TRANSCRIPTION AS A TOOL FOR UNDERSTANDING:
THE BERKELEY TRANSCRIPTION SYSTEM FOR SIGN LANGUAGE
RESEARCH (BTS)

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“What is on a transcript will influence and constrain what generalizations emerge.”  
—Elinor Ochs (1979, p. 45)

Introduction

Transcription is the very start of a linguistic analysis of a corpus. In this respect, the transcribing of sign language data is not different from transcribing data from any other language, although systematic linguistic research on sign language is less than half a century old. Stokoe’s “chirology” (sign phonetic/notational system) appeared in 1960. This means that there is hardly any notational tradition to build on. Although Miller (1994) has provided the field with family trees of notational systems, including more recent technologically based ones, the basic problem is that there is hardly agreement on what constitutes a linguistic unit in sign languages.

Of course, transcription is not the first set of choices that a researcher is confronted with: one must begin with data. The conditions for data gathering in this young linguistic discipline have not been established, and there is a general need for a more ethnographic approach than appears to be the practice. In this paper we will restrict ourselves to issues of transcribing videotaped data of sign language interactions with preschool-age children. In addition, the fact that most sign languages are not standardized, and have not been adequately described, leads to the reliance on the linguistic intuitions of a small number of native signers. Thus we are dealing with a language type that we still know very little about, whatever the linguistic level one wants to analyze. Our proposals for transcription are based on the need for developmental analysis of signing, with attention to units of meaning and conversational interaction.

The system presented here is the product of the Berkeley Sign Language Acquisition Project, developed in research meetings from 1998 to 2001.¹ Our raw data consist of about 400

¹ The Berkeley Transcription System (BTS) represents the collective work of Michelle Anthony, Yael Biederman, Nini Hoiting, Marlon Kuntze, Reyna Lindert, Jennie Pyers, Dan I. Slobin, Helen Thumann, and
hours of videotapes of signing deaf children and their Deaf and hearing interlocutors in home and
preschool settings in the Netherlands and the United States. The research goal is to document
quantitative and qualitative differences in adult input and children’s uptake. The data include
both Deaf parents and hearing parents who are acquiring a sign language. Thus the input is often
imperfect, and the data represent both children acquiring a first language and adults acquiring a
second language. Apart from selecting the relevant sequences of interactive signing from our
naturalistic data, our more problematic concern was to capture the linguistic and communicative
elements being used by these children and their parents. The basic research question is: How do
children and parents construct shared meaning in their communicative patterns? Given these
goals, a transcription at the level of basic elements of handshape, movement, and location would
be too fine-grained. The widespread practice of “glossing” would also be inappropriate, since this
would bias our analysis to issues of translation into a spoken language. (The inadequacy of
glossing was made immediately obvious to us when we confronted English glosses of American
Sign Language with Dutch glosses of the Sign Language of the Netherlands.) Our theoretical
interest is at the level of meaning components—that is, the ways in which semantic elements are
combined into lexical items and utterances. The fact that we have to deal with a language that
uses simultaneous and successive manual and nonmanual means to structure signed messages,
set us the task of how to devise a transcription system that would capture the full array of
meaning components in sign languages. We considered it essential to capture these
components—manual and nonmanual, conventional and gestural—without prejudging their
formal linguistic status. In our opinion, we must first have a full documentation of linguistic
behavior before we can ascertain whether particular types of components are standardized signs
or gestural accompaniments, and whether particular forms are productive in the use of an
individual signer. This enterprise resulted in the design of the Berkeley Transcription System
(BTS) for signed languages, presented in detail below.

Transcription as theory and as technology

Elinor Ochs (1979), in an important paper written a quarter-century ago, brought the issue of
transcription to the attention of child language researchers. She underlined the facts that “the
transcriptions are the researcher’s data” and “transcription is a selective process reflecting
theoretical goals and definitions” (p. 44). These points are especially relevant to sign language

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Institute for the Deaf “H. D. Guyot”, Haren, The Netherlands, and by the Max Planck Institute for
Psycholinguistics, Nijmegen, The Netherlands. The system has been developed on the basis of parent-child
videotapes in Sign Language of the Netherlands (SLN), collected by Nini Hoiting, and American Sign
Language (ASL), collected by Reyna Lindert. The current version reflects the consensus of a workshop
held in Berkeley, April 12-13, 2000, based on examples from American Sign Language, Danish Sign
Language, Sign Language of the Netherlands, and Nicaraguan Sign Language. In addition to the
investigators listed above, the workshop included Paul Dudis, Elisabeth Engberg-Pedersen, Philip Prinz,
Brenda Schick, Ann Senghas, Richard Senghas, Eve Sweetser, David Wilkins, and Alyssa Wulf. We have
been especially helped by the four native ASL-signers in our group, Marlon Kuntze and Paul Dudis (Deaf),
and Jennie Pyers and Helen Thumann (hearing).
research today. The sign languages used by Deaf people gained recognition as languages when a notation system was made available. Within the anthropological attempts to transcribe the sign languages used by Plains Indians of the United States, LaMont West (1960) laid the notational foundation that Stokoe (Stokoe et al., 1976) used and improved to represent the combinatorial structure of the signs used by the American Deaf population, hereby claiming the linguistic status of American Sign Language (ASL). Stokoe’s notational efforts were supported by the use of film and photo, providing detailed depictions of the systematically structured sublexical components that seemed to be the building blocks of the lexical signs of ASL. This early stage of notation clearly shows the theoretical impact of transcription, in that it made a clear claim for a formational, “phonological” level in sign languages. That is, signs are systematically put together from component elements of handshape, location, and movement, in the same way that words are systematically composed of articulatory/acoustic elements. The support of the notations by still photographs of handshapes provided precise documentation of the proposed units of analysis. With the rapid developments in video technology—now digitized and accessible to computer processing—we have fully adequate documentation of the physical and temporal parameters of sign languages.

