Language Documentation and Standards in Digital Humanities: TEI and the documentation of Mixtepec-Mixtec

Jack Bowers

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Jack Bowers

jack.bowers@oeaw.ac.at

https://github.com/iljackb/Mixtepec_Mixtec

Austrian Center for Digital Humanities (ACDH)

Inria

École Pratique des Hauts Études - Paris

INVENTEURS DU MONDE NUMÉRIQUE

ÖAW AUSTRIAN ACADEMY OF SCIENCES

Mixtepec-Mixtec (Sa'an Savi)

- Sa'an Savi '*rain language*'
- ISO 639-3 code: 'mix'
- (Family): Oto-Manguean, Mixtecan, Mixtec-Cuicatec, Mixtepec-Mixtec

• San Juan de Mixtepec Juxtlahuaca district (Oaxaca, MEX) (also spoken in Puebla & Guerrero states)

• Spoken data mostly collected in sessions working with speakers from a small village called Yucunani in the San Juan Mixtepec municipality

•status "vigorous" (source: Ethnologue 21st edition)

•Estimated +-7,611 speakers; *Source: INEGI (2010); (though probably several thousand more when considering speakers in US)*

Has been studied by:

- *Pike and Ibach (1978); Paster and Azcona (2004-2007); Beckman and Nieves-SIL (2005-current)*

On Mixtec Languages

- 52-85 Mixtec varieties! (Padgett, 2017); (Simons & Fennig 2017) & (INALI 2015:132-147)
- Unclear (possibly undefinable) boundaries between linguistic variant typology
- Tonal, most have at least 3 level tones
  - MIX has: L, M, H, F, R, *FR, *RF
- Varieties of Mixtec polysemy, spatial semantics and body part terms provide key examples to cogntive linguistics theory, particularly for language change and it's link to conceptualization (cf: Brugman, 1983; Brugman and Macaulay, 1986; Hollenbach,1995; Johnson, 1987; Lakoff and Johnson, 1989; Langacker, 2002; Bowers, 2016 (http://bit.ly/2FnsKPU); Bowers (forthcoming))

Desired Outcomes

- Create an open source body of reusable and extensible collection of multimedia language resources in the Mixtepec-Mixtec language
- Further the knowledge of all aspects of the language itself
- Demonstrate and evaluate the application of encoding and standards on an under-resourced non-Indo-European language
- Produce and publish empirical corpus-based descriptions and analyses of various aspects language's features
- Demonstrate and test the application and utility of descriptive features from cognitive linguistics such as those used to describe Mixtec in the literature in the annotation of the corpus
- Collect enough data so that it can be of help for speakers and potentially learners in using their language and creating more content
- Compatibility w/: LMF reserialization; TEI Lex-0; Ontolex-Lemon

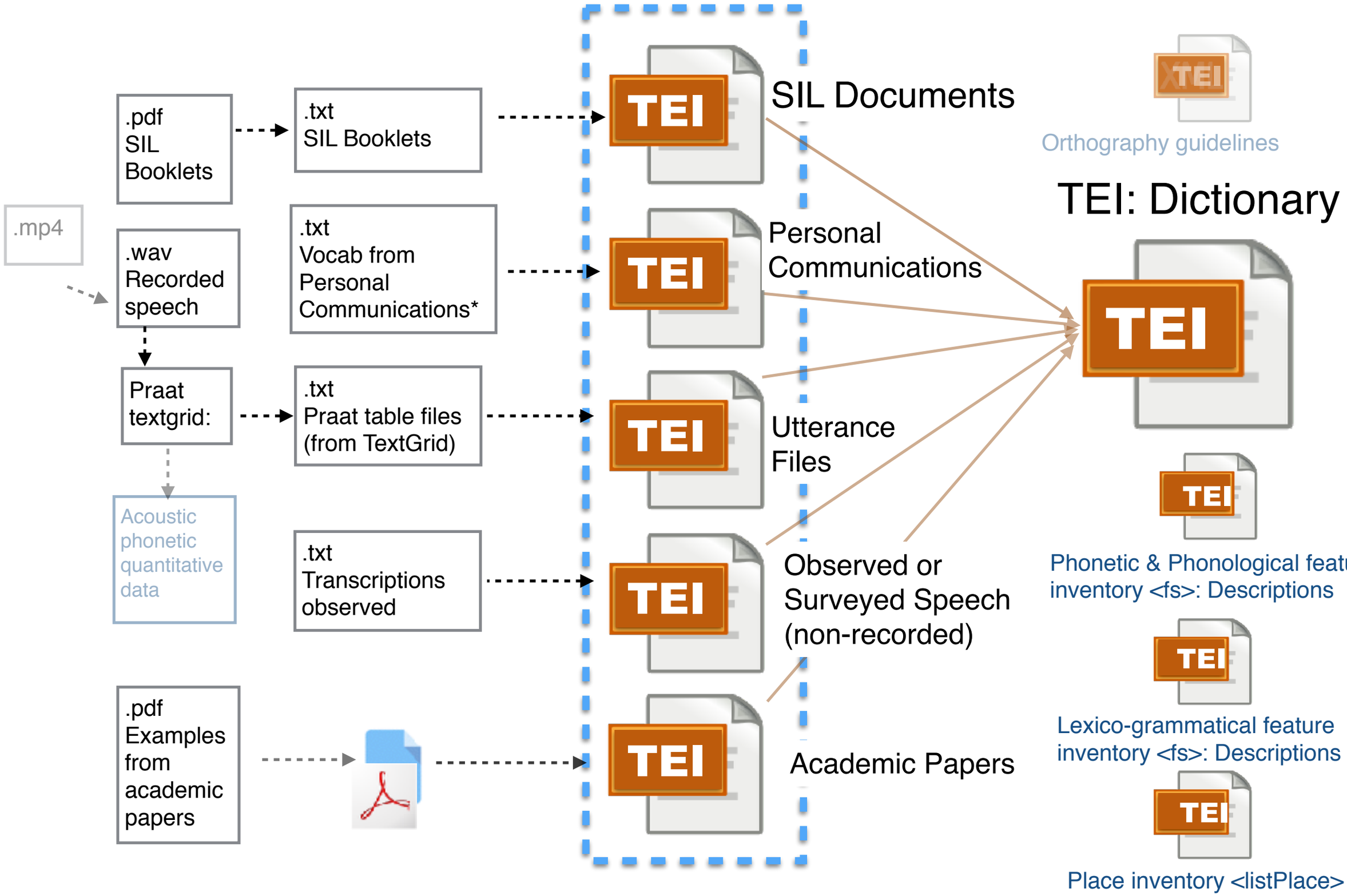
Primary Sources of Mixtepec-Mixtec Language Data

- Consultation w/ Speakers *(+- 600 recordings, written content)*
- Recordings made by speakers with other speakers
- Written content from speakers
- +-36 Children's Booklets *(Summer Institute of Linguistics Mexico)*
- Public Sources *(YouTube,etc.)*
  - Small number of papers *(phonology, some morphology)*
- Personal communications
- Public information pamphlets by Mexican government (new!)
- Videos by Conserva México Facebook page (new!)

Specific TEI Output

- New Mixtec language content
- Searchable TEI corpus
- TEI dictionary
- Time aligned utterance annotated files
- Annotated TEI files of SIL booklets
- Lexical feature inventory
- Phonetic feature inventory
- Concepts inventory
- Place inventory
- Person list

