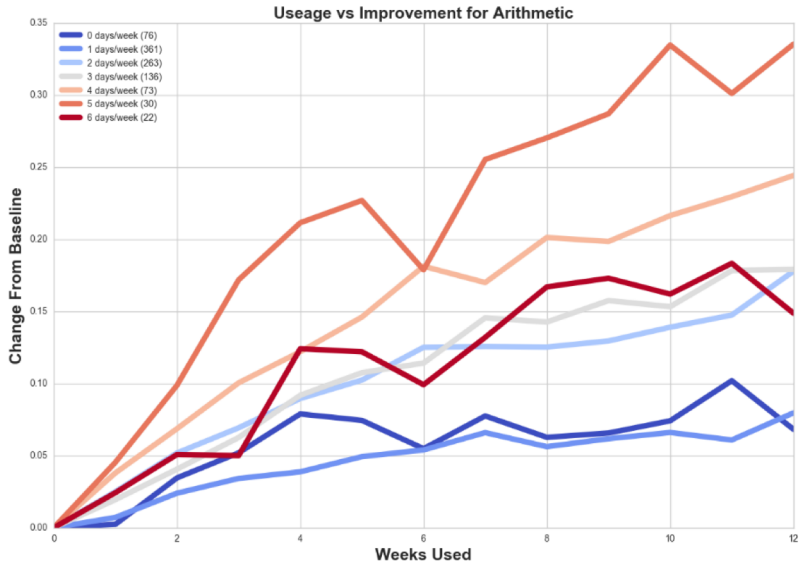

Condition Since vs Improvement for Reading
0.5 years (1152)
1.0 years (324)
2.0 years (195)
5.0 years (149)
10.0 years (53)
15.0 years (36)
Change From Baseline
Weeks Used

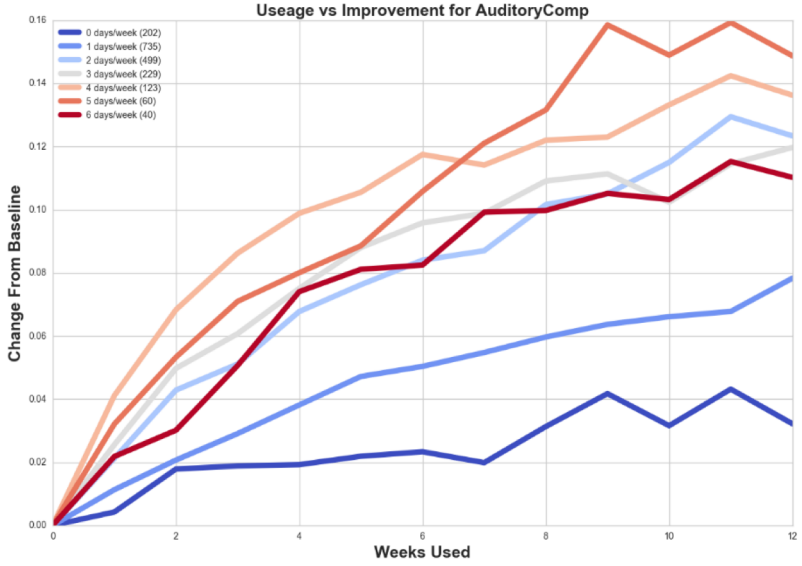


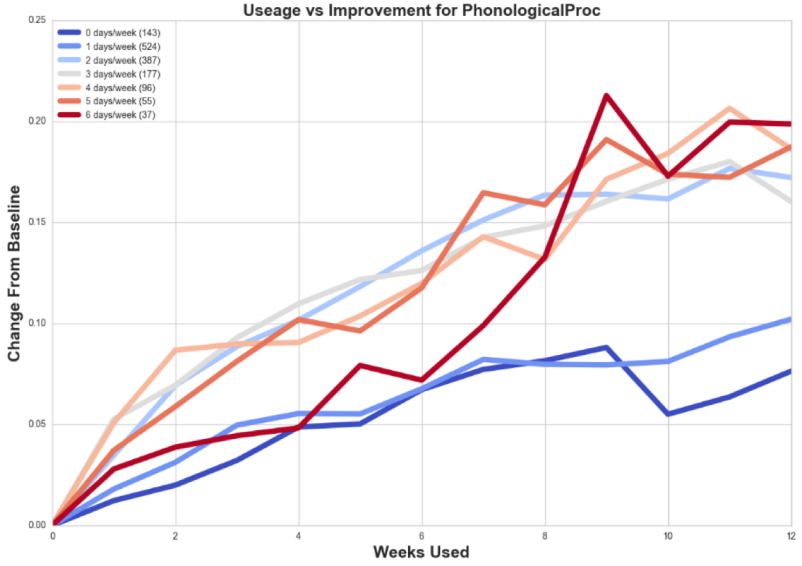
	Coef.	z	P>|z|
Intercept	-0.016	-3.518	0
avg_use[T.1]	0.013	2.63	0.009
avg_use[T.2]	0.04	7.45	0
avg_use[T.3]	0.048	7.772	0
avg_use[T.4]	0.059	8.022	0
avg_use[T.5]	0.068	7.063	0
avg_use[T.6]	0.059	5.053	0

