

# Identifying the Effectiveness of a Music-based Auditory Stimulation Method on Children with Sensory Integration and Auditory Processing Concerns: A Pilot Study

*Esteves, John; Stein-Blum, Sheri; Cohen, Jonathan; Tischler, Allison*

*John Esteves, OTR/L, TLP CP-BC*

*Sheri Stein-Blum, MS, CCC/SLP*

*Jonathan Cohen, MOT, OTR/L, SIPT, Tomatis Certified*

*Allison Tischler, MA, CCC/SLP*

Email: John Esteves, esteves34@yahoo.com

## INTRODUCTION

The Listening Program® (TLP) is a music-based auditory stimulation method. The program is used as a safe and effective method that gently trains the auditory system to process sounds for improved listening, learning, attention, and communication. The program is also used in providing advanced auditory training to the ear and the brain through systematic delivery of psychoacoustically modified music.

According to therapists qualified in the application of the program, areas of commonly reported change include: attention and concentration, listening and auditory processing, speech and language, memory, social skills, reading, sensory processing, self-regulation, balance and coordination, vocal performance and musical ability, organization and planning skills, self confidence and motivation.

## OBJECTIVE

The pilot study was developed to determine the effectiveness of The Listening Program® (TLP) on children who present with sensory processing disorder (SPD) and auditory processing concerns.

## METHODS

This study investigated the effects and outcomes from utilizing the method, which was directed and monitored by an occupational therapist and implemented by the parents, on 6 children (DF, HK, NF, PB, RC, TT), of which 4 are currently receiving therapy services: Occupational Therapy (OT), Physical Therapy (PT) and Speech/Language Therapy (SLP); 1 who received OT and SLP services in the past and 1 who never received therapy services. Participants differed in ages;

ranging from 3 years - 11 months to 8 years - 7 months, all presenting with Sensory Processing Disorder (SPD) and auditory processing concerns. Diagnoses ranged from ADD/ADHD, (Attention Deficit Disorder / Attention Deficit Hyperactivity Disorder), autism, central processing dysfunction, developmental delay, and brain injury.

All participants were placed on a Base Schedule consisting of two 15 minute listening sessions with at least a 30 minute break between sessions. All but one completed a total of 2 listening cycles totaling 20 weeks or 50 hours of listening. Participants utilized the iListen TLP Level One Premium Bone Conduction system with open-air headphones. The TLP Level One kit utilizes 24-bit, 192k Hz High Definition recordings of select classical music and is broken up into four (4) sub categories; including Full Spectrum (FS) with no filters with frequency ranges of 0 - 20,000 Hertz (Hz); Sensory Integration (SI) with Low-Pass Filters (LPF) 0 - 750 Hz range, Speech and Language (SL) with Band-Pass Filter (BPF) 500/750 - 3000/4,000 Hz range, and High Spectrum (HS) with High-Pass Filter (HPF) 3,000/4,000 - 20,000 Hz range.

Prior to the start of the program parents were asked to complete and sign consent for participation by parent/guardian, a special listening screening tool (downloaded from [www.advancedbrain.com](http://www.advancedbrain.com)), client history, parent logs to keep track of progress, listening check list and observation checklist (provided by Advanced Brain Technologies (ABT)), and a Short Form Sensory Profile.

In addition pre/post TLP testing was completed by an occupational therapist. It included: listening check list, Beery Developmental Test of Visual-Motor Integration (VMI), Peabody Developmental Motor Scales (PDMS) or Bruininks-Osteretsky Test of Motor Proficiency (BOT) (determined by age and functional level), and a writing sample.

Speech/language assessments included: (determined by age and functional level): Receptive One Word Picture Vocabulary (ROWPV), Expressive One Word Picture Vocabulary (EOWPV), Preschool Language Scale 4 (PLS 4) or Oral and Written Language Scale (OWLS), Goldman Fristoe Test of Articulation 2 (GFTA2) and/or Kaufman Apraxia Test (KAT), Pragmatic Skills Check List.

## RESULTS

### (DF)

Observations made during the post-TLP evaluation demonstrated improvements in all sub categories of the Beery VMI and the Bruininks-Osteretsky Test of Motor Proficiency (BOT). The most significant changes that were noted in the Beery VMI from pre-TLP test to post-TLP test were in the areas of motor coordination, with an increase in age equivalence of (3 years), an increase of (6 months) in the area of visual perception section, and 5 months in VMI. On the BOT DF made significant improvements from pre-TLP test to post-TLP test in the areas of: visual-motor control (1 year - 3 months), upper limb speed and dexterity (8 months), response speed (9 years - 6 months), running speed and agility (4 years - 9 months), strength (1 year - 6 months) and bilateral coordination (1 year - 6 months). DF also demonstrated improved attention to task, participation in activities, ability to follow directions, improved sensory regulation/processing, and improved balance as noted when walking or transitioning between different surfaces.

DF demonstrated improved tolerance of loud noises, improved auditory processing skills, ability to complete multi-step instructions, and improved arousal. Scores on the Sensory Profile Short Form demonstrated improvements in the areas of tactile sensitivity, movement sensitivity, under responsive/seeking sensation, auditory filtering, and visual/auditory sensitivity from pre-TLP test to post-TLP test.

Based on results noted from pre-TLP test to post-TLP test in the areas of speech and language skills DF demonstrated gains on all subcategories of the Receptive One Word Picture Vocabulary (ROWPV) and Expressive One Word Picture Vocabulary (EOWPV), Oral and Written Language Scales (OWLS), and Goldman Fristoe Test of Articulation (GFTA). Significant changes were noted from pre-TLP test to post-TLP test scores on the: ROWPV with an increase of (1 year - 2 months), EOWPV with an increase of (2 years - 2 months) ; OWLS: listening comprehension (1 year - 8 months), oral expression (1 year - 1 month), oral composite (1 year - 4.5 months); and GFTA demonstrated an increase of (1 year - 6 months).

Prior to the implementation of The Listening Program®, DF was being seen for services at APS. His scores on the most recent APS testing as compared to the scores recorded on the pre-TLP testing indicated limited changes in progress. The only significant change from Feb. 2007 to pre-TLP testing was in the area of visual- motor control with an age equivalence of (6 months). The gains noted in the post-TLP testing demonstrate that the addition of The Listening Program to other therapy services resulted in significant improvements for DF.

**RESULTS**

**(DF)**

**Bruininks-Osteretsky Test of Motor Proficiency**

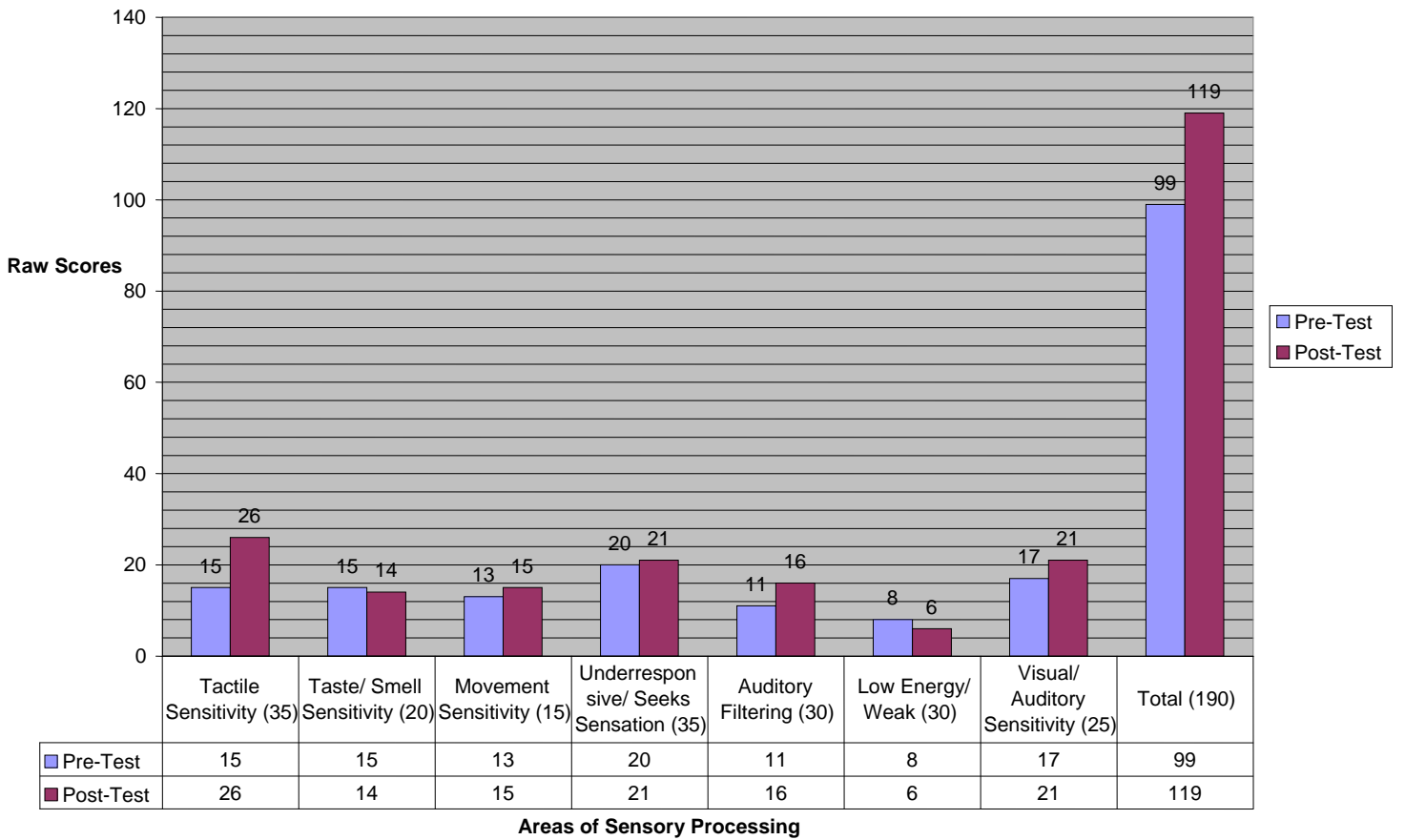
	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b><u>Fine Motor Subtests</u></b>		37	10%			61	86%	
Visual-Motor Control	8/24	14		5y- 2 m	13/24	17		6y-5m (WFL)
Upper-Limb Coordination	4/21	10		4y- 8m	7/21	12		5y-2m
Upper-Limb Speed and Dexterity	11/72	6		<4y- 2m	16/72	9		4y-8m
Response Speed	5/17	17		6y-2m (WFL)	12/17	30		15y-8m(WFL)
<b><u>Gross Motor Subtests</u></b>	43	38	12%			69	76%	
Running Speed and Agility	2/15	6		4y- 2m	9/15	23		8y-11m (WFL)
Balance	4/32	6		<4y- 2m	8/32	6		<4y-2m
Strength	8/42	16		5y- 8m	13/42	21		7y-2m (WFL)
Bilateral Coordination	4/20	15		5y- 5m	7/20	19		6y-11m (WFL)

**The Beery-Buktencia Developmental Test of Visual-Motor Integration (VMI)**

	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b>VMI</b>	15	90	25%	5y-6m (WFL)	16	101	53%	5y-11m(WFL)
<b>VISUAL PERCEPTION</b>	22	121	92%	8y-0m (WFL)	23	134	99%	8y-6m(WFL)
<b>MOTOR COORDINATION</b>	16	93	32%	5y-6m (WFL)	23	129	97%	8y-6m(WFL)