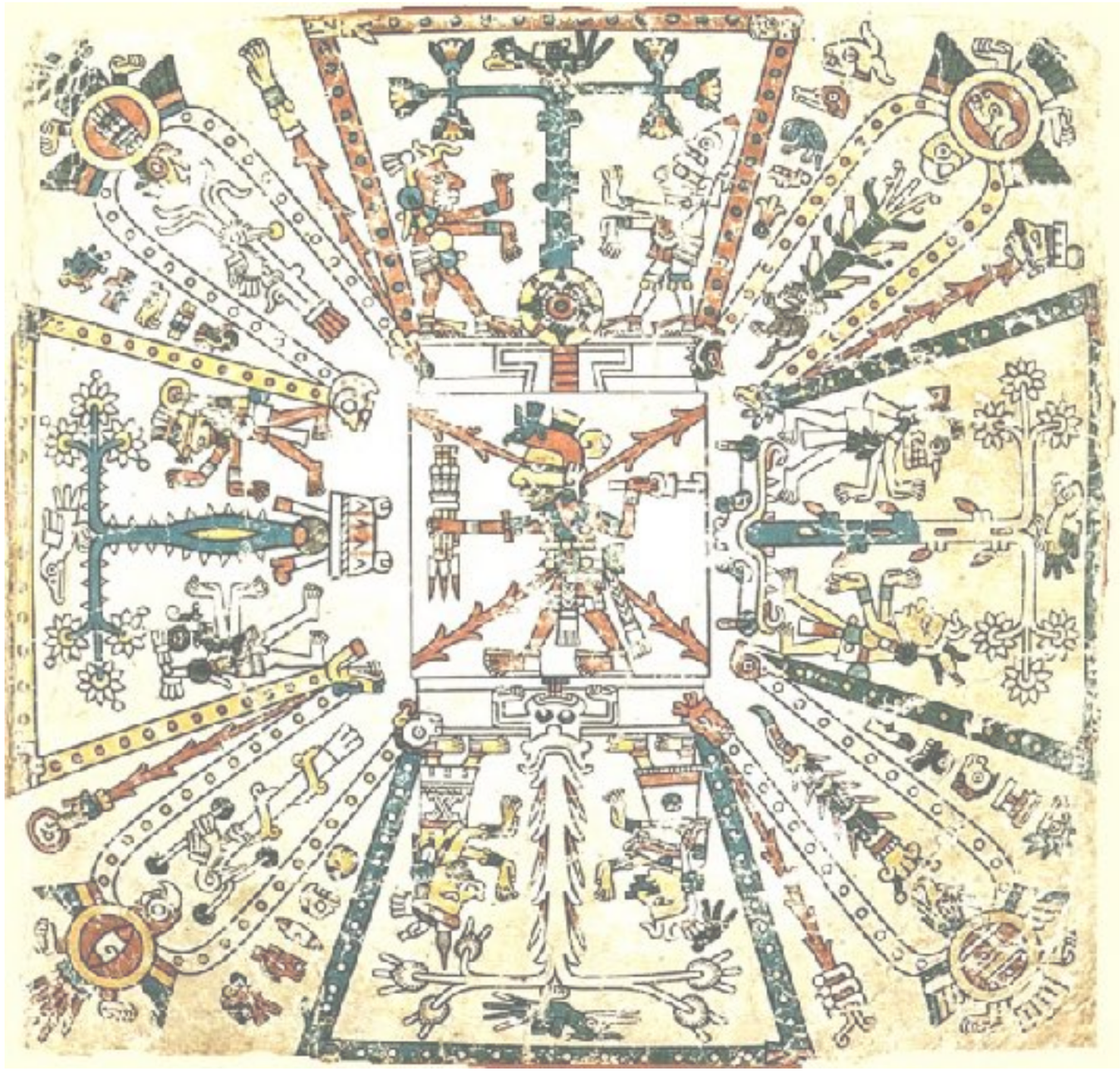
Mixtec Data: Sources, Links, Output



Intrinsic Challenges in Studying Mixtepec-Mixtec

- Lack of existing resources (under-resourced language)
- Lack of established linguistic description
- SIL Researchers working on the language in Mexico have (mostly) not shared their data
- Related language descriptions are old, syntax based, scanned documents
- Speaker consultants work full time, often don't have time to consistantly help edit, gloss text
- Orthography not fully conventionalized, still changes, speakers often not aware of/don't use the standards *(requires significant normalization in markup*)
- IPA also has too many different ways to transcribe (*especially tones*), normalization still needed
- Lexical tone, adds complexity to characterization and it is (mostly) not represented in the orthography (*lot's of homographs*)
- Not enough data to automate annotation! (*I am making the basis of any training set*)

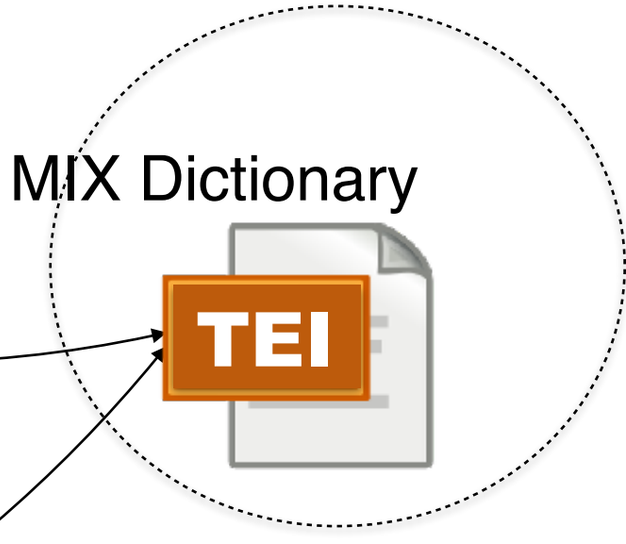
(I) Project Metadata



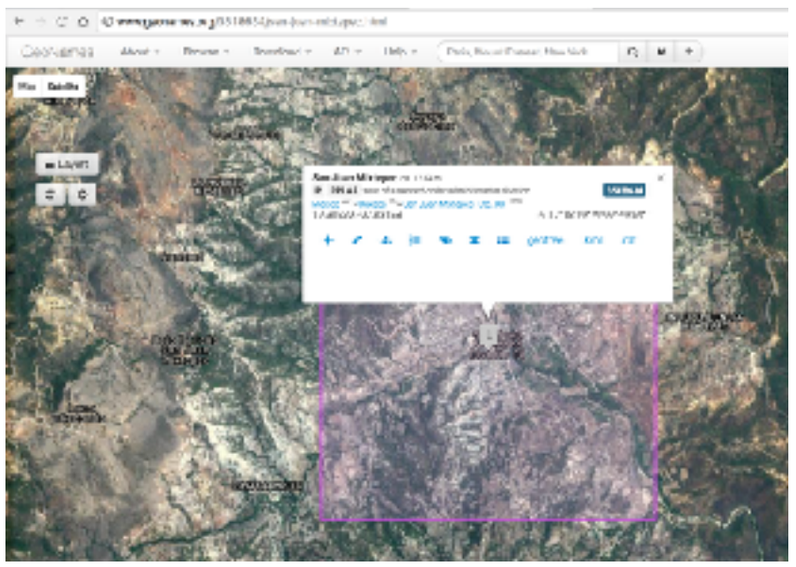
Mixtec Borgia Codex

Metadata: Places

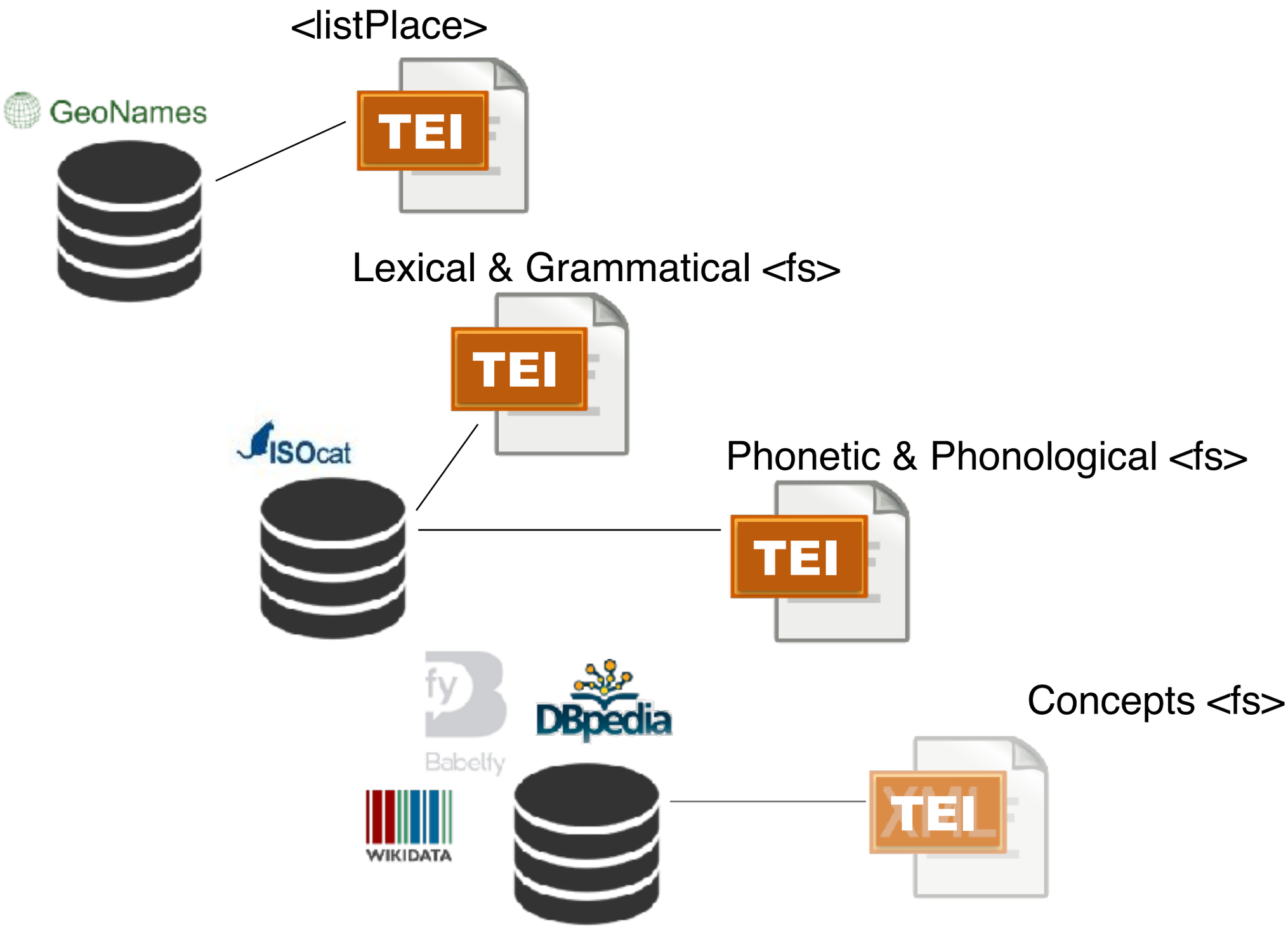
```
<listPlace>
....
  <place xml:id="Yucunany" corresp="http://www.geonames.org/8880392">
    <placeName xml:lang="es">Yucunany</placeName>
    <placeName xml:lang="en">Yucanany</placeName>
    <placeName xml:lang="en">Yucanani</placeName>
    <placeName xml:lang="mix" cert="medium">Yukunani</placeName>
    <location>
      <geo>17.30083, -97.89389</geo>
    </location>
  </place>

  <place xml:id="SanJuanMixtepec" corresp="http://www.geonames.org/3518634">
    <placeName xml:lang="es">San Juan de Mixtepec</placeName>
    <placeName xml:lang="es">San Juan Mixtepec</placeName>
    <placeName xml:lang="mix">Snuviko</placeName>
    <placeName xml:lang="mix">Xnuviko</placeName>
    <location>
      <geo>17.30539, -97.83158</geo>
    </location>
    <note resp="JB">Mixtec place name added to geonames</note>
  </place>
....
</listPlace>
```