Nevertheless, although there are dozens of lexicons of various sign languages from around the world, and a few partial sign grammars, in the year 2001 there are still basic linguistic problems to solve in this field. One of the remaining puzzles that concerns us here is the determination of the components that construct form-meaning relationships in space and time. On the lexical level, comparable to the word level in spoken languages, we do know something about the units of many sign languages. However the morphemic level is still a hotly debated issue, and it is this level in particular—in acquisition—that we want to know about in more detail. We are concerned with the learner’s mental processes of analyzing events and signed utterances into components, with the aim of producing and comprehending utterances in communicative contexts.

Sharing the Data

The goal of all transcription is to produce a permanent written record of communicative events, allowing for analysis and re-analysis. In the field of sign language research, many researchers have had to work in isolation from other projects, due to a lack of standard transcription formats and an internationally accessible database, such as has been available for many years in the field of acquisition of spoken languages (MacWhinney, 2000). At the start of our project we made a clear decision: We wanted our data to be archived and publicly accessible for sharing, discussing, and other types of scientific analysis or re-analysis. That is, a major goal of BTS is to provide resources for other researchers, now and in the future. Therefore, we aim at a standard means of representing the data of sign language acquisition, across research projects and sign languages. Furthermore, given the expectation of new developments in the field, as well as varying research goals, we aim at a system that is open to revision and applicable to a range of analyses and theoretical approaches. It will come as no surprise, therefore, that the worldwide CHILDES system came to mind as our inspiration.

That system has provided child language researchers with a common format for transcription and analysis of data, along with a large and growing archive of materials from a large number of spoken languages.² The system describes itself in the following terms (CHILDES url, 2001):

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² CHILDES is available on a North American website organized by Brian MacWhinney (http://childes.psy.cmu.edu/), on a European mirroring site organized by Steven Gillis (http://atila-
“The CHILDES system provides tools for studying conversational interactions. These tools include a database of transcripts, programs for computer analysis of transcripts, methods for linguistic coding, and systems for linking transcripts to digitized audio and video.”

BTS has joined CHILDES, where it is available as Chapter 11 of the online CHAT manual, as well as in the published version (MacWhinney, 2000). Current versions and continuing discussion of BTS are available on a website organized by Brenda Schick (http://www.Colorado.EDU/slhs/btsweb/). The rationale for BTS can be found in Slobin et al. (2001). Our eventual goal is to contribute our sign language transcriptions, in BTS, to the CHILDES archive. For this reason, BTS adheres to CHAT format, allowing the international community to access and search sign language data using the CLAN software tools provided by CHILDES.

Challenges of Transcription

Every publication on sign language has to decide on the appropriate level of analysis and means of representing handshapes, locations, movements, and information conveyed by face and posture. Representations of signs range from detailed notation of physical elements, through pictures and diagrams, to glosses in the written language of one country or another. In most instances, such representations cannot be reduced to the ASCII keyboard—a prerequisite to international data-sharing on the CHILDES model.

Stokoe began the modern era of sign language linguistics by developing a sort of “phonological” transcription, though his terminology is in some ways more appropriate: “Analogous with the phoneme is the sign language chereme (CARE-eem, the first syllable from a Homeric Greek word meaning ‘handy’)” (Stokoe et al., 1976, p. xxix). His system requires a large collection of idiosyncratic symbols, although Mandel has reduced them to an ASCII version (http://world.std.com/~mam/ASL.html). Another phonological transcription system, using only ASCII characters, is SignPhon (http://www.leidenuniv.nl/hil/sign-lang/signphon2.html). There are several modern attempts to represent signed languages on the level of formational components such as those first isolated by Stokoe. These systems make use of sets of iconic symbols for handshapes, locations, movements, and nonmanual elements, and provide special keyboards and related computer facilities:

- HamNoSys: http://www.sgn-lang.uni-hamburg.de/Projekte/HamNoSys/default.html
- Sign Writing: www.SignWriting.org
- SignFont: http://members.home.net/dnewkirk/signfont/

All of these are useful for various purposes, including detailed linguistic analysis as well as first-language literacy for Deaf children. However, none of them is at the level of analysis

3 In the analysis of both spoken and signed languages, linguists distinguish a phonetic level, which is concerned with the basic articulatory units of production, and a phonological level, which is concerned with the combinatorial patterns of such basic units according to the rules of a given language.