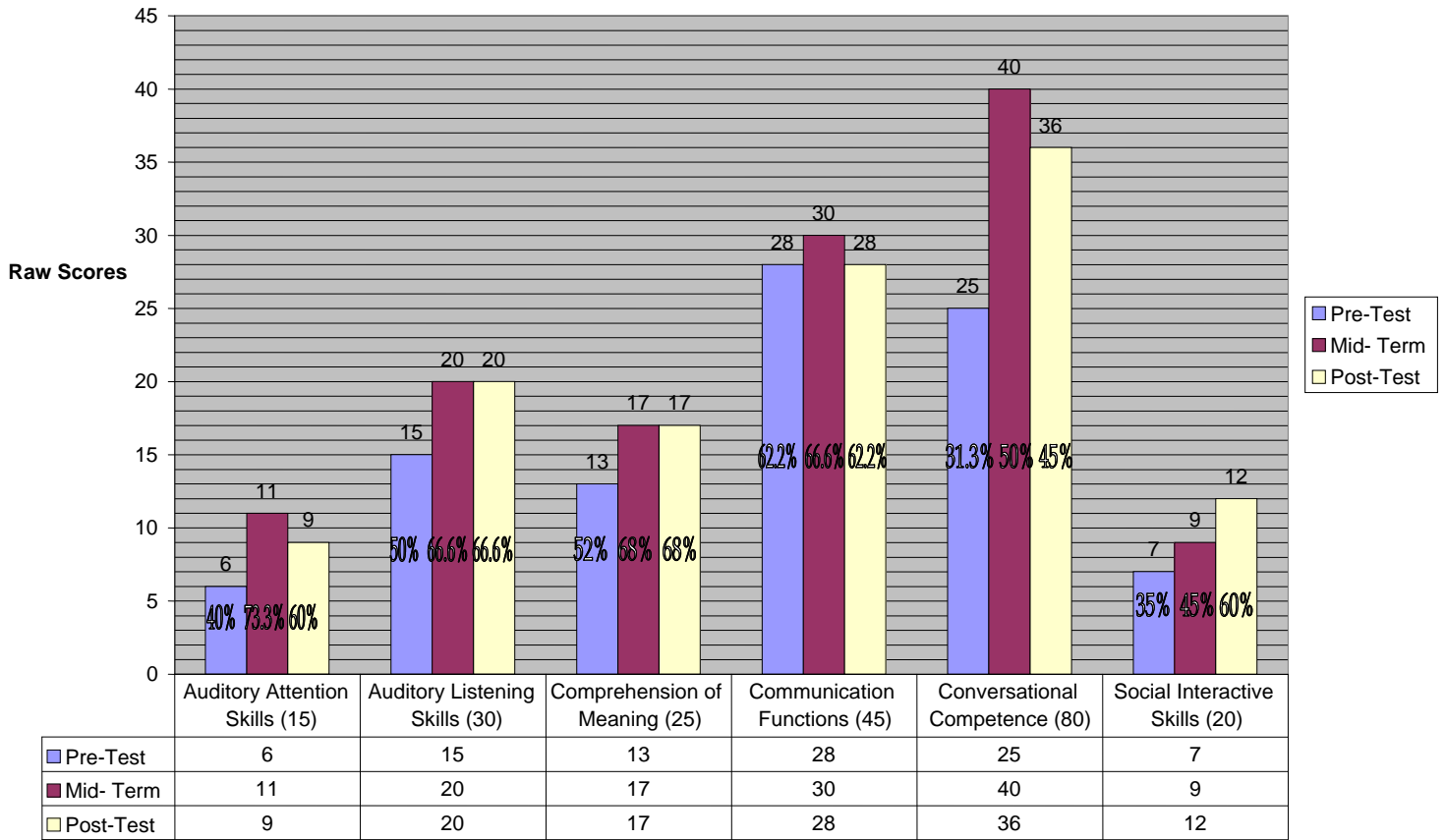
**RESULTS**  
**(DF)**

**(DF) Sensory Profile Short Form**



RESULTS  
(DF)

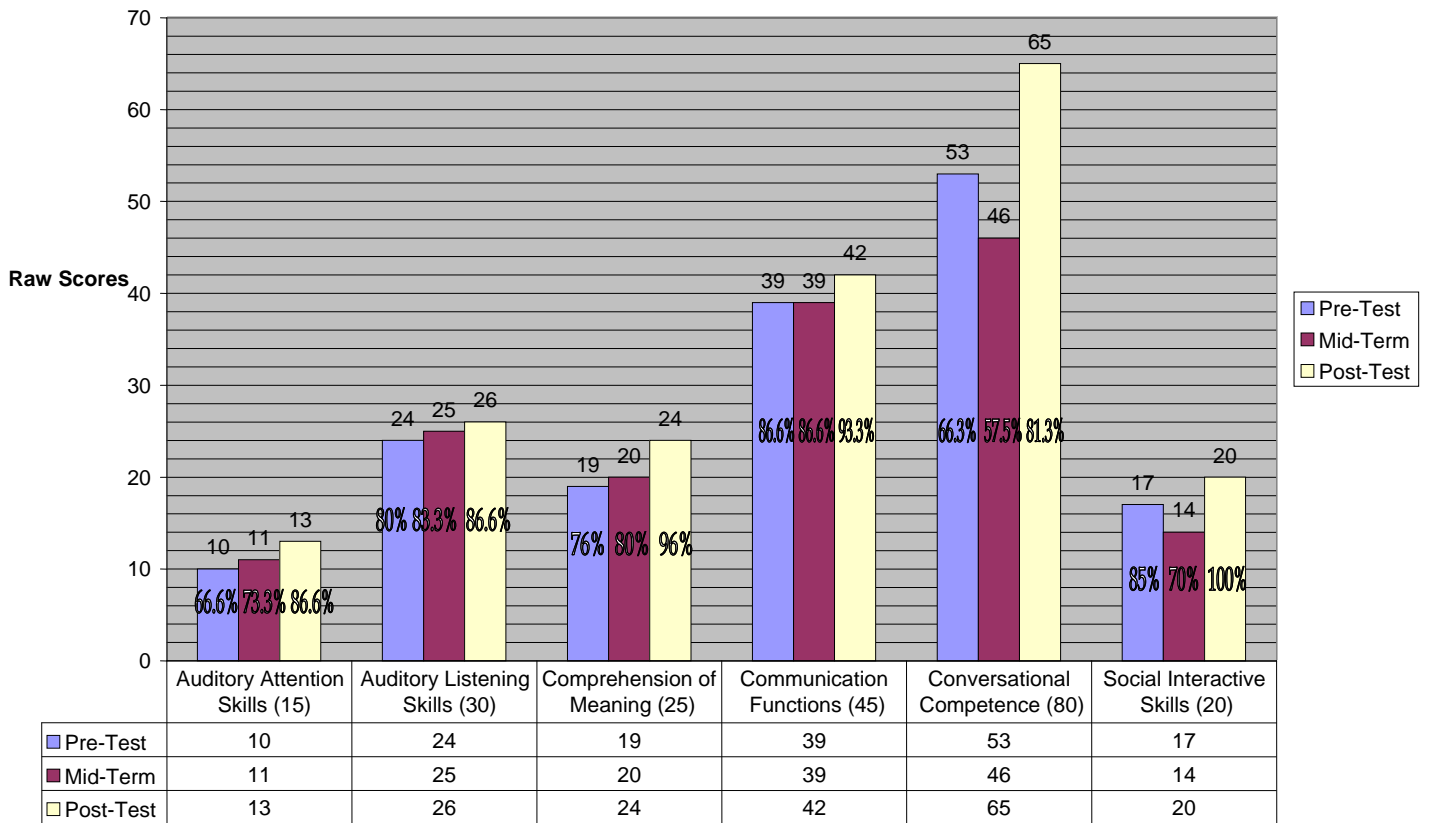
(DF) Pragmatic Language Skills Checklist (Parent)



Skills: (Higher score indicates improvement)

**RESULTS**  
**(DF)**

**(DF) Pragmatic Language Skills Checklist (Therapist)**



**Skills: (Higher score indicates improvement)**

**RESULTS**

**(DF)**

**Receptive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
35	73	4%	3y- 1m	49	82	11%	4y-3m

**Expressive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
42	85	16%	4y- 0m	65	103	54%	6y-2m

**Oral and Written Language Scales (OWLS):**

**Listening Comprehension**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
21	71	3%	3y- 1m	37	88	9%	4y-9m

**Oral Expression**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
19	75	5%	3y- 5m	29	83	10%	4y-6m

**Oral Composite**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
146	71	3%	3y- 3m	171	84	7%	4y-7.5m

**Goldman Fristoe 2 Test of Articulation:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
15	95	27%	4y- 3m	1	118	71%	5y-9m



## RESULTS

### (HK)

Observations made during the post-TLP evaluation demonstrated improvements in the Beery VMI and the Peabody Developmental Motor Scales (PDMS). The most significant changes that were noted in the Beery VMI from pre-TLP test to post-TLP test was in the area of VMI with an increase in age equivalence of (2 years - 10 months). Scores on the visual perception and motor coordination could have been affected because HK did not wear his corrective lenses during post-TLP testing. On the PDMS, HK made significant improvements from pre-TLP test to post-TLP test in the areas of: stationary (1 year -1 month), locomotion (1 year - 2 months), object manipulation (>5months), and visual-motor integration (>3 months). HK also demonstrated improved attention to task, participation in activities, ability to follow directions, improved sensory regulation/processing, improved balance and improved social interaction.

HK demonstrated improved tolerance of loud noises, improved auditory processing skills, ability to complete multi-step instructions, and improved arousal level. Scores on the Sensory Profile Short Form demonstrated improvements in the area of movement sensitivity and mild changes in tactile sensitivity, under responsive/seeking sensation, and auditory filtering from pre-TLP test to post-TLP test.

Based on results noted from pre-TLP test to post-TLP testing, in the areas of speech and language skills HK demonstrated gains on all subcategories

of the Receptive One Word Picture Vocabulary (ROWPV) and Expressive One Word Picture Vocabulary (EOWPV), Oral and Written Language Scales (OWLS), and Goldman Fristoe Test of Articulation (GFTA). Significant changes were noted from pre-TLP test to post-TLP test scores on the: ROWPV with an increase of (1 year - 4 months), EOWPV with an increase of (2 years - 5 months); OWLS: listening comprehension (1 year - 6 months), oral expression (1 year - 5 months), oral composite (1 year - 6.5 months); and GFTA demonstrated an increase of (8 months).

Other observations that were noted by HK's mother included: increased eye contact, increased self confidence, increased relationship with peers/adults, increased affection and sense of humor. HK also demonstrated increased vocabulary, spelling skills, vocal and speaking quality, increased attention, impulse control, and task performance.

**RESULTS**

**(HK)**

**The Beery-Buktencia Developmental Test of Visual-Motor Integration (VMI)**

	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
VMI	15	114	82%	5y-6m	21	134	99%	8y-4m
VISUAL PERCEPTION	23	148	99.9%	8y-6m	22	132	98%	8y-0m
MOTOR COORDINATIO N	16	107	68%	5y- 6m	16	100	50%	5y-6m

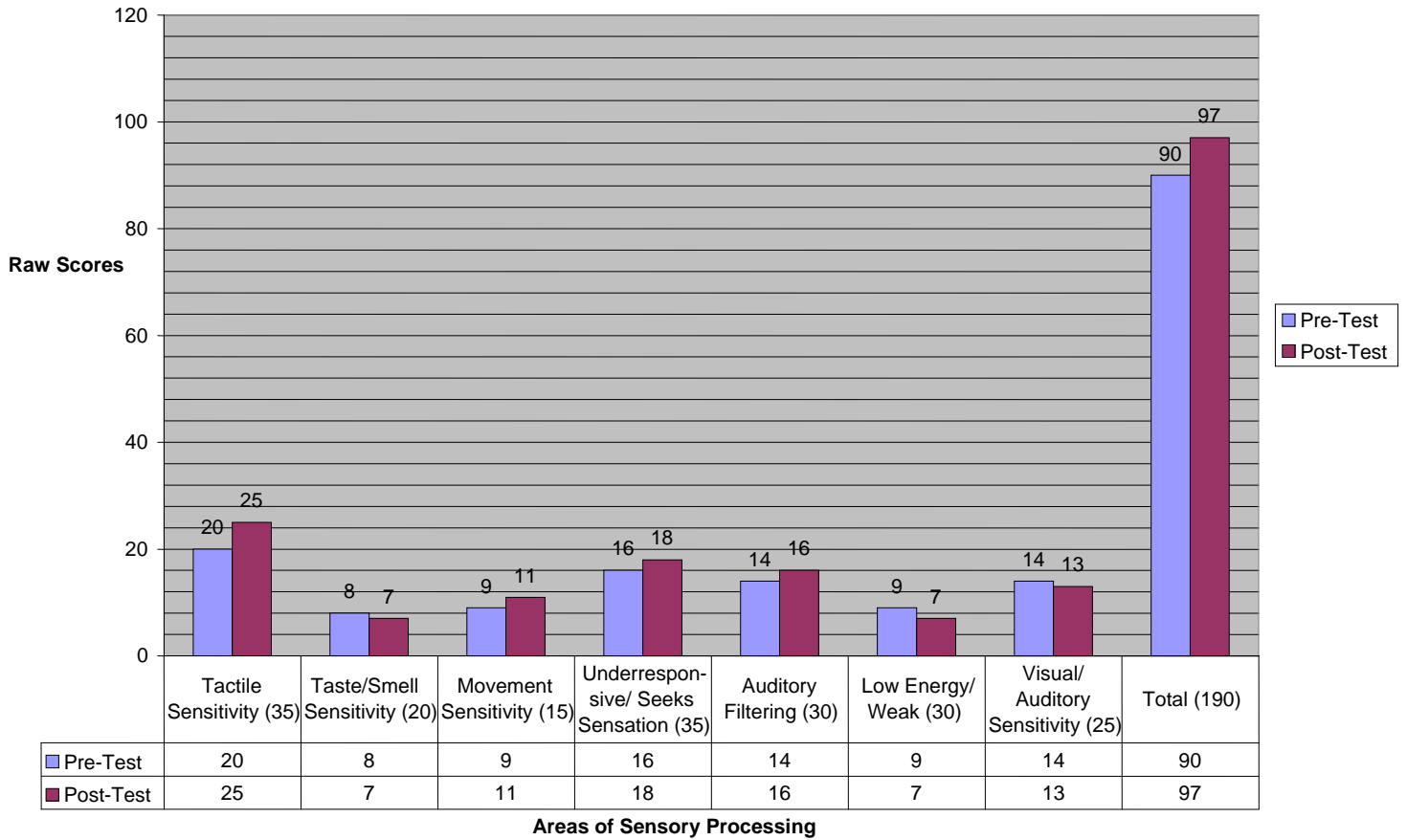
\*Scores on the Beery VMI may be skewed during post-testing due to child not wearing corrective lenses.