Note: also included as entries in Mixtec Dictionary

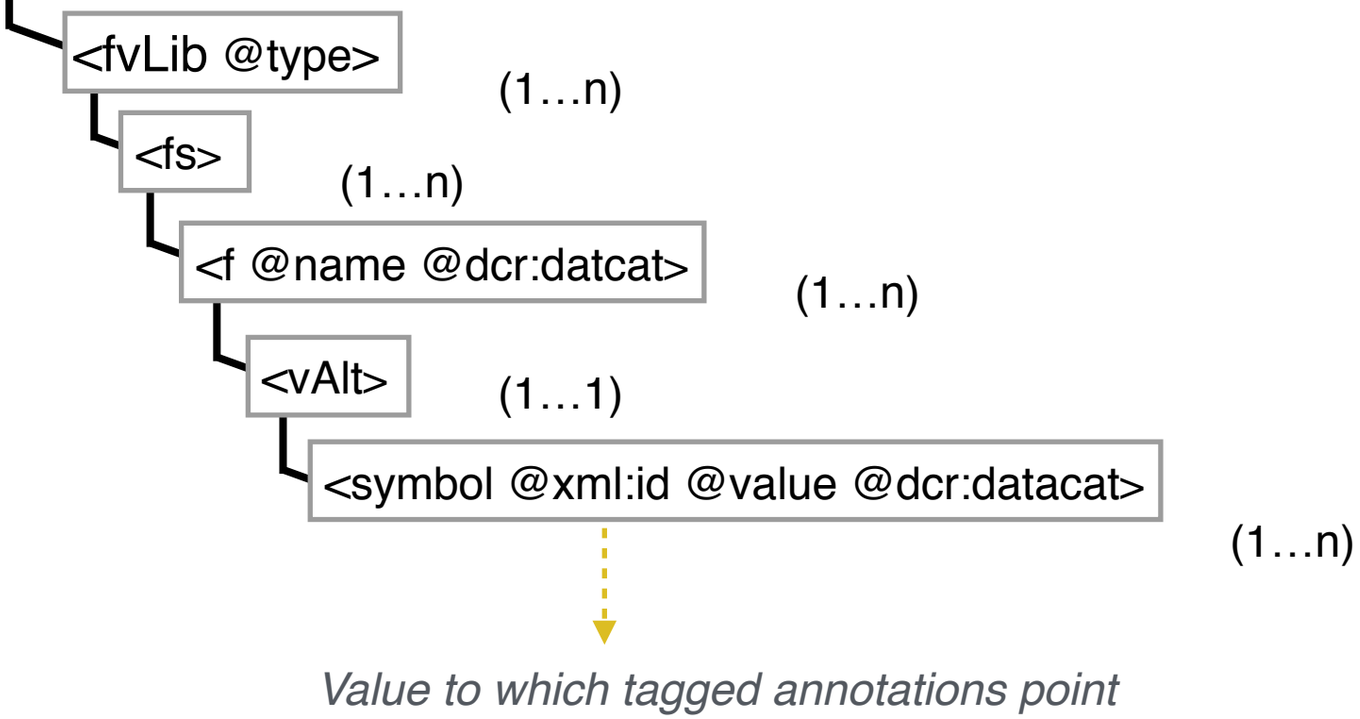


TEI Feature Structures & Standardized Resources



Linguistic Annotation: TEI Feature Structures

Inventory of MIX linguistic features kept in feature structures




```
<fvLib>
    <fs>
      <f name="number" xmlns:dcr="http://www.isocat.org/ns/dcr" dcr:datcat="http://www.isocat.org/datcat/DC-3351">
       <vAlt>
         <symbol xml:id="SG" value="singular" dcr:datcat="http://www.isocat.org/datcat/DC-252"/>
         <symbol xml:id="PL" value="plural" dcr:datcat="http://www.isocat.org/datcat/DC-253"/>
       </vAlt>
      </f>
    </fs>
    <!-- other feature structures here -->
  </fvLib>
```

Linguistic Annotation: TEI Feature Structures

Inventory of MIX linguistic features kept in feature structures

```
<fs><!--  Declerck, Thierry; The number of arguments controlled by a verbal predicate. -->
  <f name="valency" xmlns:dcr="http://www.isocat.org/ns/dcr" dcr:datcat="http://www.isocat.org/datcat/DC-1410">
    <vAlt>
      <symbol value="VAL-GRM0" xml:id="VAL-0"/><!-- Contains neither Actor or Undergoer; corresponds w/ “#ATRANS” -->
      <symbol value="VAL-GRM1" xml:id="VAL-1"/><!-- Contains only Actor or Undergoer -->
      <symbol value="VAL-GRM1" xml:id="VAL-2"/><!-- Contains Actor and Undergoer -->
      <symbol value="VAL-GRM1" xml:id="VAL-3"/><!-- Contains Actor, Undergoer and Oblique -->
    </vAlt>
  </f>
</fs>
```

```
<fs>
  <f name="transitivity">
    <vAlt>
      <symbol xml:id="TRANS" value="transitive" xmlns:dcr="http://www.isocat.org/ns/dcr" dcr:datcat="http://www.isocat.org/datcat/DC-3275"/>
      <symbol xml:id="INTRANS" value="intransitive" xmlns:dcr="http://www.isocat.org/ns/dcr" dcr:datcat="http://www.isocat.org/datcat/DC-3275"/>
      <symbol xml:id="DITRANS" value="ditransitive" xmlns:dcr="http://www.isocat.org/ns/dcr" dcr:datcat=“http://www.isocat.org/datcat/DC-1275"/>
      <symbol xml:id="ATRANS" value="a-transitive"/><!-- corresponds w/ “#VAL-0” Contains neither Actor or Undergoer -->
    </vAlt>
  </f>
</fs>
```

Linguistic Annotation: TEI Feature Structures

Inventory of MIX linguistic features kept in feature structures

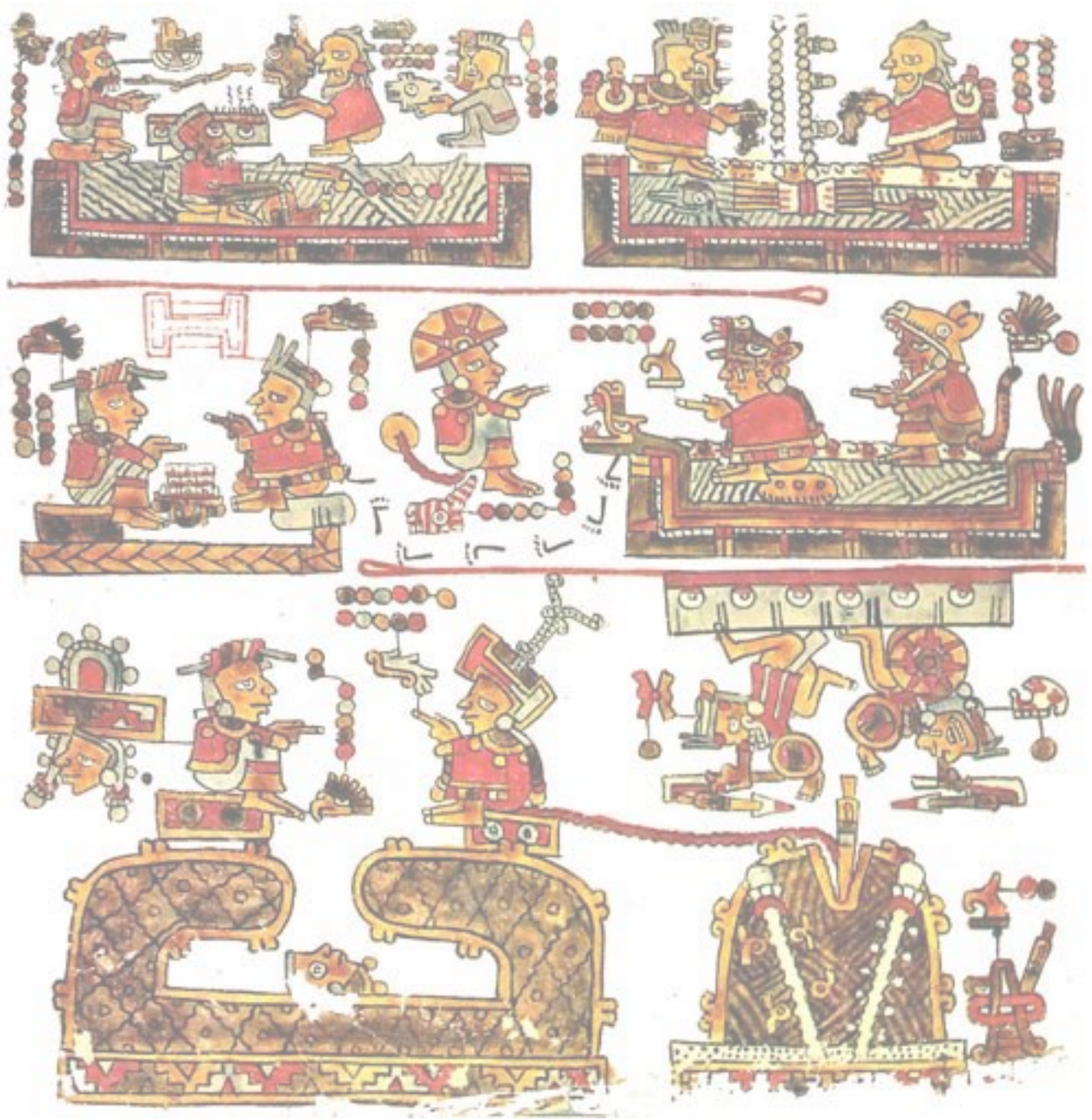
```
<fs>
  <f name="Trajector" xml:id="TR">
    <vAlt>
      <symbol value="StaticTrajector" xml:id="TR-static"/>
      <symbol value="DynamicTrajector" xml:id="TR-dynam"/>
      <symbol value="Person-Object" xml:id="TR-pers-obj"/>
      <symbol value="EventTrajector" xml:id="TR-event"/>
    </vAlt>
  </f>
</fs>
<fs>
  <f name="Landmark" xml:id="LM">
    <vAlt>
      <symbol value="personLM" xml:id="LM-PERS"/>
      <symbol value="objectLM" xml:id="LM-OBJ"/>
      <symbol value="eventLM" xml:id="LM-EVNT"/>
    </vAlt>
  </f>
</fs>

<fs>
  <f name="frameOfReference" xml:id="FoR">
    <vAlt>
      <symbol value="viewpoint-centeredFoR" xml:id="VPTC-FoR"/>
      <symbol value="relativeFoR" xml:id="REL-FoR"/>
      <symbol value="intrinsicFor" xml:id="INTR-FoR"/>
    </vAlt>
  </f>
</fs>
```

external ontologies:

- GUM?
- Eagles?

