PANHELLENIC ORGANIZATION OF LOGOPEDICS

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Cyprus University of Technology

WORKSHOP ON LINGUISITC PROFILES AND OUTCOMES IN LATE TALKING TODDLERS

MAY 26TH 2024


Europe
Kilometers
0 100 200 300 400 500
0 100 200 300
Miles
Iceland
Barents Sea
Norwegian Sea
White Sea
Faroe Islands (Denmark)
Norway
Sweden
Gulf of Bothnia
Finland
Russia
Estonia
Baltic Sea
Latvia
North Sea
Ireland
Denmark
Lithuania
United Kingdom
Russia
Belarus
Kazakhstan
Netherlands
Belgium
Germany
Poland
Luxembourg
Czech Republic
Ukraine
Slovakia
Bay of Biscay
France
Liechtenstein
Switzerland
Austria
Hungary
Moldova
Caspian Sea
Slovenia
Romania
Crimea (Ukraine de jure)
Croatia
Georgia
Azerbaijan
Andorra
San Marino
Bosnia and Herzegovina
Serbia
Black Sea
Monaco
Ligurian Sea
Armenia
Portugal
Spain
Adriatic Sea
Bulgaria
Corsica
Vatican City
Montenegro
Kosovo
Italy
Albania
North Macedonia
Mallorca
Sardinia
Iran
Turkey
Tyrrhenian Sea
Mediterranean Sea
Strait of Gibraltar
Greece
Syria
Sicily
Aegean Sea
Cyprus
Iraq
Morocco
Algeria
Tunisia
Malta
Mediterranean Sea
Crete
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ΜΕΡΟΣ 1 ΓΕΝΙΚΑ ΕΙΣΑΓΩΓΙΚΑ

- LATE TALKING CHILD WITH SEVERE APRAXIA
- LATE TALKING CHILD WITH SSD
- LATE TALKING CHILD WITH LANGUAGE DELAY
- EARLY SIGNNS
- TESTING CHECKLISTS PARENTAL REPORTS
- TEAM
- TESTS STANDARDIZED-PERFORMANCE VERSUS COMPETENCE
- DATA STARTIFICSTION ANALYSIS
- THERAPY GOALS
- INTEPHASE LEXICON PHONOLOGY
- OURCOMES
- HEREDIATARY
- QUESTIONNAIRE DEVELOPMENTAL

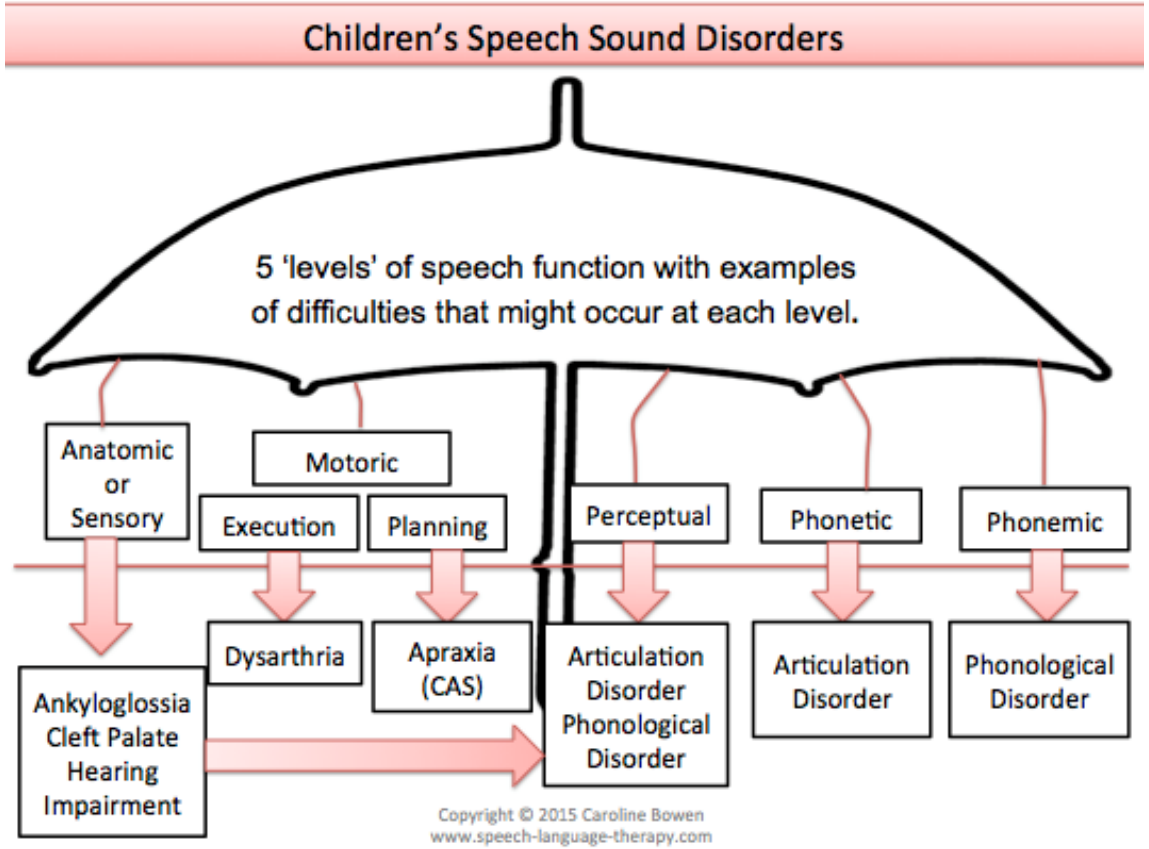
ΟΡΙΣΜΟΣ

- Διαταραχή λόγου και ομιλίας ορίζεται η πάθηση που επηρεάζει την επικοινωνιακή ικανότητα του ατόμου
  - στο επίπεδου της γλωσσικής
  - αντίληψης και παραγωγής.
  - επίδοσης στο εκπαιδευτικό, κοινωνικό και επαγγελματικό πλαίσιο.
- Οι διαταραχές χωρίζονται σε προβλήματα άρθρωσης ή και φωνολογίας οργανικής ή λειτουργικής αιτιολογίας.

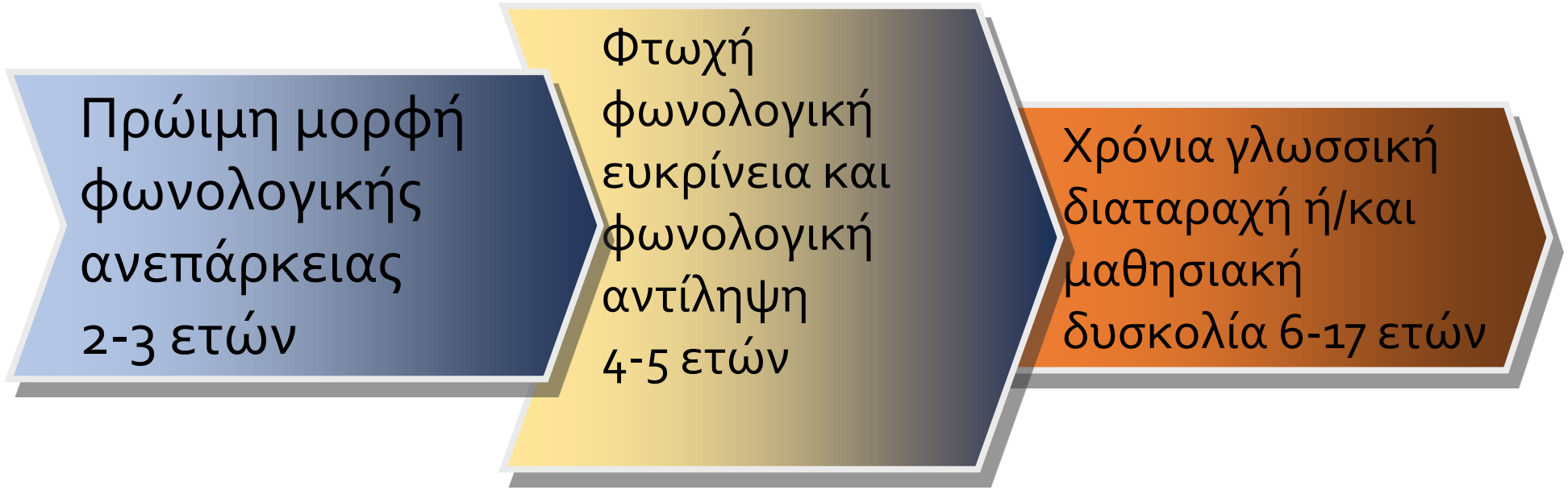
ΠΑΡΑΜΕΤΡΟΙ ΟΡΟΛΟΓΙΑΣ (SOUND SPEECH DISORDERS-SSD)

- Η Διαταραχή Άρθρωσης επηρεάζει την τυπική παραγωγή φθόγγων
  - αντικαταστάσεις,
  - προσθέσεις,
  - παραλήψεις,
  - παραφθορές
  - παραποιήσεις φθόγγων
- Η Διαταραχή Φωνολογίας επηρεάζει ομάδες φθόγγων
  - έντονη παρουσία φωνολογικών διεργασιών

ΤΑΞΙΝΟΜΗΣΗ
ΣΧΕΔΙΑΓΡΑΜΜΑ ΟΜΠΡΕΛΛΑΣ
ΔΙΑΤΑΡΑΧΕΣ ΤΕΜΑΧΙΑΚΟΥ ΕΠΙΠΕΔΟΥ
Bowen (2015)



ΣΥΝΔΕΣΗ ΕΠΙΠΕΔΩΝ



Φωνολογική Παρέμβαση

Cyprus University of Technology

CYPRUS UNIVERSITY OF TECHNOLOGY

Cyprus University of Technology

Premises of the Department

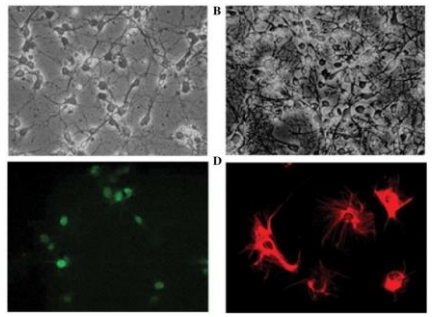
- Academic Offices and Labs (ZT3 Vragadinou Street)
- University Rehabilitation Clinic
- University premises

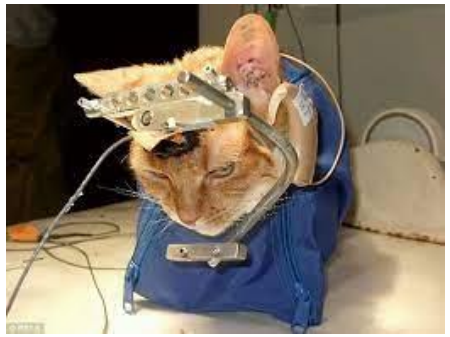
Μεθοδολογία

In vitro

In vivo/Pre-clinical studies

Clinical studies





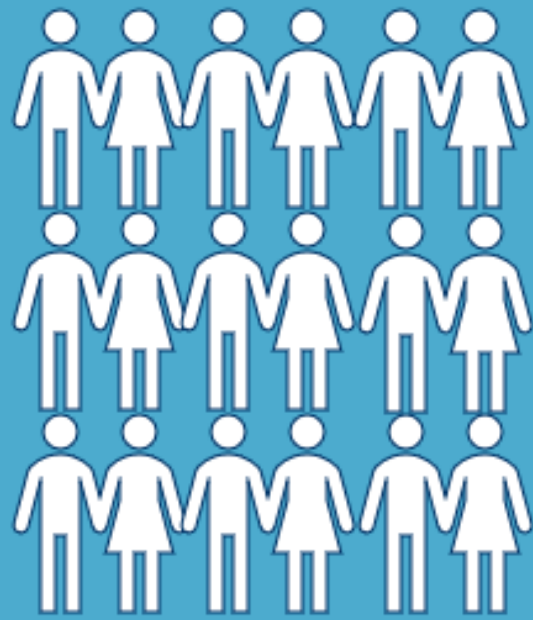
DISCOVERY & PRE-CLINICAL

CLINICAL TRIAL

PHASE I

PHASE 2

PHASE 3



FDA APPROVAL

Source: cbinsights.com

Μεθοδολογία

Behavioural/Observational Studies

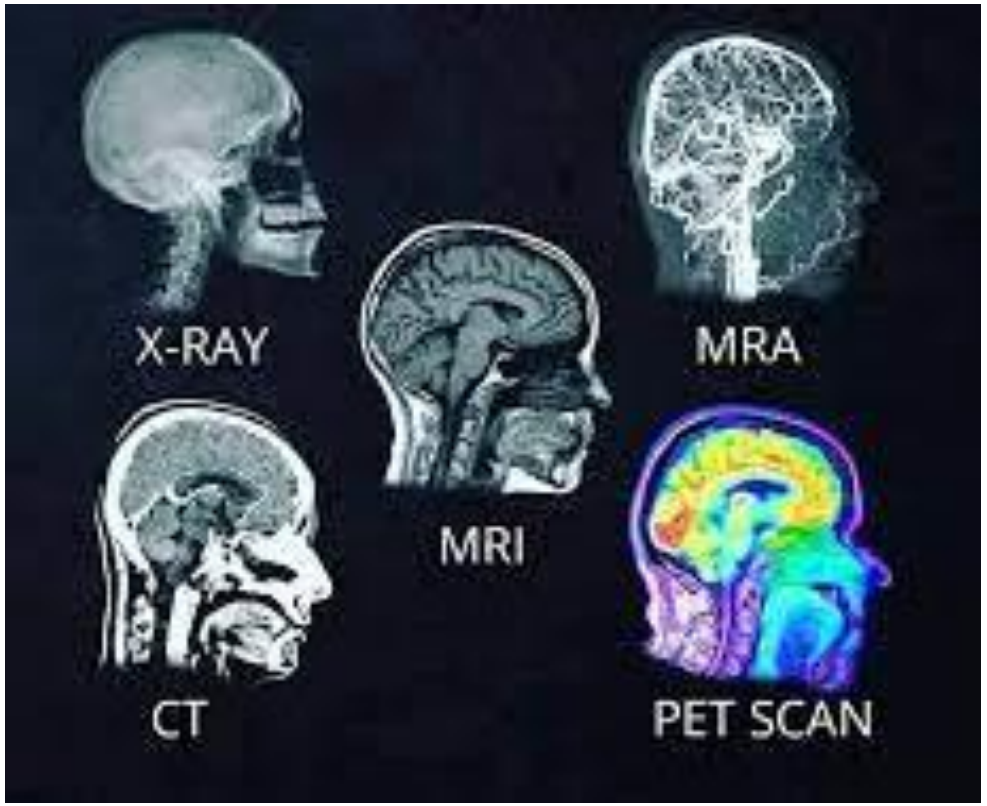
Questionnaire based studies

Imaging studies

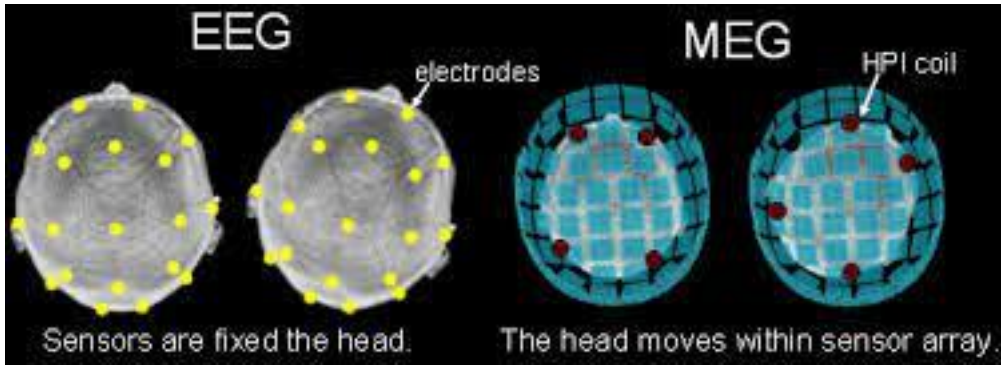
Genetic Studies

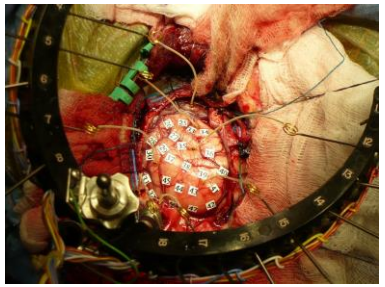
Blood Sampling-based Studies

Μεθοδολογία - Brain Imaging (Εγκεφαλικής Απεικόνησης)