**The Peabody Developmental Motor Scale**

	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b><u>Gross Motor Scales</u></b>		30	50%			34	73%	
Stationary	54	10	50%	58 months	59	12	75%	>71 months
Locomotion	162	9	37%	51 months	173	10	50%	65 months
Object Manipulation	45	11	63%	66 months	47	12	75%	>71 months
<b><u>Fine Motor Scales</u></b>		24	79%			27	92%	
Grasping	52	12	75%	71 months	52	11	63%	71 months
Visual-Motor Integration	139	12	75%	68 months	144	16	98%	>71 months

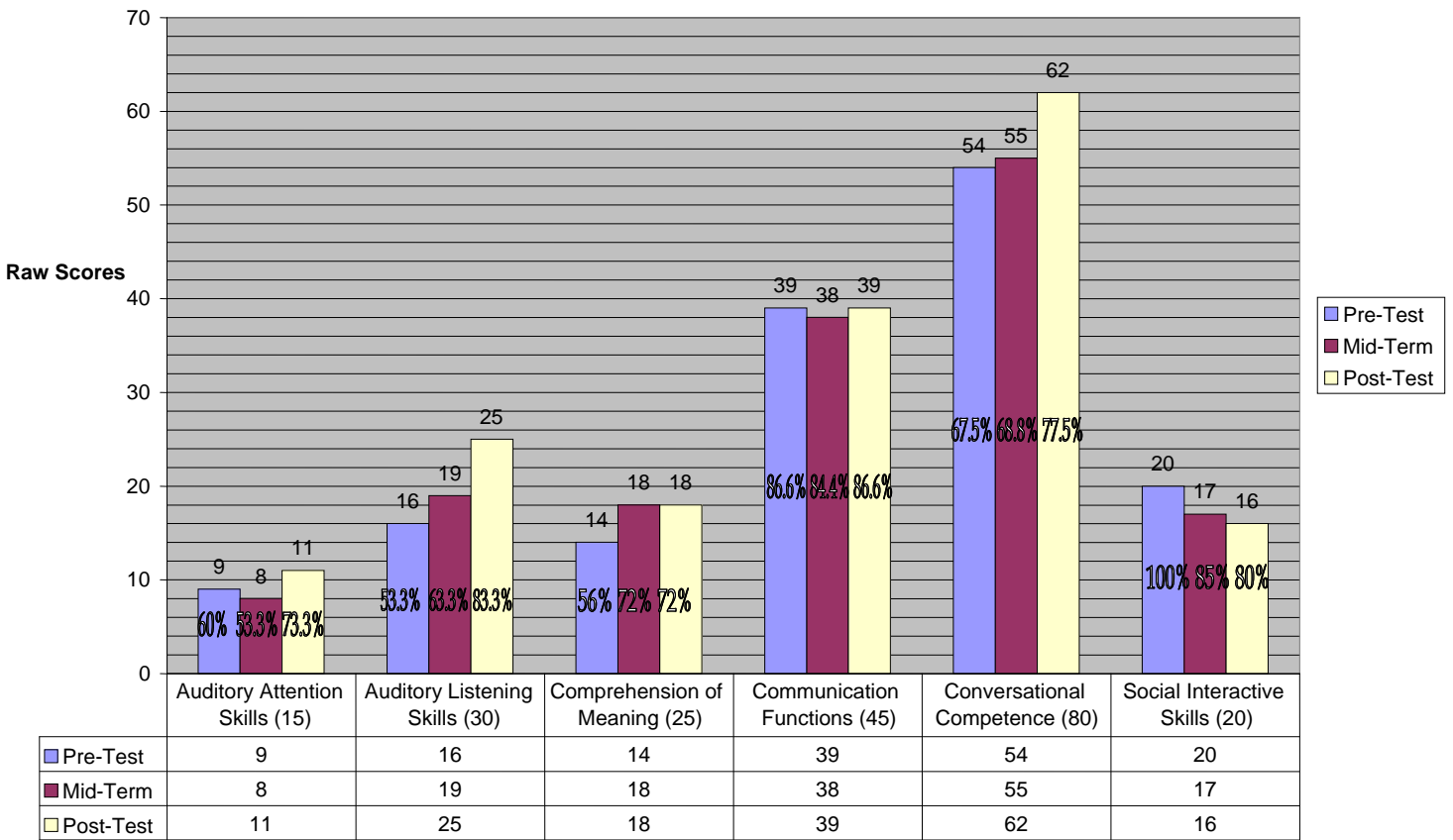
RESULTS  
(HK)

(HK) Short Sensory Profile



RESULTS  
(HK)

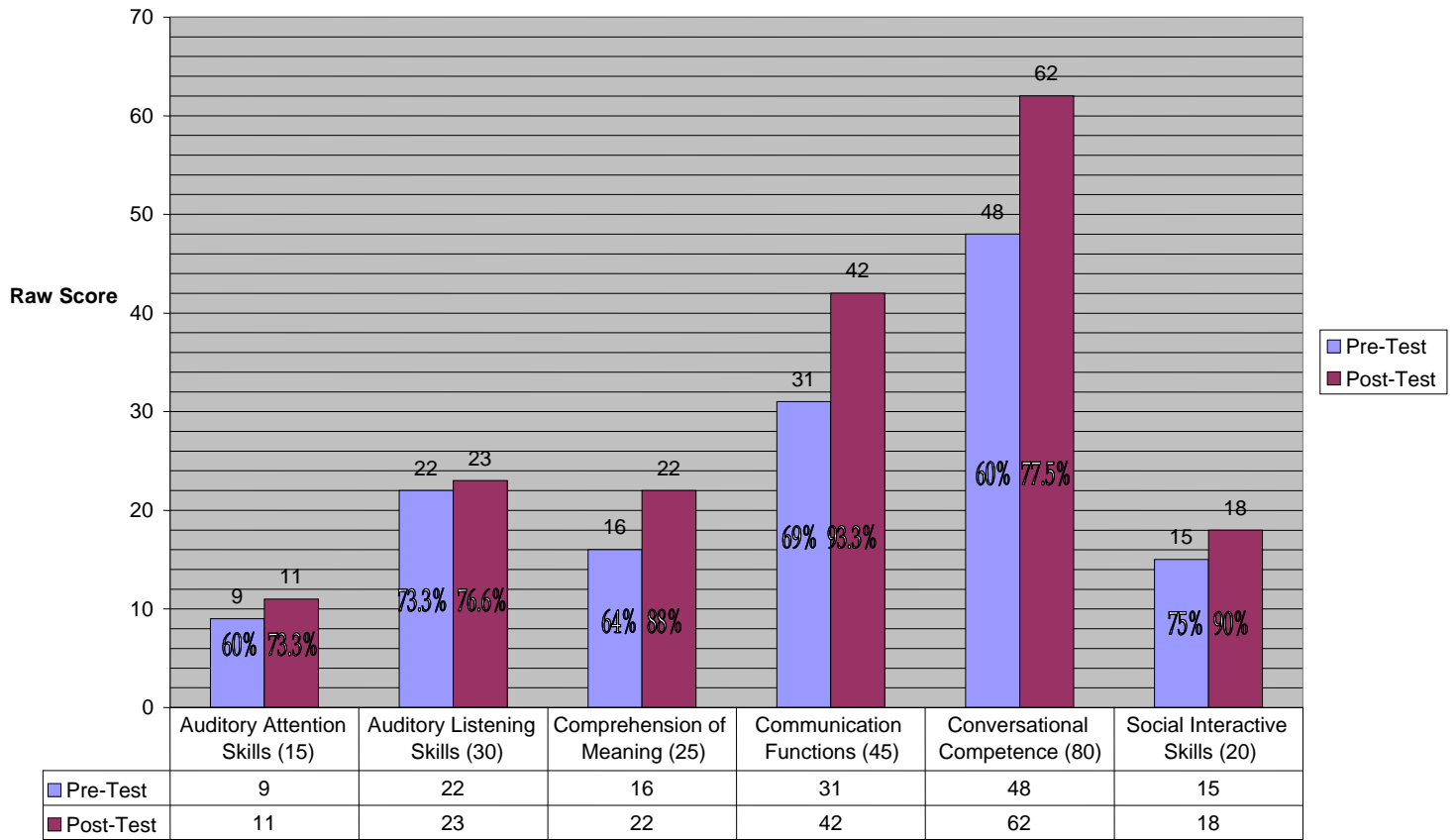
(HK) Pragmatic Language Skills Checklist (Parent)



Skills: (Higher scores indicates improvement)

**RESULTS**  
**(HK)**

**(HK) Pragmatic Language Skills Checklist (Therapist)**



**Skills: (Higher scores indicates improvements)**

**RESULTS**

**(HK)**

**Receptive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
52	97	42%	4 years- 6 months	66	105	63%	5y-10m

**Expressive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
47	97	42%	4 years- 5 months	71	115	84%	6y-10m

**Oral and Written Language Scales (OWLS):**

**Listening Comprehension**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
18	73	4%	2 years- 9 months	33	88	7%	4y-3m

**Oral Expression**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
17	78	7%	3 years- 3 months	30	90	9%	4y-8m

**Oral Composite**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
151	74	4%	3 years	178	88	7%	4y-6.5m

**Goldman Fristoe 2 Test of Articulation:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
10	106	62%	5 years	5	108	76%	5y-8m

## RESULTS

### (NF)

Observations made during the post-TLP evaluation demonstrated age appropriate skills in all sub-categories of the Beery VMI, and improvements in all the sub categories of the Bruininks-Osteretsky Test of Motor Proficiency (BOT). The most significant change that was noted in the Beery VMI from pre-TLP test to post-TLP test was in the area of motor coordination, with an increase in age equivalence of (1 year - 8 months). On the BOT, NF made significant improvements from pre-TLP test to post-TLP test in the areas of: visual-motor control (1 year - 9 months), upper-limb coordination (1 year - 6 months), upper limb speed and dexterity (1 year), response speed (1 year), running speed and agility (7 years - 6 months), strength (1 year - 9 months) and bilateral coordination (2 year - 6 months). NF also demonstrated improved attention to task, participation in activities, ability to follow directions, improved sensory regulation/processing, and improved impulse control.

NF demonstrated improved tolerance of loud noises, improved auditory processing skills, ability to complete multi-step instructions, and improved arousal. Scores on the Sensory Profile Short Form demonstrated improvements in the areas of movement sensitivity, under responsive/seeks sensation, auditory filtering, and visual/auditory sensitivity from pre-TLP test to post-TLP test based upon parents' perception. Significant changes were noted in auditory filtering and under responsive/seeks sensation: moving her from a definite difference to typical.

Based on results noted from pre-TLP test to post-TLP test in the areas of speech and language skills, NF demonstrated gains in all subcategories of the Receptive One Word Picture Vocabulary (ROWPV) and Expressive One Word Picture Vocabulary (EOWPV), Oral and Written Language Scales (OWLS), and Goldman Fristoe Test of Articulation (GFTA). Significant changes were noted from pre-TLP test to post-TLP test scores on the: ROWPV with an increase of (2 years), EOWPV with an increase of (2 years - 9 months) ; OWLS: listening comprehension (3 year - 8 months), oral expression (1 year - 10 months), oral composite (2 year - 3.5 months). On the GFTA no change was demonstrated due to scoring out of the test in both pre-TLP and post-TLP testing placing her within normal limits.

Other parent observations that were noted were: increased motivation, increased self confidence, increased relationship with peers/adults, increased talking/communication, increased reading skills, and increased spelling skills. Parents also noted less restlessness, decreased sound sensitivity, increased attention, and increased task completion.

