Can TUF Writing Make Speaking Easy?

A growing body of research has documented that Treatment of Underlying Forms (TUF) can efficiently remediate sentence production deficits associated with agrammatism (Thompson & Shapiro, 2005). TUF prescribes training production of complex, noncanonical sentence structures to evoke generalization to syntactically related sentence structures. Empirical support for this complexity training order has been established, with several studies reporting that agrammatic individuals who receive TUF achieve improved production of (a) the trained, complex sentence structures and (b) novel sentence structures syntactically related to and less complex than the trained structures (Ballard & Thompson, 1999; Thompson et al., 2003). Despite this robust generalization to untrained sentence types, additional investigation of TUF's generalization potential is needed to establish the breadth of its clinical efficiency. That is, in most studies, generalization has been examined by probing production or comprehension of untrained structures within constrained, sentence-level tasks, which exploit the same response modality (i.e., spoken output) used during TUF training. Ergo, the extent to which TUF can foster generalization to untrained language modalities as well as less structured, communicative contexts such as discourse has yet to be systematically evaluated; furthermore, the few studies examining these generalization issues have thus far yielded inconsistent findings (Thompson et al., 1996 vs. Ballard & Thompson, 1999).

Recently, Murray et al. (2007) evaluated generalization effects in an individual with chronic, agrammatic aphasia who had been provided a modified version of TUF that targeted written sentence production by combining traditional TUF procedures with a Discourse Training Module (DTM) and written homework exercises. Following treatment, their participant demonstrated substantial generalization to speech, albeit limited improvements in structural aspects of his written or spoken discourse. Given these promising but preliminary findings, the present study was designed to begin exploring factors which might influence generalization outcomes by providing a similar adapted TUF protocol (TUF procedures + DTM) to three additional individuals with chronic, agrammatic aphasia who had varying degrees of language comprehension and production impairment. The hypotheses specified that: (a) all participants would improve their written production of trained sentence structures and demonstrate generalization to untrained exemplars of targeted sentence structures as well as untrained, syntactically related syntactic structures; (b) written sentence production treatment would facilitate gains in spoken production of trained and related, untrained sentence structures; and, (c) all participants would exhibit improved written and spoken sentence production abilities in discourse post-treatment.

Participants

All three participants with chronic aphasia due to left hemisphere stroke were monolingual English speakers, right-handed, passed hearing and vision screenings, and had negative histories for other neurological disorders or psychiatric problems. All participants demonstrated moderate to moderately severe language impairments and at minimum moderate motor speech programming difficulties (Table 1). Written and spoken discourse samples (retelling the Bear and the Fly story, describing a Norman Rockwell picture, and explaining how to make scrambled eggs) were elicited to document pre- and post-treatment spoken and written language profiles but analyses of these samples have not yet been completed. Based on WAB language samples, all participants produced proportions of grammatically correct sentences, utterance lengths, and open to closed class and noun to verb ratios most consistent with agrammatism (Thompson et al., 1995).

Procedures

Probe and experimental TUF stimuli were taken from the previous work of Thompson and colleagues (Ballard & Thompson, 1999; Thompson et al., 1997). Specifically, eight pairs of line drawings were used to elicit five sentence types: object- (OE) and subject-extracted (SE) embedded who-question sentences, object- (OM) and subject-extracted (SM) matrix who-questions, and passives. Each picture pair represented the two possible interpretations of a semantically reversible sentence.

A single subject, multiple baseline design across behaviors was used. All participants received training for OE and SE sentences. Production of passives served as a control probe because training wh-movement was not anticipated to alter passive sentence productions that require NP-movement (Thompson et al., 1997, 1998).

A sentence production priming task (Thompson et al., 1997) was used to probe spoken and written production of all sentence types (8 times/sentence type = 40 items per probe per modality). For both spoken and written probes, the examiner provided a spoken model of the target sentence structure to describe one picture in a picture pair. The participant was then asked to say aloud or write on a piece of paper a similar sentence for the other picture. Comprehension was probed by asking participants to point to which picture (of the picture pair) represented the sentence spoken by the examiner. For all probe tasks, picture pairs and sentence types were randomly selected.

All participants received individual, weekly 90 min sessions of an adapted written version of TUF using procedures similar to those of Murray et al. (2007). Each session included: 40 min of probes -> 20 min of TUF -> 30 min of DTM. During DTM, participants wrote a five-sentence story containing at least one target sentence structure (i.e., OE or SE) about a current newspaper or magazine photograph. DTM incorporated “loose” training procedures (e.g., Response Elaboration Training; Kearns, 1985) in which the clinician provided support, modeling, and feedback regarding participants’ syntax and orthography to encourage their correction and elaboration of their initial written story.

