Maximizing Cochlear Implant Benefits with Short-term AR Intervention

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Purpose

- To evaluate the effectiveness of training to improve outcomes for adult cochlear implant (CI) users.

- Specifically, to provide evidence of benefits resulting from short-term aural rehabilitation (AR) in a randomized controlled clinical trial.

Cochlear Implants & Communication Function

- Increasing numbers of adults receiving CIs and many are achieving high levels of speech perception (Dowell, 2012; Fabry et al., 2009; Gifford et al., 2008; Krueger et al., 2008).

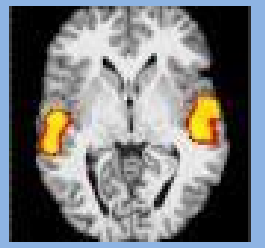
  However, a proportion of adults still struggle in daily life and seek greater communication competency.
- CI does not resolve all communication issues. Residual issues can negatively impact psychosocial function and quality of life(Helvik et al., 2006)

- Some individuals demonstrate limited outcomes, as shown by poor speech recognition and/or evidence of significant hearing handicap. Others have good speech recognition, but not sufficient to meet the communication demands of their daily life.

Role of AR and Neuroplasticity

- AR can be key to overcome and resolve communication and adjustment issues, and maximize the benefit they receive from their implant (Boothroyd, 2010; Fu & Galvin, 2008; Green, 2008; Pedley et al., 2005).

- Role of neuroplasticity- CI users develop new neural connections (Green et al., 2008; Neuman, 2005; Russo et al., 2005). Greater improvement in first year, but neuroimaging studies suggest plasticity continues longer (Fallon et al. 2008; Merabet & Pascual-Leone, 2010; Tobey et al., 2005).



- Thus an extended window of opportunity to improve performance when enhanced by AR, especially auditory training.

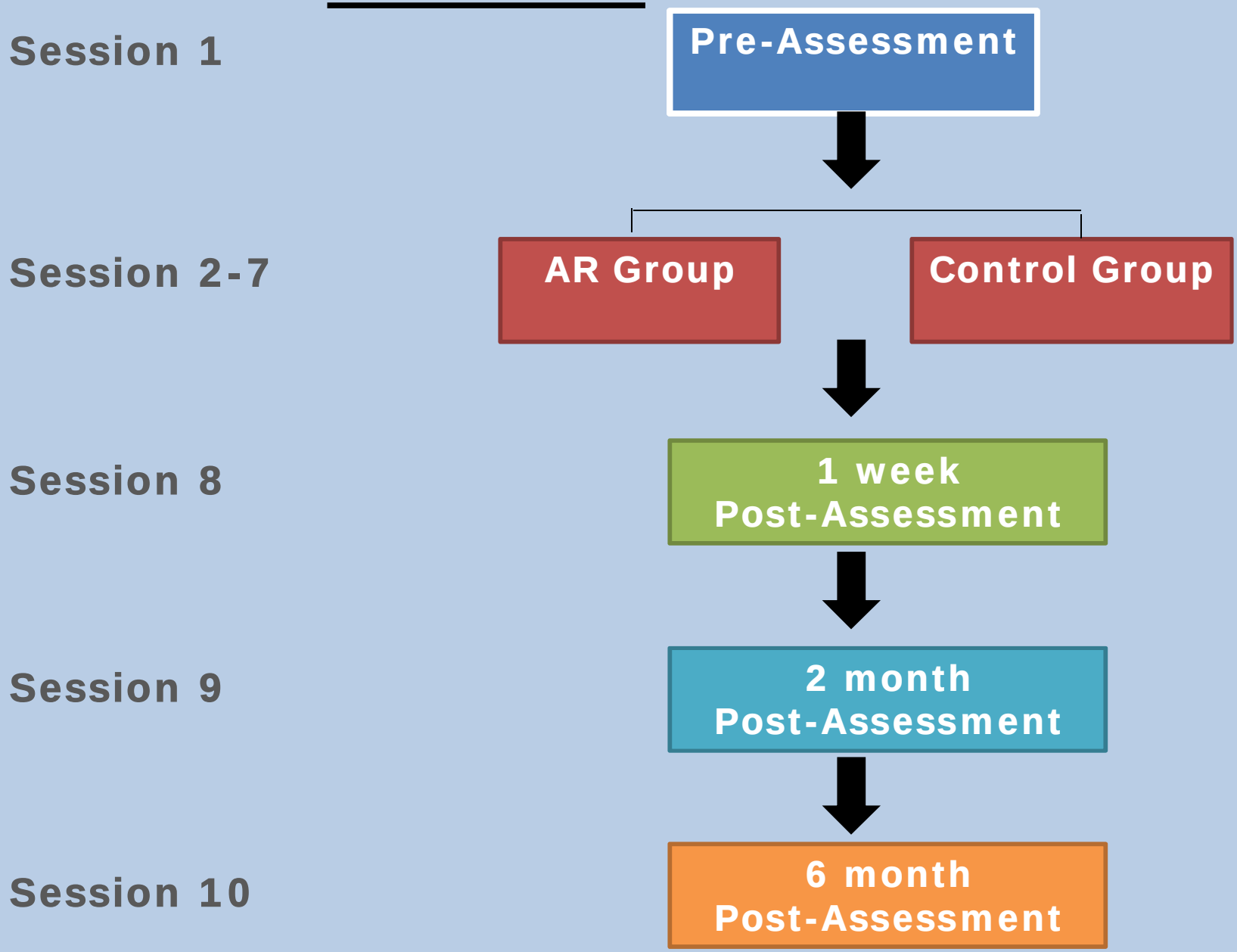
Auditory Training Outcomes

- Renewed interest in auditory training to improve speech recognition (Burk & Humes, 2008; Miller et al; 2008; Stacey et al., 2010; Sweetow & Sabes, 2007).
- Role of auditory experience, especially focused auditory training, may be key to maximize functional outcomes in CI users (Boothroyd, 2010; Fu & Galvin, 2008;Tobey et al., 2005).
- Systematic review of evidence-based practice in audiology, Sweetow & Palmer (2005), Brouns et al.(2011) and more recently, Chisolm & Arnold, in Wong & Hickson book (2012) cite evidence in support of benefits of auditory training, but recommend that future studies include a control group in order to establish the efficacy of training.