**RESULTS**

(NF)

**Bruininks-Osteretsky Test of Motor Proficiency**

	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b>Fine Motor Subtests</b>		35	18%			41	38%	
Visual-Motor Control	18 / 24	13		8y-5m	20/24	15		10y-2m (WFL)
Upper-Limb Coordination	15 / 21	11		7y- 8m	17/21	14		9y-2m (WFL)
Response Speed	8/17	15		8y-11m	9/17	16		9y-11m (WFL)
Upper-Limb Speed and Dexterity	29 / 72	7		6y- 11m	34/72	10		7y-11m
<b>Gross Motor Subtests</b>		48	21%			62	58%	
Running Speed and Agility	7/15	9		6y-8m	11/15	21		14y-2m (WFL)
Balance	27 / 32	19		11y-5m (WFL)	24/32	14		8y-2m
Strength	9 / 42	7		5y -11m	14/42	10		7y-8m
Bilateral Coordination	9 / 20	13		7y -11m	12/20	17		10y-5m (WFL)

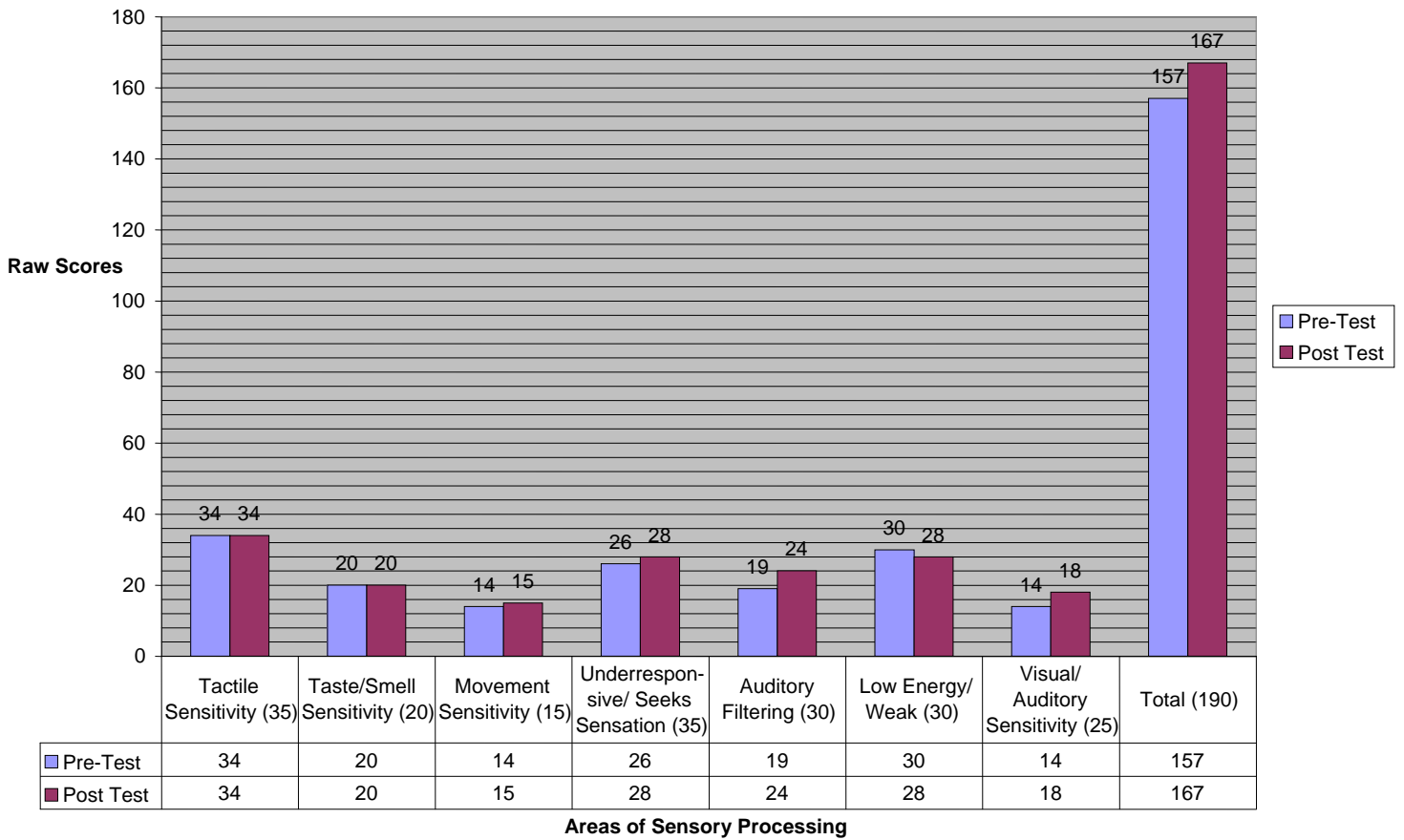
**The Beery-Buktencia Developmental Test of Visual-Motor Integration (VMI)**

	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b>VMI</b>	26	122	93%	12y-6m (WFL)	26	119	90%	12y-6m (WFL)
<b>VISUAL PERCEPTION</b>	29	143	94.5%	16y-0m (WFL)	28	127	96%	14y-3m (WFL)
<b>MOTOR COORDINATION</b>	26	113	81%	11y-3m (WFL)	27	114	82%	12y-11m(WFL)



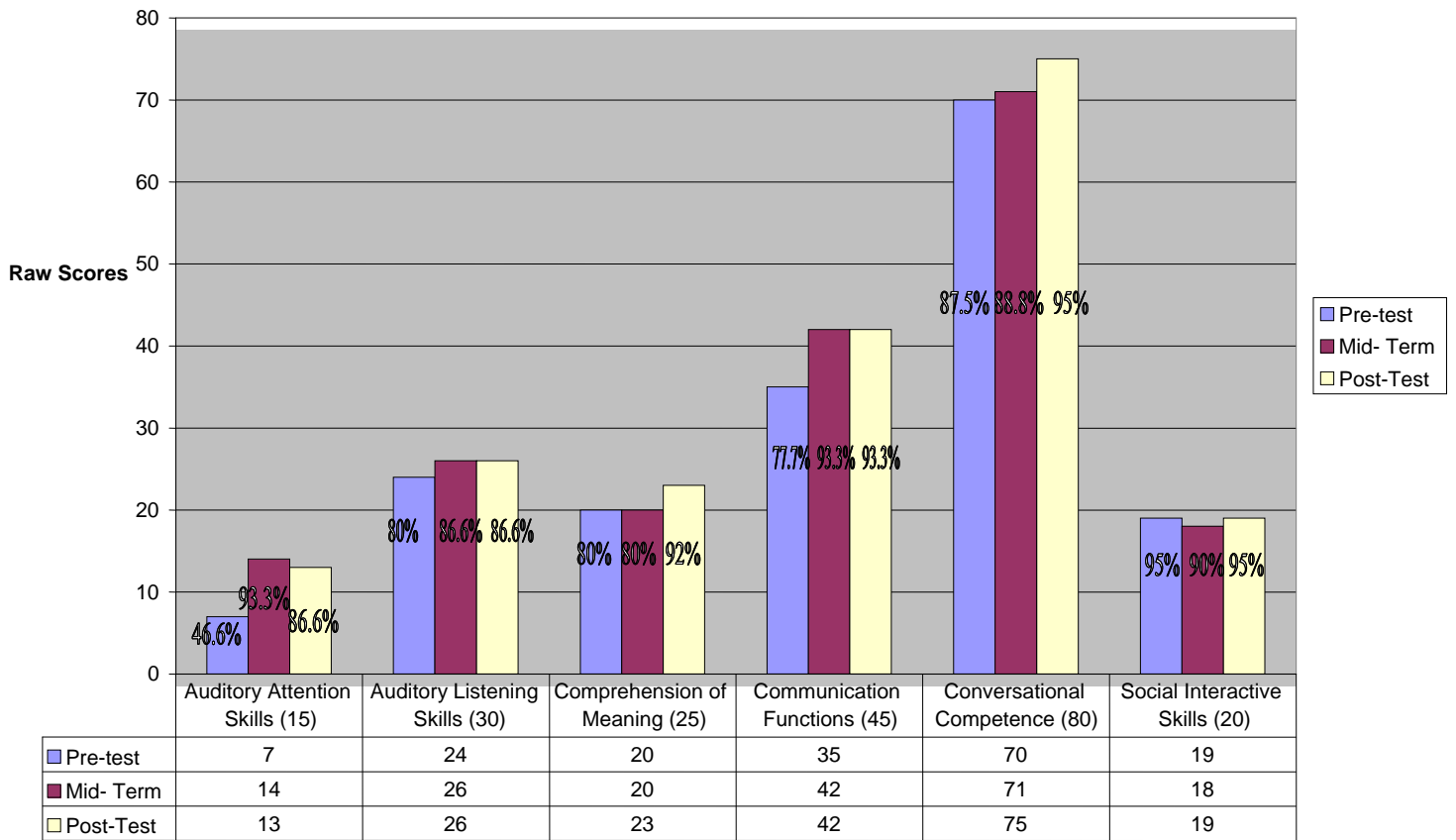
**RESULTS**  
**(NF)**

**(NF) Short Form Sensory Profile**



**RESULTS**  
**(NF)**

**(NF) Pragmatic Language Checklist (Parent)**

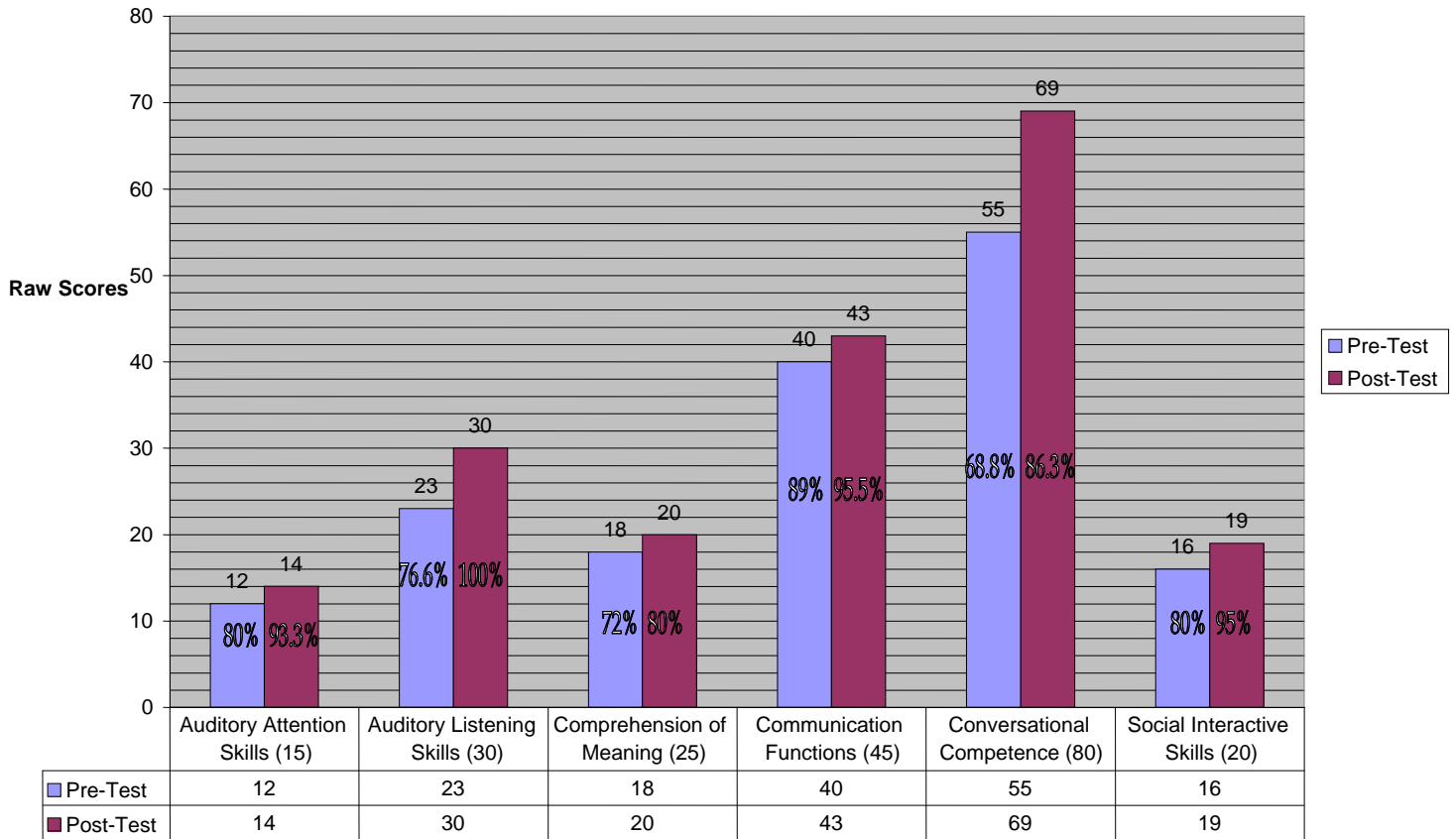


**Skills: (Higher score indicates improvement)**

RESULTS

(NF)

(NF) Pragmatic Language Skills Checklist (Therapist)



Skills: (Higher score indicates improvement)

**RESULTS**

(NF)

**Receptive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
116	125	95%	12y- 0m	127	134	99%	14y-0m

**Expressive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
104	118	88%	11y-0m	120	134	99%	13y-9m

**Oral and Written Language Scales (OWLS):**

**Listening Comprehension**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
60	94	34%	7y-10m	77	113	39%	11y-6m

**Oral Expression**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
41	74	4%	5y-11m	56	89	6%	7y-9m

**Oral Composite**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
168	82	12%	6y-10 m	202	101	18%	9y-1.5m

**Goldman Fristoe 2 Test of Articulation:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
0	103	>46	>7y-8m	0	103	>46%	>7y-8m

## RESULTS

### (PB)

Observations made during the post-TLP evaluation demonstrated improvements in 2 of the sub categories of the Beery VMI and 6 of 8 sub categories of the Bruininks-Osteretsky Test of Motor Proficiency (BOT). The most significant changes that were noted in the Beery VMI from pre-TLP test to post-TLP test were in the area of visual perception, with an increase in age equivalence of 1 year - 1 month, and an increase of 8 months in the area of VMI. On the BOT PB made improvements from pre-TLP test to post-TLP test in the areas of: visual-motor control (1 year), upper limb speed and dexterity (4 months), response speed (5 years 9 months), balance (2 months) and bilateral coordination (10 months). PB also demonstrated improved attention to task, ability to follow directions, and improved balance as noted when walking or transitioning between different surfaces. He had an increase in emotional lability that was difficult to control; with frequent emotional outbursts, including crying alternating to laughing.