Results

All participants demonstrated improved written production accuracy for trained OE and SE sentences, with generalization to at least one untrained structure containing wh-movement (Figures 1-3). Participants 1 and 3 performed near or at ceiling on the sentence comprehension probe throughout the study. Although Participant 2 demonstrated consistently good comprehension of OE and OM structures, he performed at or just above chance on SM and PA structures; his initial comprehension of SE sentences also fell below chance but steadily improved to a peak score of 63% correct. Across participants, gains in spoken production were observed. For Participants 2 and 3, gains in spoken sentence production tended to mirror those observed in their writing. Participant 1 demonstrated improvements in his spoken production of all trained and untrained sentence types, and for OE and OM sentences, these improvements exceeded those observed in his writing of these structures. Maintenance of treatment and generalization effects varied across participants with Participant 2 showing nominal maintenance of his written or spoken gains and Participants 1 and 3 demonstrating more remarkable maintenance of sentence production improvements.

Discussion

The present results support those of Murray et al. (2007) and indicate that an adapted written version of TUF that incorporates a discourse module facilitates complex, noncanonical sentence production. As in previous TUF studies (Thompson et al., 1997, 1998), training production of wh-movement sentences resulted in improved production of other, less complex wh-movement structures. Whereas cross-modal generalization to spoken sentence production was observed in all participants, Participant 1 showed substantial gains in his spoken production of all sentences types, including passives. Such gains may indicate that his spoken sentence production problems reflect impaired access to lexical representations rather than, or in addition to, syntactic processes (Edwards & Bastiaanse, 1998); the adapted TUF protocol facilitated access to the lexical and/or phonological forms of a constrained set of verbs, agents, and themes, which in turn enhanced his sentential construction abilities. Completion of discourse analyses will allow further exploration of the potential of this adapted TUF protocol to evoke cross-modal generalization as well as generalization to less structured writing and speaking contexts.

Selected References

Ballard, K. J., & Thompson, C. K. (1999). Treatment and generalization of complex sentence production in agrammatism. *Journal of Speech, Language and Hearing Research, 42*, 690-707.

Jacobs, B. J., & Thompson, C. K. (2000). Cross-modal generalization effects of training noncanonical sentence comprehension and production in agrammatic aphasia. *Journal of Speech, Language, and Hearing Research, 43,* 5-20.

Kearns, K. P. (1985). Response elaboration training for patient initiated utterances. *Clinical Aphasiology, 14,* 196-204.

Murray, L. L., Ballard, K., & Karcher, L. (2004). Linguistic Specific Treatment: Just for Broca's aphasia? *Aphasiology, 18*, 785-809.

Murray, L. L., Timberlake, A., & Eberle, R. (2007). Treatment of Underlying Forms in a discourse context. *Aphasiology, 21*, 139-163.

Thompson, C. K., Ballard, K. J., & Shapiro, L. P. (1998). The role of syntactic complexity in training wh-movement structures in agrammatic aphasia: Optimal order for promoting generalization. *Journal of the International Neuropsychological Society, 4,* 661-674.

Thompson, C. K., Shapiro, L. P., Ballard, K. J., Jacobs, B. J., Schneider, S. L., & Tait, M. E. (1997). Training and generalized production of wh- and NP-movement structures in agrammatic speakers. *Journal of Speech, Language, and Hearing Research, 40,* 228-244.

Thompson, C. K., Shapiro, L. P., Tait, M. E., Jacobs, B. J., Schneider, S. L., & Ballard, K. J. (1995). A system for the linguistic analysis of agrammatic language production. *Brain and Language, 51*, 124-129.

Table 1. Demographic and Aphasia Test Data

Measure	Participant 1		Participant 2		Participant 3	
Age	51		54		45	
Gender	male		male		male	
Education (years)	18		16		18	
Time Post Stroke (months)	40		85		36	
	Raw Score					
Western Aphasia Battery (max.)	Pre-tx	Post-tx	Pre-tx	Post-tx	Pre-tx	Post-tx
Spontaneous Speech (20)	13	14	9	13	12	17
Comprehension (200)	192	200	127	147	200	190
Repetition (100)	68	78	20	35	74	91
Naming (100)	92	83	51	56	80	76
Aphasia Quotient	74.0	80.2	44.9	58.9	72.8	86.4
Discourse Comp. Test (max.)						
Main Idea Stated (8)	8	8	8	8	6	7
Main Idea Implied (8)	6	7	7	5	8	8
Details Stated (8)	6	6	6	7	5	7
Details Implied (8)	3	6	7	5	4	8
Total (32)	23	27	28	25	23	30
Verb and Sentence Test						
Verb Comprehension (40)	39	40	20	19	39	39
Action Naming (40)	28	34	6	11	22	33
Sentence Comprehension (40)	36	31	20	22	34	38
Sent. Anagrams w. Pics (20)	20	20	11	10	17	20

[1]Standard Score with M = 10, SD = 3 based on a sample of 140 right-handed patients with left-hemisphere stroke.
[2]Standard Score with M = 100, SD = 15 based on standardization sample of 222 stroke patients.