(II) Source Documents

i. SIL Booklets



Mixtec Codex Seldon

Source Data: SIL Documents

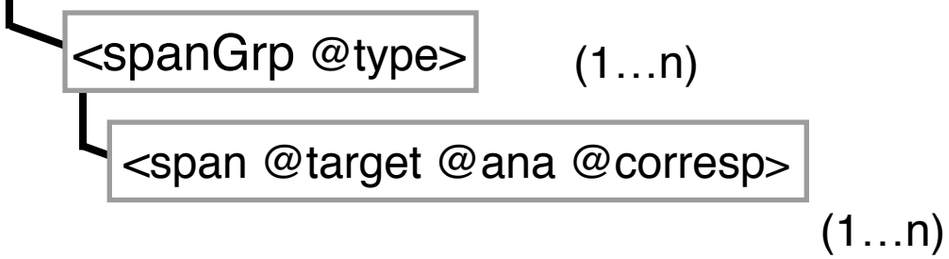
The Summer Institute of Linguistics (SIL) documents all have an intended audience of children, there are several different document types which have different formats:

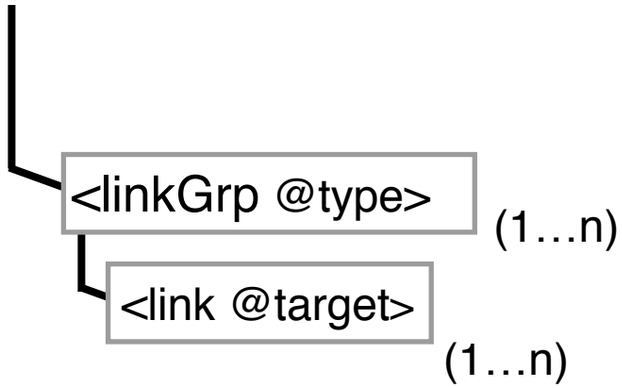
- Prose *(short stories, legends, etc.)*
- Activity/Workbooks *(picture-based excercises, crossword puzzles, mazes, etc.)*
- Vocabulary & Basic Pedigogical Reference

Current document taxonymy contains the following classifications:

- Pedagogical
  - Interactive
  - Referential
- Fiction
  - Fantasy
  - Realistic
- Folklore

Standoff Annotation in TEI: <spanGrp> & <linkGrp>:





<spanGrp> is used to annotate: Translations *(English, Spanish),* grammar, Semantics (multiple aspects), Interlinear glossed text, General editorial notes

- Points to language content *(usually <w> <seg> or <s>)*
- Requires @xml:id for all values to be annotated
- Can be included in most TEI be inserted close to target content
- Structure and tag content correspond to feature structure inventory <fs>

<linkGrp> links (via <link @target>) pre-existing translation content

SIL Documents: Basic Vocabulary

chumi xini ka'nu
tecolote
búho cornado

chumi lunchi
tecolote llanero
tecolote zancón

chumi sai
tecolotito

```
<item>
    <graphic url="Aves-01.png"/>
    <w xml:id="d1e35" xml:lang="mix" type="compound">
      <w xml:id="d1e36">chumi</w> <w xml:id="d1e38">lunchi</w>
    </w>
    <w xml:id="d1e40" xml:lang="es" type="compound">
      <w xml:id="d1e41">tecolote</w> <w xml:id="d1e43">llanero</w>
    </w>
    <w xml:id="d1e45" xml:lang="es" type="compound">
      <w xml:id="d1e46">tecolote</w> <w xml:id="d1e48">zancón</w>
    </w>
  </item>
  <item>
    <graphic url="Aves-02.png"/>
    <w xml:id="d1e53" xml:lang="mix" type="compound">
      <w xml:id="d1e54">chumi</w> <w xml:id="d1e56">xini</w> <w xml:id="d1e58">ka'nu</w>
    </w>
    <w xml:id="d1e60" xml:lang="es">
      <w xml:id="d1e61">tecolote</w>
    </w>
    <w xml:id="d1e63" xml:lang="es" type="compound">
      <w xml:id="d1e64">búho</w> <w xml:id="d1e66">cornado</w>
    </w>
  </item>
  <item>
    <graphic url="Aves-03.png"/>
    <w xml:id="d1e71" xml:lang="mix" type="compound">
      <w xml:id="d1e72">chumi</w> <w xml:id="d1e74">sai</w>
    </w>
    <w xml:id="d1e76" xml:lang="es">
      <w xml:id="d1e77">tecolotito</w>
    </w>
  </item>
```

SIL Documents: Basic Vocabulary Annotation

```
<item>
    <graphic url="Aves-02.png"/>
    <w xml:id="d1e53" xml:lang="mix" type="compound">
      <w xml:id="d1e54">chumi</w>
      <w xml:id="d1e56">xini</w>
      <w xml:id="d1e58">ka'nu</w>
    </w>
    <w xml:id="d1e60" xml:lang="es-MEX">
      <w xml:id="d1e61">tecolote</w>
    </w>
    <w xml:id="d1e63" xml:lang="es" type="compound">
      <w xml:id="d1e64">búho</w>
      <w xml:id="d1e66">cornado</w>
    </w>
</item>
```

chumi xini ka'nu

tecolote

búho cornado

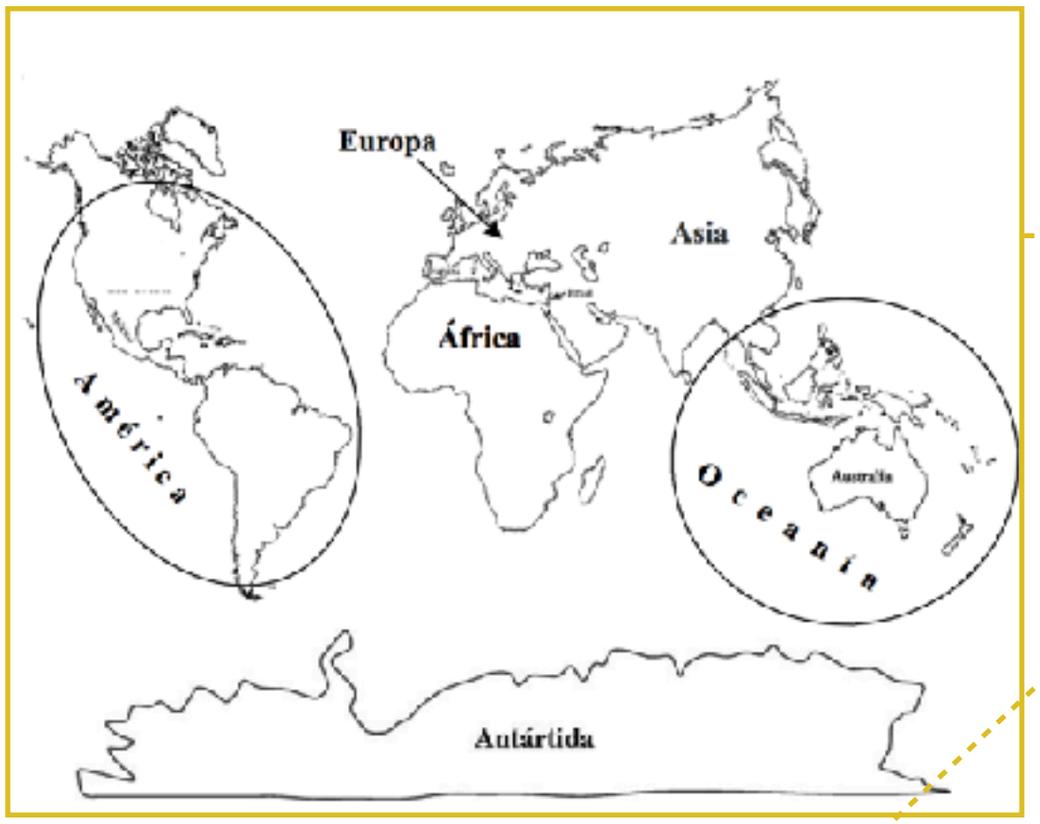
Annotations: (pre-existing) Translations & Sense (concept);

```
<linkGrp type="translation">
    <link target="#d1e53 #d1e60"/>
    <link target="#d1e53 #d1e63"/>
 </linkGrp>
<spanGrp type="semantics">
  <span type="sense" target="#d1e53" corresp="https://www.wikidata.org/wiki/Q81515"/>
  <span type="sense" target="#d1e53" corresp="http://dbpedia.org/resource/Great_horned_owl"/>
  <span type="domain" target="#d1e53" corresp="http://dbpedia.org/resource/Bird"/>
  <span type="domain" target="#d1e53" corresp="http://dbpedia.org/resource/Animal"/>
</spanGrp>
```

SIL Documents: Prose

PDF Source

Ñu'u Ncha'i ka



Yee ñu'u tsi chikuii nuu Ñu'u Ncha'i. Yee kua'a ka chikuii cha xoo ka ñu'u. Yee ñu'u luu ka nania "islas", cha inkai ma'i chikuii. Cha ñu'u ka'nu ka nania "continente". Yee iñu "continente" nania: África, América, Antártida, Asia, Europa tsi Occanía .

