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ABSTRACT
        This document reviews some of the indices of language
development which have been constructed since the Anderson study of
1937. In addition to the findings of Anderson, the T-unit proposed by
Hunt (1965), the measure of T-unit length and mean number of
sentence-combining transformations per T-unit developed by O'Donnell,
Griffin, and Norris (1967), the instrument for collecting comparable
samples of writing from children at var. us grade levels developed by
O'Donnell (1968), the syntactic complexity scale developed by
Endicott (1973), and the Syntactic Density Score developed by Golub
and Kidder (1974) are discussed. (HOD)

A REVIEW OF SOME INDICES OF
LANGUAGE DEVELOPMENT

by
Roy C. O'Donnell

The quest for an objective and reliable index of children's language development was begun many years ago. In a study reported nearly forty years ago, Anderson (1937) evaluated by statistical methods three indices of language development. He analyzed data on sentence length and pronoun index but was primarily interested in the subordination index that had been devised a short time earlier by LaBrant (1933).

Anderson was concerned with the generality of LaBrant's index and in the possibility of developing an easily applied and uniform measuring device. Because of such variables as composition length, subject matter, and situations in which language is used, he drew negative conclusions about generalized application of the subordination index. He recognized, however, the existence of ". . .a fertile field for the development of indices based on common subject matter, well-categorized scales, and adequate samples from the standpoint of length of passage."

Despite Anderson's findings, subsequent investigations of children's language relied heavily on mean sentence length and the subordination index; and, during the following twenty-five years, not much progress was made toward an easily applied and uniform index of language development. Techniques of linguistic analysis developed in the early 1960's however, offered new hope that such an index could be devised.

In a study of children's grammatical structures written at three grade levels, Hunt (1965) gave a critical evaluation of the traditional indices of language development and proposed some new indices. Pointing out the

fact that inadequate punctuation and indiscriminate use of <u>and</u> makes

sentence length an unreliable index, Hunt proposed a syntactic unit consisting

of one main clause and any subordinate clauses attached to the main clause.

Such a unit would be grammatically capable of being considered a sentence;

and since it would be a terminable unit, he proposed that it be called a

<u>T-unit</u>. This unit could be identified objectively, and it would not be

affected by poor punctuation. It would have the added advantage of preserving

all the subordination achieved by the student and all of his coordination of

words, phrases, and subordinate clauses. It would not preserve the student's

coordination of main clauses; but, as Hunt pointed out, excessive coordination

of main clauses might be a sign of immaturity rather than maturity. Thus,

the elimination of coordinated main clauses from the syntactic unit to

be used in language development studies would be a gain rather than a loss.

Hunt called attention to the fact that LaBrant counted coordinated

verbs as separate clauses; he contended that only a structure with a subject

and a finite verb should be regarded as a clause. Then, having identified

a syntactic unit more useful than the sentence and having limited the

definition of the clause, Hunt proposed a revision of the subordination

index. He proposed that, instead of dividing the number of subordinate

clauses by the total number of clauses as LaBrant had done, the total number

of clauses should be divided by the number of main clauses. This procedure

would give the mean number of clauses per T-unit, which could be converted

into the ratio of subordinate clauses to main clauses.

Hunt computed these proposed indices for the materials analyzed in

his study and found statistically significant increases in T-unit length,

clause length, and number of clauses per T-unit from grade four to grade

eight to grade twelve. He pointed out that these three measures are

interrelated. T-units can be lengthened by either or both of two means:

(1) lengthening clauses or (2) increasing the number of subordinate clauses.

His analysis, based on techniques of transformational-generative grammar,

revealed that syntactic complexity of children's language is reflected in

both clause length and number of clauses per T-unit. Hunt demonstrated that

T-unit length could be computed by multiplying words per clause by number

of clauses per T-unit. Since T-unit length incorporated the other two

indices, it seemed evident that T-unit length would be a useful index of

structural complexity of language.

O'Donnell, Griffin, and Norris (1967), in their study of children's

syntax, computed both mean T-unit length and mean number of sentence-

combining transformations per T-unit. Their rationale for the latter measure

is stated in part as follows:

> There are transformational rules which designate operations
> affecting two underlying strings so as to join them or embed
> one in the other. The process is often called generalized
> transformation, but it is also referred to as sentence-combining
> transformation, because its effect is to produce one sentence
> where otherwise there would have been two (p.16).