4 To save space in this publication, we refer the reader to online facilities that represent each of the notation systems mentioned.
required by our sort of research, and most of them cannot function without special fonts. In any case, this level of transcription is too fine-grained for our purposes—that is, transcription and analysis of children’s acquisition of lexicon, morphology, and syntax. Stokoe’s system and its derivatives correspond most closely to the International Phonetic Alphabet (IPA), while child language transcriptions in the CHILDES database tend to be at the morphological level or in ASCII versions of the available orthographies used by the various spoken languages represented in the archive. Although study of the acquisition of sign language phonology is clearly of great importance, BTS is concerned with morphosyntactic, semantic, and pragmatic dimensions of language.

The first detailed sign language study by Klima and Bellugi (1979), and many others since, have used line drawings that are free drawings or modifications of tracings taken from videotapes. For the grammatical uses of the basic handshapes involved in a signed utterance, little diagrams of the signing space are frequently added. This is, however a quite inefficient technique, both in terms of time and expense. Also, different perspectives on the execution of ongoing signing hands requires techniques such as strobe-like drawings and arrows—again time consuming and expensive. Abstracted drawing, as shown in Zeshan’s (2000) new concise study of Indo-Pakistan Sign Language, is a creative solution, solving the perspective issue by using a computer program for graphic presentations of signs. However, all such “picture” versions (including actual photographs and digitized video clips), are useless for computer-aided searching, sorting, and summarizing of data.

The most popular and traditional way of transcribing sign language is the use of glosses in capital letters, supplemented by various diacritics and discursive notes. This sort of transcription may seem to have the advantage of being a shared system, although every individual researcher seems to bring in new diacritics, given their research questions and the language they are dealing with. And, again, a mixed system of glosses and diacritics is inaccessible to computer programs of the sort used in child language research. More seriously, the glosses represent the nearest translation equivalent in the spoken language of the particular community, making it impossible to carry out serious linguistic analysis of the sign language itself. For example, in beginning our comparisons of acquisition of SLN and ASL, we were immediately struck by the fact that similar signs expressing desire in the two languages were glossed as an adverb in Dutch (GRAAG ‘gladly, with pleasure’) and as a verb in English (WANT). Clearly, neither of these words is a lexical element of SLN or ASL. Just as no linguistic analysis of a spoken language relies solely on glosses in the language of the investigator, linguistic analysis of a sign language requires representation at the level of the meaning components of that particular language.

**Transcription at the level of meaning components**

Even a cursory examination of verbs in any sign language makes it evident that we are dealing with a sort of “polysynthetic” language that is quite different from the spoken languages of the surrounding communities. Those languages—be they as different from one another as English or Finnish or Chinese—do not demonstrate the morphological complexity of verbs that is found in such languages as SLN or ASL. To find somewhat comparable examples in spoken languages it is useful to turn to indigenous languages of North America. Consider, for example, Leonard Talmy’s (1985) work on Atsugewi, a Hokan language of northern California. The verb roots in this type of language designate figures of particular shapes, postures, and consistencies, e.g.:
lup- ‘small shiny spherical object’
caq- ‘slimy lumpish object’

The roots take locative/directional suffixes, such as:

-ak ‘on the ground’
-mić ‘down onto the ground’

Polymorphemic combinations are similar to those of verbs of motion and object transfer in sign languages. Consider, for example, the Atsugewi construction: s-’w-it’-mić. The first three morphemes indicate a first-person subject in factual mood. The last two identify the postural figure and movement:

it’ ‘linear_object_in_lying_posture’
mić ‘move_down_onto_ground’

Glossing at this level of analysis is sufficient to indicate the morphological components of the verb. BTS, as demonstrated below, takes a similar approach to components of signs. In addition, following linguist practice, Talmy provides a discursive translation in English:

s-w-’it’-mić ‘I lay down onto the ground’

BTS is not concerned with this sort of paraphrase, except as a possible additional comment for clarification. Nor does BTS present simple glosses in English (or Dutch, or whatever) for signs that are clearly polycomponential. Rather, the goal is to represent those components of complex signs that can be productively used to create meaningful complex signs in the particular sign language under investigation. That is, BTS is intended to be the equivalent of a morpheme-by-morpheme analysis, with a collection of abbreviations designed for signed languages. (Signs that cannot be analyzed into evident meaning components are transcribed in traditional upper-case format, such as BOOK in ASL.)