TEI

```
<div xml:id="L145-13">
  <head>
    <s xml:id="L145-13-00" type="subject">
      <w xml:id="d1e1437">
        <w xml:id="d1e1438">Ñu'u</w>
        <w xml:id="d1e1441">Ncha'i</w>
      </w>
      <w xml:id="d1e1444">ka</w>
    </s>
  </head>
  <head><graphic url="L145_10.jpeg"/></head>
  <p>
    <s xml:id="L145-13-01" type="declarative">
      <w xml:id="d1e1458">Yee</w>
      <w xml:id="d1e1461">ñu'u</w>
      <w xml:id="d1e1464">tsi</w>
      <w xml:id="d1e1467">chikuii</w>
      <w xml:id="d1e1470" orig="nuu">nu</w>
      <w xml:id="d1e1471">
        <w xml:id="d1e1473">Ñu'u</w>
        <w xml:id="d1e1477">Ncha'i</w>
      </w>
      <pc>.</pc>
    </s>
    ....

</div>
```

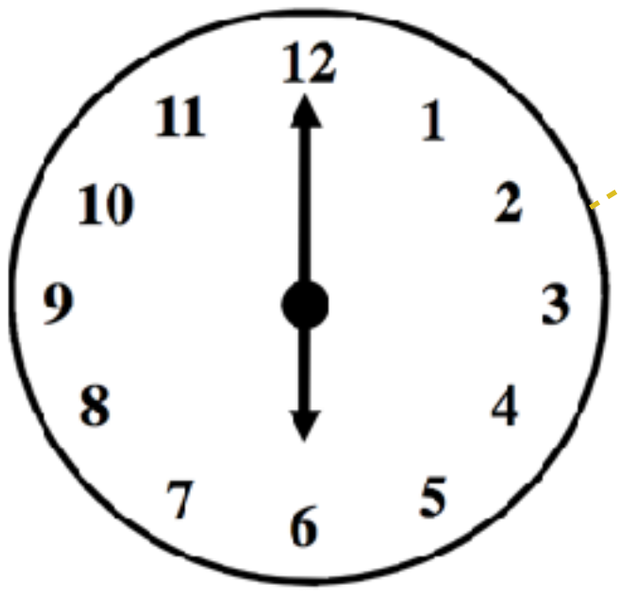
SIL Documents: Prose annotation

```
<div xml:id="L145-13">
  ...
 <s xml:id="L145-13-01" type="declarative">
  <w xml:id="d1e1458">Yee</w>
  <w xml:id="d1e1461">ñu'u</w>
  <w xml:id="d1e1464">tsi</w>
  <w xml:id="d1e1467">chikuii</w>
  <w xml:id="d1e1470"orig="nuu">nu</w>
  <w xml:id="d1e1471">
    <w xml:id="d1e1473">Ñu'u</w>
      <w xml:id="d1e1477">Ncha'i</w>
  </w>
  <pc>.</pc>
 </s>
  ...
</div>
```

Annotations: Translations

```
<spanGrp type="translation">
 <span target="#L145-13-01"xml:lang="en">There is land and water on the Earth.</span>
 <span target="#L145-13-01" xml:lang="es">Hay tierra y agua en la Tierra.</span>

 <span target="#d1e1458" xml:lang="en">there is</span>
 <span target="#d1e1458" xml:lang="es">hay</span>

 <span target="#d1e1461" xml:lang="en">land</span>
 <span target="#d1e1461" xml:lang="es">tierra</span>

 <span target="#d1e1464" xml:lang="en">and</span>
 <span target="#d1e1464" xml:lang="es">y</span>

 <span target="#d1e1467" xml:lang="en">water</span>
 <span target="#d1e1467" xml:lang="es">agua</span>

 <span target="#d1e1470 #d1e1471" xml:lang="en">on Earth</span>
 <span target="#d1e1470 #d1e1471" xml:lang="es">en la tierra</span>

 <span target="#d1e1471" xml:lang="en">Earth</span>
 <span target="#d1e1471" xml:lang="es">tierra</span>
</spanGrp>
```

SIL Documents: Workbook
(reference version w/answers)



¿Nchii hora kui?

Ka iñu ntaa.

3

```
<div xml:id="L093-01">
  <head>
    <graphic url="L093-1-what_time_is_it-6.jpg"/>
  </head>
  <label>
    <time>6:00</time>
  </label>
  <lb/>
  <p>
    <s xml:id="d1e160" type=“interrogative">
      <pc>¿</pc>
      <w xml:id=“d1e163" orig="Nchii">Nchi</w>
      <w xml:id="d1e165">hora</w>
      <w xml:id="d1e167">kui</w>
      <pc>?</pc>
    </s>
    <lb/>
    <s xml:id="d1e174" type=“declarative">
      <w xml:id=“d1e175" orig="Ka">Kaa</w>
      <w xml:id="d1e177">iñu</w>
      <w xml:id="d1e179">ntaa</w>
      <pc>.</pc>
    </s>
  </p>
</div>
```

SIL Documents: Workbook (*reference version w/answers*) annotation

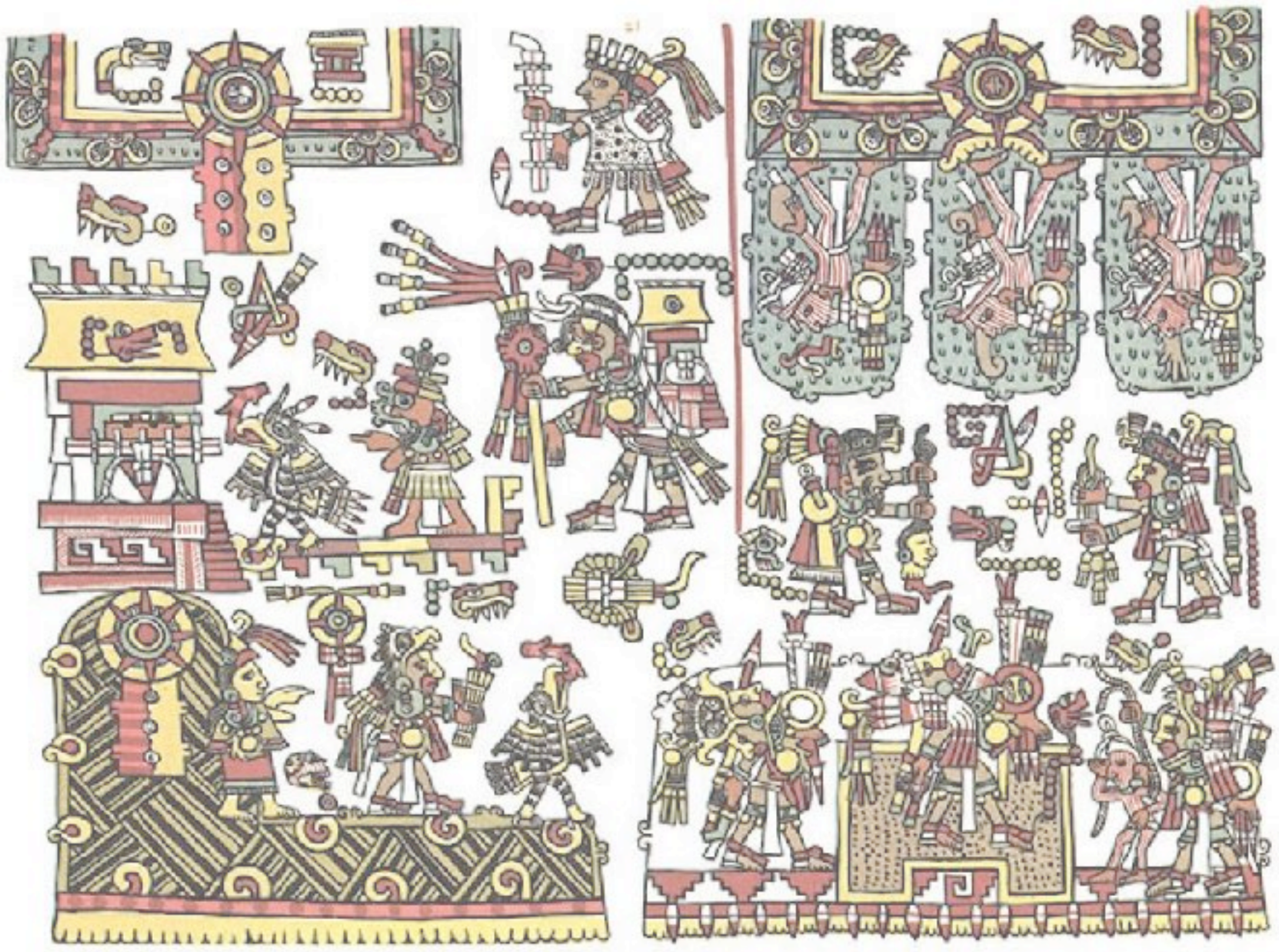
```
<div xml:id="L093-01">
…..
 <p>
    <s xml:id="d1e160" type=“interrogative">
      <pc>¿</pc>
      <w xml:id="d1e163" orig="Nchii">Nchi</w>
      <w xml:id="d1e165">hora</w>
      <w xml:id=“d1e167">kui</w>
      <pc>?</pc>
    </s>
    <lb/>
    <s xml:id="d1e174" type=“declarative">
      <w xml:id=“d1e175" orig="Ka">Kaa</w>
      <w xml:id="d1e177">iñu</w>
      <w xml:id="d1e179">ntaa</w>
      <pc>.</pc>
    </s>
  </p>
</div>
```

Annotations: Grammar

```
<spanGrp type="gram">
  <span type="sentence" target="#d1e160" ana="#Q #WH #TEMP"/>
  <span type="phrase" target="#d1e163 #d1e165" ana="#ADVP #WH #TEMP"/>
  <span type="pos" target="#d1e167" ana="#COP #INCMPL”/>
  <span type="aspect" target="#d1e167" ana=“#INCMPL"/>
  <span type="person" target="#d1e169" ana=“#3PERS"/>
  <span type="number" target="#d1e169" ana=“#SG"/>
</spanGrp>
```

```
<spanGrp type="gram">
  <span type="sentence" target="#d1e174" ana="#RESP #Q #WH #TEMP"/>
  <span type="pos" target="#d1e175" ana="#COP #REAL"/>
  <span type="phrase" target="#d1e177 #d1e179" ana="#ADVP #TEMP"/>
</spanGrp>
```