> Except for coordination of main clauses, sentence-combining
> transformations may be conceived as embedding one kernel sentence
> (often, though not always, in reduced form) into another in ways
> determined by the rules of grammar. This embedding increases
> the information carrying power of the resulting construction.
> It may well be supposed, then, that at least for children, the
> relative density of these transformations within T-units signalizes
> the degree of maturity attained (p.50).

These investigators found a positive correlation between increases
in number of words per T-unit and number of sentence-combining transformations
per T-unit. Since the two measures appeared to be of comparable value
as indices of language development, they indicated a preference for mean
T-unit length because it was easier to compute. They concluded that "mean
length of T-units has special claim to consideration as a simple, objective,
valid indicator of development in syntactic control" (pp. 98-99).

In order to see whether the indices Hunt proposed could be computed
from smaller writing samples, O'Donnell (1968) devised an experimental
instrument for collecting comparable samples of writing from children at
various grade levels. This instrument required the rewriting of a passage
composed of simple declarative sentences. Subjects were asked to rewrite the
passage, putting the short sentences together to make longer sentences of
varying degrees of structural complexity.

Data resulting from use of the sentence-combining instrument indicated
that both clause length and number of clauses per T-unit increased together
at the lower grade levels, but that clause length alone accounted for most
of the growth in complexity at higher grade levels. Since T-unit length
is accounted for by a combination of the two factors, T-unit length was
judged to be more useful than either of the other two measures alone as an
index of growth in structural complexity over a wide age-range.

In commenting on the results of his study, O'Donnell pointed out both
the potential value and the limitations of these indices of language development:

> Although it is evident that clause length, T-unit length and
> number of clauses per T-unit increase with advance in grade,

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there are no data to show how consistently these indexes
measure the structural complexity of an individual student's
writing in various situations (p.6).

But in spite of their limitations, these indices (particularly T-unit length)
were subsequently used in numerous studies of children's language development.

Another limitation, obvious to anyone who has attempted to analyze
the structure of children's language, lies in the fact that indices based
on mean length of syntactic units do not discriminate among the various
ways length can be achieved. The T-unit is more satisfactory in this
respect than the sentence, but the T-unit can be lengthened in a variety
of ways, some of which require a great deal more linguistic maturity than
c hers. The desire to find a more discriminating index of language
development has motivated researchers to attempt to develop other indices
of structural growth.

One index that appears to have potential capacity to reflect differences
in degree of complexity is that proposed by Endicott (1973). He accepts
the T-unit as a consistent and useful research tool and offers a psycho-
linguistic definition of the T-unit as: "the extent to which a child
combines units of complexity in language involving suspension of thought
and mental manipulation of syntactic structures before he breaks off and
begins again" (p.6).

Endicott advances a theoretical model intended to allow the defining
of units of syntactic complexity in psycholinguistic terms. This involves
the development of a rationale for defining such units, which he hopes will
result in a scale of syntactic complexity that will be useable by researchers
in language development, psycholinguistics, and readibility. Endicott's

theoretical model is based on transformational and morphemic analyses,

since he considers the manipulation of transformations and the suspension

or production of morphemes as phases of mental operations.

The units Endicott proposes to use in constructing the syntactic

scale are defined below.

> Co-meme: A unit of complexity in language consisting of four sub-
> categories: The base co-meme, the syntactic co-meme, the compression
> co-meme, and the morphemic co-meme.

> Base Co-meme: Those morphemes expressed at a level of language which
> has a one morpheme per-word ratio.

> Syntactic Co-meme: A theoretical syntactic operation by which sentences
> are combined or altered to achieve efficiency or variation of purpose
> beyond that achieved at a minimal level of language.

> Compression Co-meme: The theoretical morphemic burden of deep structure
> which is compressed into surface structure through combination or
> deletion transformations.

> Morphemic Co-meme: Morphemes other than those expressed by base
> co-memes, i.e., "The productivity was low." "Productivity"
> represents one base co-meme: "product," and two morphemic co-
> memes: "ive" and "ity" (p.7).

The point of reference for Endicott's scale is what he calls a minimal

level of language, defined as "a sentence which contains no optional

transformations and which, barring tense morphemes, represents a one-

morpheme per-word level" (p.7). He proposes to consider phrase structure

rules and obligatory transformations only when necessary to adjust the

scale for non-standard dialects.