Participant Characteristics

Thirty post-lingually deafened CI users.
Three months to three years post-activation.
Sentence recognition between 10%-85% (CasperSent).
Speech Tracking rate >20 wds/min
No AR therapy post-implantation.
English speaking.
Normal cognitive function.

Timeline


Session 1
Pre-Assessment
Session 2-7
AR Group
Control Group
Session 8
1 week
Post-Assessment
Session 9
2 month
Post-Assessment
Session 10
6 month
Post-Assessment

Treatment Protocol

Aural Rehabilitation Group (AR)
Informational Counseling CI orientation Hardware Assistive listening devices Telephone use
Communication Strategies Training
Auditory Training Sentence identification Vowel and consonant contrasts KTH Speech Tracking

Treatment Protocol

Cognitive Training Group (CT)

Cognitive Training Exercises

Spot the Difference
Crossword Puzzles
Ken-Ken
Word Searches
Sudoku

Choice of 3 activities

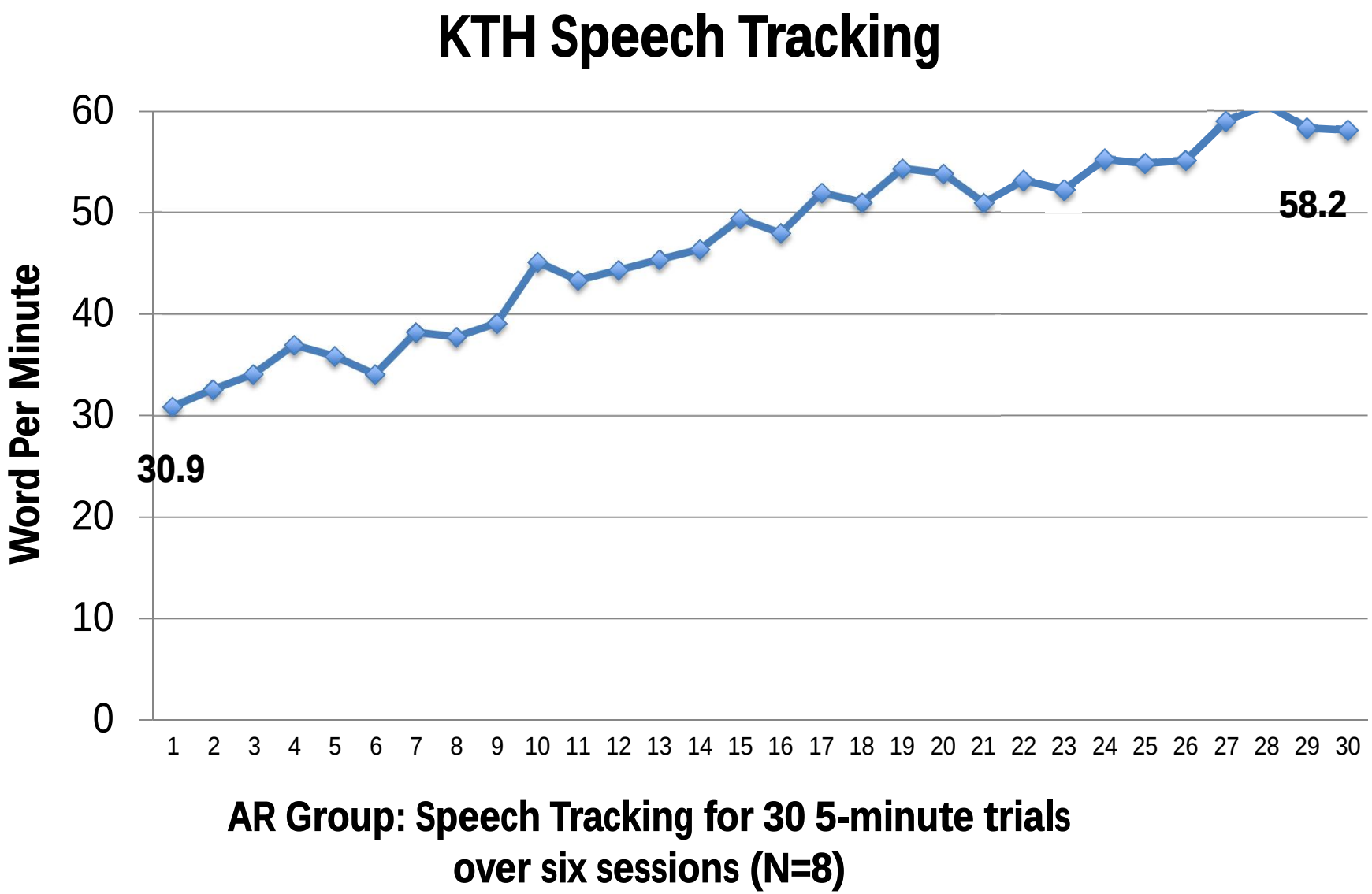
Outcome Measures

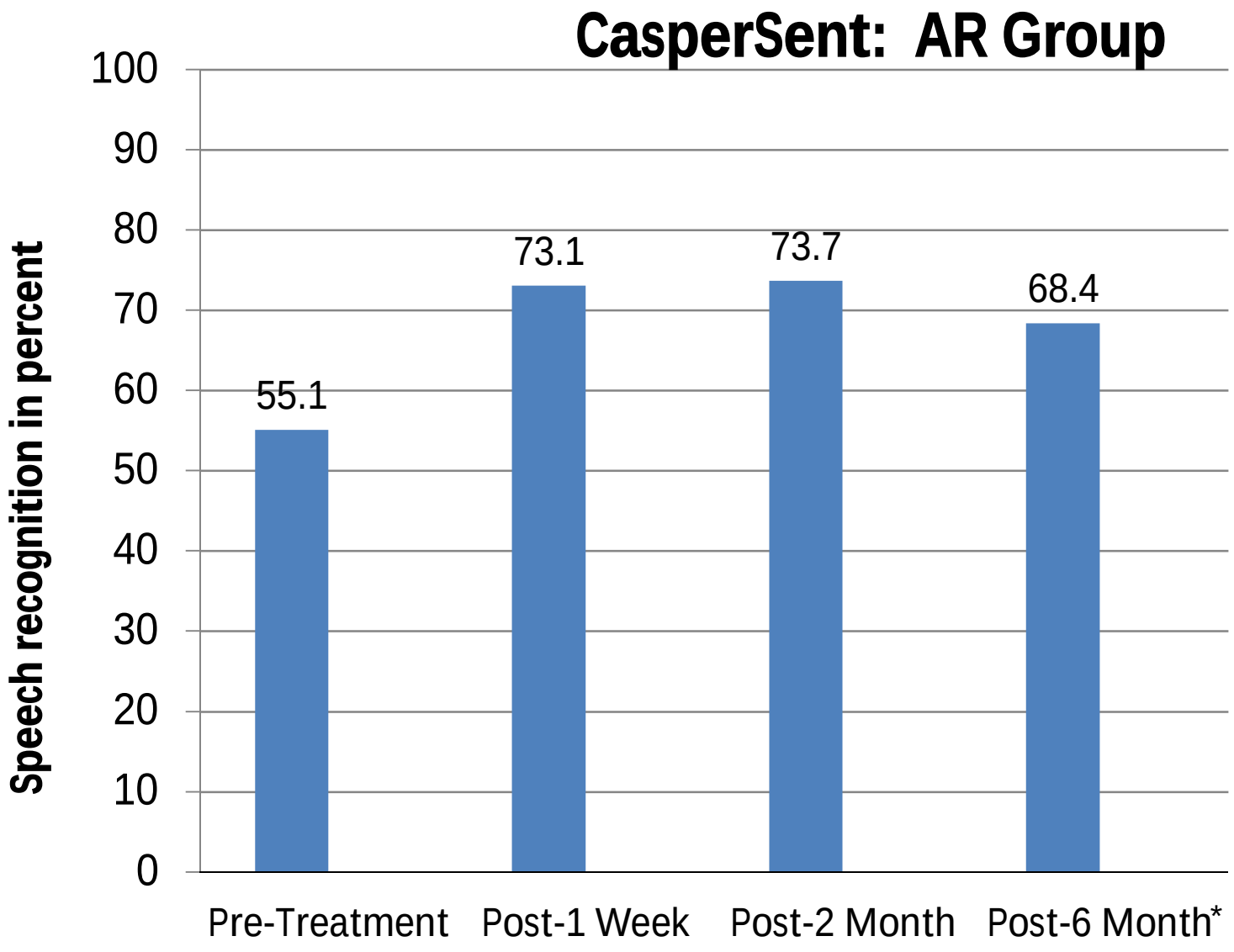
CasperSent Sentence Recognition
(Boothroyd, 2008)

Hearing Handicap Inventory (HHIE/A)
(Ventry & Weinstein, 1982;Newman et al., 1990)

Client Oriented Scale of Improvement (COSI)
(Dillon et al., 1977)

Nijmegen Cochlear Implant Questionnaire (NCIQ) (Hinderink et al., 2000)


KTH Speech Tracking
Word Per Minute
60
50
40
30
20
10
0
30.9
58.2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
AR Group: Speech Tracking for 30 5-minute trials
over six sessions (N=8)

