Sentactics®: A Virtual Treatment of Underlying Forms

Abstract

This study tested the effects of *Sentactics®,* a computer-automated version of Treatment of Underlying Forms (TUF). Results showed that treatment effects derived from *Sentactics®* replicated those of clinician-delivered TUF, improving agrammatic patients' ability to comprehend and produce complex sentences and resulting in generalization to untrained linguistically related forms, of lesser complexity. Additionally, no differences were found in a comparison of the relative effectiveness of computer-delivered *Sentactics®* and clinician-delivered TUF. These results provide further support for the efficacy of the TUF protocol and demonstrate the viability of computerized therapies in the field of aphasia treatment.

Background and Rationale

Sentactics® is a computer-automated version of Treatment of Underlying Forms (TUF) (Thompson et al., 2003), which uses interactive software developed at the University of Colorado's Center for Spoken Language Research. TUF emphasizes the linguistic properties of sentences, such as verb argument structure and syntactic movement, and trains patients to construct sentences involving movement. TUF utilizes the active, declarative form of noncanonical sentences. Subjects are taught to (a) recognize the verb as well as its arguments and thematic roles in canonical (active) form, and (b) move critical sentence constituents to derive noncanonical target sentences.

Results of clinician-administered TUF treatment studies have shown that patients regain the ability to comprehend and produce trained sentence structures and show selective generalization to sentences that are linguistically related to the trained structures (Thompson & Shapiro, 1995, 1997). In addition, when more complex sentences are trained, generalization to related but less complex structures occurs, but not vice-versa (see Thompson & Shapiro, 2007 for discussion of the Complexity Account of Treatment Efficacy (CATE)).

This study tested the effects of *Sentactics®*, which uses the treatment protocol of TUF but delivers the treatment via a computerized animated agent. We also examined the relative effectiveness of *Sentactics®* and clinician-delivered TUF by comparing the present results to those derived from previous studies.

Methods

Participants

Six individuals (5 males) with chronic, stroke-induced aphasia (ages 35 to 68; mean age=50.5) participated in the study. The aphasic profile of all participants on the Western Aphasia Battery (WAB; Kertesz, 1982) was consistent with a diagnosis of Broca's aphasia (AQs ranging from 46.5 to 86.6). All exhibited agrammatic speech and were unable to comprehend and produce complex sentences with wh-movement. Eight subjects (7 males) from previously published studies (Dickey & Thompson, 2007; Thompson et al., 2003; Thompson et al., 2008), matched for aphasia severity and other variables, served as the clinician-delivered TUF treatment comparison group.

Procedures

Sentactics® was used to train comprehension and production of object relative structures two times per week, for two one-hour sessions, the same schedule used for clinician-delivered TUF. Pre- and post-treatment computerized probes measured comprehension and production of trained object relatives and untrained syntactically simpler but related wh-movement structures: object clefts and object wh-questions.

Results

Production and comprehension of the trained object relatives improved significantly from 0% correct production at pre-treatment to 90% correct production at post-treatment ($t(5)=22.5$, $p<.0001$), and from at chance comprehension at pre-treatment ($t(5)=-0.013$, $p>.05$) to above chance comprehension at post-treatment ($t(5)=3.901$, $p<.05$). Generalized production of untrained object clefts and object wh-questions also was found, which was significant for wh-question production ($t(5)=22.67$, $p<.05$), but not for object cleft production ($t(5)=2.53$, $p=.053$). Comprehension of untrained object clefts and object wh-questions also improved with object clefts improving from chance-level comprehension at pre-treatment ($t(5)=.838$, $p>.05$) to above chance at post-treatment ($t(5)=3.18$, $p<.05$); whereas comprehension of wh-questions was above chance at both pre- ($t(5)=2.608$, $p=.048$) and post treatment ($t(5)=6.177$, $p=.002$).

In comparing these findings with those derived from patients treated with clinician-delivered TUF in previous studies, we found no statistically significant differences on the trained object relatives (production: $Z=1.752$, $p>.05$; comprehension: $Z=.215$, $p>.05$) or untrained object clefts (production: $Z=1.553$, $p>.05$; comprehension: $Z=1.286$, $p>.05$) or object wh-questions (production: $Z=1.807$, p>,05; comprehension: $Z=.144$, $p>.05$).

Discussion

The results this study showed that *Sentactics*®, a computerized TUF protocol, improved production and comprehension of trained object relative structures. In addition, generalization to related but structurally less complex structures – object clefts and object wh-questions - was observed. These results replicated those derived with human-clinician delivered TUF, providing further support for the efficacy of the TUF protocol. Further, comparison of the relative effectiveness of *Sentactics*® to clinican-trained TUF showed no statistically significant differences on any production or comprehension measures. These findings indicate that computer-delivered *Sentactics*® and clinician-delivered TUF are equally effective for training sentence deficits in agrammatism. Additionally, these results reinforce the findings of a small, but growing, number of studies that extend computer software to innovative clinical intervention in aphasia (Linebarger, McCall, Virata & Berndt 2007; Cherney, Halper, Holland & Cole, 2008), suggesting that computerized treatment is a viable direction for aphasia treatment.

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