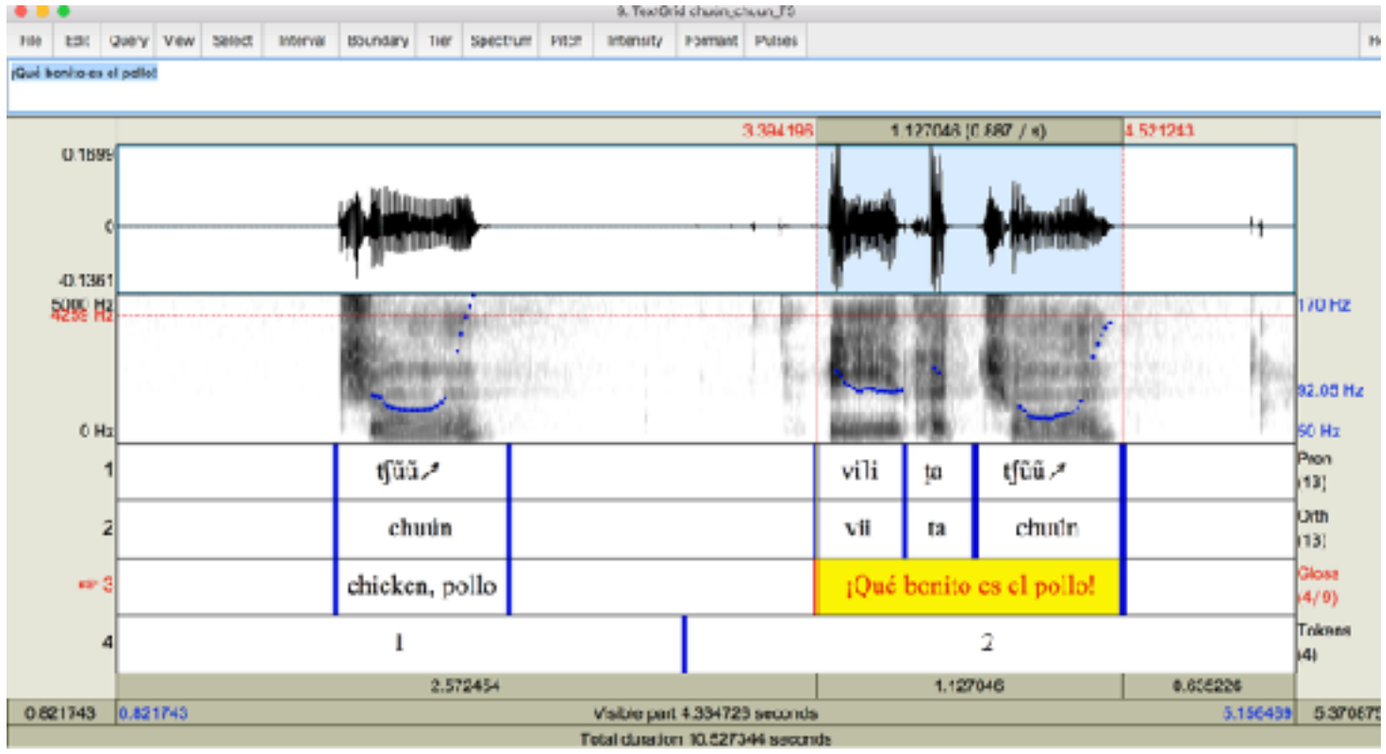
(II) Source Documents
ii. Spoken Language Resources



Codex Zouche-Nuttall, British Museum.

Speech Annotation: Praat

(basic transcription method)

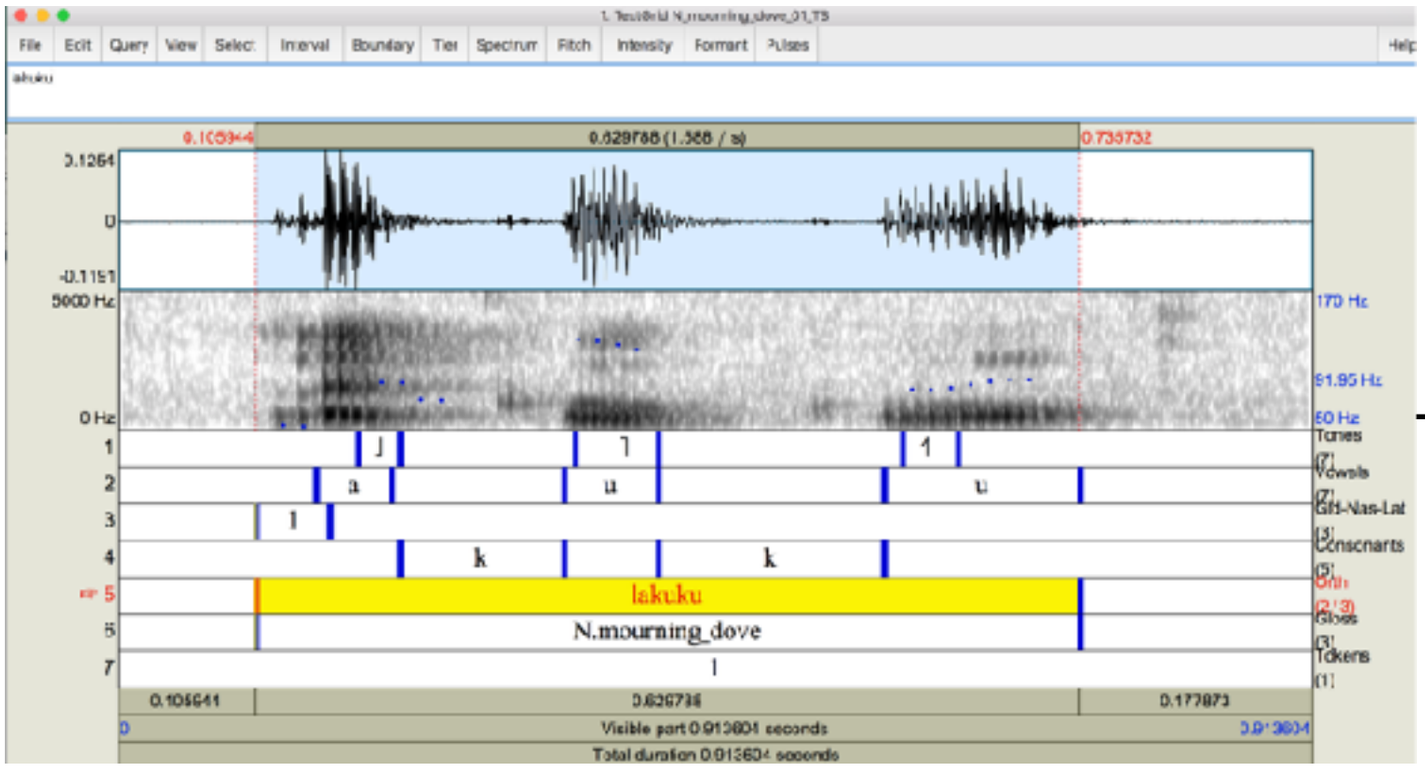


tmin	tier	text	tmax
0	Tokens	1	2.91
1.63	Gloss	chicken, pollo	2.26
1.63	Pron	tʃũũ↗	2.26
1.63	Orth	chuún	2.26
2.91	Tokens	2	5.18
3.39	Orth	vii	3.72
3.39	Pron	viˉi	3.72
3.39	Gloss	¡Qué bonito es el pollo!	4.52
3.72	Pron	t̲a	3.98
3.72	Orth	ta	3.98
3.98	Orth	chuún	4.52
3.98	Pron	tʃũũ↗	4.52

Utterance File <u>

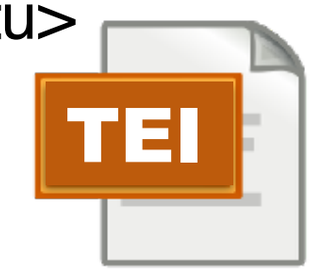
Speech Annotation: Praat

(phonetic focus transcription)



tmin	tier	text	tmax
0	Tokens	1	0.91
0.11	Gld-Nas-Latl		0.16
0.11	Orth	lakuku	0.74
0.11	Gloss	N.mourning_dove	0.74
0.15	Vowels	a	0.21
0.18	Tones	˩	0.22
0.22	Consonantsk		0.34
0.34	Vowels	u	0.41
0.35	Tones	˥	0.41
0.41	Consonants	k	0.59
0.59	Vowels	u	0.74
0.60	Tones	˧	0.64

Utterance File <u>



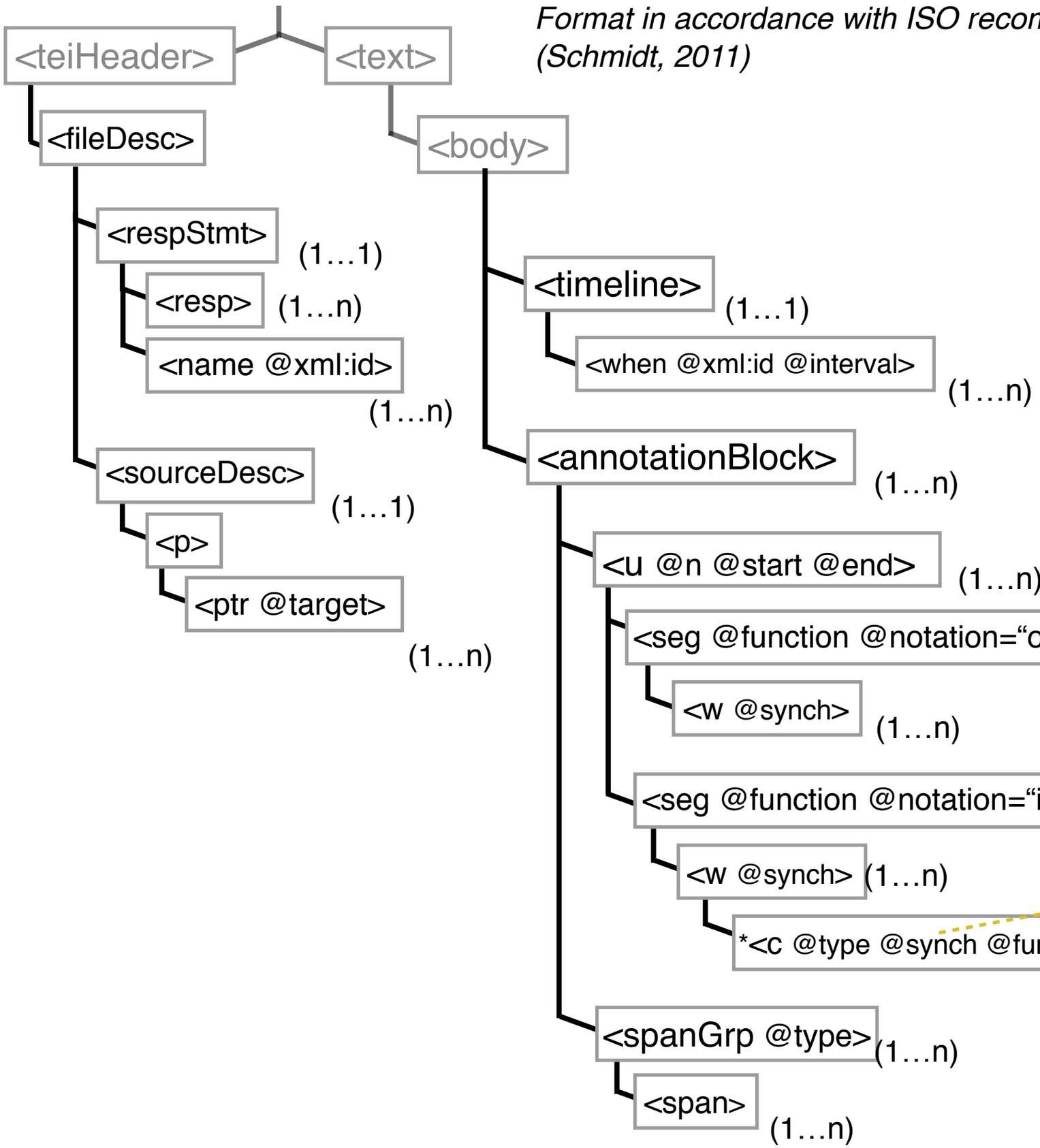
Praat (phonetic focus transcription): Available Data

