



Untrained Word Combinations and Grammatical Forms in a Newly Verbal Adult with Autism

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Abstract

The use of novel word combinations and grammatical affixes have been considered among the key features differentiating true language from simple communication. However, there is considerable controversy as to just what features are fundamental to language, and what intermediate steps might exist between basic communication and full language use. A 23-year-old previously nonverbal individual with regressive autism, who began producing meaningful sounds at the age of 14, has recently begun spontaneously producing what appear to be for him novel word combinations and grammatical suffixes (“novel” in the sense of not formally trained, and not likely to have been learned from incidental exposure) that suggest what intermediate stages may be necessary for the development of language, and in the evolution of the language faculty.

Subject

AI (not his real initials) spoke his first words at approximately 1;3; by age 1;6, he imitated words and produced a few word approximations spontaneously. However, at approximately 2;0, there was a marked decrease in social relatedness, and his vocalizations were reduced to unintelligible sounds that were felt to be non-meaningful. He was ultimately diagnosed with autism, and was considered low-functioning and nonverbal for many years. Beginning at the age of 12, AI was placed in a full-time, immersive, home-based, training program, with a wide range of activities in- and outside the home. He had extensive attempts at training visual and oral communication. He began producing meaningful sounds at the age of 14, words at 16, and by age 21.8 had utterances up to 7 words in length, as previously reported (O’Grady et al., 2005; Loughlin et al., 2010).

Methods

For the past two years, efforts have focused on increasing spontaneous speech. The methodology used is given in outline in Table 1. This methodology was developed from numerous sources in the literature [e.g., errorless learning (Terrace, 1963), inclusive plan for generalization (Carter and Hotchkis, 2002), types of feedback (Maas et al., 2008; Hula et al., 2008), effects of over-learning (Rohrer and Taylor, 2005) and least prompting (Horner and Keilitz 1975).] This training occurred within an educational program that ran full-time 5 days of the week, and also typically included 3 overnights. AI was always accompanied by at least one trained instructor; sometimes he would have two or more present

Step	Teaching Procedure	Correct Response(s)	Example	Incorrect Response(s)	Criterion	Data Collection (PDA = Personal Data Assistant)
1	Gain attention, model target word with sign + Verbal	Student looks at object and/or instructor	ex. Music is on, Instructor says “listening”, Student attends to instructor’s verbal + sign	Student is not looking at object or instructor	50 correct trials	PDA: Correct or Incorrect
2	Gain attention, model target word with sign + Verbal, HOH Prompt ASL	Student says word	ex. Music is on, Instructor says and signs “listening”, Student says and signs “listening”	Student does not say word	50 correct trials	PDA: Correct or Incorrect
3	Gain attention, model target in a two word phrase sign + Verbal, HOH Prompt ASL for target word	Student says two word phrase	ex. Student says “listening music”	Student does not say two words	50 correct trials	PDA: Correct or Incorrect
4	Manipulate the environment, use Vocabulary Prompting Hierarchy to elicit a two word phrase	Student says two word phrase	Instructor places iPod in students visual field, Student says “listen music”	Student does not say target in a phrase with at least 2 words	Reported spontaneous use one time with each instructor	PDA: Correct or Incorrect
5	Manipulate the environment, use Vocabulary Prompting Hierarchy to elicit a two word phrase	Student says two word phrase in the community	Instructor shows AI the music section at Barnes & noble’s, AI says “listen music”, AI listens to sample music on store’s headphones	Student does not say target in a phrase with at least 2 words	Reported spontaneous use one time with each instructor while in the community	PDA: Correct or Incorrect
6	Manipulate the environment, use Vocabulary Prompting Hierarchy to elicit a two word phrase	Student says two word phrase to a non instructor	AI is in a cab, instructor gives a gesture prompt, AI says “listen music”, cab driver turns on music	Student does not say target in a phrase with at least 2 words	spontaneous use directed at a non instructor in, reported one	PDA: Correct or Incorrect

The training and outcomes have been extensively documented through a variety of methods, as in the prior efforts with AI: All educational sessions have been video- and/or audio-recorded, using both focused cameras and wide-angle cameras; contemporaneous notebooks have been kept by instructors, most recently in electronic form through Personal Data Assistants (PDAs); and routine family reports on the times when the student was not in the presence of instructors. Recordings have also been reviewed by a full-time speech pathologist with the training program (EL) who has been familiar with AI’s speech for the past 3 years. In addition, AI’s father was recently interviewed about the training that goes on in the home environment, and shown examples of AI’s word- and sentence-productions to determine whether such items and constructions might have been trained outside of the formal educational environment.