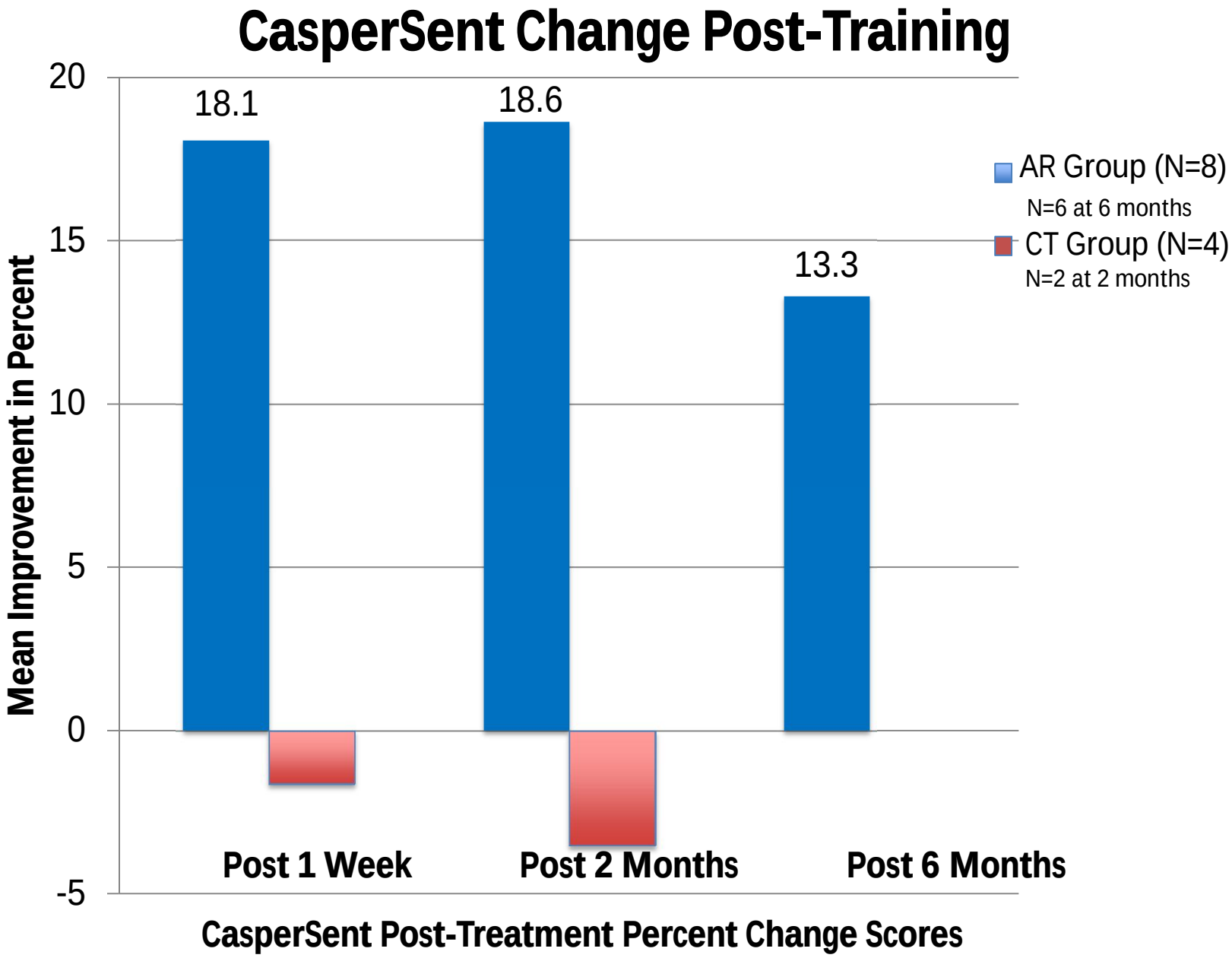


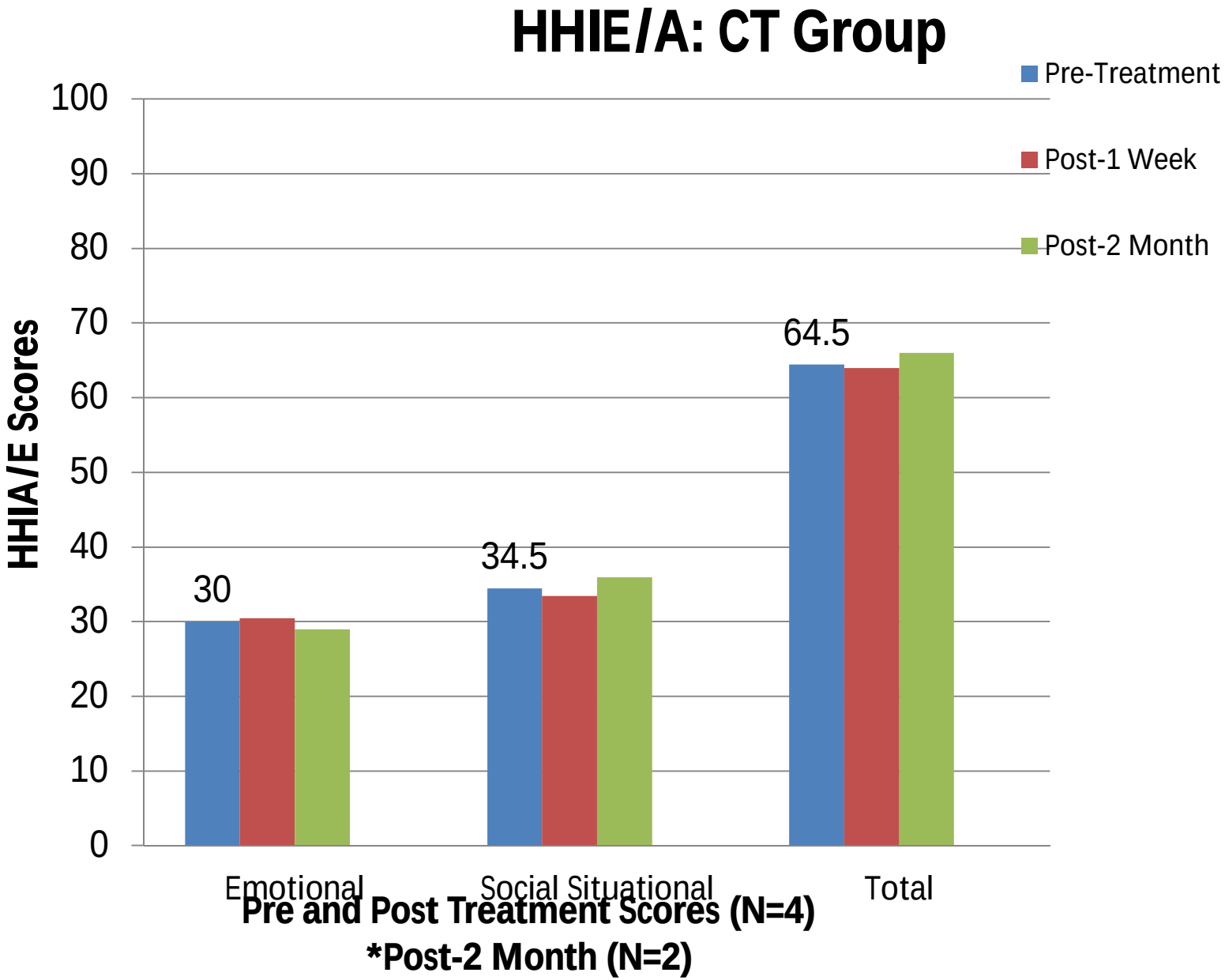
Sentence Recognition Pre and Post Intervention (N=8)
***Post-6 Month (N=6)**