After 3 months, participants who practiced less than 1x per week showed significantly slower progress through domains compared to those who practiced greater than 3x/week


Useage vs Improvement for Analytical
0 days/week (193)
1 days/week (692)
2 days/week (481)
3 days/week (212)
4 days/week (121)
5 days/week (61)
6 days/week (35)
Change From Baseline
Weeks Used


Useage vs Improvement for Arithmetic
0 days/week (76)
1 days/week (361)
2 days/week (263)
3 days/week (136)
4 days/week (73)
5 days/week (30)
6 days/week (22)
Change From Baseline
Weeks Used


Useage vs Improvement for AuditoryComp
0 days/week (202)
1 days/week (735)
2 days/week (499)
3 days/week (229)
4 days/week (123)
5 days/week (60)
6 days/week (40)
Change From Baseline
Weeks Used


Useage vs Improvement for PhonologicalProc
0 days/week (143)
1 days/week (524)
2 days/week (387)
3 days/week (177)
4 days/week (96)
5 days/week (55)
6 days/week (37)
Change From Baseline
Weeks Used

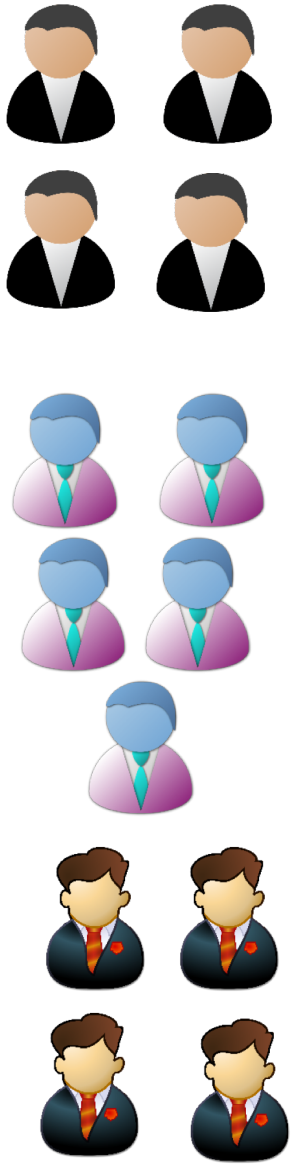
Results summary

- While all groups, on average showed improvement over time, participants who used CT greater than 3x/week showed higher rates of improvement than those that used the app 0-1x/week ($p<0.001$) across 11/14 domains.
- Rate of improvement significant 5x/6x times a week better than 1x/2x for most domains (Domains Analytical, Visuospatial, visual memory, sentence planning, reading, production, attention, arithmetic) ($p<.05$).
- For auditory comprehension, 4x times/week better than 1x, 2x, or 3x.
- Gains noted even after controlling for different age and time post-stroke.

Discussion

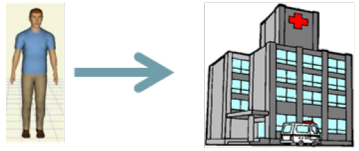
- According to the ASHA NOMS 2011 report, 78.1% of patients with stroke receive 2 or less sessions per week in the outpatient setting.
- This lower treatment dosage in the clinic is likely multifactorial including clinician time/schedule constraints, insurance reimbursement, and client fatigue (Harnish et al, 2014).
- After 3 months, participants who practiced less than 1x per week showed significantly slower progress through various skill domains compared to those who practiced greater than 3x/week (best outcomes 5x/6x per week) which reinforces the idea that increased treatment dosage results in better outcomes.
- Adds to increasing evidence of providing intensive, sustained therapy for stroke patients with aphasia, even in the chronic phase (Baumgartner et al., 2013; Carpenter & Cherney, 2016; Dignam et al., 2016;
- Next steps:
  - Identify whether different levels of severity influence the gains made with practice 4x times/week.
-