Figure Captions

Figure 1. Sentence production accuracy (max. = 8) across trained and untrained sentence types for Participant 1.

Figure 2. Sentence production accuracy (max. = 8) across trained and untrained sentence types for Participant 2.

Figure 3. Sentence production accuracy (max. = 8) across trained and untrained sentence types for Participant 3.

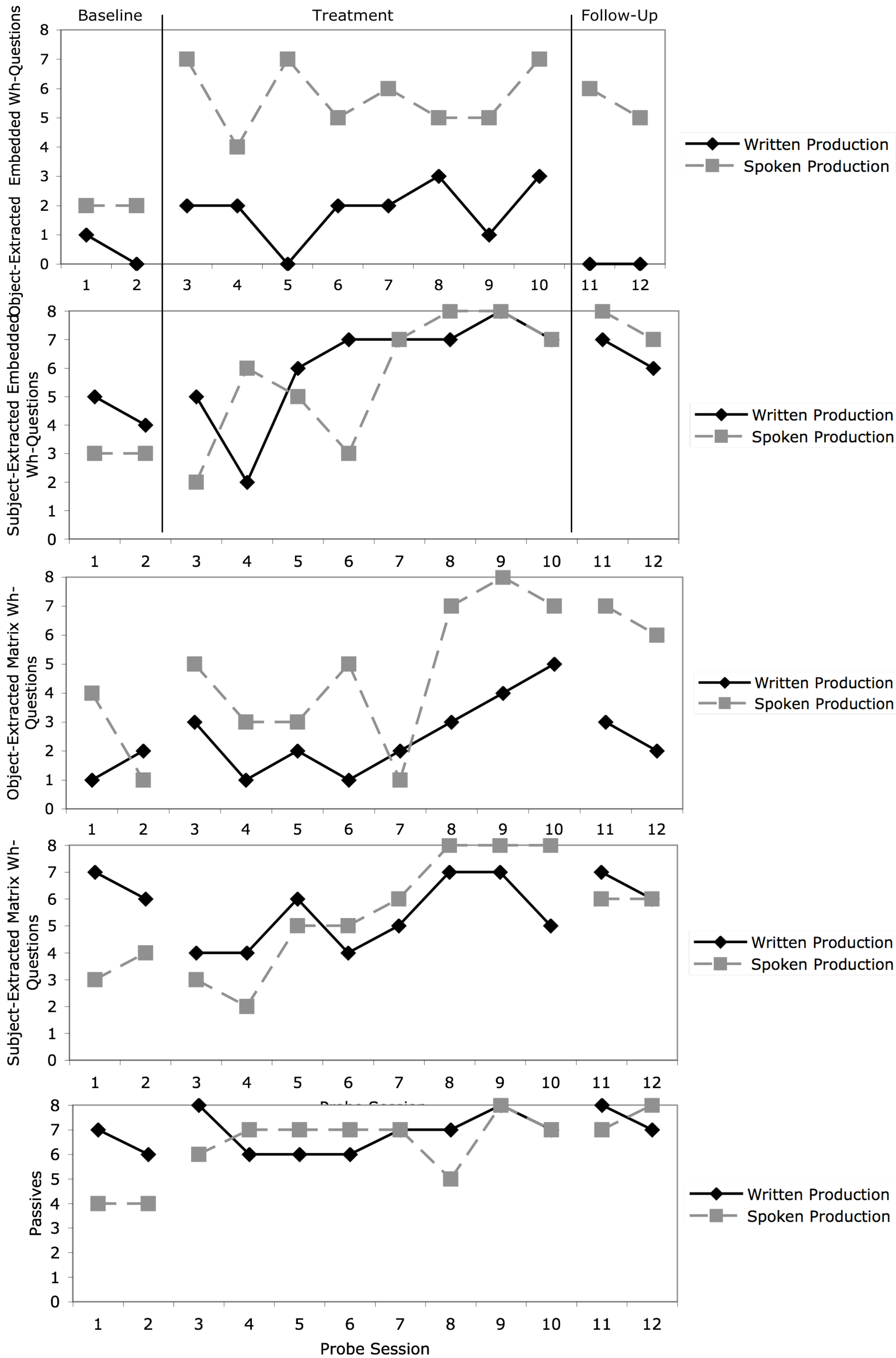

Baseline
Treatment
Follow-Up
Object-Extracted Embedded Wh-Questions
Subject-Extracted Embedded Wh-Questions
Object-Extracted Matrix Wh-Questions
Subject-Extracted Matrix Wh-Questions
Passives
Written Production
Spoken Production
Probe Session