Polycomponentional verbs in BTS

We will present one extended example of the level of analysis that has been developed in BTS, and then will discuss applications to the study of first- and second-language development. Verbs of motion (self-movement, caused-movement, object transfer) are polycomponential, including handshapes or body parts that indicate the figure and/or ground involved in the motion event. These verbs have traditionally been designated as “classifier predicates” (e.g., papers in Emmorey, 2003; Valli & Lucas, 1992). That is, the handshapes for figure and ground are components that specify, or “classify” a relevant semantic property of the corresponding referential entities. BTS treats “classifiers” as property markers—that is, handshapes that identify a referent by indicating a relevant property of that referent (for justification, see Slobin et al., 2003).5 For example, an “inverted V” handshape is transcribed as pm’TL (two-legged

5 ‘While various categories of polycomponential signs can be proposed, our work has focused on alternative conceptualizations of “classifiers.” Rather than emphasize classification as the central feature of “classifier” handshapes in polycomponential signs, it seems more useful to treat them as marking a relevant property of a referent. The major function of such a handshape is to evoke a relevant referent in discourse, indexing a particular referent according to properties that are appropriate for the current discourse. That is,
In essence, verbs of motion in signed languages (at least in ASL and SLN, the languages we have worked with in detail), consist of components of ground, figure, path, and various additional movement elements indicating features such as aspect and manner. Such verbs cannot be directly glossed in English, or the other Indo-European languages that are characteristic of the surrounding speech communities that have been most extensively studied. Consider, for example, an ASL verb with the following components, with BTS conventions in parentheses: the non-dominant hand is held vertically, with flat palm, fingers extended forward (pm’PL_VL ‘plane showing vertical length’); the dominant hand is in an inverted-V position (pm’TTL ‘two-legged animate being’) and it moves to a goal at the top of the non-dominant hand (gol’PL_VL TOP ‘move to top of vertical plane’) to straddle the hand (pst’STR ‘posture straddle’). This verb could refer to a range of events, such as a cowboy mounting a horse or a boy sitting up on a fence. It can be represented as a verb with four meaning components (“morphemes”), as indicated by four hyphens.

.pm’PL_VL-pm’TTL-gol’PL_VL_TOP-pst’STR

Note that the linguistic status of each meaning component is given in lower-case letters (pm, gol, pst), while upper-case letters indicate the semantic content of each component. (As mentioned above, upper-case letters are also used for unanalyzed signs, allowing for separate searches for morphological and lexical elements combined.)

This is, in fact, a sufficient transcription linguistically, but it lacks legibility—at least for hearing readers. We would like to be reminded of a comparable English verb, but we do not want such a gloss to influence our transcription or analysis. To solve this problem, BTS allows the transcriber to begin a verb with a parenthetical, lower-case possible equivalent. Thus one might type:

(mount)-pm’PL_VL-pm’TTL-gol’PL_VL_TOP-pst’STR

The parenthetical gloss is not a conventional part of the system, and each transcriber can provide a suitable equivalent. For example, this verb could also be glossed as (get_up_on_horse) or (mount_straddling), or whatever seems useful to the transcriber. The parenthetical glosses stand outside of the analyses, and function only to facilitate reading.

If more contextual detail is needed, it can be provided on a dependent tier, under the utterance line. For example, one could add a “gloss” tier (%gls). Following CHILDES format, the utterance line begins with an asterisk and an identifying code for the speaker in three upper-case letters, while dependent tiers begin with a percent sign and lower-case ID:

*MOT: COWBOY (mount)-pm’PL_VL-pm’TTL-gol’PL_VL_TOP-pst’STR .
%gls: the cowboy got up on the horse’s back

the “classifier” handshape designates, or specifies, or indicates a referent with a particular property (e.g., two-legged, horizontal plane, etc.). In the Berkeley Transcription System such handshapes are designated as property markers (pm)” (Slobin et al., 2001).
The transcription is thus based on linguistic analysis, often resulting in initially non-obvious decomposition of complex signs. Note that this work cannot be done without the active participation of native signers. At almost every point in the development of BTS, the native signers in our group have helped us to discover contrasts, nuances, and possibilities that may not have been evident to second-language signers.6

Segmentation of a sign into meaning components depends on the availability of contrasts in the language. For example, our analysis of ‘mount’ is based on the possibilities of substituting the ground component (e.g., by use of a horizontal plane to indicate movement onto a different sort of ground), the figure component (e.g., by reference to an animal, such as a cat, mounting a horse), and the posture component (e.g., by contrast with a person standing on a horse’s back). The search for contrasts is essential to the analysis, and contrasts are not always obvious without careful examination of a range of potential scenarios and their signed descriptions.

To continue the demonstration of this method, note that ‘mount’ is part of a collection of verbs that have a derivational relationship with one another, as revealed by the addition or removal of a meaning component:

- If the path component (-gol-) is replaced by a static component (-loc-) the result is a verb describing a static configuration:

\[(be\_mounted)-pm^1PL\_VL-pm^2TL\_loc^1PL\_VL\_TOP-pst^1STR\]

Again, the parenthetical gloss is not part of the analysis. This verb could describe a man seated on a horse, a boy seated astraddle on a fence, etc.