Μεθοδολογία - Brain Imaging (Εγκεφαλικής Απεικόνησης)

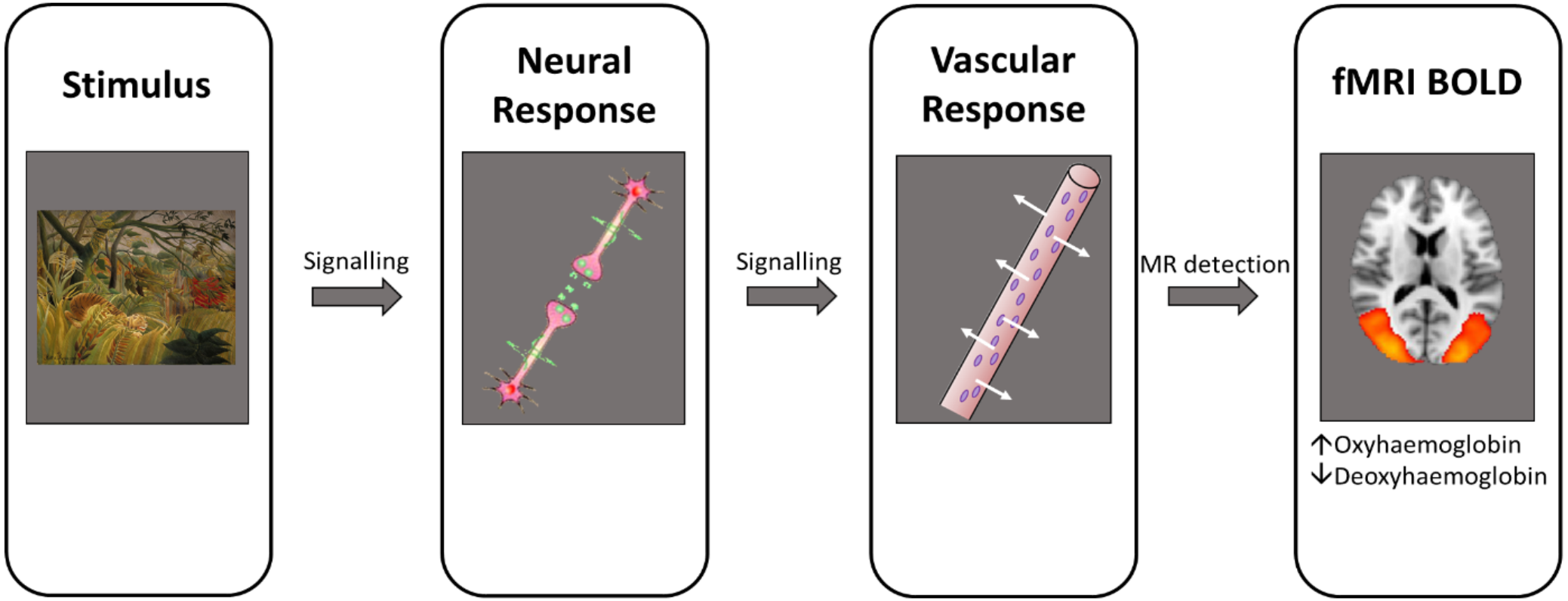




Single-unit recording study

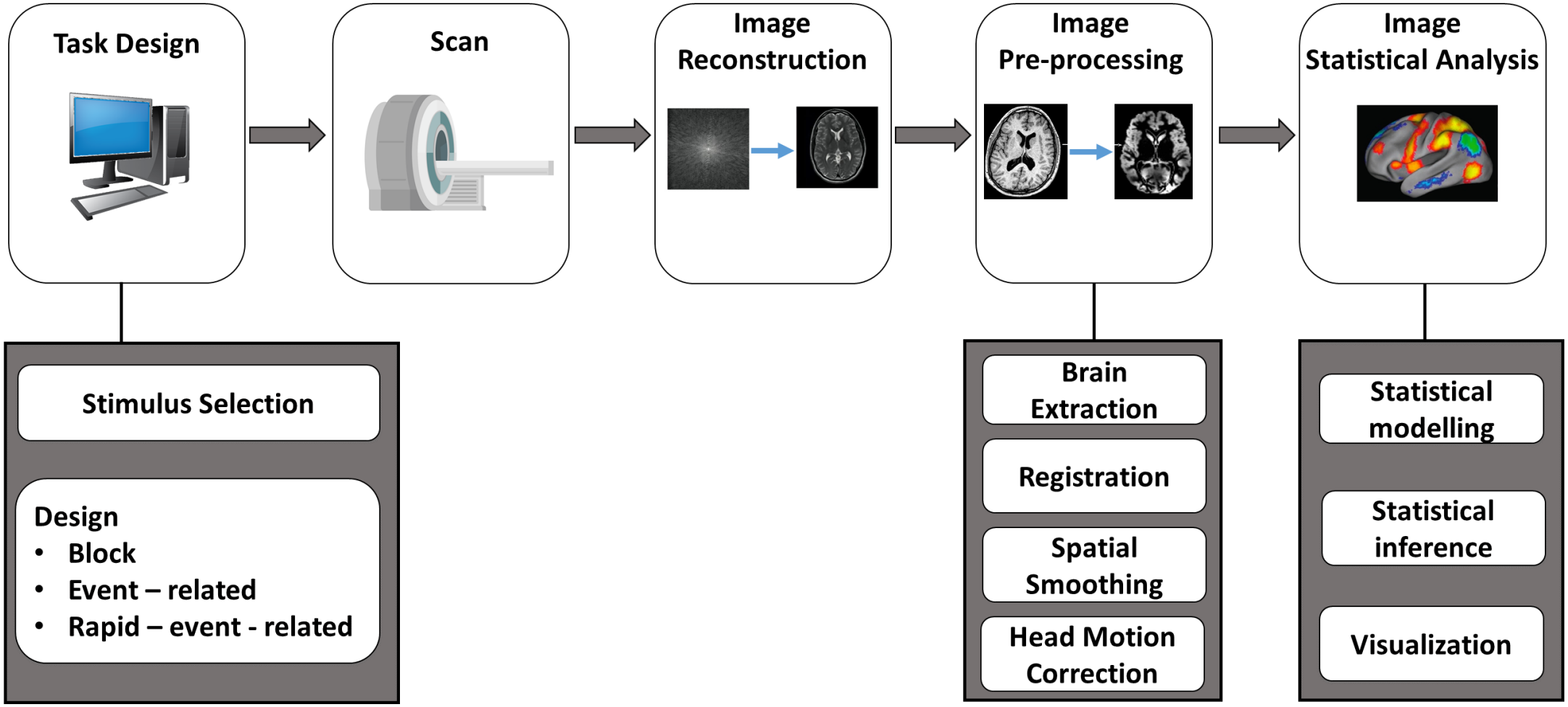
TMS

Functional Magnetic Resonance Imaging (fMRI)



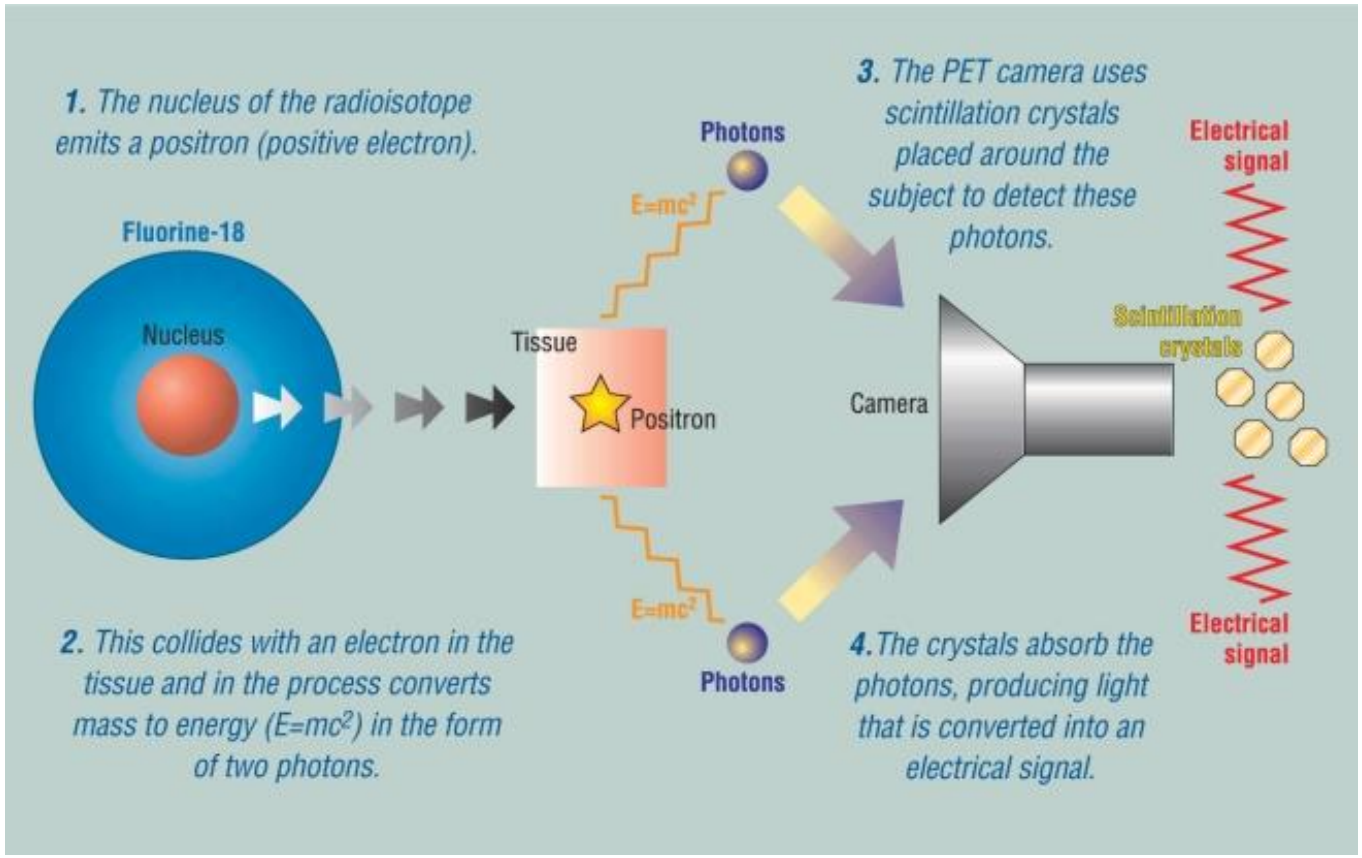
Demetriou, L (2019). Investigation of kisspeptin's effects on the human brain using fMRI. Imperial College London . https://doi.org/10.25560/94275

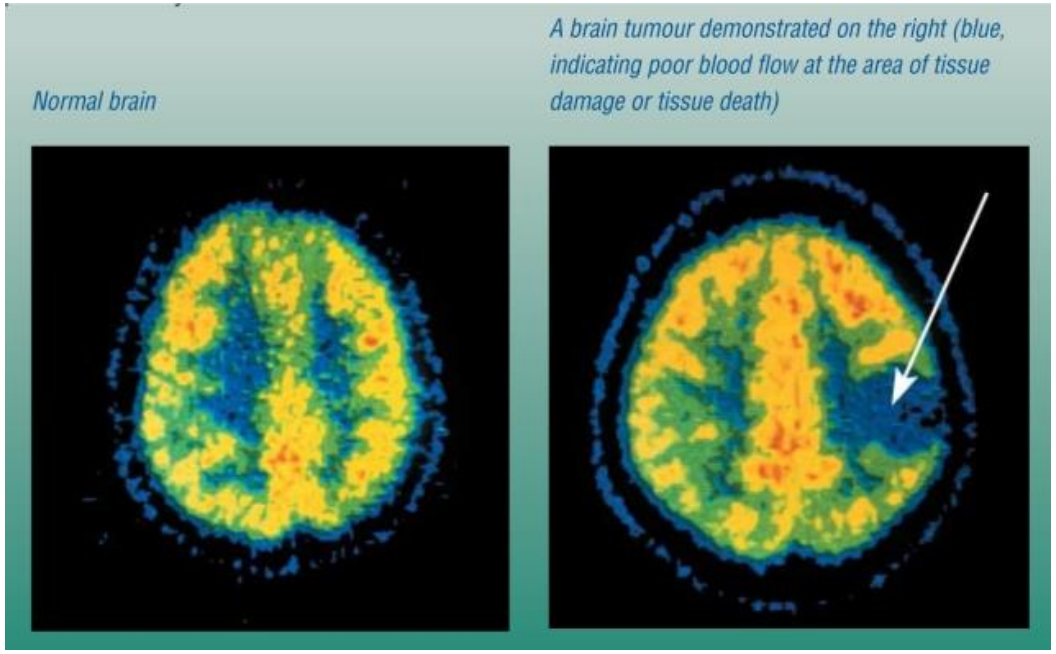
Functional Magnetic Resonance Imaging (fMRI)



Demetriou, L (2019). Investigation of kisspeptin's effects on the human brain using fMRI. Imperial College London . https://doi.org/10.25560/94275