Figure 1

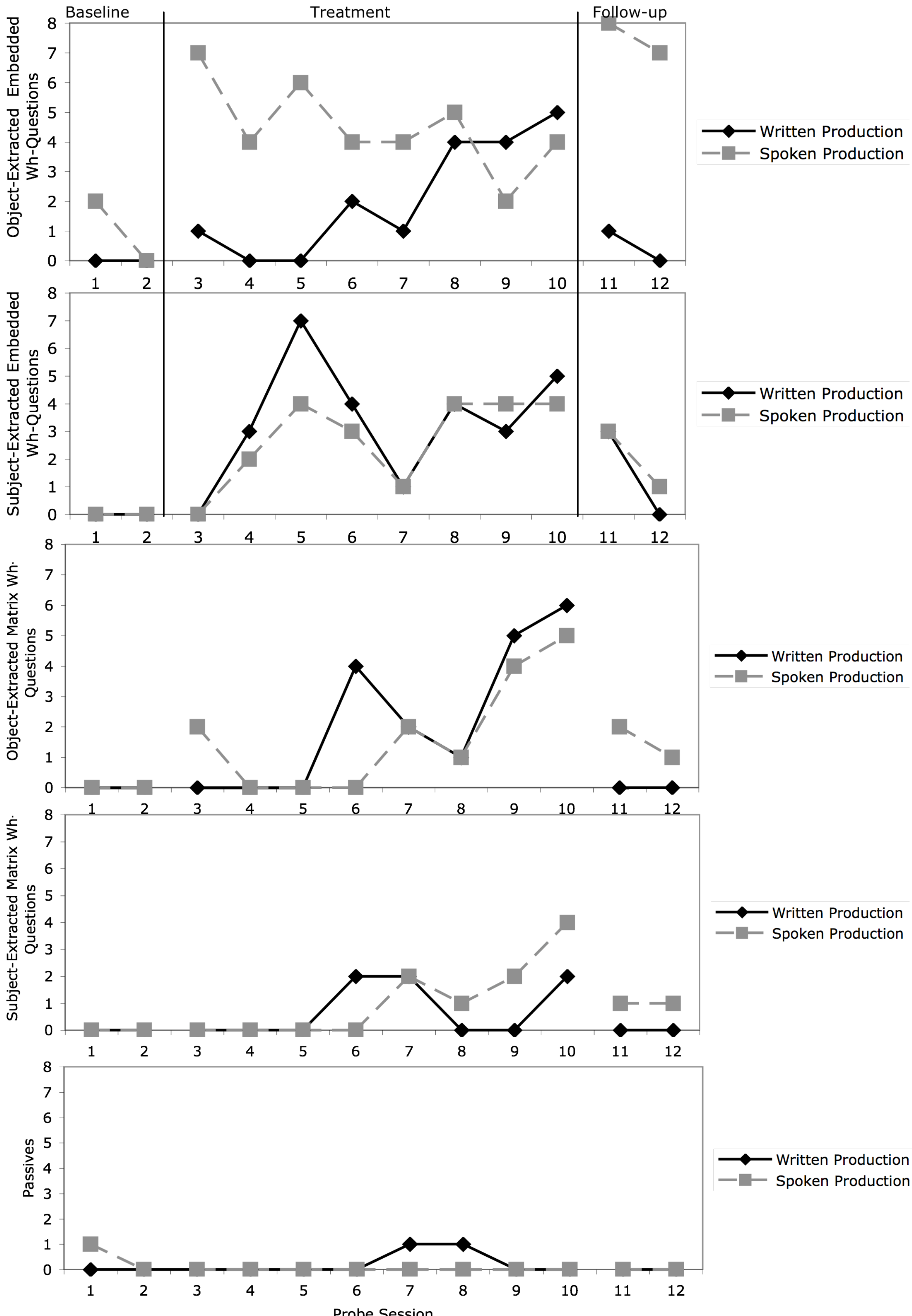
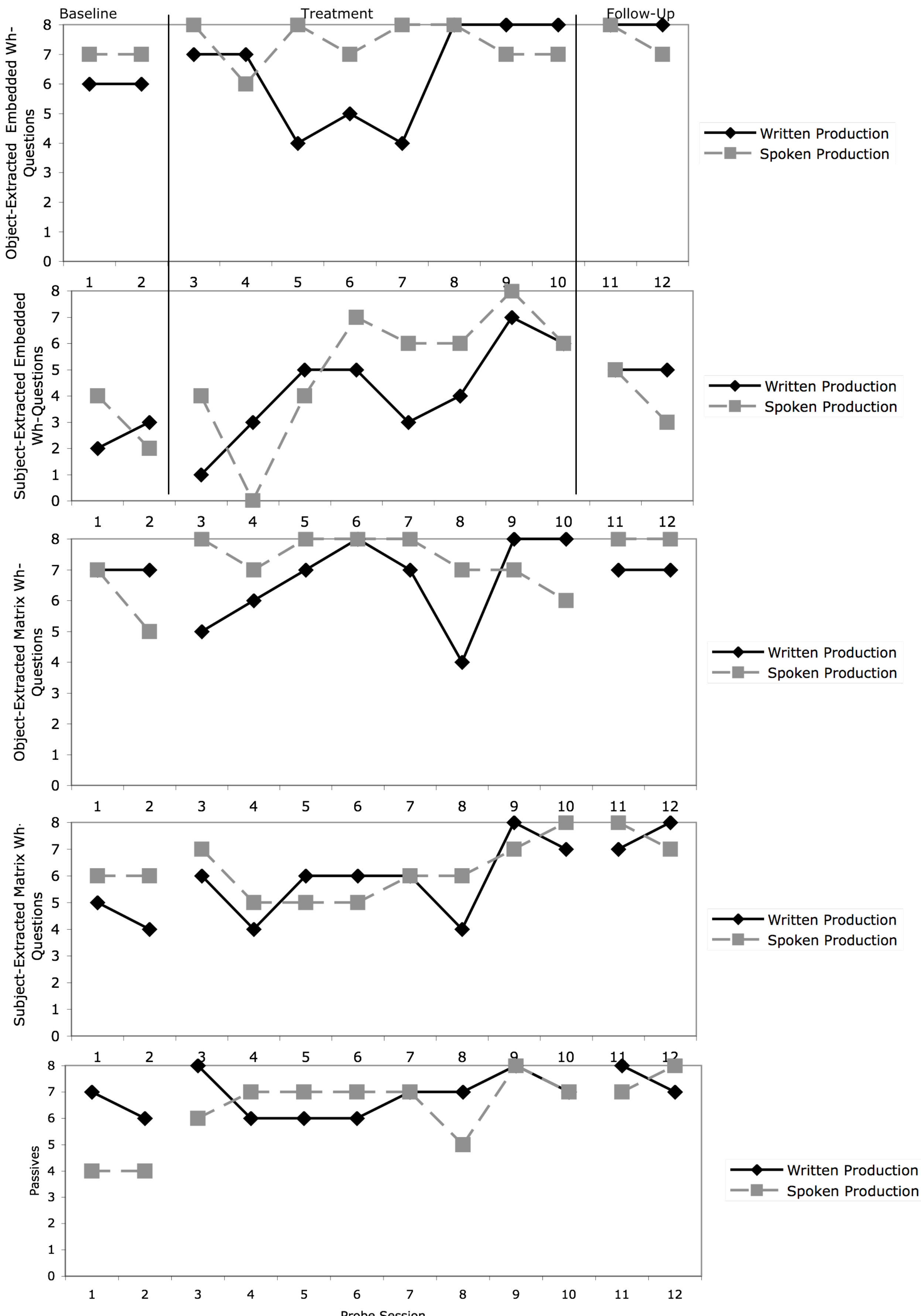

Baseline
Treatment
Follow-up
Object-Extracted Embedded Wh-Questions
Subject-Extracted Embedded Wh-Questions
Object-Extracted Matrix Wh-Questions
Subject-Extracted Matrix Wh-Questions
Passives
Written Production
Spoken Production
Probe Session

Figure 2



Baseline
Treatment
Follow-Up
Object-Extracted Embedded Wh-Questions
Subject-Extracted Embedded Wh-Questions
Object-Extracted Matrix Wh-Questions
Subject-Extracted Matrix Wh-Questions
Passives
Written Production
Spoken Production
Probe Session

Figure 3