PB demonstrated improved tolerance of loud noises, improved auditory processing skills, and ability to follow multi-step instructions on occasion. Scores on the Sensory Profile Short Form demonstrated that improvements were noted in all the sub-category areas of sensory processing including: tactile sensitivity, taste/smell sensitivity, movement sensitivity, under-responsive/ seek sensation, low energy/weak, and significant improvements in the areas of auditory filtering and visual/auditory sensitivity; moving him from definite differences to typical.

Based on results noted from pre-TLP test to post-TLP test in the areas of speech and language skills, PB demonstrated gains on all subcategories of the Receptive One Word Picture Vocabulary (ROWPV) and Expressive One Word Picture Vocabulary (EOWPV), Oral and Written Language Scales (OWLS), and Kaufman Speech Praxis Test (KSPT). Changes were noted from pre-TLP test to post-TLP test scores on the: ROWPV with an increase of (3 months), EOWPV with an increase of (6 months) ; and KSPT demonstrated an increase in oral movements (8 months), simple (11 months), complex able to complete at post-TLP test after his inability to complete during pre-TLP testing.

Parents' observations included increased eye contact, increased independence, an improvement in relationship with peers/adults, increased affection, increased vocal quality and speaking quality. Other observations included changes in sleep patterns, decreased sensitivity to sounds, and increased attention.

Prior to the implementation of The Listening Program® PB was being seen for services at APS. His scores on the most recent APS testing as compared to the scores recorded on the pre-TLP testing indicated limited changes in progress. The only significant change from Nov. 2006 to pre-TLP test was in the area of upper limb coordination, with an age equivalence of (6 months). No other changes were noted. The changes measured in the post-TLP test demonstrate that with the continuation of therapy services and the addition of The Listening Program, PB made significant improvements in areas tested compared to just receiving therapy services.

**RESULTS**

**(PB)**

**Bruininks-Osteretsky Test of Motor Proficiency**

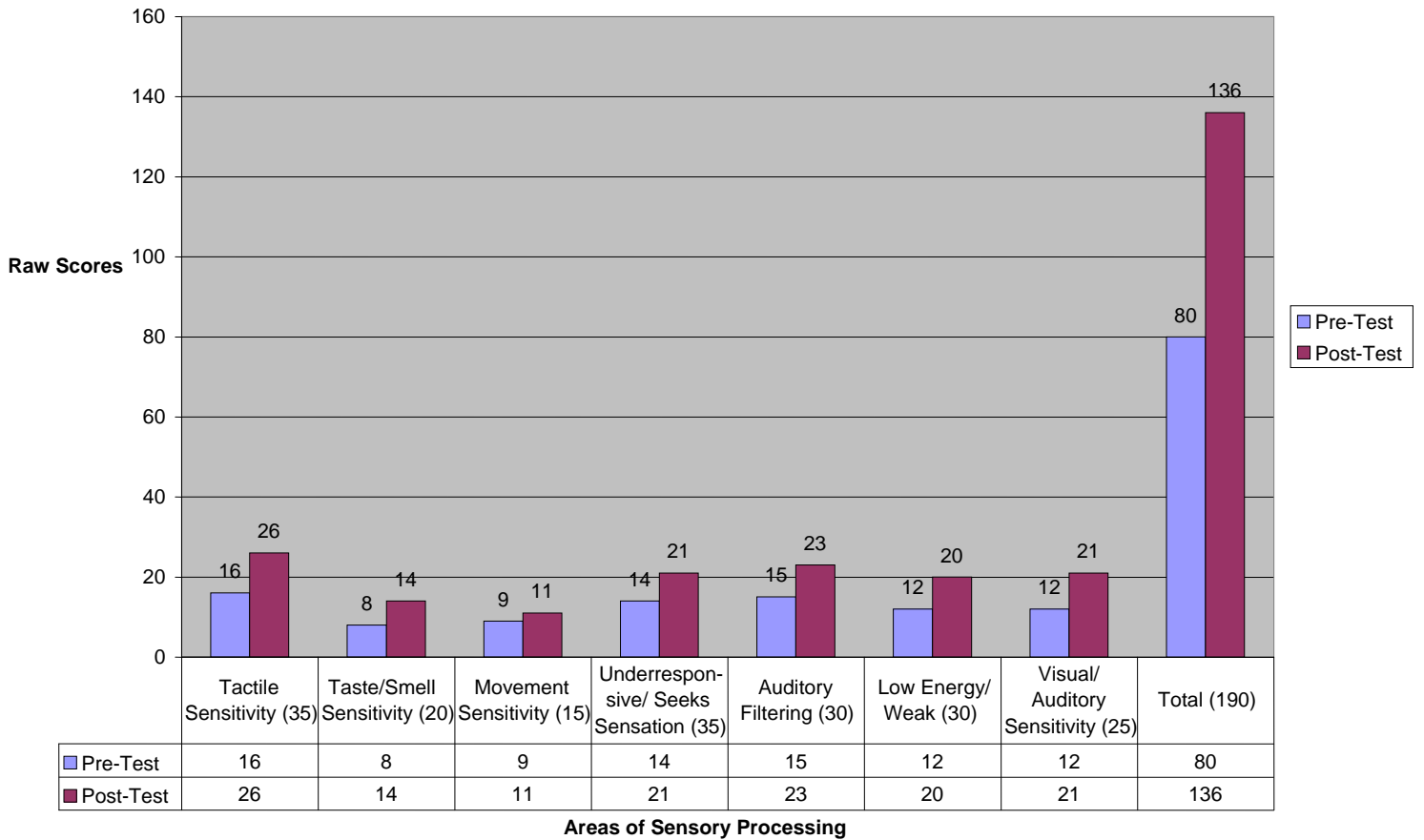
	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b><u>Fine Motor Subtests</u></b>		5	-1%		22	22	1%	
Visual-Motor Control	4/24	1		4y-2m	8/24	1		5y-2m
Response Speed	0/17	3		<4y-2m	9/17	18		9y-11m (WFL)
Upper-Limb Coordination	4/21	1		4-8m	7/21	1		5y-2m
Upper-Limb Speed and Dexterity	15/72	1		4y-8m	22/72	3		5y-8m
<b><u>Gross Motor Subtests</u></b>		11	-1%		27	27	1%	
Running Speed and Agility	11/15	25		14y-2m (WFL)	9/15	17		8y-11m (WFL)
Balance	6/32	1		<4y-2m	12/32	1		4y-2m
Strength	6/42	6		5y-2m	6/42	5		5y-2m
Bilateral Coordination	0/20	1		<4y-2m	3/20	4		4y-11m

**The Beery-Buktencia Developmental Test of Visual-Motor Integration (VMI)**

	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b>VMI</b>	13	69	2%	4y-10m	15	75	.5%	5y-6m
<b>VISUAL PERCEPTION</b>	9	45	.02%	2y-11m	13	59	.7%	4y-0m
<b>MOTOR COORDINATION</b>	12	60	.8%	3y-9m	11	51	.08%	3y-6m

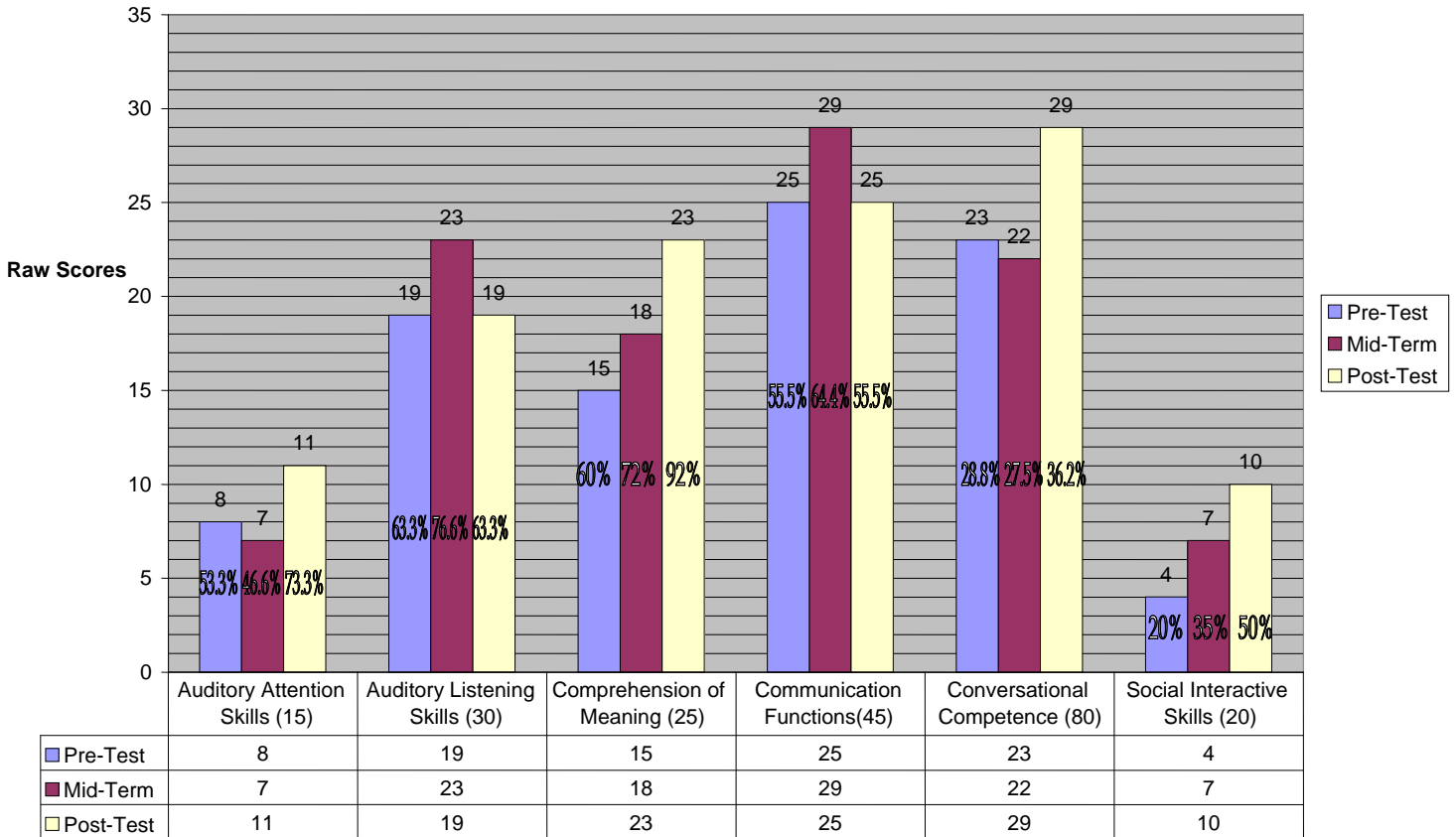
RESULTS  
(PB)

(PB) Short Sensory Profile



RESULTS  
(PB)

(PB) Pragmatic Language Skills Checklist (Parent)