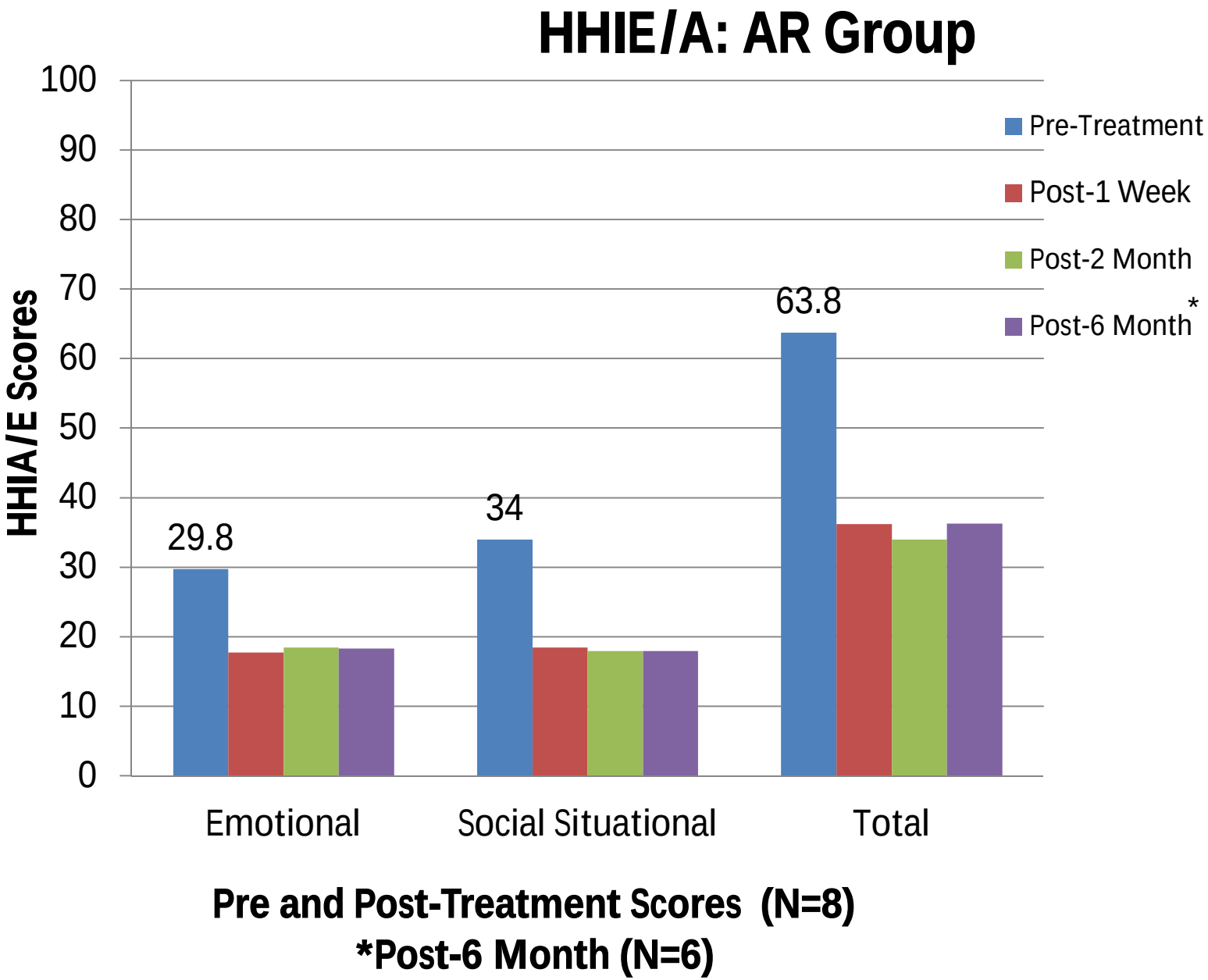
Participant	Pre-Treatment	Post 1 Week	Post 2 Month	Post 6 Month
CT01	83.5	79.3	80.0	78.3
CT02	36.7	37.0	36.3	------
CT03	21.5	20.5	-------	------
CT04	59.3	61.7	-------	------

Individual CasperSent Scores

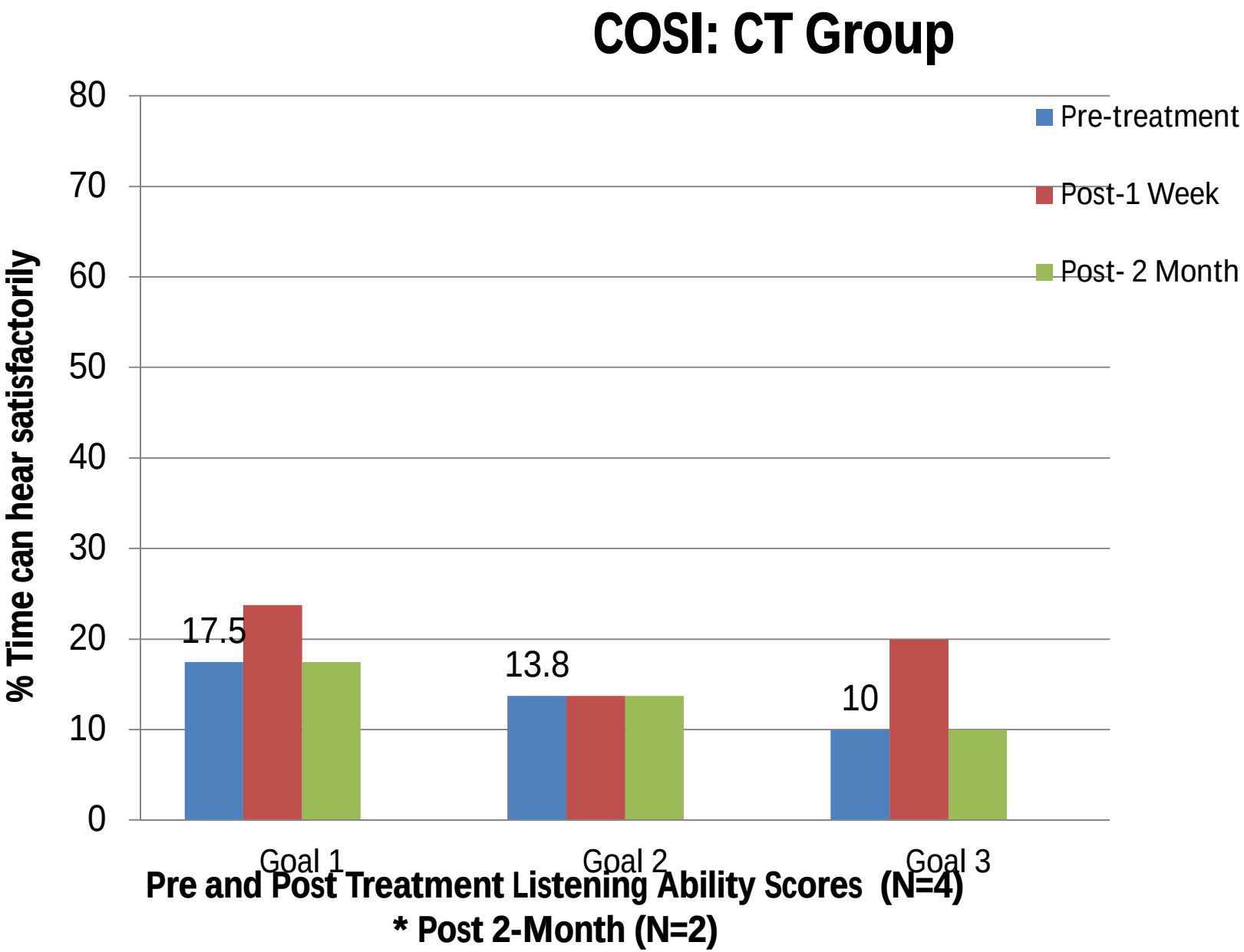
Pre and Post-Treatment for CT Group Participants