Analysis

AI’s oral productions were classified into the following dimensions:

- 1) Spontaneous vs cued or prompted. “Spontaneous” productions were ones where there was no instructor cueing or prompting, either immediately or in the interval before the production occurred.
- 2) Context-appropriate vs Context- in-appropriate. This was determined by the instructor present, but could often be double-checked by review of the wide-angle video and contemporaneous notes.
- 3) Intentional vs non-intentional. This was determined by the instructor and/or others present, and based upon such features as context-appropriateness, direction of gaze and body posture, and/or pointing.
- 4) Novel versus probably novel vs explicitly trained. “Novel” was reserved for items that we felt AI could never have been exposed to, under any circumstances. “Probably novel” were items that had neither been formally trained in the educational program, nor trained in the course of his time with the family. An additional criterion was that it was felt that these were items it would unlikely he would have been exposed to incidentally. Words vs non-words (e.g., humming).
- 5) Single words versus apparent word combinations.
- 6) Word inflections.
- 7) Novel constructions: contains trained sentence frames and phrases that AI combined in a novel way.
- 8) Requests, questions, or comments..

Results

In the past two years, spontaneous productions (requests, comments, and questions) have increased in frequency from ~100/month at age 21, to ~500-1000/month at age 23.7. In addition, AI’s Mean Length of Utterance (MLU) increased from 0.6 at age 21.7 to 1.14 at age 23.7. The data and examples given below are from this two year period.

Of his spontaneous productions: there were 4 Comments that were felt to be Novel constructions. Of “Probably novel” constructions, there were 617 instances (191 unique forms). Of “Probably novel” inflections, there were 91 instances (19 unique forms).

There were no instances of his asking novel questions, but he did spontaneously ask questions using trained frames, e.g. “where remote”, “when studio”.

AI produced several conjoined words which were felt to be novel, and which were felt to have been generated by him to convey meanings he otherwise could not:

- Remotube: this may be a combination of “youtube” and “remote”
- Computube: this may be a combination of “youtube” and “computer”.

He generated a number of words that were inflected, in a format which had never been formally taught. For example:

Taught	Probably Novel
Make loud	Make louder
Loud music	Louder music
	Make louder music
Slow	slower

He extended the sentence frames he had been taught explicitly, by either substituting new words for those used in the teaching, or combining word elements into longer, meaningful units: Including comments (or indirectly making requests), e.g., “Playing too loud” and “I’m reading book.”

Taught Sentence Frame	Novel Construction
Want Tv	Want more tv
Let’s go	Let’s go school
Give phone	Give me phone
More work	Greg, more work
I want	I want small book
	I want treadmill
	I want sit on chair
Small book	Want small book
More candy	Want more candy
On hook	Put on hook
Make loud	Make louder
Eat slow	Eat slower
Want walk	Want take a walk
Give book	Give me book
Read book	I’m reading a book
I’m reading	
Give headphones	Give headphones, want music
Listen music	
Sit on couch	Sit on couch, read book
Read book	
I’m finished	I’m finished, put away in bag
Put away	
In bag	
I want help	I want help open bag
Open bag	
I’m finished	I’m finished reading book
Reading book	I’m reading a book
	I’m reading
Play music	Playing too loud
Too loud	

Discussion

This report has a number of limitations and caveats: It is a single case study. It was observational and retrospective, rather than experimental, so there were no challenges or rigorous tests. And the subject involved was atypical in a number of respects, compared to a typically developing child or what might have been expected in humanity’s ancestors. However, it is also unique in several respects: This young man did learn to speak, despite being mute for over 10 years. This by itself is extremely rare (Pickett et al., 2009). A truly unusual degree of intervention as possible, because of the attentions of a full-time speech pathologist and a full-time home-based program. Much if not most of the efforts were done in naturalistic environments, rather than laboratory-like settings. And an unprecedented amount of documentation was possible, because of the subject’s special circumstances. Therefore, we believe these data are valid, at least to a degree.

These data may therefore contribute to the debate over the precursors and characteristics of true language. What was holding AI back? What abilities has he developed to allow him to eventually produce speech? What is allowing him to generate somewhat novel word combinations, inflections, and novel combinations of sentence elements? We suspect the answer is multifactorial, and suggest several main factors: One is that his need to communicate. But this does not explain his speech production *per se*, as this factor has been relatively constant over least the last 7 years and probably longer than that. What we think is now a critical factor is that he now has not only an outlet

for communication, but one that is relatively convenient: oral speech. While he had a few signs, and been taught using a visual communication system, these were clumsy and difficult compared to oral speech, even though oral speech itself is still difficult for him to produce (because of what might be characterized as oromotor apraxia). What we suspect has been most important has been a bootstrapping process. As he has learned more vocabulary items, and more sentence frames, and as they been learned more securely, they are easier to retrieve and easier to combine, and it becomes more economical use syntactic coding. This proposal is in keeping with the hypotheses put forward by Bates and her colleagues (e.g., Bates & Goodman (1999), by Nowak et al. (2000), and by others, for the development of grammar in the individual, and in evolution. We argue in AI’s case that populating his lexicon with these elements, and the practice he has had with them, has helped him increase his working memory – his workspace – and therefore allowed him to create these combinations. We suggest that normally developing children accomplish this so apparently easily, while AI requires such effort, because normally developing children inherit the intrinsic neural substrates able to develop these functions, whereas AI must cobble them together out of neural tissue that was not endowed with such full capabilities. AI’s efforts, therefore, might replicate to some extent the efforts required by our ancestors in trying to communicate more effectively through the speech/sound channel, and establish through Darwinian trial and error the neural systems that could best aid this purpose.

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