- If a movement pattern (-mvt-) is added to ‘be_mounted’ the resulting verb is dynamic: ‘ride’. BTS is not concerned with a phonological description of this particular movement pattern, because it does not contrast with other movement patterns using this configuration of property markers: Its only function is to indicate that this configuration has the meaning of ‘ride’. Therefore we simply designate the forward rotational movement of this verb as mvt^1LEX, where LEX refers to the movement pattern that identifies this particular verb. That pattern is pointed to parenthetically: mvt^1LEX(ride). (This is similar to spoken language transcriptions, such as transcriptions of English verbs as ‘walk-PAST’ or ‘run-PAST’, where the reader can provide walked or ran on the basis of knowledge of the language.) With regard to the parenthetical gloss, note that ASL has a different verb for riding in a vehicle, so we indicate the verb we are transcribing here as ‘ride_mounted’:

\[(ride\_mounted)-pm^1PL\_VL-pm^2TL\_loc^1PL\_VL\_TOP-pst^1STR-mvt^1LEX(ride)\]

- Once we have a dynamic verb of motion, we can then add further components of manner and aspect. For example, the following extended notation indicates that the referent event was rapid (-mod^1RAP) and that it came to a stop (-asp^1CES ‘cessive’):

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6 In our Berkeley group there are three native ASL signers: Marlon Kuntze, who is Deaf, and Jennie Pyers and Helen Thumann, who are CODAs (hearing offspring of Deaf parents: “Child of Deaf Adult”). In the Netherlands, Nini Hoiting works with several native SLN-signing Deaf colleagues at the Royal Institute for the Deaf “H. D. Guyot” in Haren: Bottie Reitsma, Annemarie Terpstra, and Diny Visch, who are Deaf, and Ari Terpstra, who is a CODA. We are grateful for the linguistic insights and expert advice of all of these collaborators.
(ride_mounted)-pm’PL_VL-pm’TTL-loc’PL_VL_TOP-pst’STR-mvt’LEX(ride)-mod’RAP-asp’CES

It is important to note that these relationships are not evident in the standard English glosses for each of the ASL verbs discussed above. That is, if one relied on glosses as the central element of transcription, there would be no reason to see the regular relationships that hold between three verbs that describe a human being mounting, straddling, and riding a horse: GET_ON, BE_LOCATED, and RIDE.

Sign language researchers with experience in typological linguistics should not be surprised by the elaborateness of BTS transcriptions of polycomponential verbs. Such relatively opaque morpheme-by-morpheme glosses are familiar in papers dealing with a wide range of agglutinative and polysynthetic languages, as discussed with regard to Atsugewi, above. Polycomponential verbs are quite accessible to children learning spoken languages of this type. Consider the following example from Inuktitut, spoken by an Eskimo child of 2;6. Here we have an entire sentence in one polycomponential utterance (Allen, 2000, p. 495).

```
ma -una -aq -si -junga
here -VIALIS -go -PROSPECTIVE.ASPECT -PARTICIPIAL.1SG
'I’m going through here.'
```

Note that the morpheme-by-morpheme gloss (what-consume-NOM-former-be-IND.1SG) is uninterpretable without knowledge of Inuktitut, just as BTS utterance-line transcriptions are uninterpretable without knowledge of the particular sign language. Because BTS is designed for investigators who know the sign language, however, the utterance line should generally be sufficient. The use of a `%gls line, like the line in single quotes above, is always available for clarification.

**Nonmanual components of signs**

A defining feature of signed languages is the use of the face and/or body to add meaning to signed utterances. BTS transcribes four distinct types of nonmanual components. These can occur simultaneously with a single sign, or can have duration (scope) over several signs. In many transcription systems, a horizontal line drawn above glosses of signs indicates the temporal scope of a nonmanual component. BTS restricts itself to a series of ASCII characters, using the carat (^) to indicate temporal onset and offset of a nonmanual component that has scope. The four types of nonmanual components are operators, modification, affect, and discourse markers:

- A grammatical operator has scope over a phrase or clause (negation, interrogation, topic, relative clause, conditional, etc.). The notation is `^opr’X ... ^`. For example, the following transcription format indicates negation of a proposition in BTS:

  *CHI: ^opr’NEG WANT BOOK ^.
Modification can add a dimension to the referential meaning of a lexical item or proposition by means of noncanonical articulation of the sign and/or accompanying facial expression, such as augmented or diminished size, rate, or intensity. The notation is \(^{\text{mod}'} X \ldots ^{\text{mod}'^2} \). For example, an SLN-signing 2-year-old wanted her mother to draw a big house. She greatly extended the sign HOUSE (AUG = augmented):

\[
*\text{CHI: HOUSE-}^{\text{mod}'\text{AUG}}.
\]

In this example, the nonmanual component is part of a single sign. There is no offset carat because such a nonmanual ends with the end of the sign. Of course, modification can also extend over sequences of signs.

Affective accompaniment to signing is provided by use of mouth, face, and body, indicating the signer’s attitudinal stance towards the situation being communicated (e.g., disgust, surprise, excitement). The notation is \(^{\text{aff}'} X \ldots ^{\text{aff}'^2} \). For example, an SLN-signing teacher asks a child to do something and the child agrees, though with some worried concern (PNT_1 = point to self):

\[
*\text{CHI: }^{\text{aff}'\text{WORRIED CAN PNT}_1} ^{\text{aff}'}.
\]

Note that affective information can be provided in spoken languages by prosody, as well as by affective particles and inflections. We think it appropriate to include all meaning components in our transcription, without prejudging their “linguistic” status.