Positron Emission Tomography (PET)

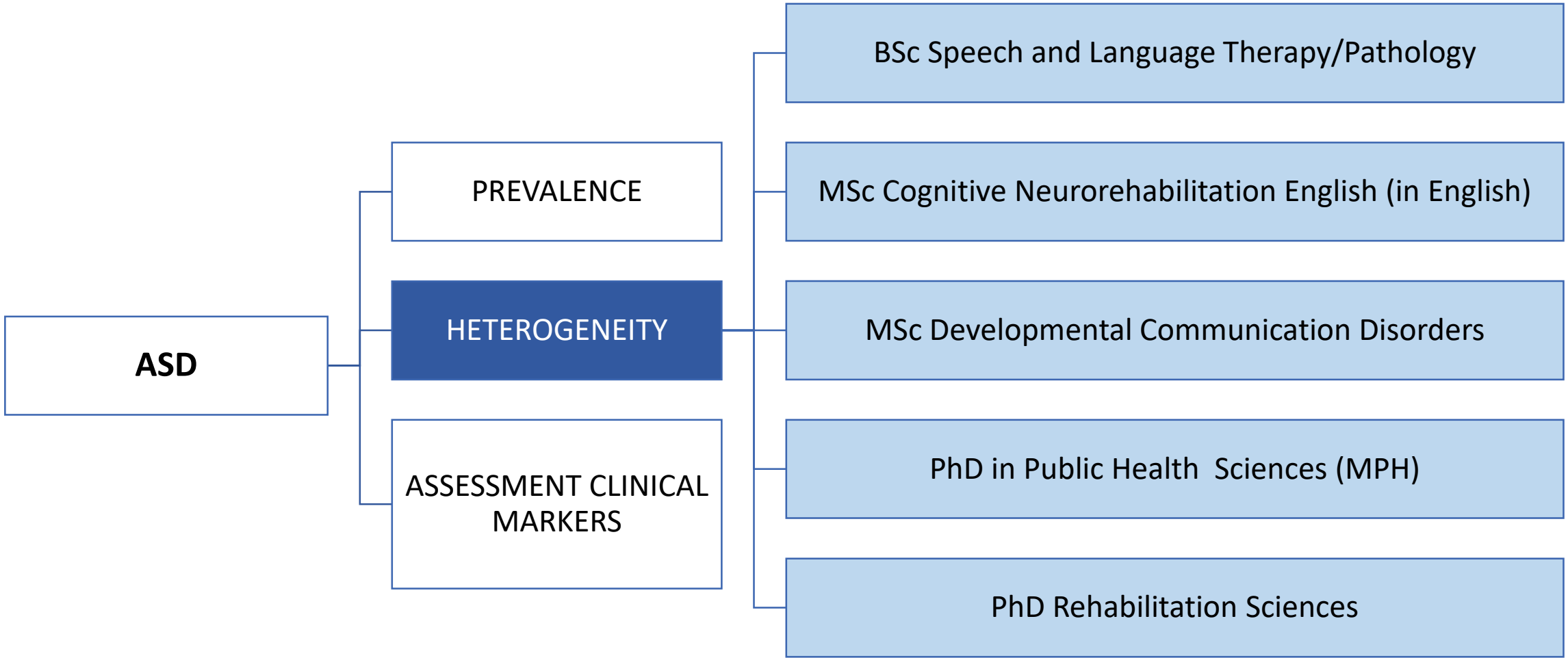




Berger, A. (2003). How does it work?: Positron emission tomography. BMJ: British Medical Journal, 326(7404), 1449.

Cyprus University of Technology

School and department structure



Cyprus University of Technology

Premises of the Department

- Academic Offices and Labs (ZT3 Vragadinou Street)
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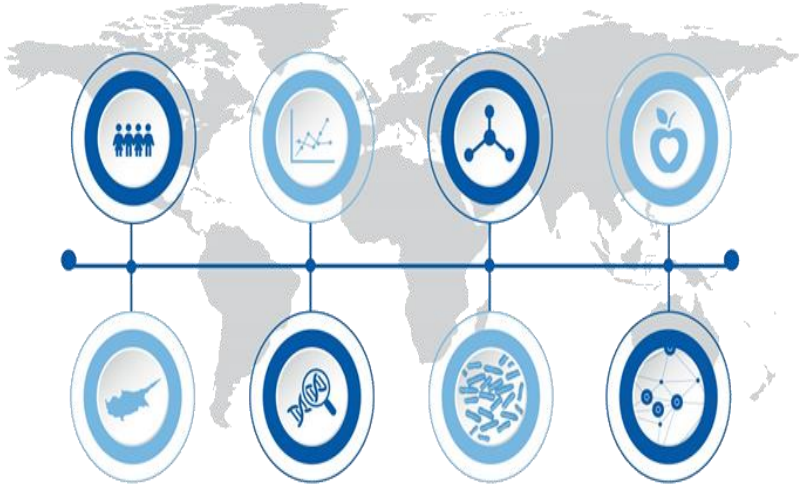
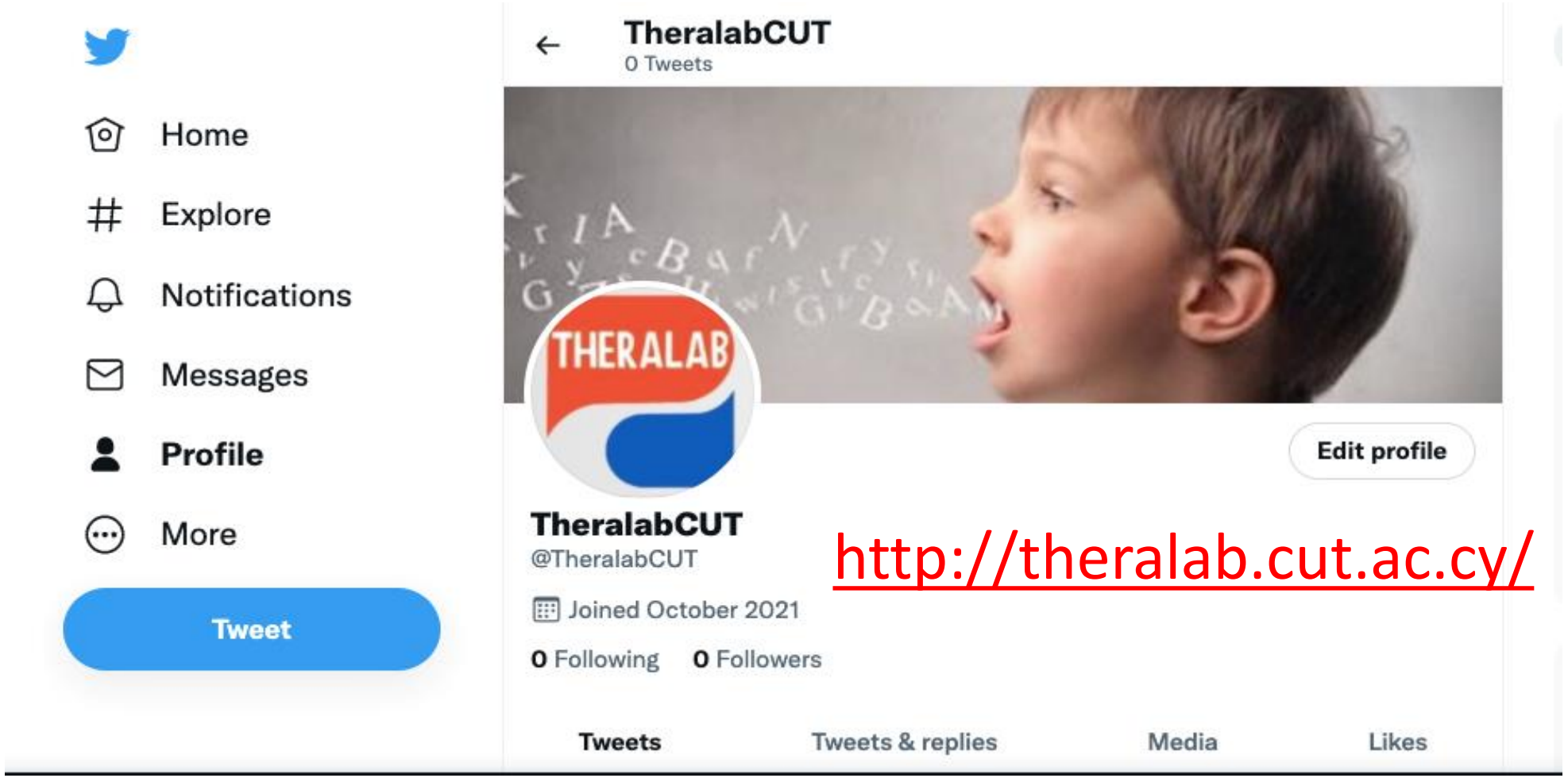
- University premises

ΕΠΙ.ΛΟ.Γ.ο
Ερευνητικό Εργαστήριο
Επικοινωνίας • Λόγου • Γλώσσας




Home
Explore
Notifications
Messages
Profile
More
Tweet
TheralabCUT
0 Tweets
THERALAB
Edit profile
TheralabCUT
@TheralabCUT
Joined October 2021
0 Following
0 Followers
Tweets
Tweets & replies
Media
Likes
http://theralab.cut.ac.cy/

UMBRELLA RESEARCH PROJECT CALLED

LINGUISTIC OUTCOMES GROWTH OF SPEECH [LOGOS]

FUNDING SECURED 200,000 EURO (2013-2022)

Linguistic Outcomes & Growth Of Speech (LOGOS)-sub projects

1.Assessing Parameters Expressive Communication Targets	ASPECT
2.Promoting Articulatory Motor Expression	***Tx PAME***
3.Testing Of Phonological Skills	***TOPS***
4.Gainng Articulatory Motor Expression	GAME
5.Gaining Articulatory Intelligibilty	GAIN
6.Transdiagnostic Speech Expression	TRASE
7.Profiling Early Diagnostic Indexes	PEDI

THERALAB SPEECH & LANGUAGE REHABILITATION LABORATORY

In a nutshell…

- PIS shows a *strong relationship* with words and grammar *synchronically*, both at 28 and 36 months.
- Importantly, PIS28 shows a *strong relationship* with sounds, words and grammar *predictively*.

Overall…[2]

- Dividing children into Low and High PIS28 groups shows different profiles:
- High group: no relationships synchronically or predictively.
- Low group (DLD): strong relationships synchronically (28 and 36m), and relationship only with PIS36.

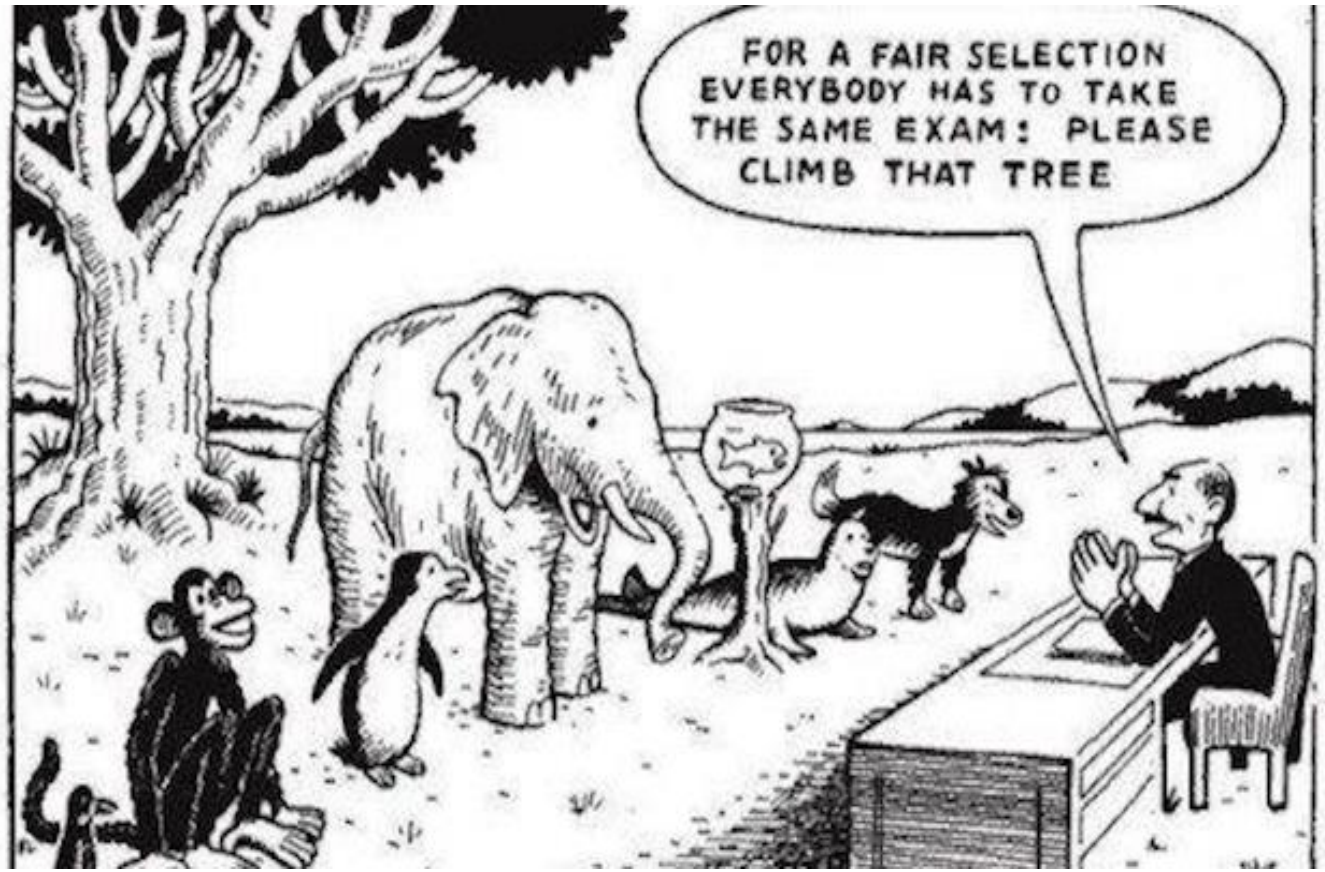
Overall…[3]

- A good robust phonetic system will assist in developing and maintaining other linguistic skills such as lexicon
- Early assessment should focus on relationships among linguistic parameters
- Move away from measuring only lexicon
- Cross-linguistic typology differences might give us different results
- Extent the model on children with late language onset
- **PHONOLOGY UNDERSCORES DLD OUTPUT CHARACTERISTICS**

PART II:

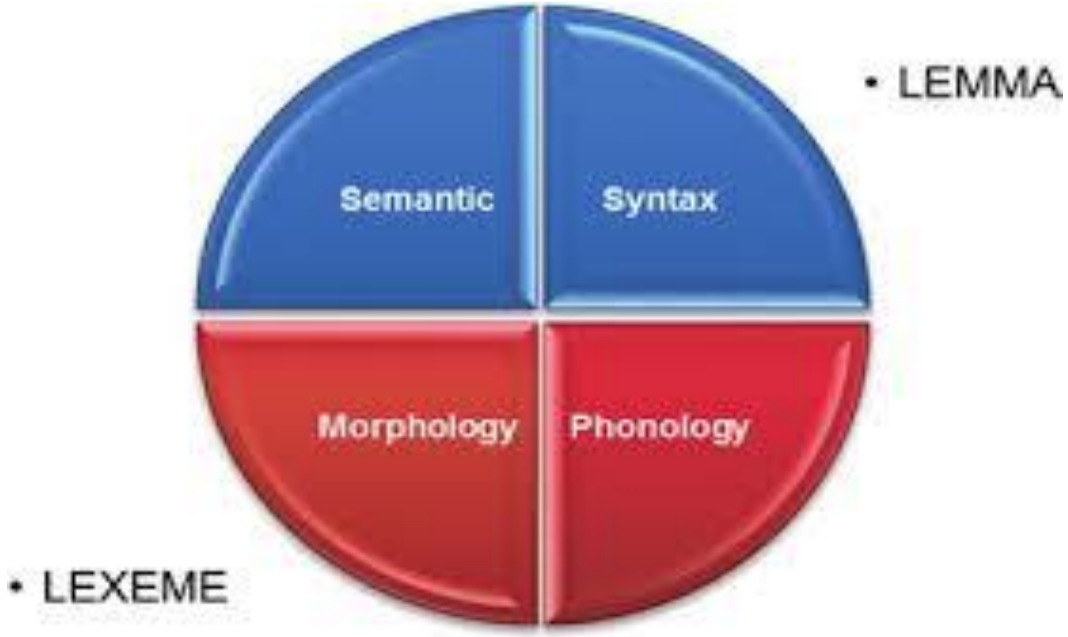
THEORY MOTIVATED INTERVENTION EFFECT SIZE

LEXICAL ORGANIZATION MODELS


FOR A FAIR SELECTION EVERYBODY HAS TO TAKE THE SAME EXAM: PLEASE CLIMB THAT TREE

Lexical and phonological interphase

[κ a t] LEXICAL
[κ] [α] [t] SUB-LEXICAL



Statistical properties of word forms[2]
Sound -> Meaning-Access-Selection-Engaging-Production

Words need to be remembered

- Organized
- Processed
- Selected
- Comprehended

Humans need to

- Engage
- Configure
- Proceed
- Produce

Statistical properties of word forms

- Statistical properties and word-level characteristics determine phonological accuracy and lexical access
- **Phonotactic probability**: aligns with phonological representation and accuracy
- **Neighbourhood density**: alights with lexical access
- **Word frequency**: facilities overall lexical acquisition

Density and Sparsity word form [2]

- “Neighbourhood density” refers to the number of words that are phonologically similar to a given word.
- Density versus Sparsity exert differential **impact on phonological gains**
- “Phonological similarity” is typically defined as the cluster of words that differ from a given word by one sound.
- For example, neighbours of “road” (/rod/) include “node” (/nod/), “rid” (/rɪd/), “roam” (/rom/), “row” (/ro/), and “ode” (/od/).

Statistical properties of word forms [3]

- Although there are differing definitions **of high and low density (dense versus sparse)**, in the phonological treatment literature, **a density of 10 neighbours is a common cut-point for high versus low density** (Gierut & Morrisette, 2012b; Gierut, Morrisette, & Champion, 1999; Morrisette & Gierut, 2002).
- Using an adult-written corpus (the Hoosier Mental Lexicon), road has 29 neighbours and would be considered high density.
- In contrast, raccoon has 0 neighbours and would be coded as low density. These two examples illustrate the relationship between frequency and density: “road” is high density and high frequency, whereas “raccoon” is low density and low frequency.
- These two examples illustrate the relationship between frequency and density: “road” is high density and high frequency, whereas “raccoon” is low density and low frequency.

Statistical properties of word forms [4]

- Recent line of research suggests that
- Children procure faster and more accurately words coming from DN
- Common sound sequences are produced faster
- High phonotactic probability words reside in DN
- DENSITY PRODUCTION ADVANTAGE
- Experimental Manipulation word targets to induce phonological gains

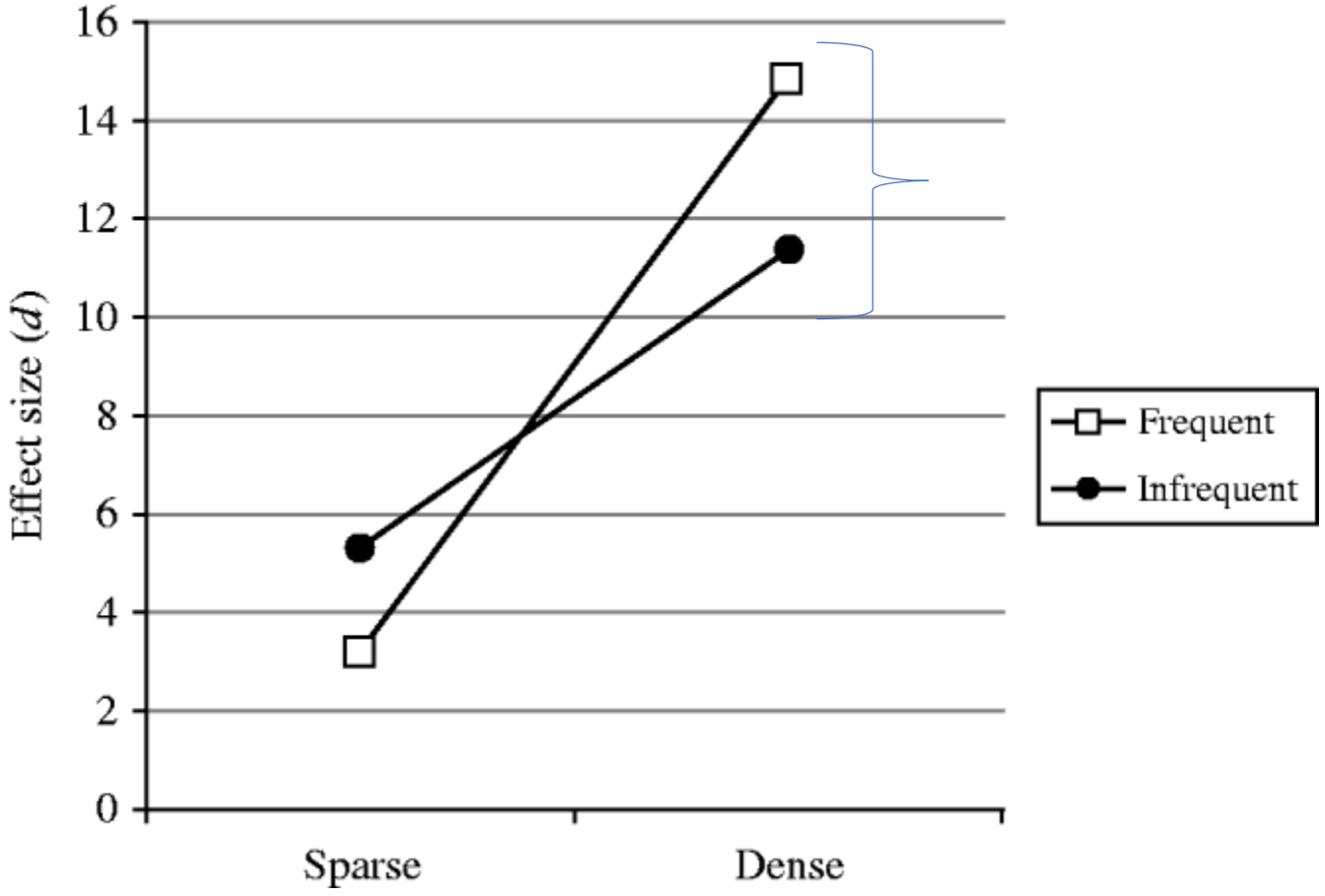
Building a hypothesis

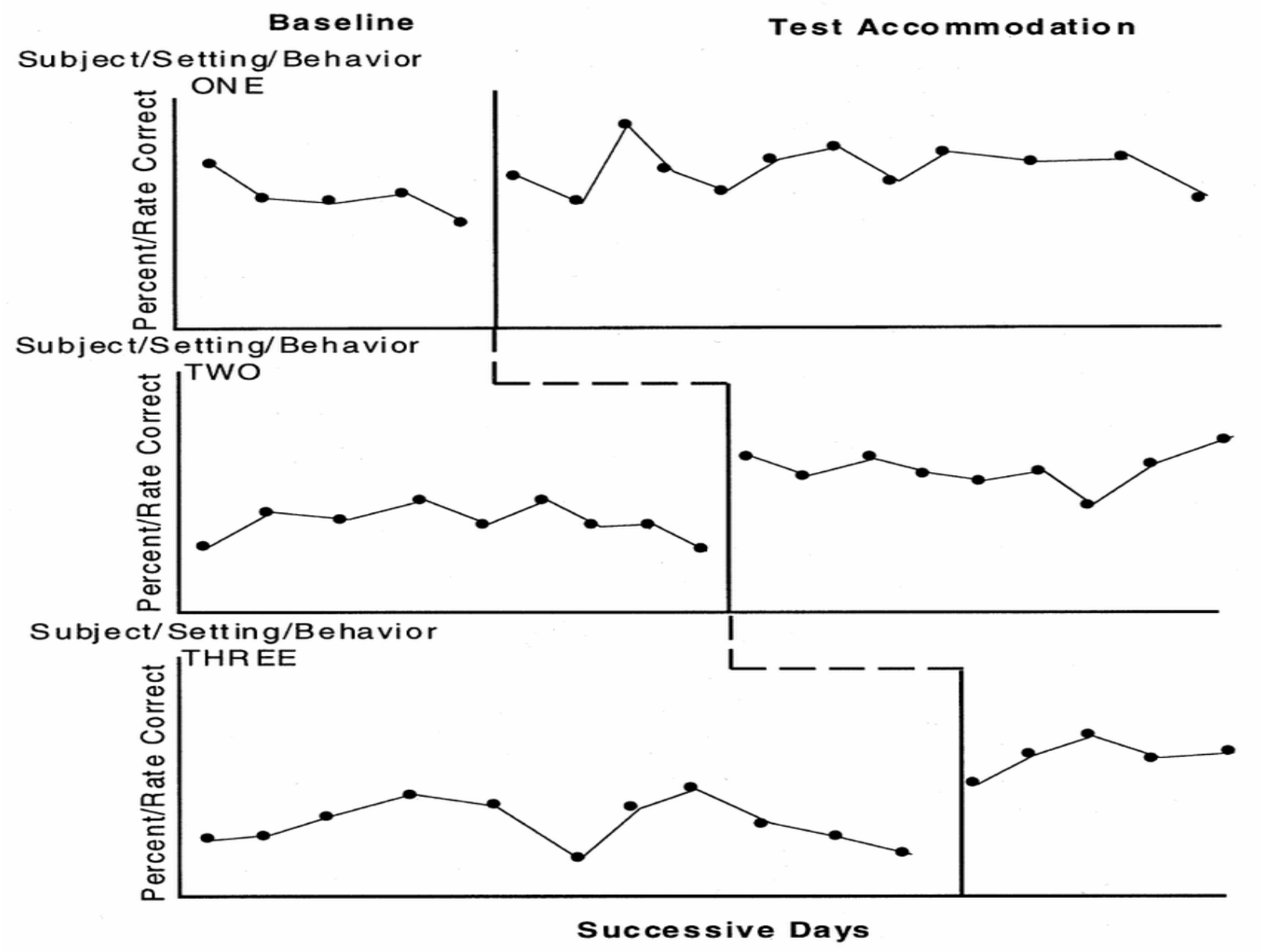
- As such, PN variables exert a differential impact on speech sound production in the sense that similarly-sounding targets in the lexicon align with accuracy of segmental production (Edwards, Munson, & Beckman, 2000; Luce & Pisoni, 1998; Sosa & Stoel-Gammon, 2012; Storkel, 2001).
- Research findings indicate that typically developing (TD) toddlers imitate more accurately sounds which occur within PDN as opposed to targets resting in PSN, thus leading to a "phonological density advantage" (Beckman & Edwards, 2000; Sosa & Stoel-Gammon, 2012; Stokes, 2012).

Building a hypothesis [2]

- Most notable is that the PDN advantage appears to "sharpen" phonological representations such as that words with overlapping phonological form "force" a child to engage in a finer-grained sub-lexical (phonological) elaboration, thus inducing the enrichment of expressive phonological and lexical skills (Luce, 1986; Storkel, Maekawa, & Hoover, 2010).
- Presumably, these underlying mechanisms trigger a more detailed processing of the competing words.
- Consequently, a fine-grained phonological processing allows knowledge of phonological contrasts which mark word meaning (Stoel-Gammon, 2011).
- PDN is an influential factor, which along with word frequency, form the most optimal triggers for inducing wide-system expressive phonological gains (Geirut & Morisette, 2012b; Petinou & Theodorou, 2018).

An outcome wide system expressive phonological gains Eng (Gierut et al. 2012; 2015)




Baseline
Test Accommodation
Subject/Setting/Behavior
ONE
Percent/Rate Correct
Subject/Setting/Behavior
TWO
Percent/Rate Correct
Subject/Setting/Behavior
THREE
Percent/Rate Correct
Successive Days

Participants

- The participants in this study were three bi-dialectal Cypriot Greek CG-speaking children ages 3;2-4;0 years.
- Participant 1 was a female (DJ age 3;6) while the other two were males including subject 2 EG (age 3;2) and subject 3 NM (4;0).
- All met eligibility criteria for participating in the current study which included clinical profiles consistent with SSD in Greek (Petinou & Theodorou, 2018; Petinou, 2021). (TOPS)

Dependent variables

- The dependent variables included the following:
  - (a) Phonetic Inventory Size as per the number of established segments (PIS),
  - (b) Proportion of Consonants Correct (PCC),
  - (c) Percentage correct of Whole Word Matches metric (WWMs) (Bernheardt & Stemberger, 2017; Ingram, 2002; Stemberger, personal communication)
  - (d) Intelligibility Context Scale (ICS) adapted in Greek (McLeod & Kambanaros, 2012).
- PIS included the number of singleton consonants presented in the child's speech output as per productions of the probe targets as well as PCC and PPs variables.
- For the percentage of WWMs a binomial coding system with metric scoring of 0 for no production/no response or incorrect match and 1 as total match.
- The ICS was scored numerically from a scale of 1-5 (1 = always unintelligible, 2 = usually unintelligible, 3 = sometimes unintelligible, 4 = rarely unintelligible, 5 = never unintelligible).