Acoustic data available potentially allows for:

- Quantitative, acoustic evidence for phonetic and phonological linguistic descriptions of language;
- Fine grained tests of existing hypotheses about phonology
  - tone patterns, sandhi, etc.;
- Train HMM models for ASR (applied to: Automatic Annotation of spoken data);
- Comparative studies of different speaker groups (e.g. *from different villages, those who live in the US and those that don't*)

TEI Utterance files (from Praat)

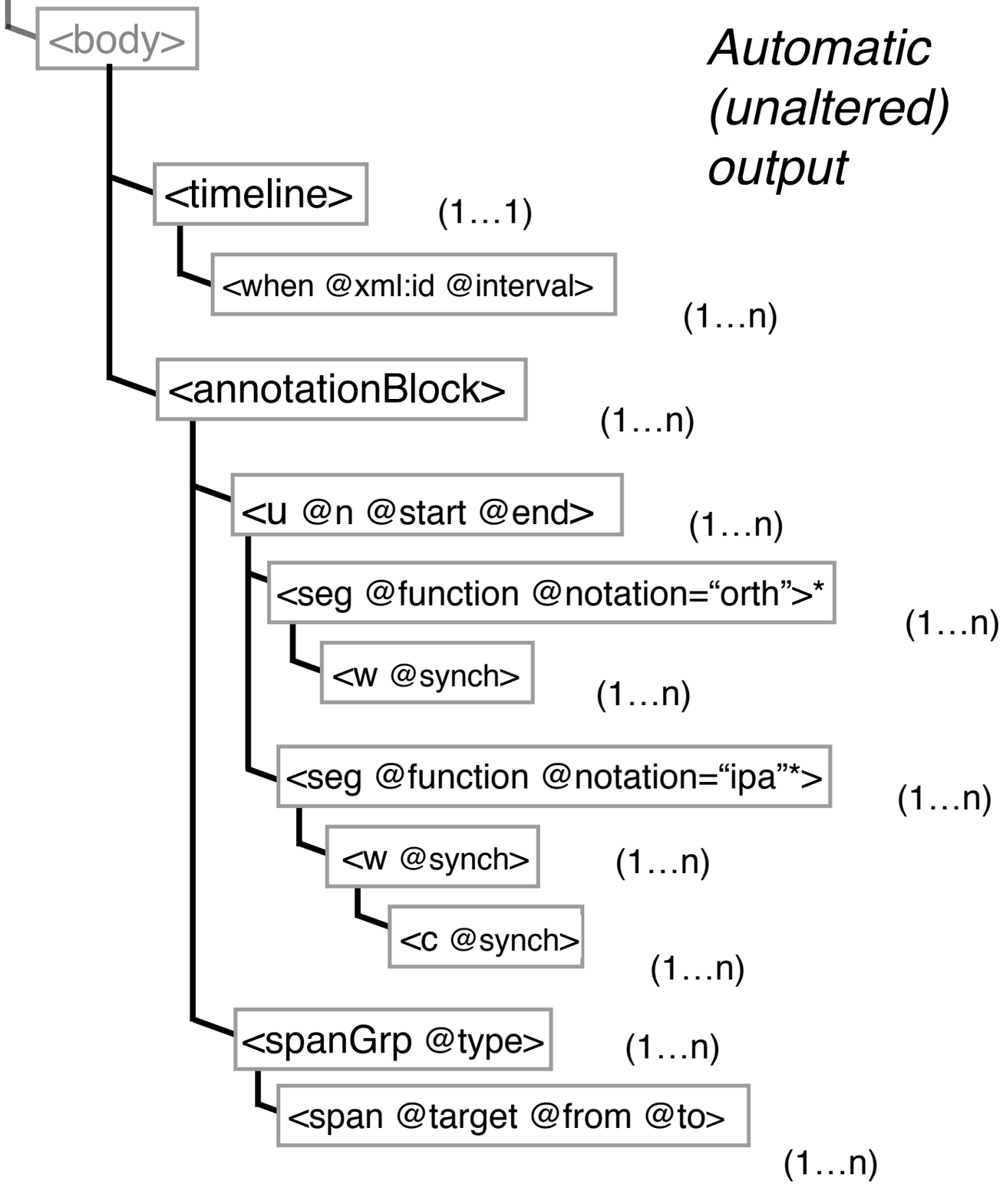
Format in accordance with ISO recommendation for speech transcription (Schmidt, 2011)



- One utterance file per Praat TextGrid
- Source .wav and praat textgrid filenames in header <ptr @target> within <sourceDesc>
- Can generate speaker info in header from file name <respStmt>

<c>'s correspond to <fs> values for phonetic/phonological invetory (only included in output from fully segmented (phonetic focus) praat annotations)

TEI Utterance files (from Praat)



Automatic (unaltered) output

```
<body>
  <timeline>
    <when xml:id="T1" interval="0.11"/>
    <when xml:id="T2" interval="0.15"/>
    <when xml:id="T3" interval="0.18"/>
    <when xml:id="T4" interval="0.22"/>
    <when xml:id="T5" interval="0.34"/>
    <when xml:id="T6" interval="0.35"/>
    <when xml:id="T7" interval="0.41"/>
    <when xml:id="T8" interval="0.59"/>
    <when xml:id="T9" interval="0.60"/>
    <when xml:id="T10" interval="0.74"/>
  </timeline>
  <annotationBlock>
    <u xml:id="d1e39" n="1" start="0" end="0.91">
      <seg xml:id="d1e40" function="utterance" notation="orth">
        <w xml:id="d1e41" synch="#T1">lakuku</w>
      </seg>
      <seg xml:id="d1e44" function="utterance" notation="ipa">
        <w xml:id="d1e45" synch="#T1">
          <c>l</c>
          <c>a</c>
          <c function="tone">˩</c>
          <c>k</c>
          <c>u</c>
          <c function="tone">˥</c>
          <c>k</c>
          <c>u</c>
          <c function="tone">˩</c>
        </w>
      </seg>
    </u>
    <spanGrp type="praatGloss">
      <span from="#T1" to="#T10">N.mourning_dove</span>
    </spanGrp>
    .....
  </annotationBlock>
</body>
```

TEI Utterance files (from Praat):Annotated

```
<timeline>
……
</timeline>
<annotationBlock>
  <u xml:id="d1e39" n="1" start="0" end="0.91">
    <seg xml:id="d1e40" function="utterance" notation="orth">
      <w xml:id="d1e41" synch="#T1">lakuku</w>
    </seg>
    <seg xml:id="d1e44" function="utterance" notation="ipa">
      <w xml:id="d1e45" synch="#T1">
        <c>l</c>
        <c>a</c>
        <c function="tone">˩</c>
        <c>k</c>
        <c>u</c>
        <c function="tone">˥</c>
        <c>k</c>
        <c>u</c>
        <c function="tone">˥</c>
      </w>
    </seg>
  </u>
  <spanGrp type="praatGloss">
    <span from="#T1" to="#T10">N.mourning_dove</span>
  </spanGrp>
  <spanGrp type="gram">
    <span type="pos" target="#d1e41 #d1e45" ana="#N"/>
  </spanGrp>
  <spanGrp type="semantics">
    <span type="sense" target="#d1e41 #d1e45" corresp="http://dbpedia.org/resource/Mourning_dove"/>
    <!-- is_a:Bird -->
    <span type="domain" target="#d1e41 #d1e45" corresp="http://dbpedia.org/resource/Bird"/>
  </spanGrp>
  <spanGrp type="translation">
    <span target="#d1e41 #d1e45" xml:lang="en" corresp="https://en.wiktionary.org/wiki/mourning_dove">mourning dove</spa
    <span target="#d1e41 #d1e45" xml:lang="es" corresp="https://es.wiktionary.org/wiki/tortolita">tortolita</span>
  </spanGrp>
</annotationBlock>
```