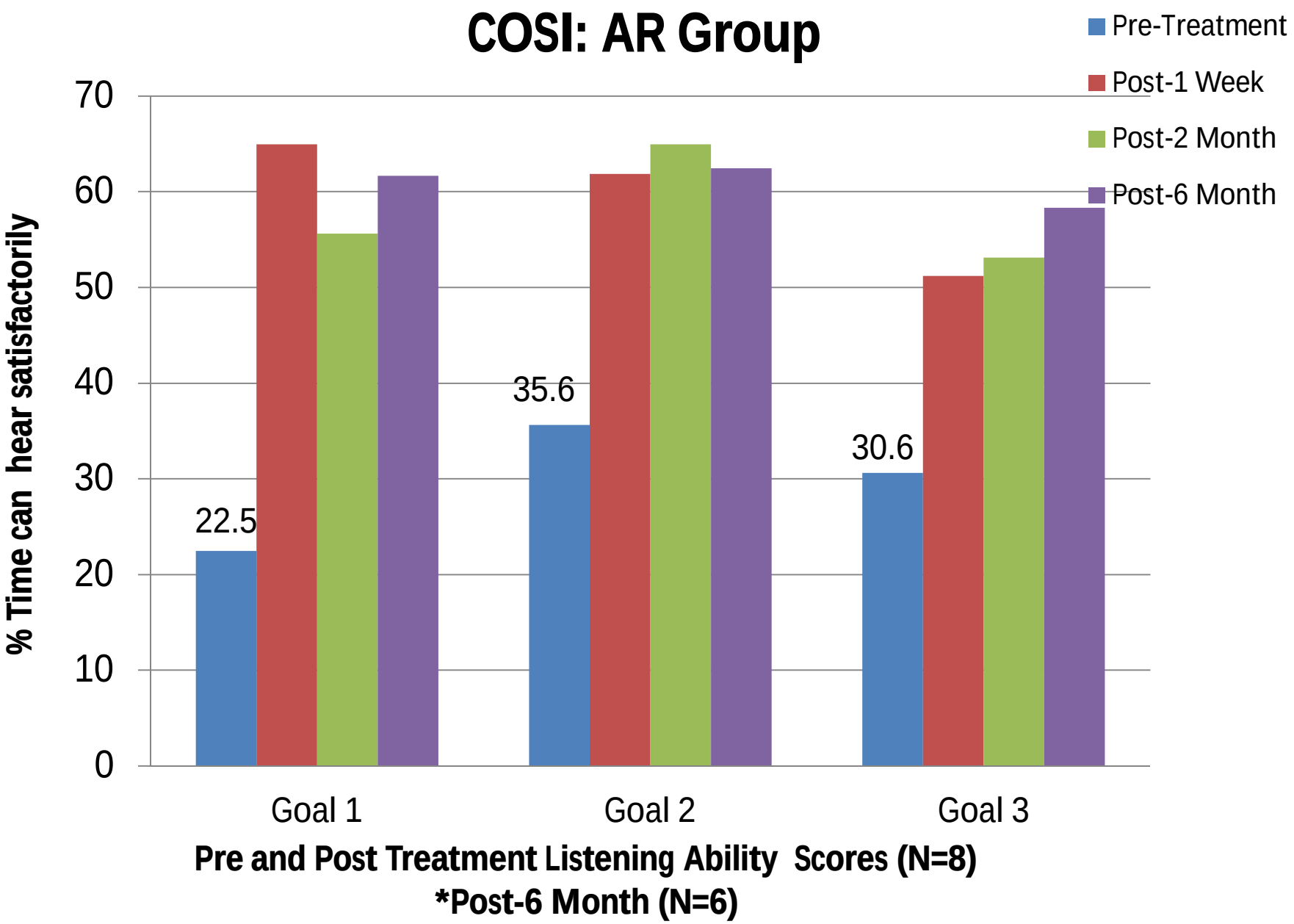

CasperSent Change Post-Training
20
15
10
5
0
-5
Mean Improvement in Percent
18.1
18.6
13.3
AR Group (N=8)
N=6 at 6 months
CT Group (N=4)
N=2 at 2 months
Post 1 Week
Post 2 Months
Post 6 Months
CasperSent Post-Treatment Percent Change Scores