Stimuli

- The experimental stimuli were designed according to three criteria:
- (a) phonological neighborhood **density [PDN],**
- (b) **phonological overlap** and
- (c) characteristics of children's knowledge of word targets on the bases of segmental **stimulability.**
- For the first criterion and given that in CG and in SMG metrics remain either unavailable or sparse, the creation of intervention word stimuli and their organization into word- clusters proved to be a challenging task.
- For phonological density the study capitalized on available reported data regarding word form pertinent to Standard Modern Greek. Specifically, there is no spoken language corpus one can refer to, but there are several written language corpora which can be used.

Stimuli [2]

- These were created by the Institute of Language and Speech Processing (ILSP) in Athens and are openly available to researchers at the Golden Corpus website of ILSP (Kyparissiadis, van Heuven, Pitchford & Ledgeway (2017).
- In order to calculate **PDN, the Phonological Levenstein Distance (PLD20)** measure was used as provided by Kyparissiadis et al. (2017) in their psycholinguistic database.
- This was derived by calculating the mean distance from the 20 closest neighbors in order to identify a word's phonological similarity with its closest phonological neighbours in the target language as defined by a specific corpus (Suarez, Tan, Yap & Goh, 2010).
- Eight of the words in the stimuli set did not have any values as they were either dialectal items (N = 6) or proper names (N = 3), and did not occur in any of the corpora. The mean PLD20 as well as the mean frequency of the words in each cluster (in the form of zipfFreq) (Van Heuven et al., 2014) was calculated for each child separately. Preliminary analyses showed that across the three children the PDN, as well as frequency of words did not differ statistically (PDN: $F(2, 170) = .27$, $p = .77$; zipfFreq: $F(2, 179) = .83$, $p = .44$).

Phase 1:

Set of single words

Phase 2:

Wider range of single words

Phase 3: Connected speech

/kala’mari/
‘squad’

/ka’lami/
‘fishing rod’

/kala’maci/
‘straw’

Phase 1:

Set of single words

Phase 2:

Wider range of single words

Phase 3: Connected speech

/kala’mari/
‘squad’

/ka’lami/
‘fishing rod’

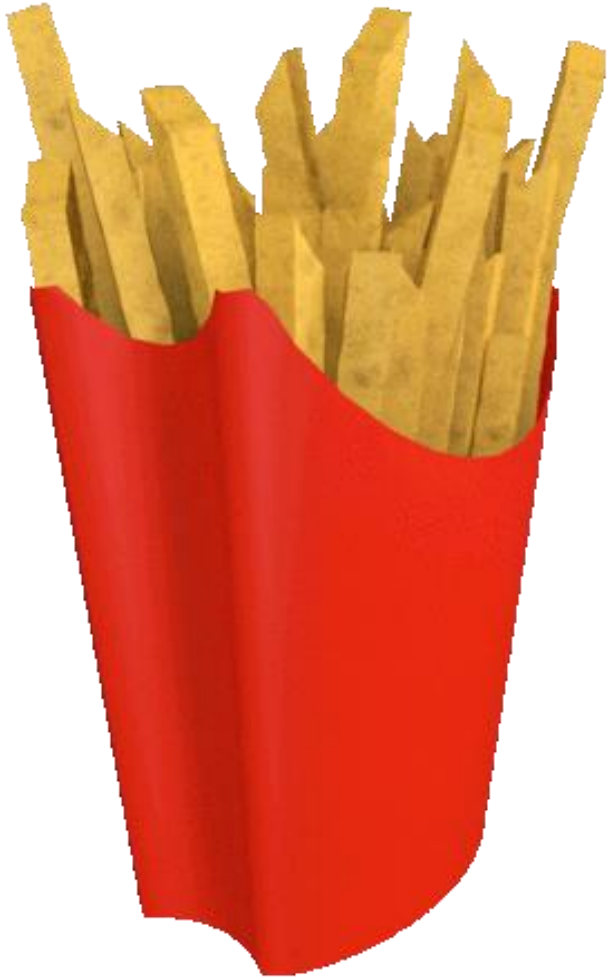
/kala’maci/
‘straw’

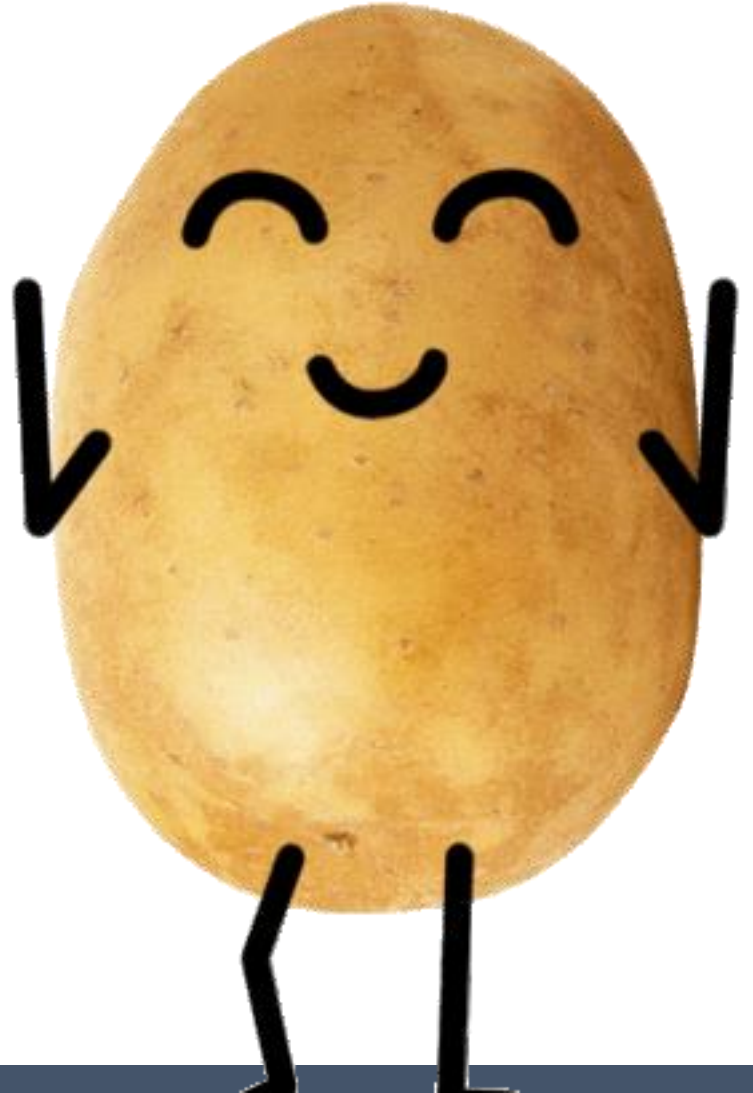
ΠΟΤΑΜΟΣ

ΙΠΠΟΠΟΤΑΜΑΚΙ

ΠΟΤΑΜΑΚΙ

ПАТАТА





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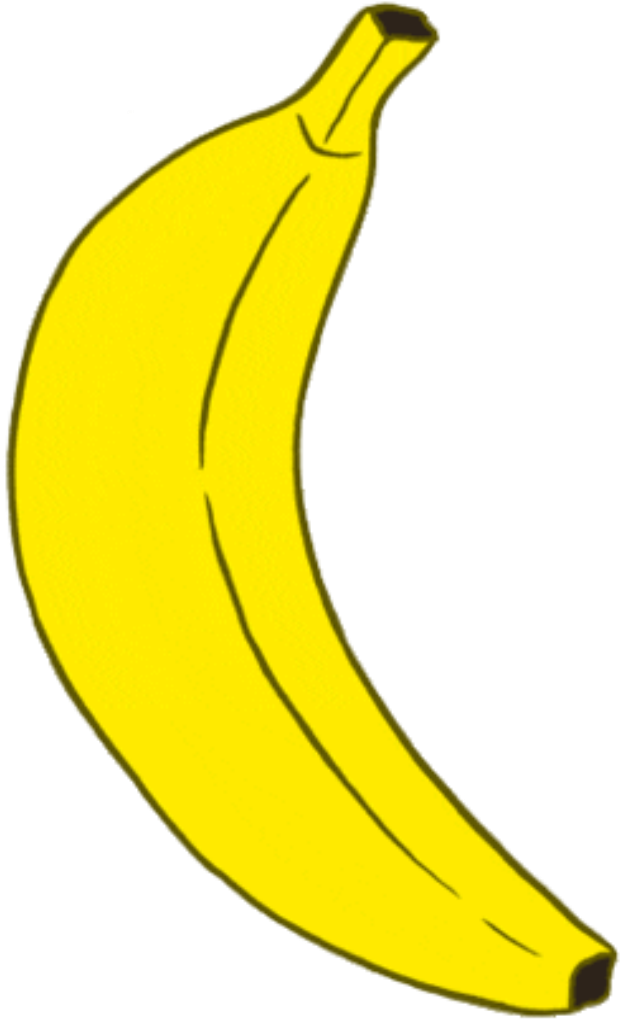
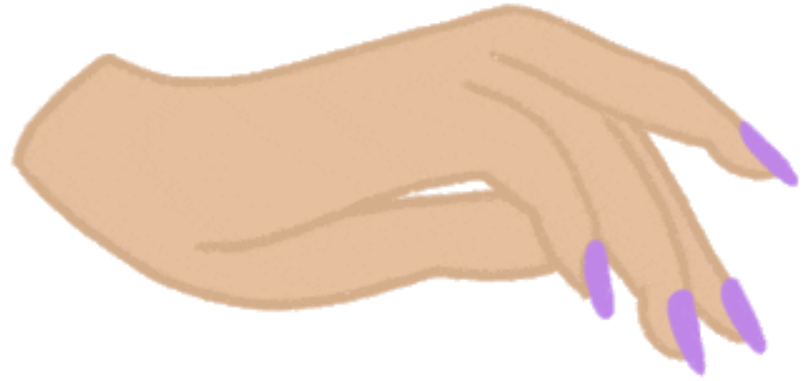


ΓΑΛΟΠΟΥΛΑ

ΚΑΝΕΛΛΑ



Timeline

BASELINE (PRE-TEST)

Three sessions

Week 1

Week 2

Week 3

Week 4

Administration 49-word probe and scoring of ICS

INTERVENTION PHASE

16-Bi-weekly 45-minute treatment sessions

Week 1-4; 2-syllable cohort implementation

Week 5-8, 3-syllable cohort implementation

POST-TEST WEEK 9

One session one week after completion of treatment cycle

49-word probe administration

FOLLOW-UP WEEK 16

One session two months after last treatment session

Administration of 20-word probe

Newly-presented words not used during treatmnet or baseline

Testing Of Phonological Skills ALGORITHM

Α/Α	Ορθογραφία	"Προφορά"	ΔΦΑ	"Προφορά"	ΔΦΑ
1	μάμμα	"mamma	ˈmam:a	"mama	ˈmama
2	παπά	pa"pa	paˈpa	pa"pa	paˈpa
3	μπότα	"mbota	ˈmbota	"oka	ˈoka
4	μάτι	"mati	ˈmati	"aci	ˈaci
5	μύττη	"mit:i	ˈmit:i	"ic:i	ˈic:i
6	γελά	je"la	ɟeˈla	"eja	ˈeɟa
7	πουλί	pu"l:i	puˈl:i	ku"li	kuˈli
8	νινί	"nin:i	ˈnin:i	"nini	ˈnini
9	πίττα	"pit:a	ˈpit:a	"cik:a	ˈcik:a
10	πετά	pe"ta	peˈta	"eka	ˈeka
11	τούμπα	"tumba	ˈtumba	"kuka	ˈkuka
12	κουμπί	kum"bi	kumˈbi	u"ci	uˈci
13	κουππί	ku"pi	kuˈpi	u"ci	uˈci
14	κότα	"kota	ˈkota	ko	ko
15	μέλι	"meli	ˈmeli	"eGi	ˈeɣi
16	μαλλί	ma"l:i	maˈl:i	a"ji	aˈji
17	λαγός	la"Gos	laˈɣos	Ga"Go	ɣaˈɣo
18	λίγος	"liGos	ˈliɣos	"GiGo	ˈɣiɣo
19	ποτά	po"ta	poˈta	o"ka	oˈka
20	ζητώ	ci"to	ciˈto	ci"ko	ciˈko
21	λαχείο	la"Cio	laˈçio	ak"io	akˈio
22	Φώτος	"fotos	ˈfotos	"koto	ˈkoto
23	κάππα	"kap:a	ˈkap:a	"kak:a	ˈkak:a
24	κούππα	"kup:a	ˈkup:a	"kuk:a	ˈkuk:a
25	φώτα	"fota	ˈfota	"kota	ˈkota
26	ντούφα	"tufa	ˈtufa	"koka	ˈkoka
27	πάγος	"paGos	ˈpaɣos	"kaGo	ˈkaɣo
28	νερό	ne"ro	neˈro	e"Gio	eˈɣio
29	σόπα	"sopa	ˈsopa	"koka	ˈkoka
30	κόκκαλο	"kok:alo	ˈkok:alo	"okaGio	ˈokaɣio
31	καρότο	ka:"rot:o	kaːˈrot:o	"ok:o	ˈok:o
32	μπαλόνι	mba"loni	mbaˈloni	"koni	ˈkoni
33	λουλλούδι	lul:"luDi	lulːˈluði	"uki	ˈuki
34	παττάτα	pa"tata	paˈtata	a"kaka	aˈkaka
35	μπανάνα	mba"nana	mbaˈnana	ka"nana	kaˈnana
36	ντόματα	ndo"mata	ndoˈmata	ko"maka	koˈmaka
37	τίποτα	"tipota	ˈtipota	"ikoka	ˈikoka
38	καμπάνα	ka"mbana	kaˈmbana	"kana	ˈkana
39	πάτωμα	"patoma	ˈpatoma	"koma	ˈkoma
40	παγωμένο	paGo"meno	payoˈmeno	o"keno	oˈkeno
41	τηλέφωνο	ti"lefono	tiˈlefono	i"kekono	iˈkekono
42	συννεφάκι	sin:e"faci	sinːeˈfaci	ka"kaki	kaˈkaki
43	λουλλουδάκι	lul:"uDaci	lulːˈuðaci	u"Gaki	uˈɣaki
44	κουκουβάγια	kuku"vaja	kukuˈvaja	kuku"Ga	kukuˈɣa
45	κουνουπίδι	kunu"piDi	kunuˈpiði	"kiki	ˈkiki
46	χαμομήλι	xamo"mili	xamoˈmili	"kiGi	ˈkiɣi
47	πουκάμισο	pu"kamiso	puˈkamiso	"kakiko	ˈkakiko
48	λουκάνικο	lu"kaniko	luˈkaniko	"kakiko	ˈkakiko
49	μανταρίνι	manda"rini	mandaˈrini	ak"ini	akˈini

Testing Of Phonological Skills ALGORITHM [2]

Φωνητικό Ρεπερτόριο (ανεξάρτητη ανάλυση): Ποσοστό εμπεδωμένων φθόγγων = 23% (8/35)· Ποσοστό αναπτυσσόμενων φθόγγων = 3% (1/35).