Discourse markers regulate the flow of interpersonal exchange, such as checking if the addressee has comprehended, has agreed, and so forth. These sorts of nonmanual components correspond to discourse particles and intonation contours in spoken languages; again, BTS includes them in the complex of meaning components. The notation is \(^{\text{dis}'} X \ldots ^{\text{dis}'^2} \). In the following example, a Deaf SLN-signing mother responds to her 2-year-old’s labeling of the lights on a picture of an ambulance. Note that there are two types of nonmanual elements in this utterance. The first is an operator, indicating confirmation (YES); the second is a discourse marker checking whether the child agrees (CONF = confirmation check). The operator (repeated head-nodding) extends throughout the utterance, including the discourse marker (a sort of questioning facial expression). The offset timing of the two non-manuals coincides (\(^{\text{\text{dis}'^2}}\)).

\[
*\text{MOT: }^{\text{opr}'\text{YES CAR } ^{\text{dis}'\text{CONF LIGHTSIGNALS}}} ^{\text{opr}'^2}.
\]

Role shift

A pervasive aspect of sign language communication is the subtle shifts of gaze and posture that allow the signer to convey the utterances, thoughts, or actions of other people. This part of sign language needs much more careful study, and BTS does not present a fine-grained analysis of role shift at this time (see, e.g., Emmorey & Riley, 1985; Engberg-Pedersen, 1993; Liddell, 1998; Taub, 2001). However, we do consider it to be a meaningful dimension, and one that follows conventional, linguistic patterns. At this point, we simply indicate role shift by RS. Note that we use capital letters for this element, treating role shift as a meaning component in an utterance. We do not use the carat (\(^\)) to indicate onset and offset of role shift, because we want to search
separately for nonmanual features and role-shifting. Instead, we use the reverse apostrophe (left single quote, grave accent,) for this function: ‘RS ... ’. For example, in a book-reading activity, a Deaf ASL-signing mother points out a picture of a dog, and then role shifts into the dog to indicate that the dog is excited. She signs EXCITE with an accompanying non-manual indicating the dog’s affect (INTENSE). The notation ‘RS(dog)’ indicates that she has taken on the role of the dog. Note that ^aff can co-occur with role shift.

*MOT: DOG ‘RS(dog) EXCITE^-aff‘INTENSE ’.

Polycomponential analysis and the issue of morphological productivity

BTS relies heavily on criteria of morphological productivity for the analysis of a sign into components. That is, the level of transcription is based on a thoroughgoing analysis of signs into meaning components. To the extent that we have succeeded for a particular sign, this is a contribution to linguistic description. We are well aware, however, that children who are learning a language may not yet have carried out the adult analyses reflected in the transcription. This problem is a familiar one in child language research, where it is well known that children’s early forms may be “amalgams” or unanalyzed gestalts that correspond to more complex and analytic adult forms. The only way to determine if a particular morphological analysis is productive for a given child is to try to find evidence of productivity. Such evidence is available in two forms: (1) One can search the corpus for uses of a given morpheme across lexical items and contexts, looking for diversity in use. Overgeneralizations are particularly informative; for example, when an English-speaking child says “breaked” we have evidence for the productivity of the past-tense inflection. (2) One can present the child with new lexical items (often nonsense, or “nonce” terms made up for experimental purposes), putting them in contexts that should elicit a particular morpheme if it is productive. For example, if an English-speaking child is presented with a nonce verb, wug, and says that someone “wugged” yesterday, we have evidence for productivity (e.g., Berko, 1958).

The same issue of rote-learned versus productive forms applies to the acquisition of signed languages. The purpose of the detailed componential analysis embodied in BTS is to make it possible to discover, for a particular child, when there is sufficient evidence to credit the child with control of various components of signs. The advantage of detailed analysis is that it pushes us to describe the language carefully, and makes us sensitive to critical dimensions of acquisition.

Notations of communicative behavior, context, and additional coding

BTS is designed for studying the development of signing within the context of ongoing communication; therefore there are means of noting attention-getting devices and gestures and actions that are relevant to communicative events. Gestures (%ges) and actions (%act) can be entered as part of the utterance line, or on a dependent tier, at the discretion of the transcriber. In our preliminary transcriptions of parent-child interaction with 2-year-olds, we have often found it useful to include such information on the utterance line. For example, an SLN-signing 2-year-old is looking for a pen. The child gestures that she “doesn’t know”; signs WHERE; and then looks around the room. The mother shows the pen to the child and signs FIND.

*CHI: [%ges: don’t know] WHERE [%act: looks around room] ?
*MOT: [%act: shows pen to chi] FIND .
BTS also provides means of indicating factors that are relevant to analysis of child signing, with notation conventions for gaze direction, errors, interruptions. For example, errors are noted by [*], with further information on a dependent tier (%err). In the following example, an ASL-signing child of 1;9 signs HORSE with a handshape error. For this analysis, the transcriber is not concerned with the phonology of the error and simply notes on the error tier that there was a handshape error ($hs); however, another transcriber might have added a dependent tier for phonological notation (%pho).