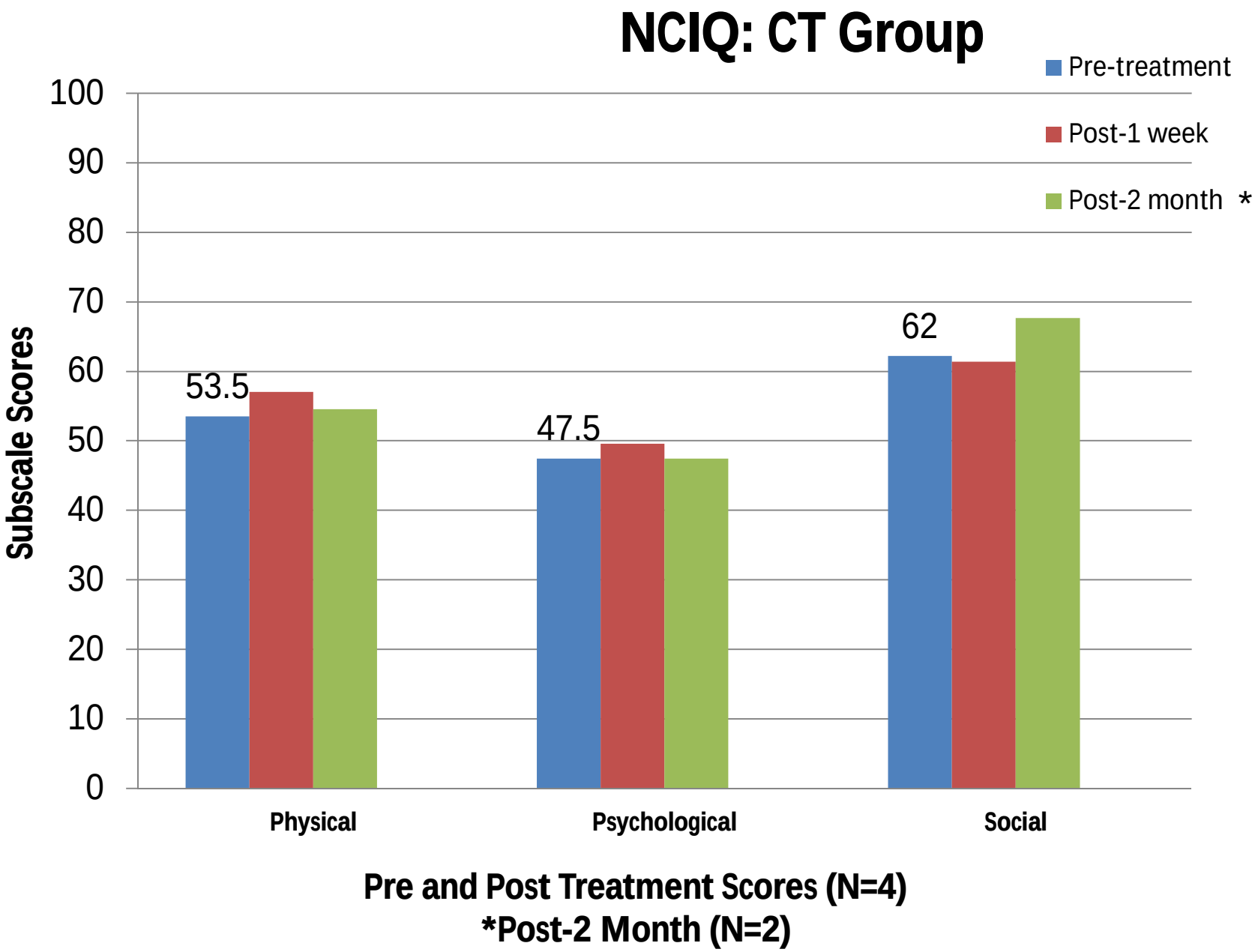

HHIE/A: CT Group
Pre-Treatment
Post-1 Week
Post-2 Month
HHIA/E Scores
100
90
80
70
60
50
40
30
20
10
0
30
34.5
64.5
Emotional
Social Situational
Total
Pre and Post Treatment Scores (N=4)
*Post-2 Month (N=2)