Application of the proposed scale for syntactic complexity is illustrated

by examples. The sentences The cloud was ominous and The cloud was black

are given as examples of the minimal level of language, i.e., one morpheme

per word (Endicott does not explain why he regards _ominous_ as a single
morpheme). At the minimal level, there is only one co-meme per word and
the complexity ratio of each of these sentences is 4/4. _The_ black cloud
was ominous has a complexity ratio of 9/5, since it is regarded as a
combination of the base co-memes of the two constituent sentences plus
the co-memes involved in the combining transformation. Specifically,
the sentence is regarded as having five base co-memes, three compression
co-memes (one each for _the, cloud,_ and _was_ which are "superimposed"),
and one syntactic co-meme. The higher complexity ratio of the latter
sentence is regarded as resulting from the application of a syntactic
resource beyond the minimal level of language.

Compounding _The man walked a mile_ and _The boy walked a mile_ to produce
The man and the boy walked a mile results in a complexity ratio of 12/8.
The co-meme count includes eight base co-memes, three compression co-memes,
and one syntactic co-meme. _The beaten team left the field_ is regarded
as resulting from the transformational combining of _The team left the field_
and _Someone beat the team._ The complexity ratio of 12/6 is explained by
reference to the base co-memes and the several syntactic co-memes associated
with the passive, deletion, and adjective transformations involved. The
genitive in _The boy's dog is a spaniel_ is accounted for by combining
The dog is a spaniel and _The boy has a dog._ The complexity ratio of 11/6
for the resulting sentence is explained as follows:

> Count one syntactic co-meme, one base co-meme, one compression
> co-meme for the deletion of "has", two compression co-memes for
> the superimposition of "dog" and "the", and one morphemic
> co-meme for the possessive inflection. The count is six
> co-memes for a genitive (p.11).

To emphasize the usefulness of the scale as an indicator of level
of maturity, Endicott contrasts Their imaginative resourcefulness was a
productive factor with The brown dog was a good dog, both of which have
a T-unit length of seven words. The former sentence, which obviously
represents a relatively high level of language maturity, has a complexity
ratio of 24/7; the latter sentence has a complexity ratio of 15/7.

Endicott recognizes the possibility that various interpretations of
a transformational analysis of language might be applied in the derivation
process. He says the derivation of values is equivalent to exercising the
predictive function of the theory. Thus, if researchers disagree on
particular derivations, their differences can be resolved by comparison
of predictions and research results. He also recognizes the necessity
of isolating a familiarity factor for each structure, since lack of
familiarity with words or syntactic operations may block comprehension.
He suggests the possibility of determining the difficulty factor for
structures by means of cloze techniques.

Another approach to devising a discriminating linguistic index is
reported by Golub and Kidder (1974). Their Syntactic Density Score also
involves T-unit analysis. It reflects measures of T-unit length and sub-
ordinate clause length and also takes into account uses of complex verb
phrase expansions and various kinds of embedded structures.

Golub and Kidder report that the first step in developing this
measure of syntactic density was to determine how children use specific
syntactic structures and which ones seem to predict whether their writing

will be rated nigh, medium, or low by their teachers. The items included
in the score were selected from sixty-three structures which had been
subjected to multivariate analysis. The variables selected were those
which correlated highly with teachers' ratings of written language samples.
Canonical correlation analysis was performed to assign relative weights
to variables according to their contribution to syntactic density.

The Syntactic Density Score incorporates ten items, including words
per T-unit, subordinate clauses per T-unit, words per main clause, words
per subordinate clause, number of modals, number of be and have forms,
number of prepositional phrases, number of possessives, number of adverbs
of time, and number of gerunds, participles and unbound modifiers. Each
item is assigned a loading, ranging from .20 for words per main clause to
.95 for words per T-unit. The loading for each item is multiplied by
frequency, and the resulting products are summed and divided by the total
number of T-units. The quotient is the Syntactic Density Score, which
can be converted to a grade level equivalent. A score of .5 is equivalent
to grade level 1, and a score of 10.9 is equivalent to grade level 14.
Each grade level differs from the one below it by a Syntactic Density
Score value of .8.