			Διχειλικά		Χειλοδοντικά		(Μεσ)οδοντικά		Φατνιακά		Ουρανικοφατνικά		Ουρανικά		Υπερωικά	
			Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά
	Έκκροτα	απλά	p	b			t̪	d̪					c	ʔ	k	ʔ
		μακρά	ʔ				ʔ						ʔ		ʔ	
	Προστριβόμενα	απλά								ʔ	ʔ	ʔ				
		μακρά							ʔ		ʔ					
	Τριβόμενα	απλά			f	ʔ	ʔ	ð	s		ʔ		ʔ	ɟ	ʔ	ɣ
		μακρά								ʔ		ʔ				
	Έρρινα	απλά		m						n						
		μακρά												ʔ		
	Πλευρικά	απλά								(l)						
	προσεγγιστικά	μακρά												ʔ		
	Μονοπαλλόμενα	απλά								ɾ						
	Πολυπαλλόμενα	μακρά														

Ποσοστά ορθών παραγωγών ανά σύμφωνο (σχετική ανάλυση).

			Διχειλικά		Χειλοδοντικά		(Μεσ)οδοντικά		Φατνιακά		Ουρανικοφατνικά		Ουρανικά		Υπερωικά	
			Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά	Άηχα	Ηχηρά
	Έκκροτα	απλά	[p] 2/15 (13%)	[b] 0/5 (0%)			[t̪] 2/17 (12%)	[d̪] 0/2 (0%)					[c] 1/3 (33%)	[ɟ] 0/0	[k] 5/14 (36%)	[g] 0/0
		μακρά	[pʰː] 0/0				[t̪ʰː] 0/0						[cʰː] 0/0		[kʰː] 0/0	
	Προστριβόμενα	απλά								[d̪z̪] 0/0	[t̪ʃ] 0/0	[d̪ʒ̪] 0/0				
		μακρά							[t̪s̪ʰː] 0/0		[t̪ʃʰː] 0/0					
	Τριβόμενα	απλά			[f] 0/5 (0%)	[v] 0/1 (0%)	[θ] 0/0	[ð] 0/3 (0%)	[s] 0/7 (0%)		[ʃ] 0/0		[ç] 0/1 (0%)	[ʝ] 0/2 (0%)	[x] 0/1 (0%)	[ɣ] 3/4 (75%)
		μακρά								[zː] 0/0		[ʒː] 0/0				
	Έρρινα	απλά		[m] 3/12 (25%)						[n] 8/11 (73%)						
		μακρά												[ɲː] 0/0		
	Πλευρικά	απλά								[l] 0/12 (0%)						
	προσεγγιστικά	μακρά												[ʎː] 0/0		
	Μονοπαλλόμενα	απλά								[ɾ] 0/2 (0%)						
	Πολυπαλλόμενα	μακρά														

Testing Of Phonological Skills ALGORITHM [3]

ΔΕΣΑΛ	40%	διαγραφή της έμβασης συλλαβής στην αρχή της λέξης
ΠρΑφ	17%	προχωρητική εξ αποστάσεως πλήρης αφομοίωση της έμβασης συλλαβής στην αρχή της λέξης προς την επόμενη έμβαση
Ορθή παραγωγή της έμβασης	21%	ορθή παραγωγή της έμβασης συλλαβής στην αρχή της λέξης
Άλλες διεργασίες	21%	άλλες διεργασίες που επηρεάζει την έμβαση συλλαβής στην αρχή της λέξης

Results

- Statistical analyses were performed using Jamovi (Jamovi, 2021).
- To explore the effectiveness of the intervention, performance on the test was compared between the baselines, the post-test, and the follow-up, separately for each child.
- All analyses were performed using non-parametric tests. Specifically, we used the McNemar test to investigate differences in whole word match (WWM) scores and calculated a **log Odds Ratio** to estimate the ratio between pre-intervention (baselines) and post-intervention (post-test and follow-up) performance (binomial)

Results [2]

- To analyze performance for the percentage of consonants correct (PCC) for each child, percentages were transformed to arcsines
- The arcsine transformation resulted in data ranging from a scale of 0 to $\pi/2$, thus overcoming the limitations of performing analyses on percentages (e.g., Lin & Xu, 2020).
- Differences between all the baseline scores, the post-test scores, and the follow-up scores, were explored using the non-parametric repeated measures ANOVA (Friedman), and post-hoc tests were performed using the non-parametric Wilcoxon Rank test.
- To estimate the effect sizes, we calculated a repeated measure **Cohen's d (drm)** (paired-mean difference), which acknowledges the correlation between repeated measures, thus controlling for an overestimated effect size (Lakens, 2013).

$$d = \frac{\overline{x} - \overline{x}}{S}$$

control group

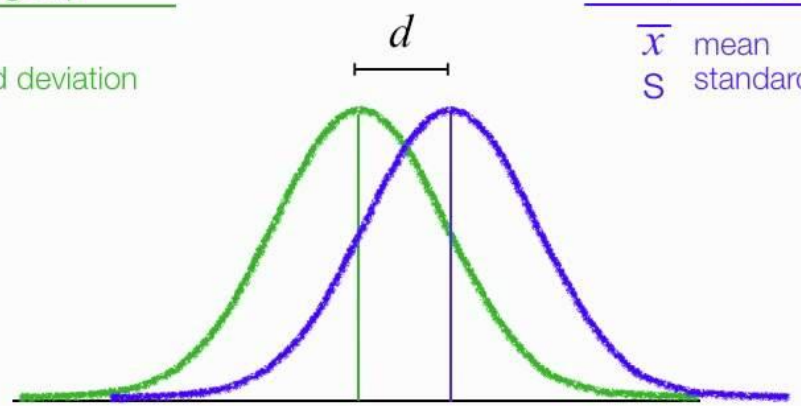
$\overline{x}$ mean

S standard deviation

experimental group

$\overline{x}$ mean

S standard deviation



Υπολογισμός Μεγέθους Επίδρασης/Αποτελέσματος σε Επαναλαμβανόμενες Μετρήσεις

ΦΟΙΒΟΣ ΦΥΛΑΚΤΟΥ (ΠΕ)

- Όταν τα δεδομένα αποτελούνται από επαναλαμβανόμενες μετρήσεις (π.χ., μετρήσεις από το ίδιο άτομο σε διαφορετικές συνθήκες), τότε μπορούμε να υπολογίσουμε το μέγεθος της επίδρασης/αποτελέσματος (Cohen's *d'*) με την φόρμουλα:

$$\text{Cohen's } d_z = \frac{M_{\text{diff}}}{\sqrt{\frac{\sum (X_{\text{diff}} - M_{\text{diff}})^2}{N-1}}}$$

Όπου M_{diff} είναι ο μέσος όρος όλων των διαφορών μεταξύ της πρώτης και δεύτερης μέτρησης, και X_{diff} είναι μια συγκεκριμένη διαφορά μεταξύ πρώτης και δεύτερης μέτρησης.

ή

$$\text{Cohen's } d_z = \frac{t}{\sqrt{n}}$$

Εναλλακτικά, η ίδια μέτρηση μπορεί να υπολογιστεί λαμβάνοντας υπόψη την τιμή t (από το paired sample t-test) και το σύνολο των μετρήσεων (n).

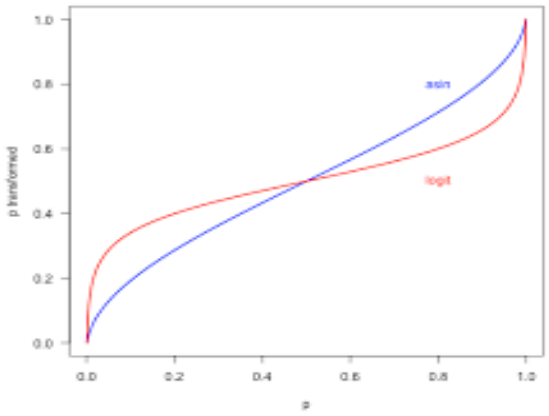
- Όμως, οι επαναλαμβανόμενες μετρήσεις παραβιάζουν την ανεξαρτησία των δεδομένων. Όταν τα δεδομένα δεν είναι ανεξάρτητα (π.χ., προέρχονται από το ίδιο άτομο παρά από διαφορετικές ομάδες ατόμων), θεωρείται ότι οι μετρήσεις πιθανόν να συσχετίζονται μεταξύ τους. Οι πιο πάνω φόρμουλες δεν υπολογίζουν αυτή την συσχέτιση, και γι' αυτό θεωρείται ότι συχνά υπερεκτιμούν το μέγεθος επίδρασης.
- Μια διαφορετική και πιο ευαίσθητη φόρμουλα, υπολογίζει το μέγεθος επίδρασης λαμβάνοντας υπόψη την συσχέτιση (Pearson's *r*) μεταξύ των μετρήσεων και την τυπική απόκλιση στην κάθε μέτρηση:

$$\text{Cohen's } d_{rm} = \frac{M_{\text{diff}}}{\sqrt{SD_1^2 + SD_2^2 - 2 \times r \times SD_1 \times SD_2}} \times \sqrt{2(1-r)}$$

(Lakens, 2013)

arcsine transformation

Value	Transformed Value
0.0	0.0
1/7	0.247
1/4	0.334
0.4	0.436
0.5	0.500
0.6	0.564
0.8	0.705
0.9	0.796
1.0	1.000



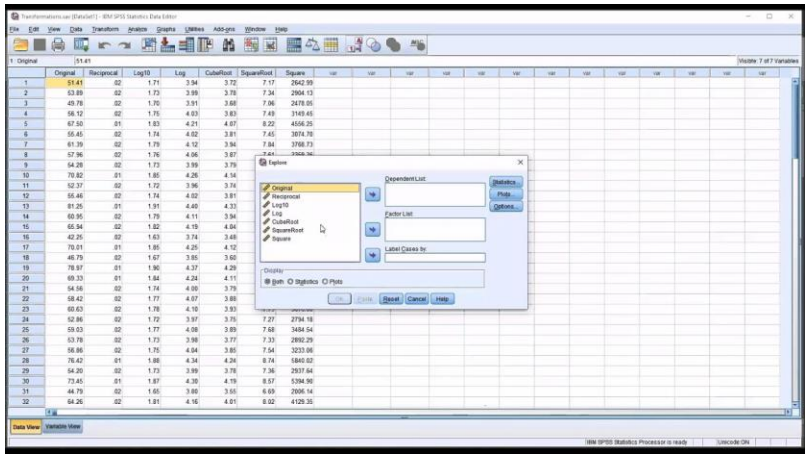
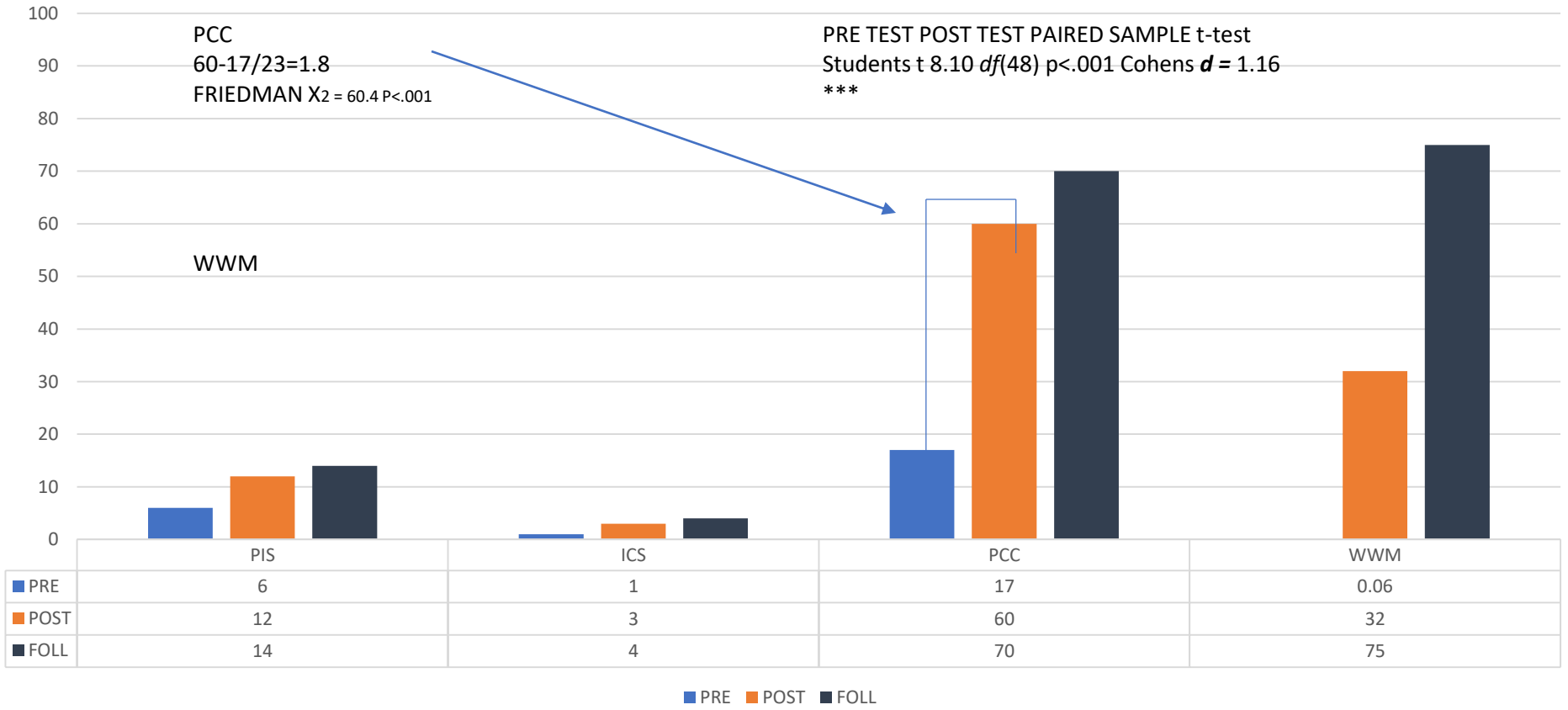


Table II: Mean Percentage and standard deviations of Whole word match (WWM) performance of each child during baseline, post-test, and follow-up.				
Child	Baseline % (sd)	Post-test % (sd)	Follow-up % (sd)	
1	8% (0.28)	42% (0.3)	75% (0.44)	
2	6% (0.24)	47% (0.5)	60% (0.5)	
3	6% (0.24)	41% (0.5)	55% (0.51)	