Population analysis

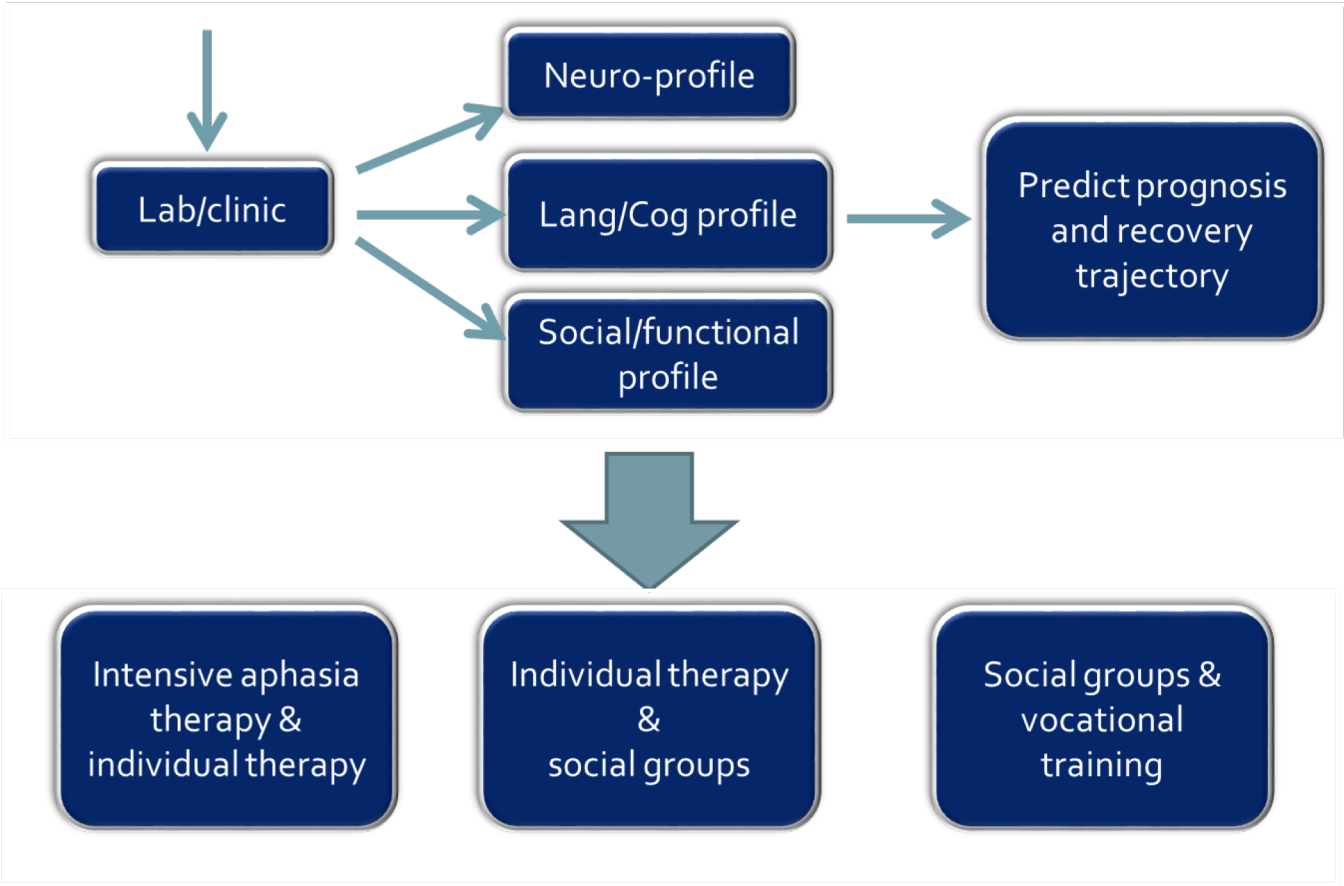


Small cohort analysis

Individual patient analysis



In the future

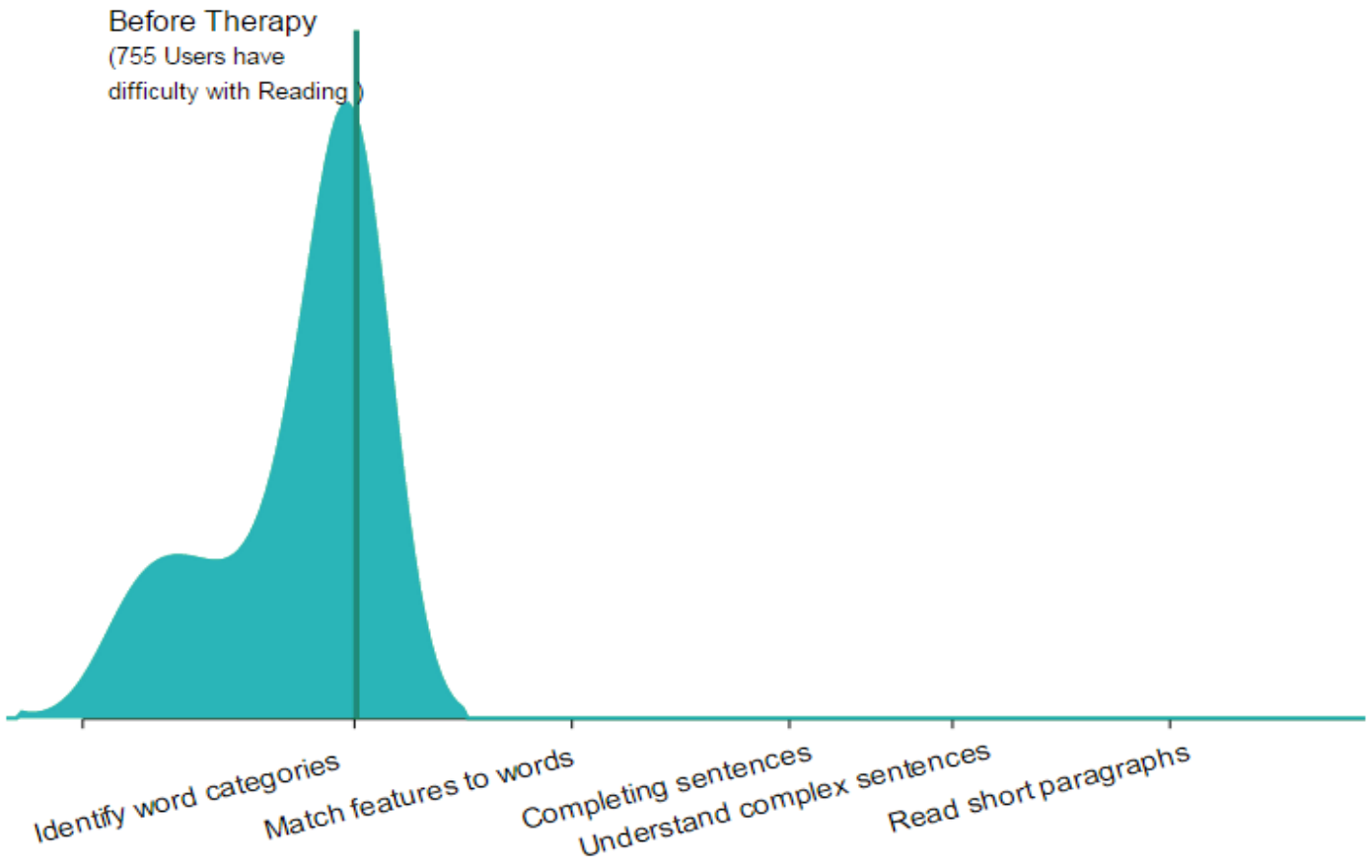


Next Steps: Population analysis to predict recovery trajectory

0 months | 1 months | 2 months | 3 months | 4 months | 5 months | 6 months