The researchers indicate that a 500 word language sample can be
scored in about thirty minutes, but for greater convenience they have
written a computer program, which they have found to be satisfactorily
accurate and consistent. They believe the computerized scoring process
has a number of valuable uses:

The computer program is useful for classroom teachers who want
to diagnose entering behavior levels and subsequent performance
levels of their students and to match these levels with reading
materials used in class. Examination by a teacher of English
of the subscores of a class of students gives an indication of
strengths and weaknesses that can guide the teacher's planning
of objectives and procedures. The Syntactic Density Score of
the variety of novels, textbooks and other reading materials
used in specially designed mini-courses or performance-based
curriculums can be determined quickly, accurately, and inexpen-
sively (p.1131).

Golub and Kidder recognize that their measure quantifies only the

syntactic aspect of language, and they report that they are attempting to

prepare a vocabulary intensity index which will make it possible to present

a more precise picture of language development.

The indices of language development devised by both Endicott and

Golub appear to have greater capacity to discriminate among various kinds

of syntactic constructions than do indices such as mean length of T-units,

mean length of clauses, and mean number of subordinate clauses per T-unit.

Upon close examination, however, a critical observer can hardly avoid

concluding that the quest for an efficacious index of language development

is not yet ended.

Endicott's proposed scale of syntactic complexity seems to be based

on an early stage of transformational theory, and he apparently believes

in the psycholinguistic reality of transformational processes. Perhaps

The beaten team is more complex than The brown dog, and perhaps the

difference can be explained by differences in the number of transformational

processes involved in the derivation of the sentences. But it seems quite

unlikely that The beaten team is any more complex conceptually than The

new team, a structure which would get the same complexity ratio as The

brown dog. Likewise, it is hard to see how His dog is any more complex than
The dog, but the latter structure gets much less weight on the syntactic
scale. Probably nobody would argue that Their imaginative resourcefulness
was a productive factor is not a complex structure, but it is not at all
certain that the complexity can be accounted for by the number of morphemes.
Even if number of morphemes is a valid indicator, analysts are likely to
encounter occasional difficulty in deciding what to count as a separate
morpheme. For example, why shouldn't ominous be counted as omen + ous?
And how many morphemes are there in advertised detergents?

Thus, while it is obvious that Endicott's proposed scale has the
capacity to discriminate one type of structure from another, it is not
so obvious that it would always discriminate in the right direction. The
proposed scale probably merits the kind of testing by researchers that Endicott
calls for, and perhaps it will prove to be self-correcting. It may be that
the familiarity factor can be dealt with in a satisfactory manner, but it
appears that a great deal of work remains yet to be done.

Golub's Syntactic Density Scale also has considerable capacity to
discriminate types of structures, and it appears to have been developed
by empirical procedures. The items included, however, appear to be highly
redundant. For example, words per T-unit results from the combined effects
of number of clauses and length of clauses, and length of clauses results
in part from the remaining items on the scale. Although the statistical
procedures may be impeccable, it appears that some arbitrary decisions were
made in assigning weights. For example, it is difficult to see why participles
should have a loading of .85 when prepositional phrases are valued at only .75.

Indeed, it is difficult to see why all prepositional phrases should be assigned the same weight since they differ widely in the difficulty level of concepts they represent.

Although Golub's measure has more statistical evidence of validity than Endicott's, it seems likely that the Syntactic Density Score is less precise than it appears to be, particularly when it is converted to grade level equivalency. Given the diversity of individual writing styles, the diverse demands imposed on language by different situations, and other factors yet unknown, it is hard to see how grade equivalence based on a Syntactic Density Score could be used with a high degree of confidence.

Since neither Golub nor Endicott specify how large a sample of writing is needed and how many modes of discourse it should represent, it may be that these specifications have not yet been worked out. If so, O'Donnell's comment on the limitations of earlier measures is still applicable: "there are no data to show how consistently these indexes measure the structural complexity of an individual's writing in various situations."

In spite of the limitations cited above, however, there is little doubt that if the language sample is large enough and diverse enough both Golub's and Endicott's measures will reveal developmental differences in syntactic complexity of language. Since both of them involve rather complex and expensive procedures of analysis, however, it seems appropriate to raise the question of how much better they are than the grosser measures of T-unit length, clause length, and number of subordinate clauses. For if the language sample is large enough and diverse enough, there is little doubt that these less precise measures will also reveal developmental differences in language

complexity. It may turn out that in spite of lack of precision T-unit length is still the most useful and useable index of syntactic development over a wide age-range and that mean clause length is the best single measure of syntactic complexity at the high school level and beyond. The research required to find out how the various indices compare with one another ought to be done.

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