Table III: Mean Percentage and standard deviations of Consonants Correct (PCC) performance of each child during baseline, post-test, and follow-up.						
Child	Baseline 1	Baseline 2	Baseline 3	Baseline 4	Post-test	Follow-up
	PCC (sd)	PCC (sd)	PCC (sd)	PCC (sd)	PCC (sd)	PCC (sd)
1	18% (0.28)	20% (0.31)	-	-	62% (0.31)	71% (0.32)
2	36% (0.28)	34% (0.27)	33% (0.29)	-	63% (0.34)	62% (0.36)
3	33% (0.27)	34% (0.26)	36% (0.25)	36% (0.26)	63% (0.37)	71% (0.31)

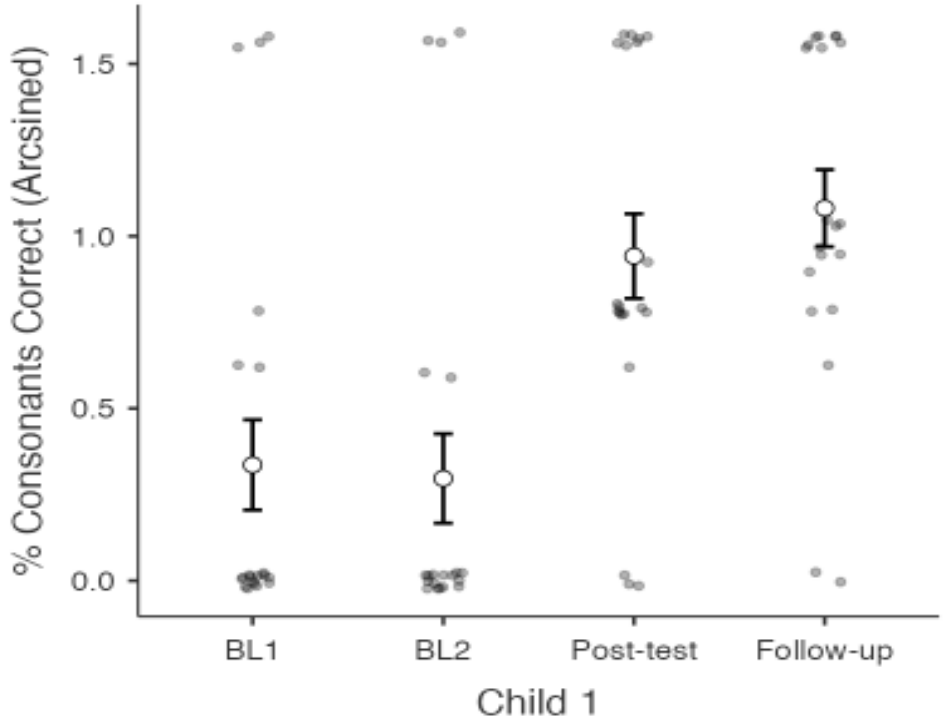
CHILD 1 GAINS AS A FUNCTION OF SESSIONS



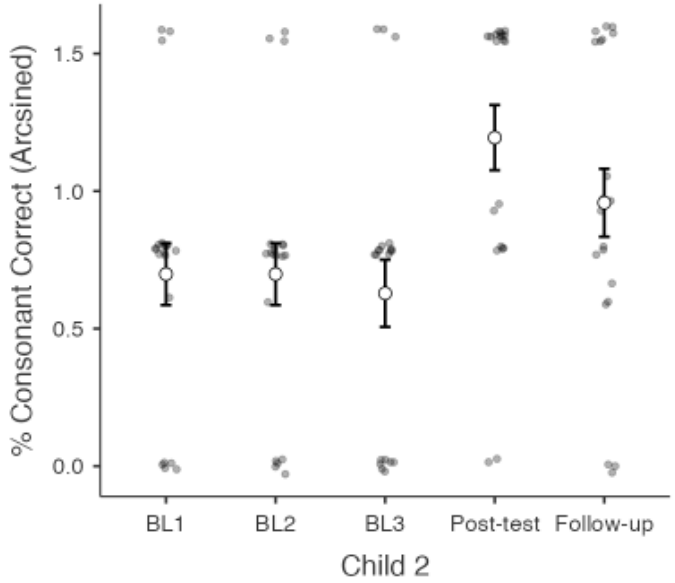
	PIS	ICS	PCC	WWM
PRE	6	1	17	0.06
POST	12	3	60	32
FOLL	14	4	70	75

Child 1 PCC

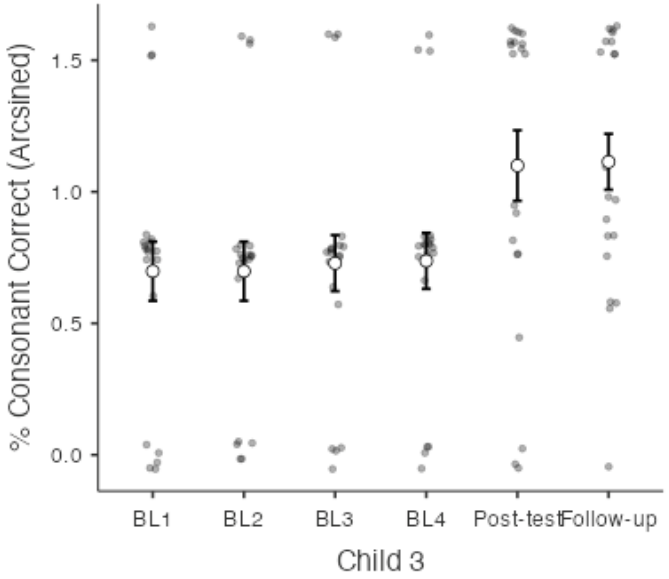
ES d *standard mean difference* (SMD) with values ranging from *d*= .88-1.45.



Child 2 PCC


% Consonant Correct (Arcsined)
1.5
1.0
0.5
0.0
BL1
BL2
BL3
Post-test
Follow-up
Child 2

Child 3 PCC


% Consonant Correct (Arcsined)
1.5
1.0
0.5
0.0
BL1
BL2
BL3
BL4
Post-test
Follow-up
Child 3

Conclusion

- Notably, advances in the area of MBL have contributed to seminal improvements in methodological procedures including data collection, treatment timeline and the use of effect size (ES) as a means of quantifying and interpreting the magnitude of the effects (e.g., small, medium, robust) (see Geirut, Morrisette & Dickinson, 2015 for a detailed review; Kazdin, 2010; Kratochwill & Levin, 2013; Olswang, 1998).
- MBL designs provide a fruitful and promising platform in research regarding phonological treatment efficacy. New directions for research were offered to further tease apart the complexities of statistical regularities relative to expressive phonology, with emphasis on the concurrent manipulation of more than one variable.

Ελληνικά Δείκτης καταληπτότητας ομιλίας

Intelligibility in Context Scale (ICS): Standard Modern Greek

(McLeod, Harrison, & McCormack, 2012)

Translated by: Maria Kambanaros, Ph.D., University of Cyprus, Cyprus, 2012

Όνομα:_____

Ημερομηνία Γέννησης:_____ Αγόρι/Κορίτσι:_____

Γλώσσα/ γλώσσες που μιλάει το παιδί:_____

Τρέχουσα ημερομηνία: _____ Ηλικία:_____

Το Ελληνικά Δείκτης καταληπτότητας ομιλίας έχει συμπληρωθεί από τον/την:_____

Συγγένεια με το παιδί:_____

Οι παρακάτω ερωτήσεις αφορούν το ποσοστό καταληπτότητας ομιλίας του παιδιού σας από διαφορετικά άτομα/ Οι παρακάτω ερωτήσεις έχουν ως στόχο να διαπιστώσουν πόσα από αυτά που λέει το παιδί σας είναι κατανοητά από διαφορετικά άτομα. Καθώς σημειώνετε την απάντηση σας σε κάθε ερώτηση, παρακαλείστε να λάβετε υπόψη την ομιλία του παιδιού σας κατά το μήνα που πέρασε. Κυκλώστε ένα αριθμό για κάθε ερώτηση.

	Πάντα	Συνήθως	Κάποτε	Σχεδόν ποτέ	Ποτέ
1. Η ομιλία του παιδιού σας είναι καταληπτή από εσάς	5	4	3	2	1
2. Η ομιλία του παιδιού σας είναι καταληπτή από τα μέλη της άμεσης οικογένειάς σας (π.χ. γονείς, αδέλφια)	5	4	3	2	1
3. Η ομιλία του παιδιού σας είναι καταληπτή από τα μέλη της εκτεταμένης οικογένειάς σας (π.χ. παππούδες, θείοι, ξαδέλφια)	5	4	3	2	1
4. Η ομιλία του παιδιού σας είναι καταληπτή από τους/τις φίλους/φίλες του	5	4	3	2	1
5. Η ομιλία του παιδιού σας είναι καταληπτή από άτομα έξω από την οικογένειά σας	5	4	3	2	1
6. Η ομιλία του παιδιού σας είναι καταληπτή από τις δασκάλες του	5	4	3	2	1
7. Η ομιλία του παιδιού σας είναι καταληπτή από τους ξένους	5	4	3	2	1
ΣΥΝΟΛΙΚΗ ΒΑΘΜΟΛΟΓΙΑ =	/35				
ΜΕΣΟΣ ΟΡΟΣ ΣΥΝΟΛΙΚΗΣ ΒΑΘΜΟΛΟΠΑΣ =	/5				

[1] Αυτός ο δείκτης μπορεί να προσαρμοστεί στην ομιλία ενός ενήλικα, αντικαθιστώντας *παιδί* με *σύζυγος*

[2] Ο όρος *ξένος* μπορεί να αντικατασταθεί με *άγνωστο πρόσωπο*

McLeod, S., Harrison, L. J., & McCormack, J. (2012). The Intelligibility in Context Scale: Validity and reliability of a subjective rating measure. *Journal of Speech, Language, and Hearing Research, 55*(2), 648-656. http://jslhr.asha.org/cgi/content/abstract/55/2/648

McLeod, S., Harrison, L. J., & McCormack, J. (2012). Ελληνικά Δείκτης καταληπτότητας ομιλίας [Intelligibility in Context Scale: Standard Modern Greek]. (M. Kambanaros, Trans.). Bathurst, NSW, Australia: Charles Sturt University. Retrieved from http://www.csu.edu.au/research/multilingual-speech/ics. Published November 2012.

ES = 0.65 *

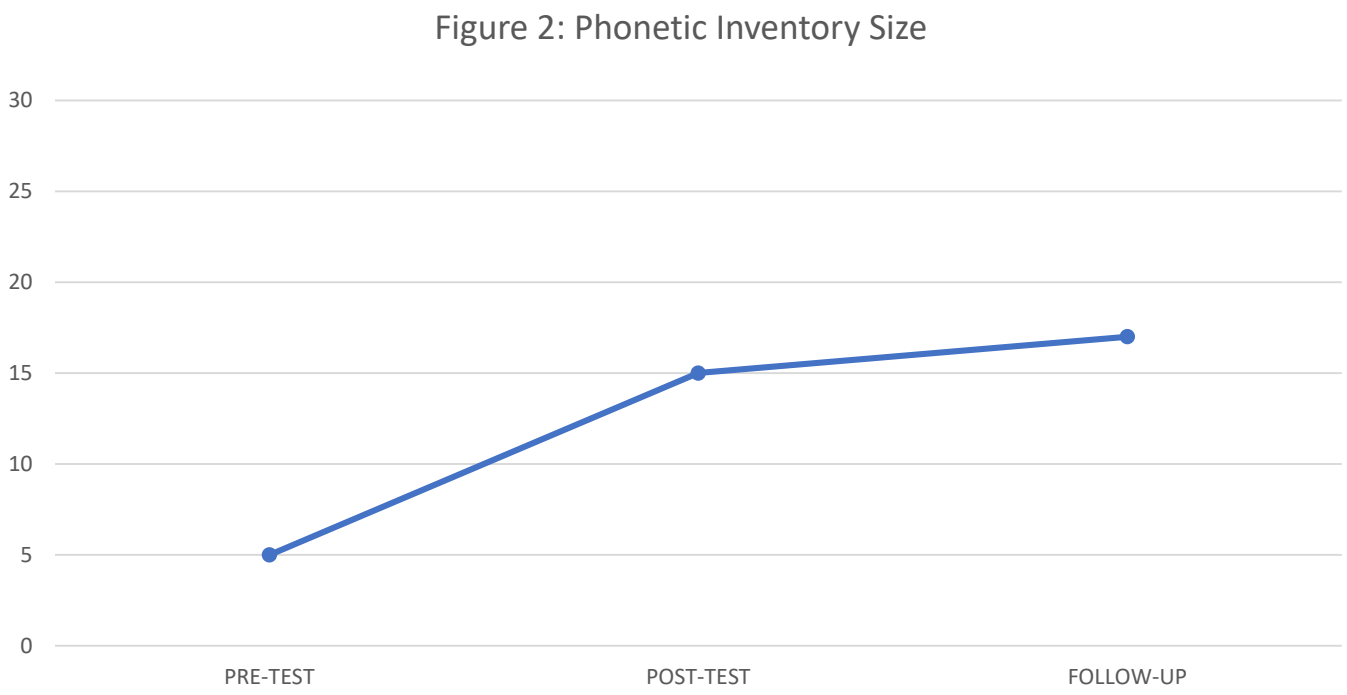


Figure 2: Phonetic Inventory Size
30
25
20
15
10
5
0
PRE-TEST
POST-TEST
FOLLOW-UP

PCC *d = 7.5*

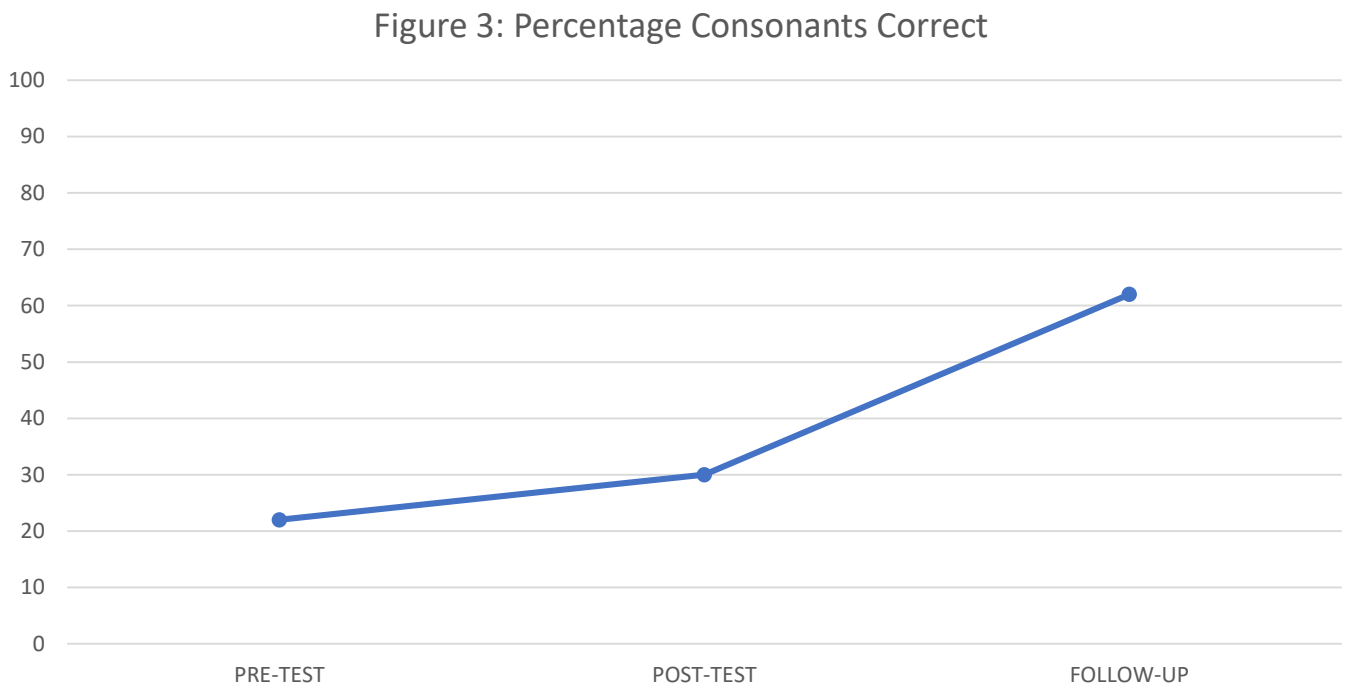


Figure 3: Percentage Consonants Correct
100
90
80
70
60
50
40
30
20
10
0
PRE-TEST
POST-TEST
FOLLOW-UP