Improvements shown by Constant Therapy users in Reading for 0 months

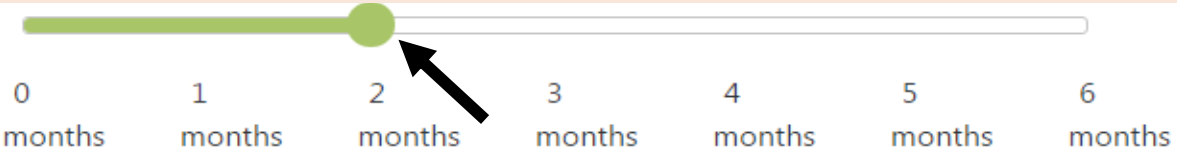
Reading



Many Constant Therapy users who had difficulty deciding if two written words belong to the same category were able to master this task and continue on to other exercises.

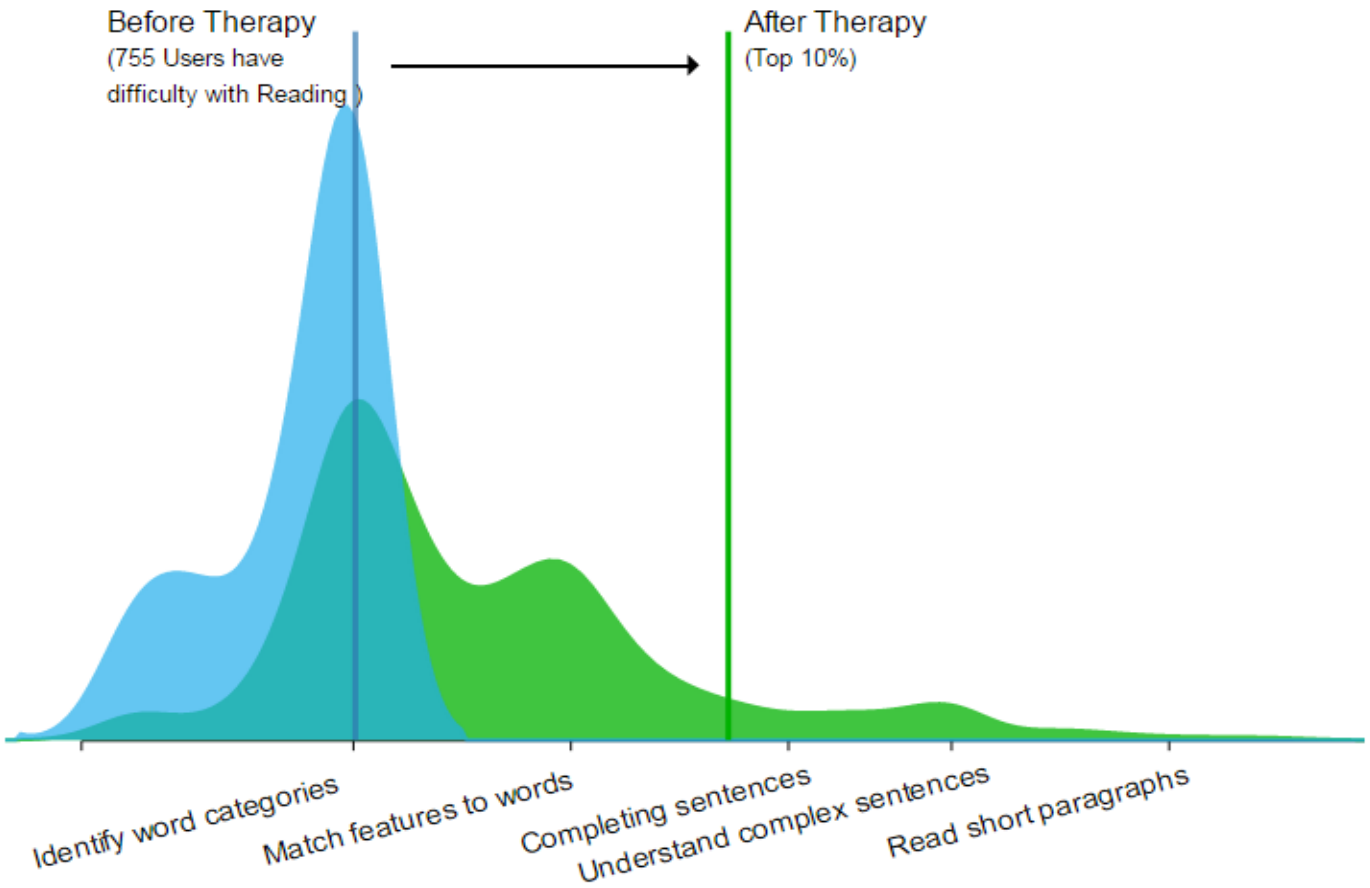
Move the slider bar to see more details!