*CHI: HORSE [*].
%err: HORSE $hs;

In addition, following CHILDES format, dependent tiers can be created for additional information and coding (e.g., morphology, syntax, vocalization, situation, etc.). For example, a hearing ASL-signing mother is signing to a 3-year-old; the comment tier (%com) provides the transcriber’s clarifications:

*MOT: ^opr’Q SISTER ^?
%com: asking if girl doll is sister
*MOT: SISTER PNT_3 WHO PNT_3 ?
*MOT: ^opr’NEG NOT SISTER ^ NO .
%com: commenting on mislabeling of doll as SISTER

Using BTS to study sign language acquisition

We have been using BTS in the United States and the Netherlands to transcribe signed utterances produced by children between the ages of 18 and 38 months, Deaf and hearing parents, and Deaf and hearing preschool teachers. In order to provide an idea of research applications of BTS, we present several examples from our recent paper, *A cognitive/functional perspective on the acquisition of “classifiers”* (Slobin et al., 2003; see Lindert [2001] for a detailed report of the use of polycomponential predicates by ASL-using children and their Deaf or hearing parents).

*Early uses of handshapes in polycomponential verbs*

As discussed above, BTS treats “classifiers” as *property markers* that reference entities on the basis of salient object properties, manner of manipulation, or by the use of fixed forms (“whole entity classifiers”). For purposes of demonstration, consider two types of handshapes that are based on properties involved in manipulation (“instrumental classifiers,” “handle classifiers,” “manipulators”):

- *manipulative handle*: The handshape represents the hand that is manipulating an object (e.g., ASL property marker for ‘screwdriver’, using a rotating S-handshape for the grasping hand);
- *depictive handle*: The handshape represents a physical feature of the object being manipulated (e.g., ASL property marker for ‘screwdriver’, using a rotating H-handshape for the tip of the screwdriver).

We expected that manipulative handles would be acquired earlier than depictive handles, both for our L1 (child) learners and our L2 (hearing parent) learners. BTS transcripts of both SLN and ASL, however, showed early use of both types, by L1 as well as L2 learners.
**Manipulative handles.** BTS transcribes property markers of this sort in a preliminary way, using an abbreviation for the physical form of the handshape involved. This is because we cannot yet determine the semantic categories underlying the use of such handshapes. By indicating the handshape in physical terms, we are able to search individual transcripts to determine the range of uses of a particular handshape. With sufficient data, these preliminary physical descriptions can be replaced by semantic definitions of manipulative property markers. Thus the transcription format allows for search of the contexts—linguistic and situational—in which individual meaning components are used. For example, a Dutch girl of 2;6 is seated on the floor with her hearing mother, looking through family photos. She describes a picture in which she is seated in a baby buggy being pushed by her father. The manipulative handle component of the verb ‘push’ is realized as two S-hands, palms down, arms straight, incorporated in a forward motion. The property marker is transcribed as a form of hold (pm’HO), with an indication of the handshape using designations derived from the ASL hand alphabet (pm’HO_S); a parenthetical 2h indicates that this is a two-handed form. The direction of the sign is represented by a path component (pth) that is realized as forward motion (pth’F):

*CHI: FATHER PNT_1 (push)-pm’HO_S(2h)-pth’F .

Dependent tiers could provide further information, such as a description of the situation, a paraphrase (e.g., ‘father push me’), and perhaps more detailed description of handshape form and orientation and the physical movement of the signer.

Our transcripts show that hearing parents also make early and appropriate use of manipulative handle property markers. The hearing mother of this Dutch girl had been using SLN for eight months when she produced the following utterance. The girl had put a doll to bed in a toy cradle. The mother tells her to close the curtains around the cradle, moving two S-hands in a closing arc towards her own chest. The path of movement is backwards, and the hands move toward each other (pth’B_EO):

*MOT: (close)-pm’HO_S(2h)-pth’B_EO .

With a large corpus, it will be possible to search for all instances of property markers such as pm’HO, and all instances of pm’HO_S, in an attempt to determine the semantic dimensions and productivity of property markers, as well as their developmental changes. Note, too, that the use of hyphens between components allows for a calculation of sign complexity. In these two examples, both verb signs have two meaning components—a manipulative handle and a path. Parenthetical glosses (‘push’, ‘close’) are not included in quantitative analyses; they only serve to aid legibility.

**Depictive handles.** Property markers of this sort are transcribed in terms of the salient dimension of the referenced entity—e.g., whether it is a plane, a stick-like object, a cylindrical object, and so forth. For example, consider an utterance dealing with placement of a thin, flat object. The handshape is a horizontal flat 5-hand, palm down, which BTS treats as a horizontal plane (pm’PL_H). A Dutch girl of 2;11 comments to her mother about putting a flat rubber alphabet letter into the corresponding puzzle space. She points to the space, indicated by a 3rd-person point (PNT_3) followed by a parenthetical indication of the aim of the point, and then moves her hand to that object as a goal (gol):

*CHI: PNT_3(puzzle_space) (put)-pm’PL_H-gol’OBJ(puzzle_space) .
BTS counts elements that are separated by spaces as lexical items; thus there are two lexical items in this utterance. The second item has two meaning components; thus there are three “morphemes” in this utterance. However, we prefer to withhold the linguistic label “morpheme” until we have done much deeper corpus analysis, along with more extensive linguistic work.