WWMs
ES = 8.75

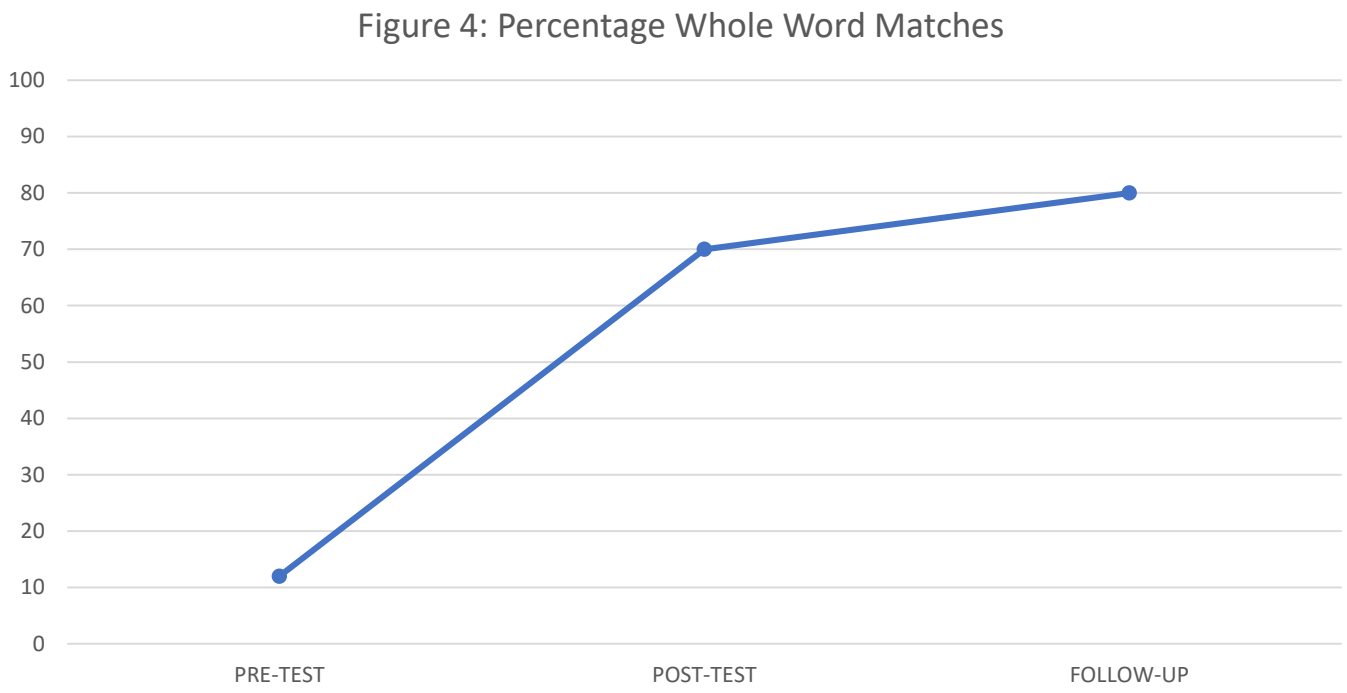
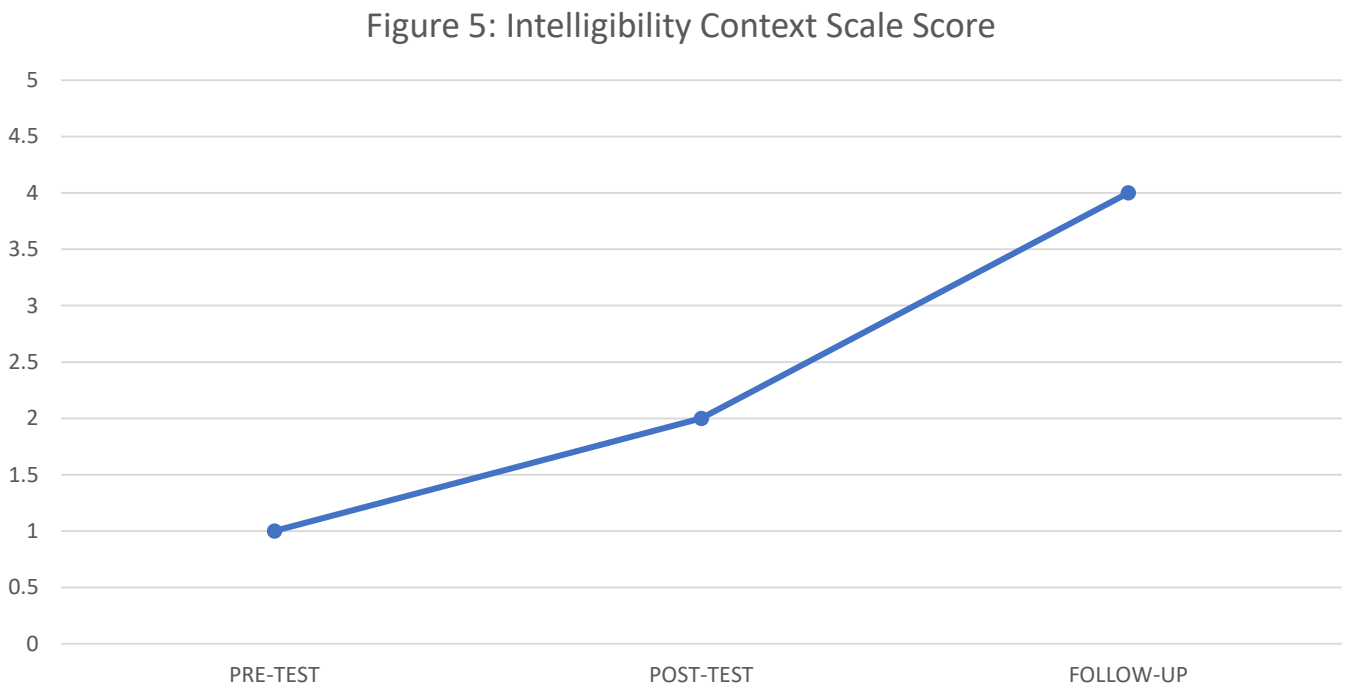


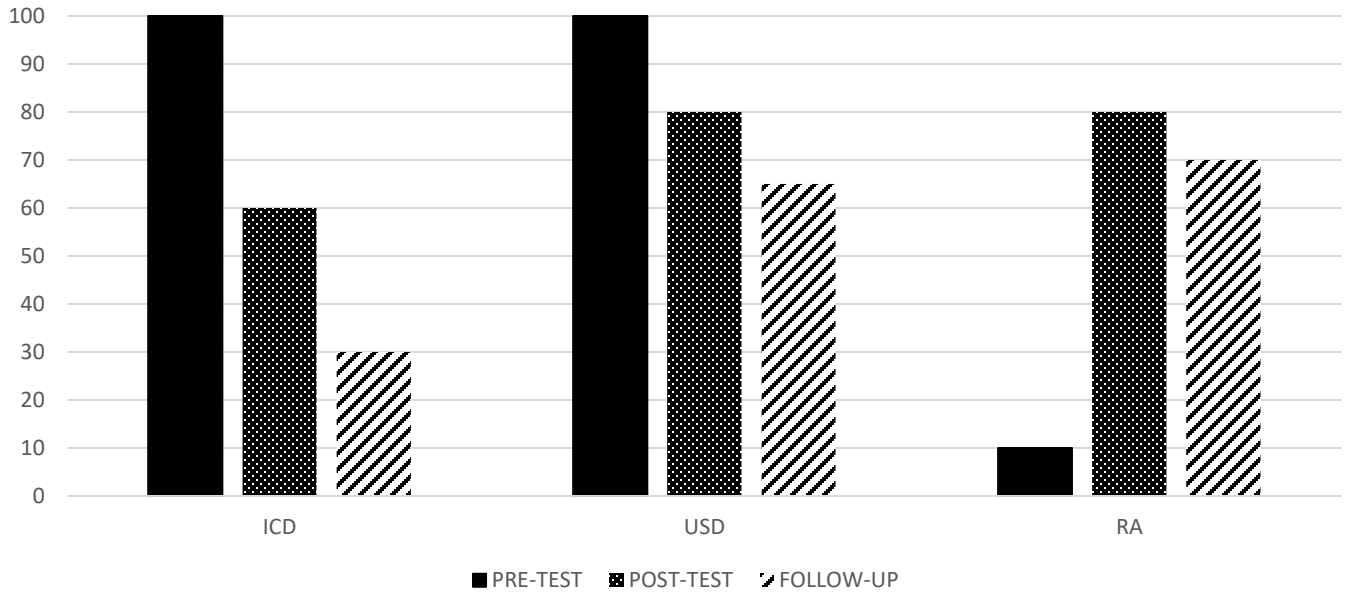
Figure 4: Percentage Whole Word Matches
100
90
80
70
60
50
40
30
20
10
0
PRE-TEST
POST-TEST
FOLLOW-UP

ICS score likert scale



ΑΛΛΑΓΗ ΣΤΗ ΧΡΗΣΗ/ΕΜΦΑΝΙΣΗ ΦΩΝΟΛΟΓΙΚΩΝ ΔΙΕΡΓΑΣΙΩΝ

Figure 6: Percentage Phonological Process Ocurrence Initial Consonant Deletion (ICD), Unstressed Syllable Deletion (USD), Regressive Assimilation (RA)




thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
bedankt
dziękuję
go raibh maith agat
mochchakkeram
sukriya
kop khun krap
terima kasih
спасибо
Баярлалаа
рахмат
tapadh leat
dank je
arigatô
dakujem
takk
grazie
sagolun
mauruuru
hvala
감사합니다
ευχαριστώ
мерси
ありがとう
mersi
kia ora
barka
welalin
tack
spas
mahalo
paldies
grazzi
misaotra
matondo
blagodaram
спасибі
vinaka
faafetai lava
kiitos
dankie
nanni
nandri
dhanyavad
enkosi
bayarlaa
gràçie
köszönöm
dankon
akun
ačiū
хвала
asante
manana
obrigada
murakoze
tenki
djiere dieuf
tau
дякую
mamnun
chokrane
sulpáy
taiku
chnorakaloutioun
gratias ago
gràcies
sobodi
děkuji
mèsi
didi madloba
najis tuke
kam sah hamnida
rahmat
tanemirt
rahmet
diolch
dhanyavadagalu
shukriya
mercé
trugarez
xièxie
তোমাকে ধন্যবাদ

KAKIA NOTES [1]

- In light of the aforementioned, recent advances in the area of phonological intervention provide robust evidence regarding the effectiveness of phonologically-dense and frequently- occurring word for inducing expressive phonological gains in SSD populations (Geirut & Morrisette, 2014; 2012b; Storkel et al, 2010). Research findings, with particular focus on English-speaking youngsters, converge towards the impact of the PDN advantage on intervention outcomes in children with SSD. Such findings translate to clinical contexts, underscore the need to develop intervention methods on par with theory-motivated protocols. Thus, the selection of stimuli from specific phonological and lexical pools can inform treatment protocols, can allow systematic manipulation of selected word targets during the intervention phase, with results translating into evidence-based practice (EBP) (Dollaghan, 2007; Enderby, 2015). Furthermore, the careful selection of phonological targets during intervention exerts a positive impact on increasing and maintaining phonological gains (Dodd, Crosbie, McIntosh, Holm, Harvey, et al., 2008). This is especially important during critical developmental periods where increased intelligibility and acceleration of phonological and lexical learning occurs (Shriberg, et al., 1994).

KAKIA NOTES [2]

- One claim of the psycholinguistic models is that phonological elaboration of lexical representations is motivated by dense neighborhoods comprised of frequent words, such that phonetically similar forms necessitate phonemic distinctiveness. Specifically, (i) the locus of PD may lie in the nature of children's lexical representations; (ii) the sublexical structure of representations may be vulnerable given children's restricted phonemic inventories; (iii) word-level variables prompt sublexical change in expressive phonology; (iv) density and frequency are two specific word-level variables that motivate sublexical change; and (v) dense neighborhoods composed of frequent words provide a ripe context for sublexical change. If true, then experimental manipulations of word-level variables in the treatment of PD are expected to result in differential phonological learning, such that frequent words from dense neighborhoods are predicted as optimal for growth of the expressive phonologyhe plausible hypothesis posits that phonological challenges may stem from limitations in the underlying representation of sub-lexical aspects (e.g., speech sound structures), resulting in poor phonological discrimination and phonological distinction of words (shriberg? REFERENCE). The best-of-the-best conditions for phonological learning were thus sparse neighborhoods or frequent words. While this work demonstrated that word-level variables affect phonological learning by children with PD, it was not without caveat. On the side of frequency, the findings were in sync with typical phonological acquisition (Stoel-Gammon, 2011), but on the side of density, they were not. In PD, sparse neighborhoods were optimal for production, but in typical development, it was the reverse, with dense neighborhoods being of use, most beneficial for expressive phonology. There are at least two possible reasons for the observed asymmetry associated with density. One possibility is that children with PD do not, or cannot, capitalize on dense structure to the same extent, or in the same way, as in typical development (Storkel, 2004b; Storkel & Hoover, 2010b). Another possibility is that the density asymmetry was entwined with the methodology. Recall that density was manipulated independent of frequency in prior treatment studies (Gierut et al., 1999; Morrisette & Gierut, 2002).