Next Steps: Population analysis to predict recovery trajectory



Improvements shown by Constant Therapy users in Reading for 1 months

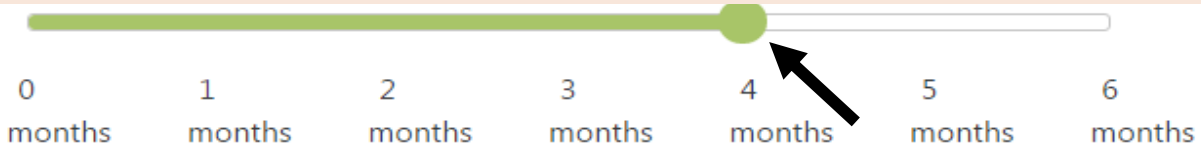
Reading



After 1 month(s) of Constant Therapy, 51% of users who initially had difficulty deciding if two written words belong to the same category where able to master this task and continue on to other exercises.

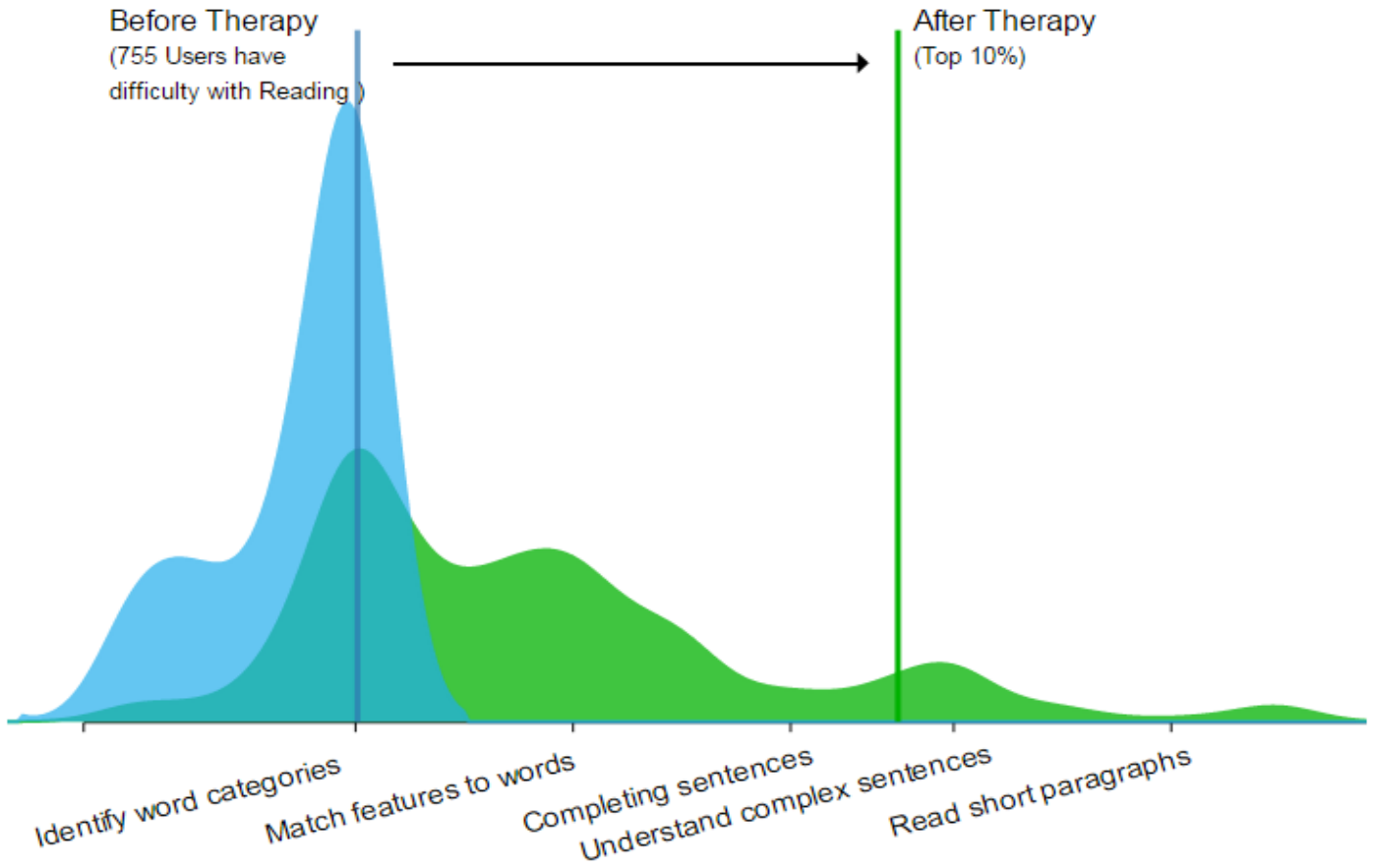
The top 12% of users continued on and mastered being able to decide if a description of a feature matches a given picture.