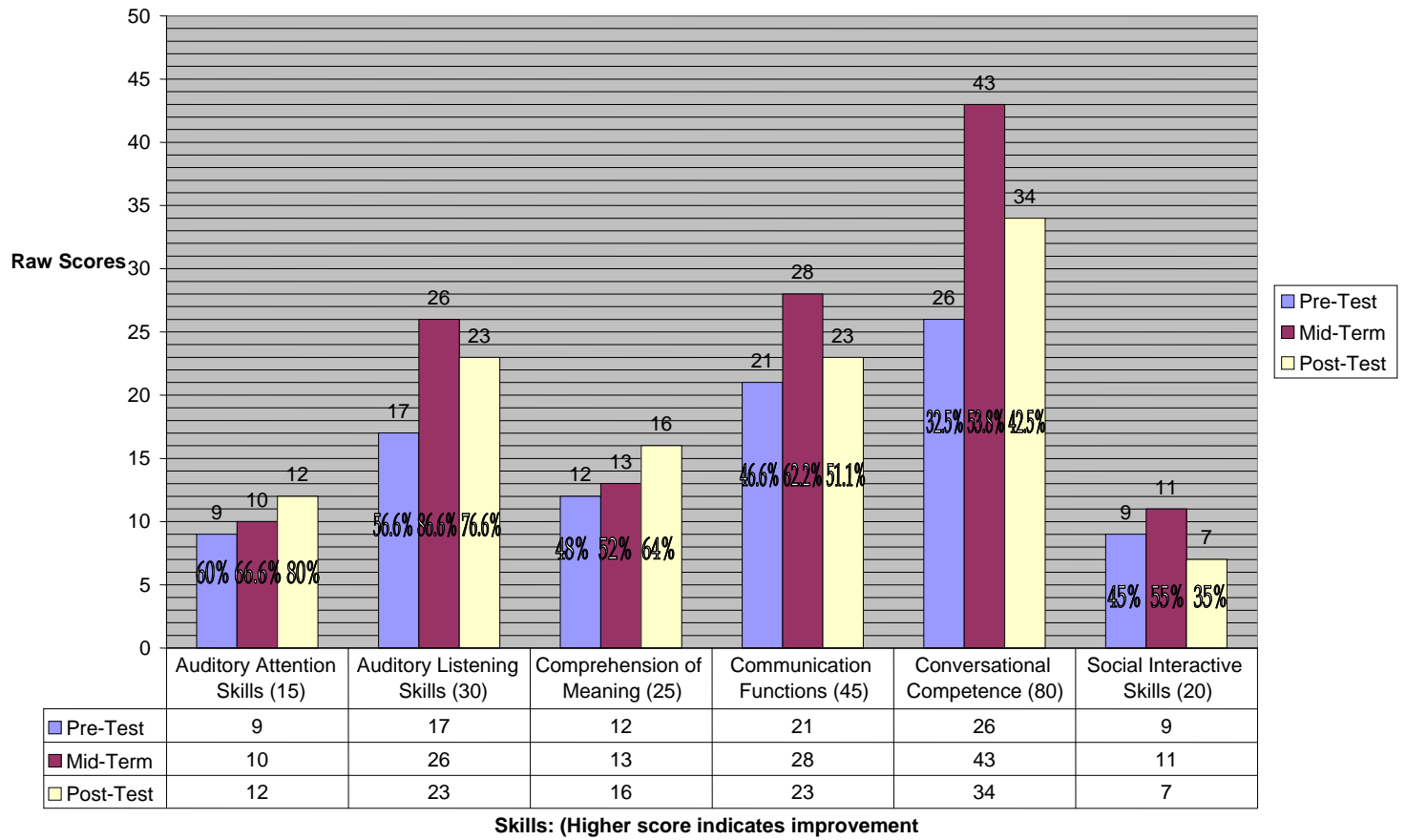


Skills: (Higher score indicates improvement)



**RESULTS**  
**(PB)**

**(PB) Pragmatic Language Skills Checklist (Therapist)**



**Skills: (Higher score indicates improvement)**

**RESULTS**

**(PB)**

**Receptive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
48	70	<1%	4y- 2m	51	68	2%	4y-5m

**Expressive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
37	62	2%	3y -6m	44	64	1%	4y-2m

**Kaufman Speech Praxis Test:**

**Part 1 (Oral Movement)**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
8	81	13%	4y-5m	10	101	34%	5y-1m

**Part 2 (Simple)**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
56	67	10%	3y-9m	60	87	42%	4y-8m

**Oral and Written Language Scales (OWLS):**

**Listening Comprehension**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
18	47	n/a	2y-9m	18	40	n/a	2y-9m

**Oral Expression**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
10	46	n/a	2-6m	10	40	n/a	2y-6m

**Oral Composite**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
93	44	n/a	2y-7m	80	40	<1	2y-7.5m

## RESULTS

### (RC)

Observations made during the post-TLP evaluation demonstrated improvements in the Beery VMI and the Bruininks-Osteretsky Test of Motor Proficiency (BOT). The most significant changes that were noted in the Beery VMI from pre-TLP test to post-TLP test were in the area of visual perception with an increase in age equivalence of (>6 months) and an increase of (3 months) in the area of motor coordination. On the BOT, RC made significant improvements from pre-TLP test to post-TLP test in the areas of: visual-motor control (6 months), upper-limb coordination (9 months), upper limb speed and dexterity (> 2 years), response speed (11 years) (\*significant changes due to decreased participation in pre-testing), running speed and agility (11 years) (\*significant changes due to decreased participation in pre-testing), balance (>2 months), strength (1 year- 3 months) and bilateral coordination (1 year- 6 months). RC also demonstrated improved attention to task, participation in activities, ability to follow directions, and improved sensory regulation/processing. Difficulties with behaviors and emotional regulations have been noted for some time now with RC and continue to be problematic in treatment sessions.

Based on results noted from pre-TLP test to post-TLP test in the areas of speech and language skills RC demonstrated few gains on all subcategories of the Receptive One Word Picture Vocabulary (ROWPV) and Expressive One Word Picture Vocabulary (EOWPV), Oral and Written Language Scales (OWLS), and Goldman Fristoe Test of

Articulation (GFTA). Changes noted from pre-TLP test to post-TLP test scores on the: ROWPV with an increase of (2 months), EOWPV with an increase of (4 months); OWLS: no noted changes; and GFTA no noted changes.

Prior to the implementation of The Listening Program® RC was being seen for services at APS. His scores on the most recent APS testing as compared to the scores recorded on the pre-TLP testing indicated limited changes in progress. The only significant change from Jan 07 to pre-TLP test was in the area of VMI with an age equivalence of (6 months). No other changes were noted. RC's scores may be skewed because of continued difficulties with behavior that were encountered during therapy sessions and at home. RC was also unable to complete the TLP program as it was written due to his difficulties with tolerance of the high frequencies. That should have been resolved if the family had followed the protocol. The family was encouraged to finish one complete cycle of The Listening Program to help address continued concerns related to sound sensitivity, auditory processing skills, attention and emotional regulation. Other recommendations included behavioral services to help address the noted concerns of avoidance, emotional liability, refusal to participate and compliance, and to help provide consistency in his care. Those recommendations were not followed. RC was the only child that did not show significant improvement. He was the only child who did not complete The Listening Program.

**RESULTS**

**(RC)**

**Bruininks-Osteretsky Test of Motor Proficiency**

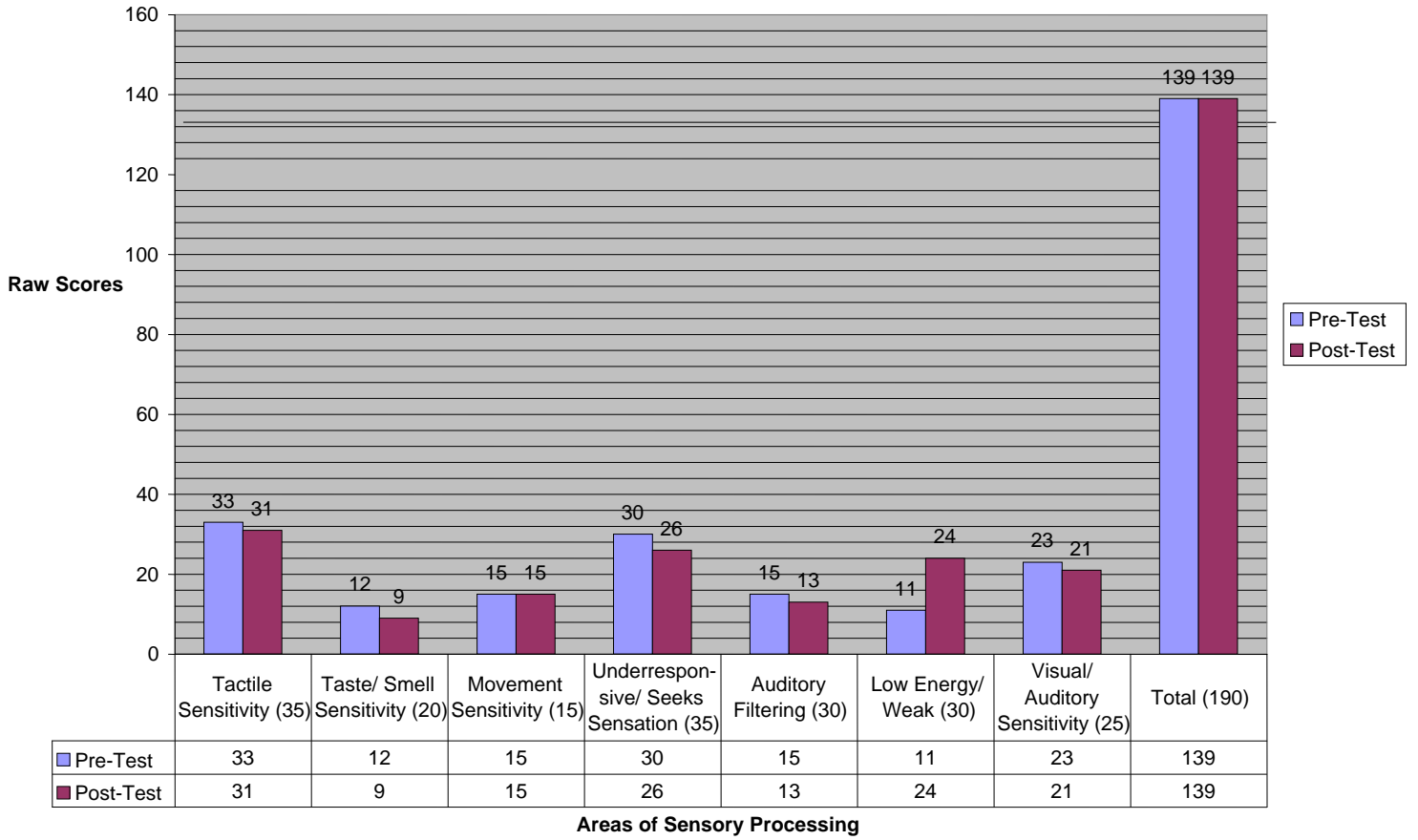
	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b><u>Fine Motor Subtests</u></b>	12	-20	-1%		32	38	12%	
Visual-Motor Control	8/24	2		5y-2m	11/24	4		5y-8m
Upper-Limb Coordination	10/21	6		5y-11m	12/21	8		6y-8m
Response Speed	3/17	9		4y-11m	13/17	23		15y-11m+ (WFL)
Upper-Limb Speed and Dexterity	10/72	1		-4y-2m	25/72	5		6y-2m
<b><u>Gross Motor Subtests</u></b>	15	-20	-1%		63	53	62%	
Running Speed and Agility	4/15	3		4y-11m	13/15	32		15y-11m+ (WFL)
Balance	9/32	1		-4y-2m	12/32	1		4y-2m
Strength	5 /42	5		4y-11m	10/42	9		6y-2m
Bilateral Coordination	4/20	6		5y-5m	7/20	11		6y-11m

**The Beery-Buktencia Developmental Test of Visual-Motor Integration (VMI)**

	(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
<b>VMI</b>	14	73	4%	5y-2m	14	71	3%	5y-2m
<b>VISUAL PERCEPTION</b>	3	n/a	n/a	-2y-2m	7	<45	<.02%	2y-8m
<b>MOTOR COORDINATION</b>	9	45	.02%	3y	10	54	.2%	3y-3m