The transcription system also makes it easy to pick up nonconventional uses of meaning components (“errors”). For example, an American girl of 2;6, learning ASL from Deaf parents, is also signing about the insertion of a flat piece into a puzzle. In this case, the piece is a disc, which would be treated as two-dimensional in ASL. The child, however, uses a cylinder handshape (pm’CYL), moving it downwards, palm to the side, to make contact with the puzzle board. An asterisk in square brackets indicates that this is an error from the point of view of the adult language, and an asterisk within the polycomponential verb indicates the location of the error. A dependent tier (%err) identifies the nature of the error: that this is a property marker error, in which CYL should have been a flat disc (FD), indicated by a dollar sign ($pm = FD).

*CHI: (put)-pm’CYL*-gol’OBJ(puzzle) [*].
%err: CYL $pm = FD

A dependent tier for comments (%com) could add the transcriber’s ideas about this utterance—for example, the task of inserting the piece into a puzzle may have highlighted its three-dimensional quality to the child; or perhaps this is a phonological error, reflecting lack of fine digit control. With a sufficiently large corpus, a search for errors can be useful in revealing acquisition strategies and problems.

**Problems of mastering polycomponentional signs beyond the early phases**

Our data on the acquisition of both ASL and SLN show that by age 3, children are adept at integrating handshapes into polycomponentional signs, along with other meaning components. Their hearing parents also have productive control of these basic morphological structures. However, there is much more to be learned, and even 12-year-olds do not use the entire set of options with the skill and flexibility of native-signing adults. Our preschool videotapes consist almost entirely of short utterances in dialog, with support from present context and adult scaffolding. In the school years, by contrast, children are faced with the demands of extended discourse, often monologic, and often without support in the physical context. This is especially clear in narrative productions, where the signer has to create a spatial and temporal scenario and maintain reference to individuals and events while shifting perspective. In our California research, the school-age narrative data of Michelle Anthony, Marlon Kuntze and Philip Prinz highlight these issues (Anthony, 2002). BTS transcriptions have enabled us to identify several classes of linguistic and discourse problems faced by children beyond preschool:

- **Establishing reference:** Who is acting? What other entities are involved?
- **Specifying ground:** What are the reference points for location and movement?
  - **Ground as anchor:** What part of the ground is a constant background? When and how does it change?
  - **Scale of ground:** What viewpoint is taken (close up zoom, distant view, lifesize, etc.)?
  - **Flexibility of focus:** Where is the signer’s attention, and how does it move from utterance to utterance?
• **Choosing from among multiple perspectives:**
  
  - **Shifts in narrator’s perspective:** From what angle is an event being signed?
  
  - **Shifts between perspectives of narrator and one or more protagonists:** Whose perspective is being used from utterance to utterance?

  BTS transcriptions of narrative discourse are complex, and we present only one example, to give a brief indication of the extension of the system beyond our preschool data. In Kuntze’s recordings of a kindergarten story circle, a girl of 5;0, with Deaf parents, is telling the group about a vacation trip. In the following utterance, she is relating an attempt to crawl through a small opening, but she has trouble with the scale of the opening in relation to the figure (presumably her own body), and she has not specified what kind of opening this was. She uses a property marker indicating that the ground was a round opening, using an F-handshape (pm’CIR) on one hand, and indicates that the moving figure was human, using a V-handshape for *two legs (pm’Tl)* on the other hand. Here she has run into a problem of relative scale of the two handshapes: the ground is represented as a view from the distance, while the figure represents a close-up view. This lack of correspondence between the scales of figure and ground property markers leads to an articulatory problem, because she cannot fully fit the figure through the space in the ground, as she presumably intended to do. Therefore pm’CIR is marked with an asterisk as an error; an adult signer would probably choose a C-handshape (pm’CYL) for the ground, allowing pm’Tl to move through it. The BTS transcription also indicates that the posture of the figure was reclining (pst’RCL); that the handshape was oriented towards the signer’s body (ori’B); that the motion was carried out with a *wiggling* movement (mvt’WIG); and that the goal of the motion was the interior of the circle (gol’INT_CIR). Thus this polycomponential verb has six components:

  *CHI: (crawl)-pm’CIR-pm’Tl-pst’RCL-ori’B-mvt’WIG-gol’INT_CIR [*].
  
  %err: CIR $pm = CYL

**Conclusion**

The Berkeley Transcription System has given us a tool to look into the component structure of signs, with all of their simultaneous manual and nonmanual features. BTS is based on linguistic analysis of each sign language being studied, and is continually open to revisions as linguistic descriptions improve. It is also open to revision in response to insights about child language, as well as challenges of computer technology. We have succeeded in keying BTS transcripts to timecodes of analog videotapes, and are beginning to explore digital resources.

It is evident from analysis at the level of meaning components that child L1 learners, as well as adult L2 learners, quickly grasp the polycomponential nature of sign language and use meaning components productively in complex signs. This form of transcription also allows for detailed exploration and documentation of learners’ mastery of the full morphosyntactic, semantic, and pragmatic structures of sign language. Although we are only at the beginning, it seems to be a highly promising first step. We welcome participation from the international community of sign language researchers, and look forward to criticisms, advice, and collaboration.
References