Next Steps: Population analysis to predict recovery trajectory



Improvements shown by Constant Therapy users in Reading for 3 months

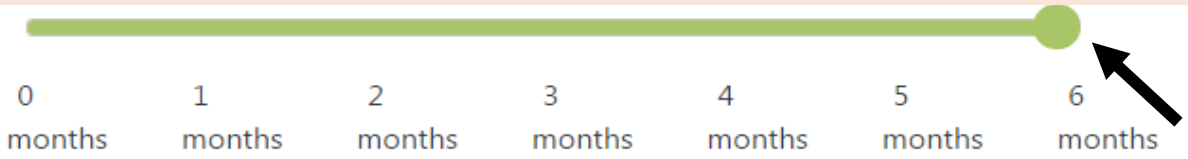
Reading



After 3 month(s) of Constant Therapy, 64% of users who initially had difficulty deciding if two written words belong to the same category where able to master this task and continue on to other exercises.

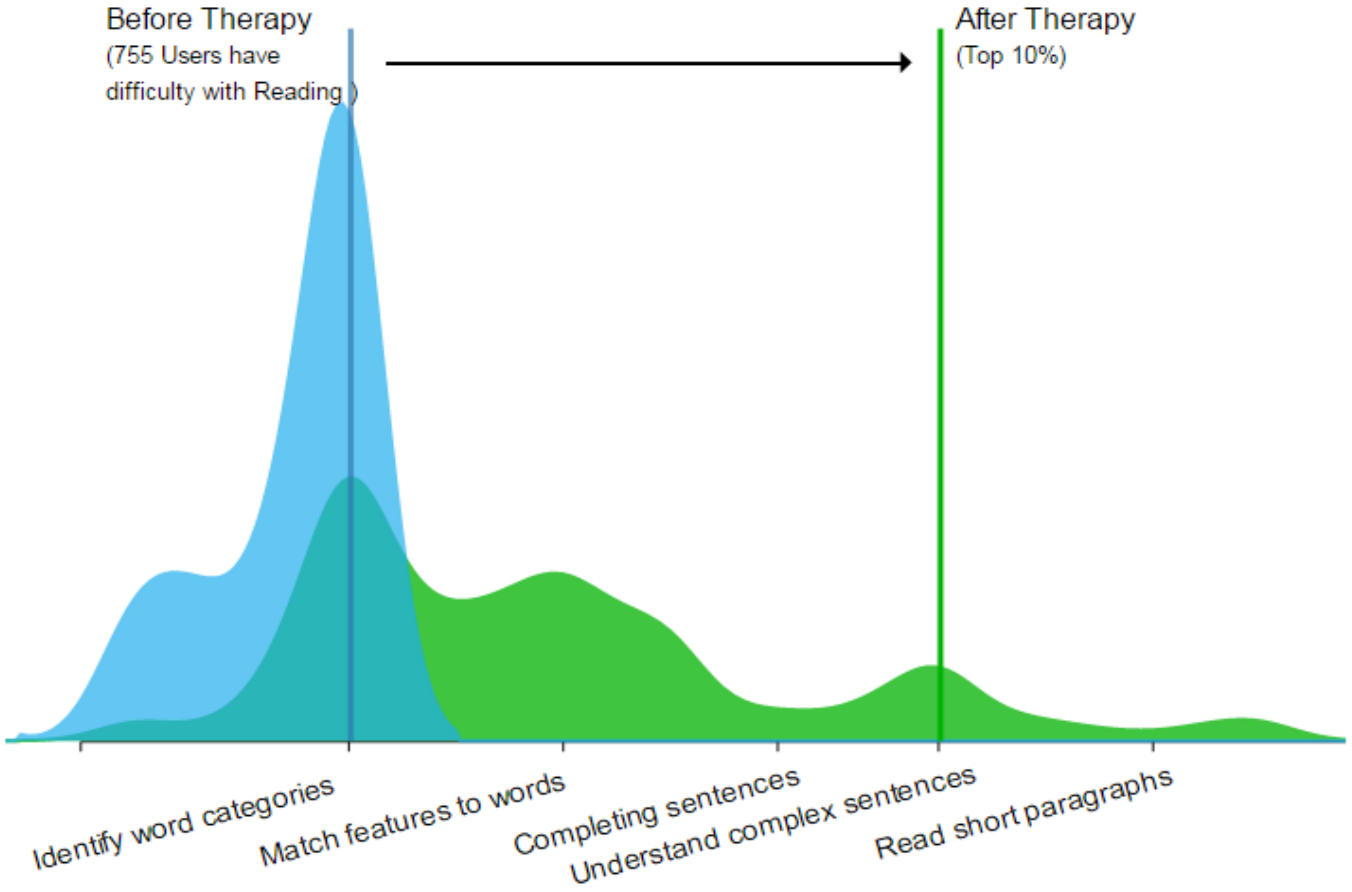
The top 10% of users continued on and mastered being able to fill in the blank to complete a passive (direct object-verb-subject) sentence.