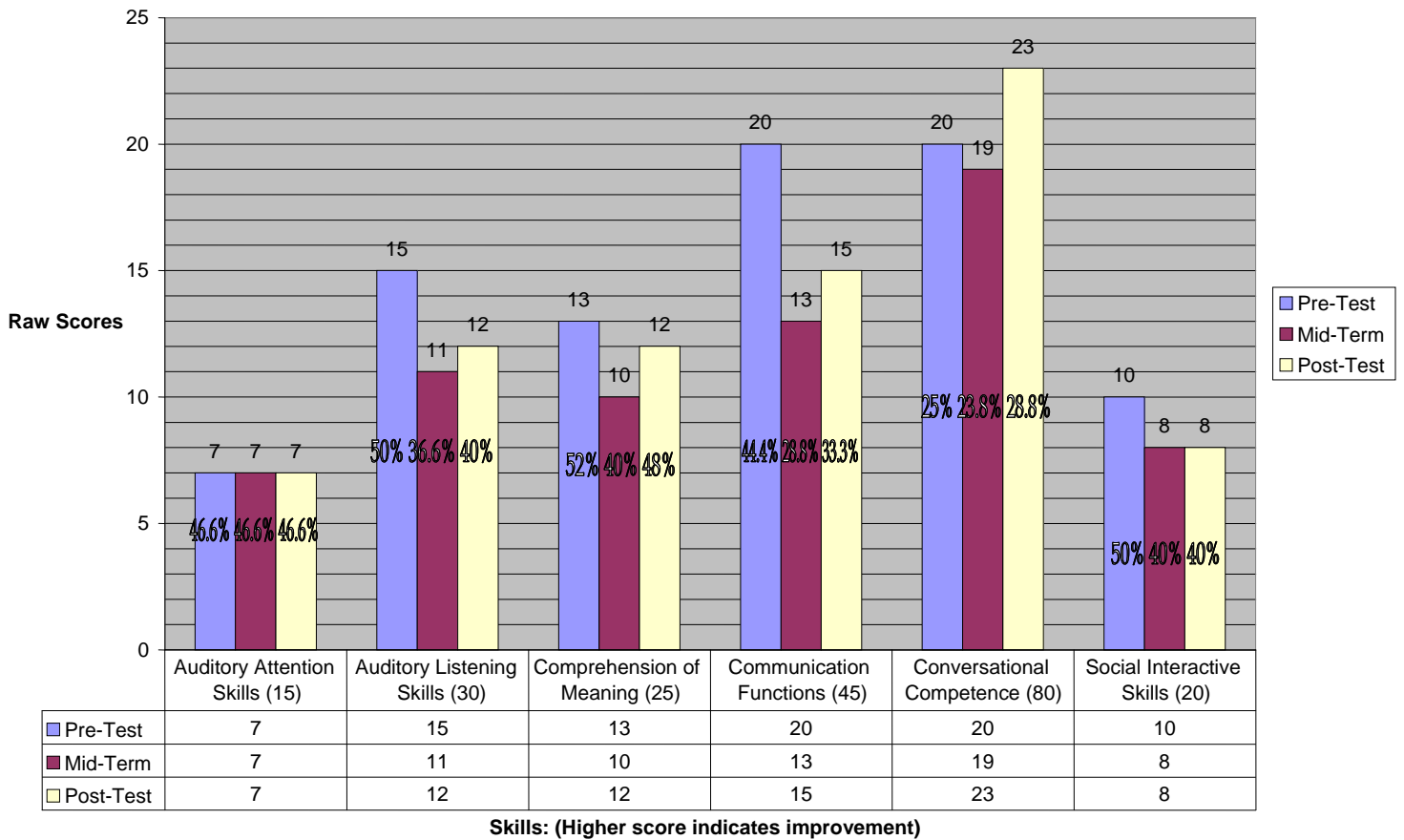
RESULTS  
(RC)

(RC) Short Form Sensory Profile



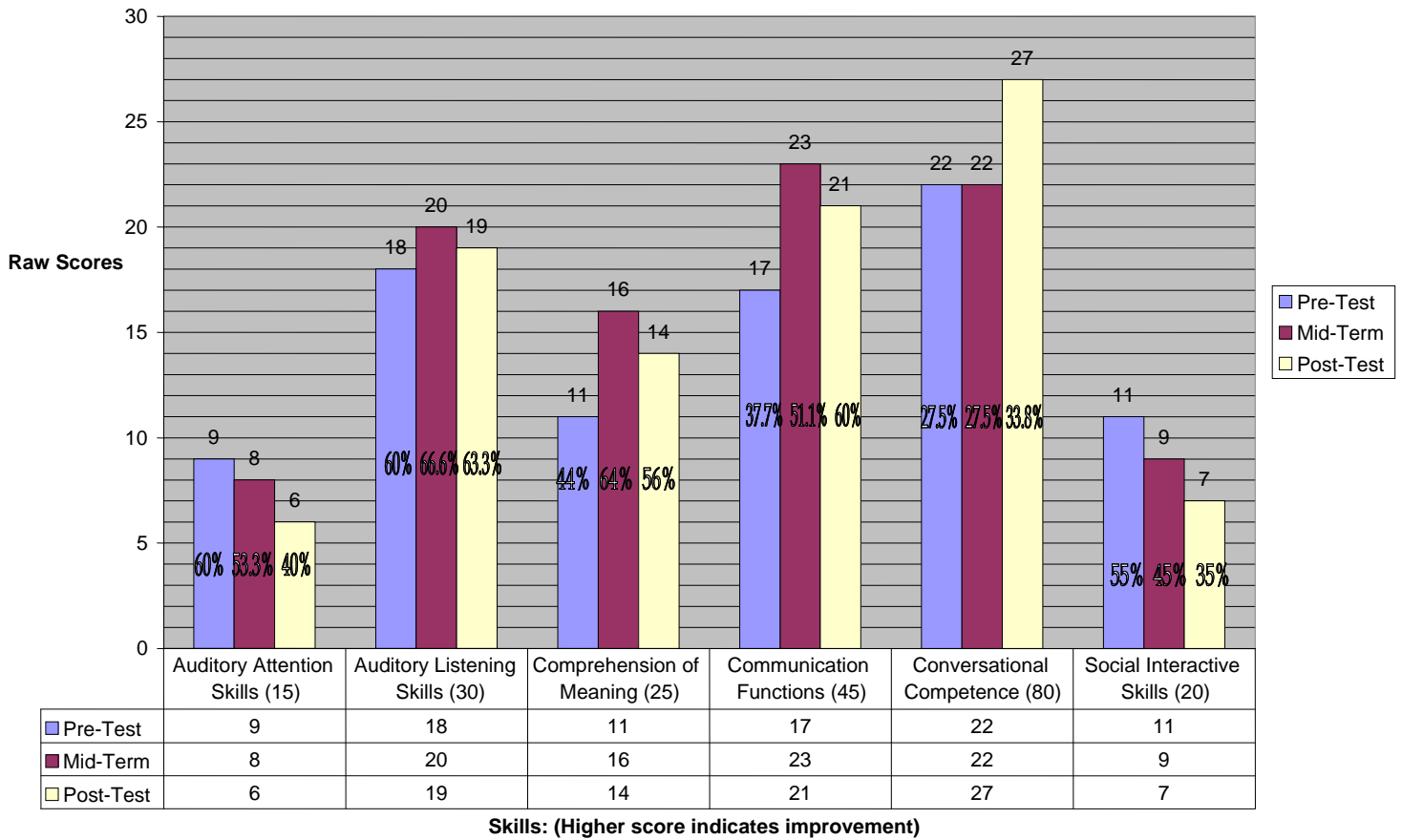
RESULTS  
(RC)

(RC) Pragmatic Language Skills Checklist (Parent)



RESULTS  
(RC)

(RC) Pragmatic Language Skills Checklist (Therapist)



**RESULTS**

**(RC)**

**Receptive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
15	<55	<1%	1y -7m	18	<55	<1%	1y-9m

**Expressive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
5	<55	<1%	1y- 2m	11	<55	<1%	1y-6m

**Oral and Written Language Scales (OWLS):**

**Listening Comprehension**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
6	40	n/a	1y-7m	6	40	n/a	1y-7m

**Oral Expression**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
7	41	n/a	2y -2m	7	40	n/a	2y-2m

**Oral Composite**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
81	40	n/a	1y -10m	80	40	n/a	1y-10m

**Goldman Fristoe 2 Test of Articulation:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
49	<40	<1%	<2y -0m	49	<40	<1%	<2y-0m



## RESULTS

### (TT)

Observations made during the post-TLP evaluation demonstrated significant improvements in all subcategories of the Beery VMI and Peabody Developmental Test, placing TT above age appropriate levels or within functional limits (WFL) for all gross and fine motor components. The most significant changes that were noted in the Beery VMI from pre-TLP test to post-TLP test were in the area of visual perception with an increase in age equivalence of (1 year - 10 months) and an increase of (1 year - 2 months) in the area of motor coordination. On the Peabody test TT made significant improvements from pre-TLP test to post-TLP test in the areas of: object manipulation (2 years - 1 month), grasping (1 year - 4 months), and stationary (1 year - 3 months). TT also demonstrated improved attention to task, participation in activities, ability to follow directions, improved sensory regulation/processing, and improved impulse control.

TT also demonstrated improved tolerance of loud noises, decreased sound sensitivity, and improved emotional control. Scores on the Sensory Profile short form demonstrated minimal change with the exception of under-responsive/seek sensation, auditory filtering, and low energy/weak.

Based on results noted from pre-TLP test to post-TLP test in the areas of speech and language skills, TT demonstrated gains on all subcategories of the Receptive One Word Picture Vocabulary (ROWPV) and Expressive One Word Picture Vocabulary (EOWPV), Preschool Language Scale (PLS4), and Goldman Fristoe Test of Articulation (GFTA).

Significant changes were noted from pre-TLP test to post-TLP test scores on the EOWPV, with an increase in age equivalence of (2 years - 3 months), and PLS4; auditory comprehension (1 year - 10 months), expressive communication (1 year - 8 months), total language score (2 years).

Parents noted many changes from the start of The Listening Program®; including improved attention, improved tolerance of noise and improved social interactions. The biggest observation was made when TT was able to tolerate the noises of a restaurant and was able to sit and complete an entire meal. Prior to starting TLP TT was unable to tolerate the sounds/noises that occurred in restaurants and she would completely shut down resulting in the family's inability to ever complete a meal while eating out.

Prior to the implementation of The Listening Program TT was being seen for services at APS. Her scores on the most recent APS testing, Jan. 2007 as compared to the scores recorded on the pre-TLP testing indicated limited changes on the Peabody in progress with changes in stationary of (2 months), locomotion (1 year - 3 months), object manipulation (2 months), grasping (8 months), and visual motor integration (1 year - 4 months). Significant changes were made after The Listening Program, as noted in the post-TLP testing. This demonstrates that with the continuation of therapy services and the addition of The Listening Program, TT made increased improvements in all the areas tested post-TLP as compared to just receiving therapy services alone.

**RESULTS**

(TT)

**The Beery-Buktencia Developmental Test of Visual-Motor Integration (VMI)**

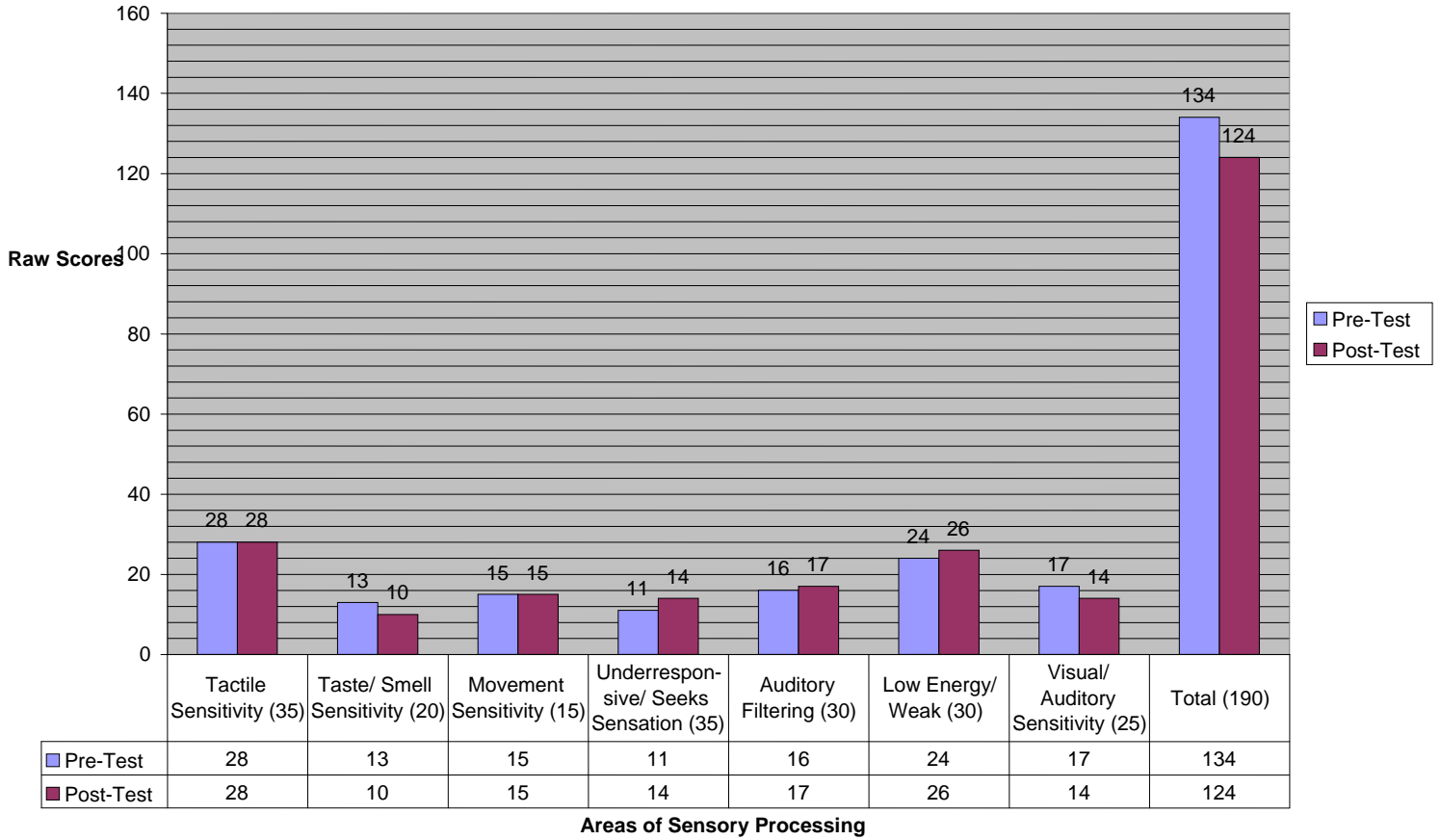
	(pre-TLP) Raw Score 5/9/07	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score 12/3/07	Standard Score	Percentile	Age Equivalent
VMI	12	119	90%	4y-6m (WFL)	14	112	79%	5y-2m (WFL)
VISUAL PERCEPTION	18	144	99.6%	6y-2m (WFL)	22	148	99.91%	8y-0m (WFL)
MOTOR COORDINATION	12	100	50%	3y-9m	15	106	65%	4y-11m (WFL)