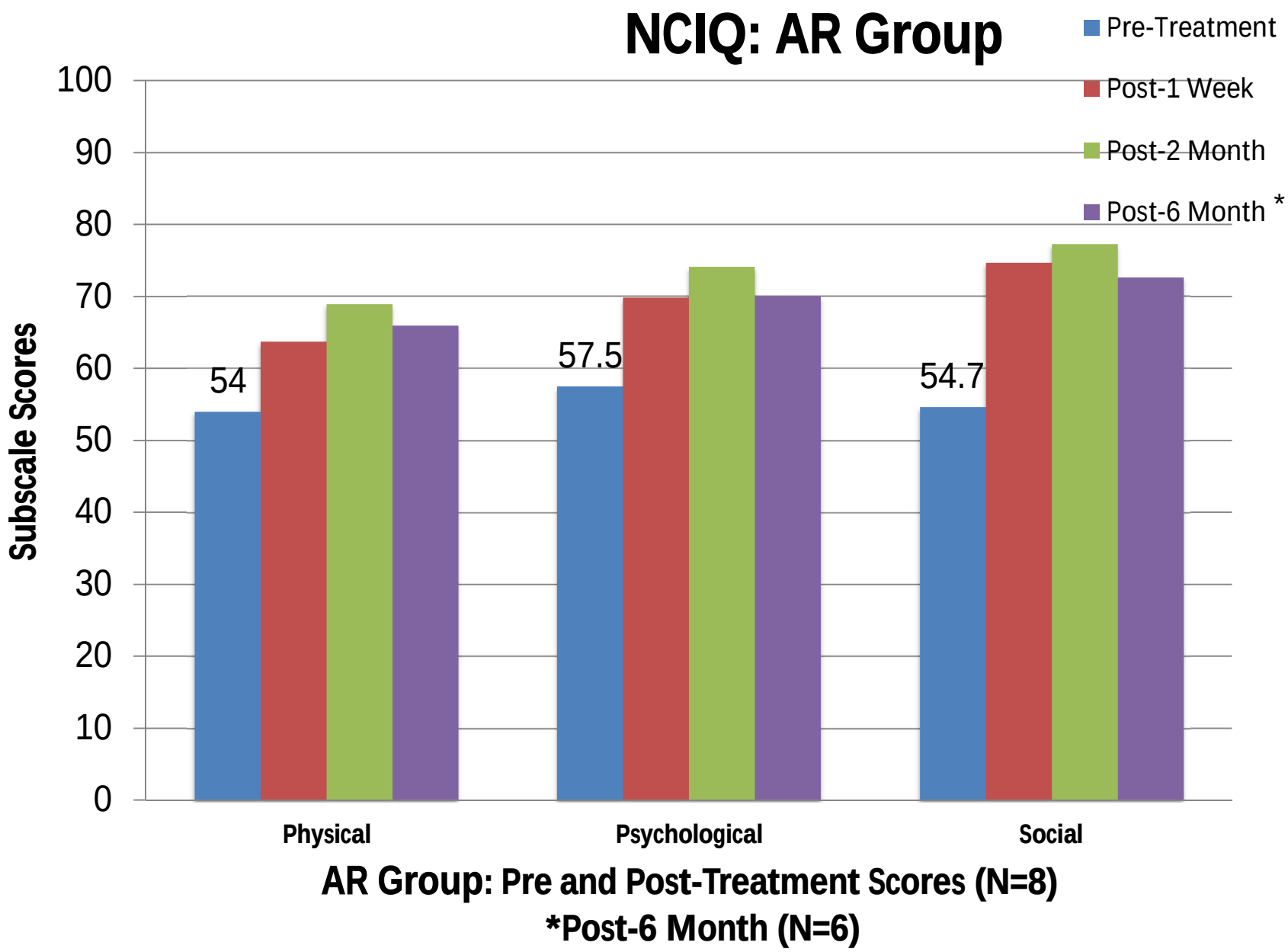


Pre and Post-Treatment Scores (N=8)
***Post-6 Month (N=6)**


COSI: CT Group
80
70
60
50
40
30
20
10
0
% Time can hear satisfactorily
Pre-treatment
Post-1 Week
Post- 2 Month
17.5
13.8
10
Goal 1
Goal 2
Goal 3
Pre and Post Treatment Listening Ability Scores (N=4)
* Post 2-Month (N=2)


COSI: AR Group
Pre-Treatment
Post-1 Week
Post-2 Month
Post-6 Month
% Time can hear satisfactorily
70
60
50
40
30
20
10
0
22.5
35.6
30.6
Goal 1
Goal 2
Goal 3
Pre and Post Treatment Listening Ability Scores (N=8)
*Post-6 Month (N=6)


NCIQ: CT Group
Pre-treatment
Post-1 week
Post-2 month *
Subscale Scores
100
90
80
70
60
50
40
30
20
10
0
53.5
47.5
62
Physical
Psychological
Social
Pre and Post Treatment Scores (N=4)
*Post-2 Month (N=2)



AR Group: Pre and Post-Treatment Scores (N=8)
***Post-6 Month (N=6)**

Summary of Preliminary Findings: Speech Recognition Measures

CT Group

- Participants showed no improvement in sentence recognition following training.

AR Group

All participants showed improved speech recognition post-training (from 6.5% to 28.3%).

Mean improvement post-training was

- 18.1% at one week post-training
- 18.6% at two months post
- 13.3% at six months post

Summary of Preliminary Findings: Psychosocial Measures

CT Group

- Minimal improvement was seen on the COSI.
- Minimal improvement basic speech domains, but none in psychosocial function (NCIQ).
- No reduction in self-perceived hearing handicap(HHIE/A)

AR Group

- Improvement seen in personal goals (COSI).
- Improvement seen in social participation, self-assessed communication, and psychosocial function (NCIQ).
- Reduction of self-perceived hearing handicap(HHIE/A).

Who Can Benefit from Training?

Participant	Initial Score	Mean Change
AR04	78.5	17.2
AR03	75.0	10.7
AR01	71.5	20.9
AR08	67.25	15.25
AR07	57.3	24.7
AR06	32.5	28.0
AR05	30.0	22.9
AR02	28.5	6.4

Individual CasperSent Scores
Pre and Post-Treatment in Descending Initial Performance Order.

Preliminary Conclusions

- Study contributes to the body of evidence that informs clinical practice of AR
- AR intervention contributed to increased speech recognition and to self-perceived improvement in psychosocial function
- **This preliminary data suggests that short-term AR can maximize outcomes for adult CI users**

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Participant	Age	Gender	Device	Etiology	Time Post-Activation	Duration of Profound HL			
AR01	65	Female	Cochlear Nucleus 5	Familial	5 months	2 years			
AR02	77	Female	Cochlear Freedom	Unknown	1 year, 4 mos	37 years			
AR03	58	Female	MED-EL Opus 2	Turner's syndrome	1 year, 4 months	8 years			
AR04	56	Male	Cochlear Nucleus 5	Noise-induced	4 months	2 years			
AR05	67	Female	Cochlear Freedom	Familial	3 months	17 years			
AR06	64	Male	AB Harmony	Meningitis	11 months	61 years			
AR07	73	Female	Cochlear Nucleus 5	Familial	9 months	10 years			
AR08	61	Female	AB Harmony	Auto-immune	4 months	8 years			
CT01	59	Female	Cochlear Nucleus 5	EVAS	5 months	45 years			
CT02	55	Female	MED-EL Opus 2	Meniere's	4 months	3 years			
CT03	68	Female	MED-EL Opus 2	Familial	11 months	1 year, 9 months			
CT04	50	Female	MED-EL	High Fever	8 months	34 years			