Next Steps: Population analysis to predict recovery trajectory



Improvements shown by Constant Therapy users in Reading for 5 months

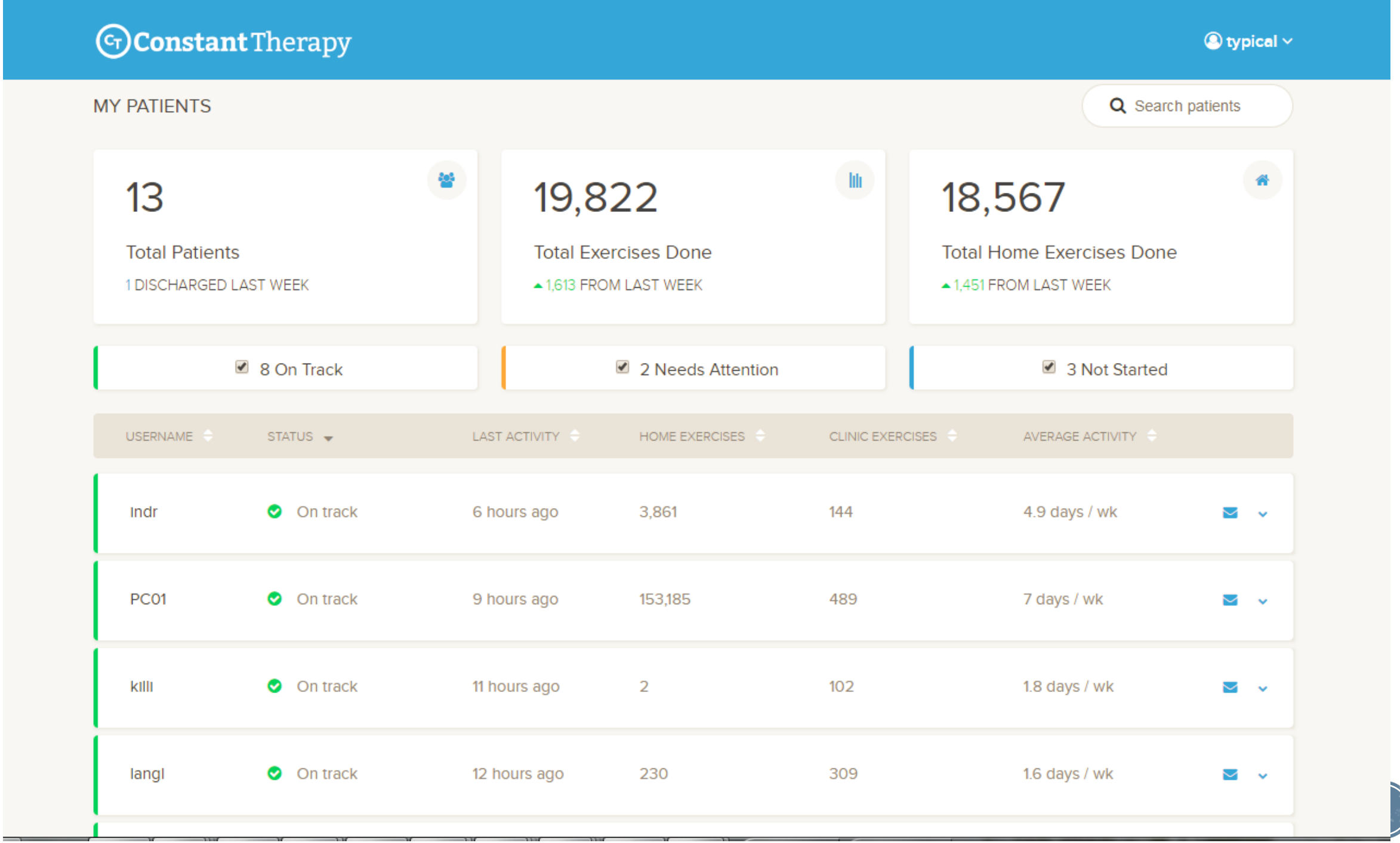
Reading



After 5 month(s) of Constant Therapy, 68% of users who initially had difficulty deciding if two written words belong to the same category where able to master this task and continue on to other exercises.

The top 10% of users continued on and mastered being able to organize and sequence steps to everyday tasks.