**The Peabody Developmental Motor Scale:**

	(pre-TLP) Raw Score 5/2/07	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score 11/30/07	Standard Score	Percentile	Age Equivalent
<b>Gross Motor Scales</b>								
Stationary	53	13	84%	55m (WFL) 4y-7m	58	12	75%	70m (WFL) 5y-10m
Locomotion	174	15	95%	67m (WFL) 5y-7m	178	15	95%	>71m (WFL) >5y-11m
Object Manipulation	38	10	50%	46m 3y-10m	46	12	75%	71m (WFL) 5y-11m
<b>Fine Motor Scales</b>								
Grasping	50	12	75%	55m (WFL) 4y- 7m	52	12	75%	71m (WFL) 5y-11m
Visual-Motor Integration	140	16	98%	71m (WFL) 5y-11m	142	15	95%	>71m (WFL) >5y-11m

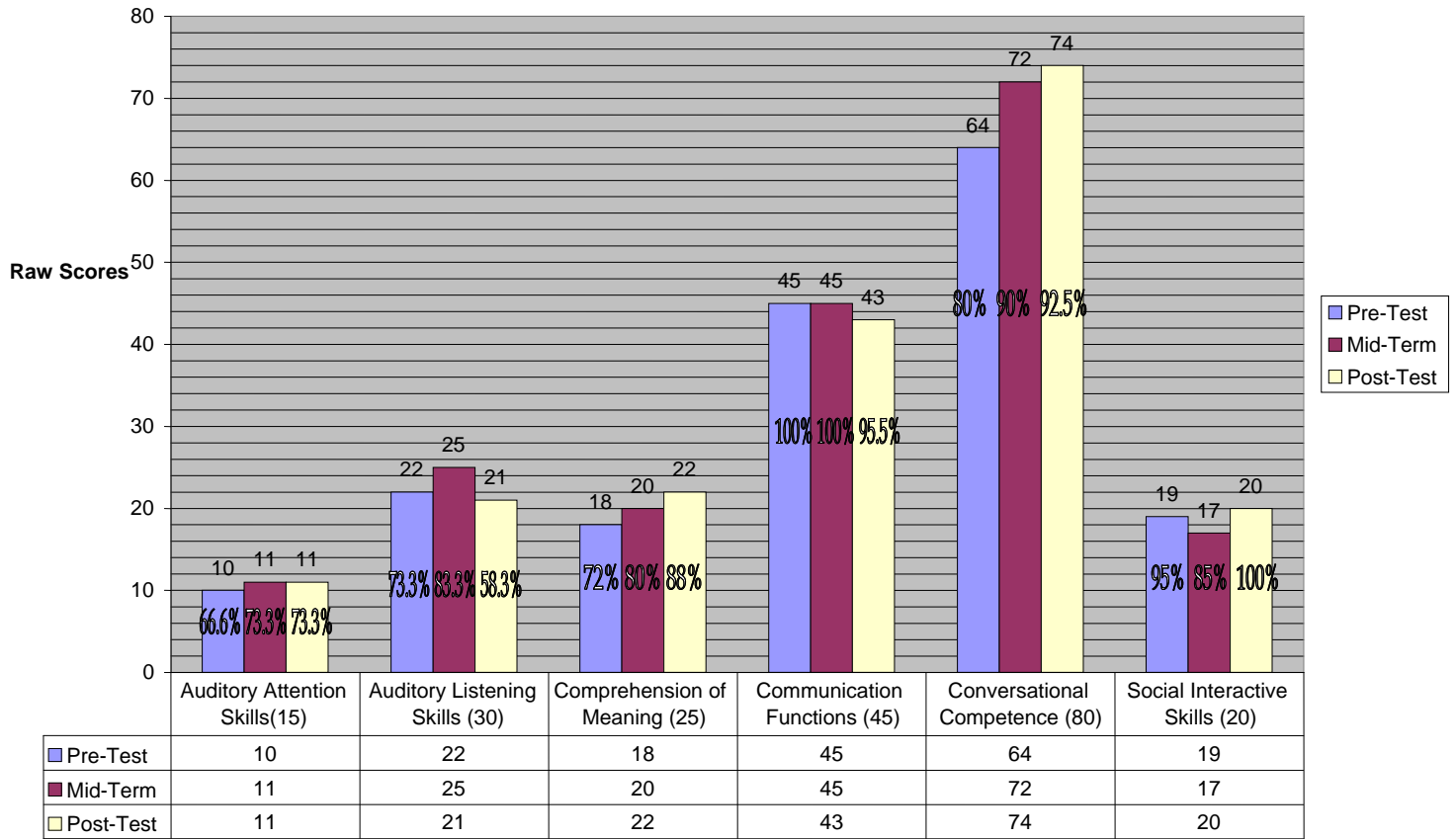
RESULTS  
(TT)

(TT) Short Sensory Profile



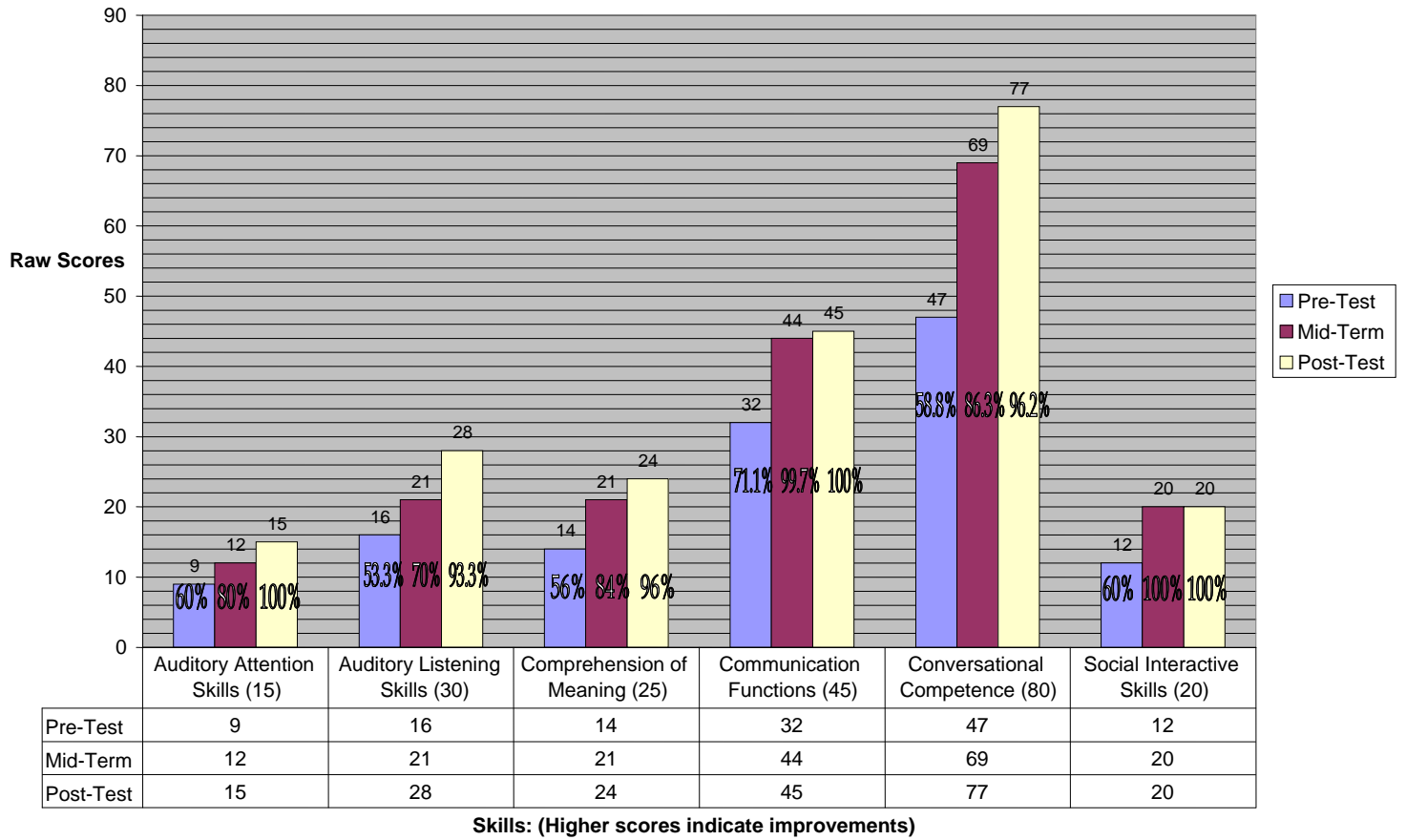
RESULTS  
(TT)

(TT) Pragmatic Language Skills Checklist (Parent)



**RESULTS**  
**(TT)**

**(TT) Pragmatic Language Skills Checklist (Therapist)**



**RESULTS**

**(TT)**

**Receptive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
51	107	68%	4y-5m	60	109	73%	5y-3m

**Expressive One Word Picture Vocabulary:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
40	99	47%	3y-10m	64	119	90%	6y-1m

**Preschool Language Scale 4<sup>th</sup> (PLS4):**

**Auditory Comprehension**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
49	110	75%	3y-11m	59	120	91%	5y-9m

**Expressive Communication**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
51	109	73%	4y-0m	63	114	82%	5y-8m

**Total Language Score**

(pre-TLP) Raw Score Total	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score Total	Standard Score	Percentile	Age Equivalent
219	111	77%	4y-0m	234	119	90%	6y-0m

**Goldman Fristoe 2 Test of Articulation:**

(pre-TLP) Raw Score	Standard Score	Percentile	Age Equivalent	(post-TLP) Raw Score	Standard Score	Percentile	Age Equivalent
7	114	79%	4y-11m	0	121	91%	5y-8m

Over the twenty weeks of The Listening Program® (TLP), most of the participants demonstrated significant improvements in the tested areas. Parents also reported improvements in attention, socialization, sensitivity to sounds, and sensory processing. Participants' scores on the post-TLP testing demonstrated significant improvements after completion of The Listening Program when compared to scores achieved prior to the start of TLP. The Listening Program implementation added to other therapies appears to be effective in helping to address auditory processing concerns, improving behaviors related to sensory processing, improving speech and language/communication skills, and increased fine and gross motor skills, as shown by scores noted in the study.

**CONCLUSION**

As demonstrated by the scores taken from pre-TLP and post-TLP testing, compared to scores taken prior to the start of the program base/pre-testing (4 children receiving services at APS): there was a significant improvement in the progress made by all the children who completed the program, as compared to just therapy alone. This demonstrated that The Listening Program is effective in helping increase functional skills and outcomes in children who present with sensory integration and auditory processing concerns, when used along with skilled therapies to help achieve maximum potential and independence in everyday tasks/skills.