Closing the loop between the clinician and patient

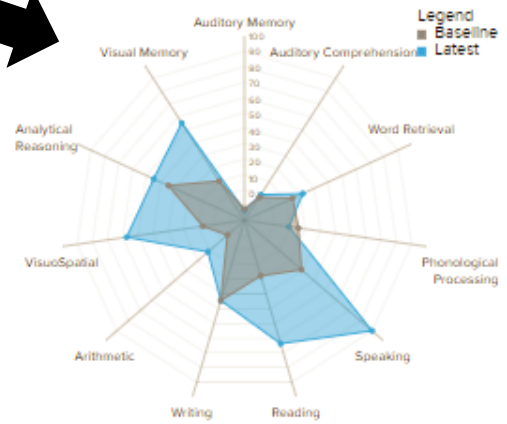

Constant Therapy
typical
MY PATIENTS
Search patients
13
Total Patients
1 DISCHARGED LAST WEEK
19,822
Total Exercises Done
1,613 FROM LAST WEEK
18,567
Total Home Exercises Done
1,451 FROM LAST WEEK
8 On Track
2 Needs Attention
3 Not Started
USERNAME
STATUS
LAST ACTIVITY
HOME EXERCISES
CLINIC EXERCISES
AVERAGE ACTIVITY
Indr
On track
6 hours ago
3,861
144
4.9 days / wk
PC01
On track
9 hours ago
153,185
489
7 days / wk
kIIII
On track
11 hours ago
2
102
1.8 days / wk
langl
On track
12 hours ago
230
309
1.6 days / wk

Constant Therapy

typical

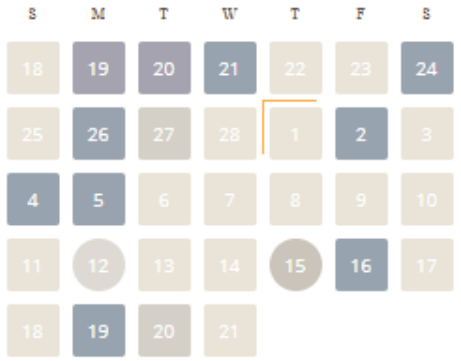
USERNAME	STATUS	LAST ACTIVITY	HOME EXERCISES	CLINIC EXERCISES	AVERAGE ACTIVITY
kllll	On track	11 hours ago	2	102	1.8 days / wk
langl	On track	12 hours ago	230	309	1.6 days / wk
sullaw	On track	1 day ago	6,320	262	3.3 days / wk
meslau	On track	5 days ago	38	90	0.9 days / wk

Skill Areas



Review Performance >

February-March 2018



Review Therapy Calendar >

Current Home Therapy

1. Word Spelling Completion, L3
2. Voicemail, L1
3. Short Reading, L3
4. Read Number Sequences Aloud, L3
5. Picture Spelling, L3
6. Pattern Recreation, L3
7. Map Reading, L3
8. Long Reading Comprehension, L1
9. Letter to Sound Matching, L2

+ 2 other tasks

Constant Therapy

typical

Accuracy	Total Exercises Completed	Average Activity
78%	6,637	3.3
RECENT AVERAGE	EXERCISES	DAYS PER WEEK

11
Skill Areas
Review

Closing the loop between the clinician and patient

ANPA 2018

SKILL AREAS

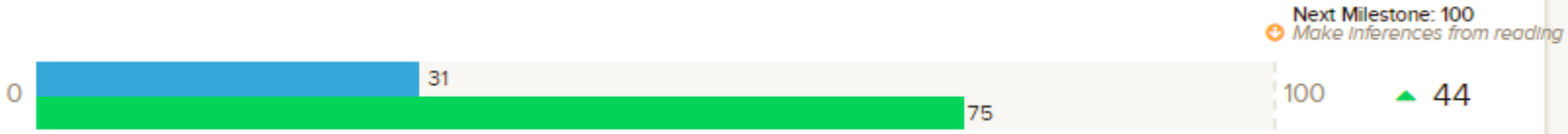
Analytical Reasoning	
Arithmetic	
Auditory Comprehension	
Auditory Memory	
Phonological Processing	
Reading	
Speaking	View Details
Visual Memory	View Details
Visuospatial Processing	View Details
Word Retrieval	View Details
Writing	View Details

Constant Therapy

typical

READING

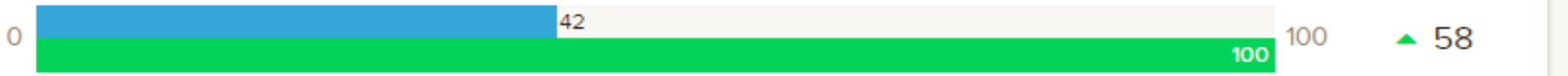
Description: Read words, sentences, paragraphs, and pages of text



Baseline 31 (11/22/2017) *Identify how written words fit into different categories*
Latest 75 (3/19/2018) *Comprehend short paragraphs*

SPEAKING

Description: Speak words and sentences



Baseline 42 (12/28/2017) *Repeat words*
Latest 100 (2/7/2018) *Name challenging pictures*

VISUAL MEMORY

Description: Remember pictures, faces, written words, and visual patterns

Baseline 24 (11/22/2017) *Remember the order of pictures*
Latest 67 (3/18/2018) *Remember locations of images in a small grid*

VISUOSPATIAL PROCESSING

Description: Interpret visual information and spatial relationships of objects

- Acknowledgements:
- **CONSTANT THERAPY**
- Mahendra Advani
- Veera Anantha

- **BOSTON UNIVERSITY**
- Carrie Ann Des Roches
- Isabel Balachandran
- Elsa Ascenso