to TEI Dictionary: (value of) //form[@type="lemma"]/orth

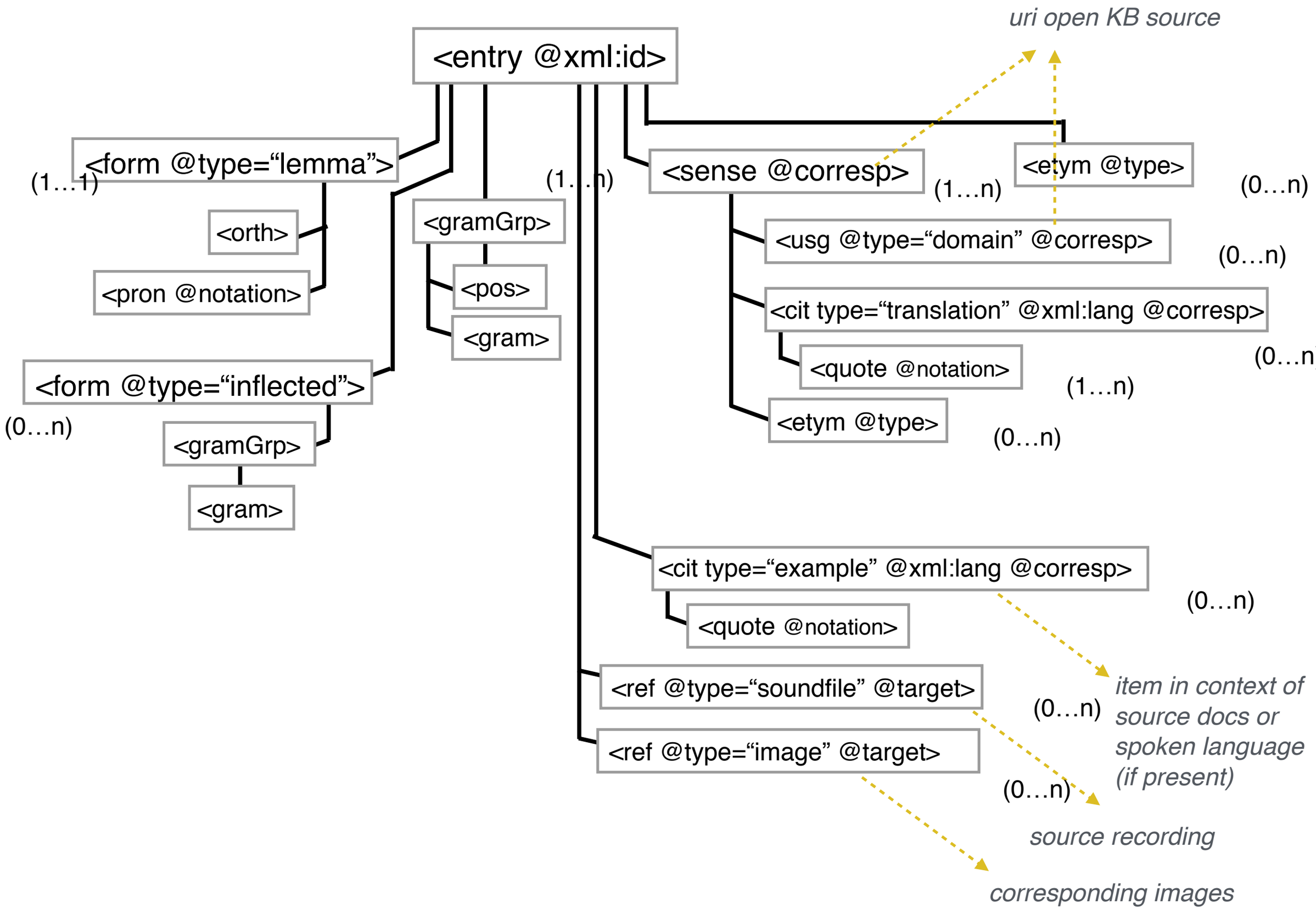
to Dictionary: (value of) //form[@type="lemma"]/pron[notation="ipa"]

Manually added in Oxygen

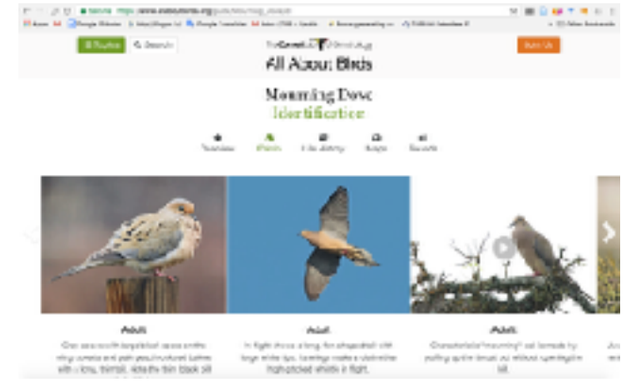
(III) TEI Dictionary

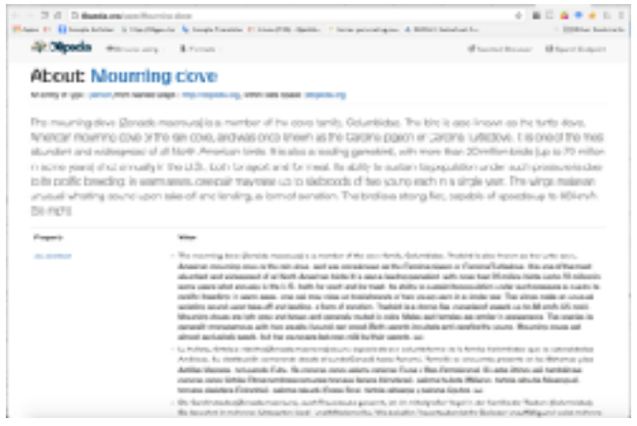
Mixtec Codex Nuttal- British Museum

TEI Dictionary Structure



TEI Dictionary Entry:
Basic example: TEI






```
<entry xml:id="bird-mourning_dove">
  <form type="lemma">
    <orth>lakuku</orth>
    <pron notation="“ipa”">laɻkuˀkuˈ</pron>
  </form>
    <gramGrp>
      <pos>noun</pos>
    </gramGrp>
  <sense corresp="“http://dbpedia.org/resource/Mourning_dove">
    <usg type="domain" corresp="http://dbpedia.org/resource/Bird">Bird</usg>
    <cit type="translation" xml:lang="en" corresp="“https://en.wiktionary.org/wiki/mourning_dove”>
   <!— hypernymOf(Bird) —>
      <quote>mourning dove</quote>
    </cit>
    <cit type="translation" xml:lang="es" corresp="“https://es.wiktionary.org/wiki/tortolita">
      <quote>tortolita</quote>
    </cit>
  </sense>
  <cit type="example" corresp="“/SIL_docs/L152/L152-tok.xml#L152-01-01”>
    <quote>In kii ra iin <oRef>lakuku</oRef> kunia tanta'i tsi in ncho'o, cha koo xu'in sa'i viko.</quote>
  </cit>
  <ref type="soundfile" target="N_mourning_dove_01_TS.wav"/>
  <!-- could also include references to images (where available) -->
</entry>
```

(III) TEI Dictionary
ii. Etymology

Mixtec Codex Bodley - Bodleian Library Oxford

Overview of Mixtec Etymology

Despite having no written (phonetic) records of the language before the 1567* there is nonetheless a great deal we can see with regards to the origin of a wide variety of Mixtec vocabulary particularly by analysis of:

- Polysemy
- Compounds
- Inference via anthropological knowledge
- *Other:* codex

**Dominican Benito Hernández; 1593 Alvarado - vocabulary published; de los Reyes published grammar (same year)*

TEI Dictionary Etymology

Bowers & Romary (2016), Bowers et al. (*forthcoming*) propose expansion and refinement of etymology section of the TEI dictionary module to include detailed proposals for the encoding of many important processes of linguistic change; e.g.

- Borrowing
- Inheritance* (*in conjunction w/ cognates*)
- Derrivation
- Phonetic changes
- Compounding (*and combinations of other processes*)
- Sense changes:
  - Metaphor
  - Metonymy
  - Grammaticalization *(and sub-process)*

**changes in phonology and inherited etymologies would be in contrast to Proto-Mixtecan posited by Mak & Longacre (1960)*

Etymological Markup: Borrowing

Loanwords

Spanish > MIX: **polo**

‘pole’ (as in region of Earth)

```
<entry xml:id="pole-MIX" xml:lang="mix">
  <form type="lemma">
    <orth>polo</orth>
    <gramGrp>
      <pos>noun</pos>
    </gramGrp>
  </form>
  <sense corresp="http://dbpedia.org/resource/Category:Polar_regions_of_the_Earth">
    <usg type="domain" corresp="http://dbpedia.org/resource/Earth">Earth</usg>
    <etym type="borrowing">
      <cit type="etymon" xml:lang="es">
        <oRef>polo</oRef>
      </cit>
    </etym>
    <cit type="example" xml:lang="mix">
      <quote>Kunchee ña “Polo" tsi "Hemisferio" siin siin kui.</quote>
      <ptr target="SIL_docs/L145/L145-tok.xml"/>
    </cit>
    <cit type="translation" xml:lang="en">
      <quote>pole</quote>
    </cit>
    <cit type="translation" xml:lang="es">
      <quote>polo</quote>
    </cit>
  </sense>
</entry>
```

Etymological Markup: Inheritance & Cognates

Generally inheritance from an ancestor form can be inferred via comparative with cognates in related Mixtec (and Mixtecan) varieties;

Mixtepec Mixtec
xini
[ʃìnĭ]
'head'

Proto-Mixtecan
*ʃīnī
'head'

Mixtec Variety	form	source
Ayutla	shīhih	(Hills, 1990)
San Martín Duraznos	ʃīɲī	(Padgett, 2017)
Guadalupe Nundaca	ʃīɲī	(Padgett, 2017)
Santa Rosa Caxtlahuaca	ʃīɲī	(Padgett, 2017)
Santa Catarina Noltepec	ʃīɲī	(Padgett, 2017)
San Miguel Cuevas	ʃīɲī	(Padgett, 2017)
Yucunicoco	ʃīɲī	(Padgett, 2017)
Coicoyán de las Flores	ʃìnĭ	(Padgett, 2017)
Chalcatongo Mixtec (San Miguel El Grande)	šinì	(Macaulay, 1996)

Etymological Markup: Inheritance & Cognates

```
…
  <etym type="inheritance">
            <desc resp="#JB">The consistancy of the form of the cognate lexical item meaning "head" in the
varieties of Mixtec listed below:</desc>

            <cit type="etymon" xml:lang="proto-mix" cert="medium"> <!-- NO ISO TAG FOR (proto-mixtecan) -->
              <lang>Proto-Mixtecan</lang>
              <pRef resp="#JB">*ʃīnī</pRef>
            </cit>

            <cit type="cognate" xml:lang="mig">
             <lang>Chalcatongo Mixtec (San Miguel El Grande)</lang>
              <pRef notation="trans-macaulay-mig">šinì</pRef>
              <ref type="source" target="#Macaulay-ChalcatongoMixtec-1996">(Macaulay, 1996)</ref>
            </cit>

            <cit type="cognate" xml:lang="miy">
             <lang>Ayutla Mixtec</lang>
              <pRef notation="trans-hill-1990-miy">shīhih</pRef>
              <ref target="#Hills-AyutlaMixtec-1990">(Hills, 1990)</ref>
            </cit>

            <cit type="cognate" xml:lang="smd">
              <lang>San Martín Duraznos Mixtec</lang>
              <pRef notation="ipa">ʃīɲī</pRef>
              <ref target="#Padgett-2017">(Padget, 2017)</ref>
            </cit>

            <cit type="cognate" xml:lang="gna">
             <lang>Guadalupe Nundaca Mixtec</lang>
              <pRef notation="ipa">ʃīɲī</pRef>
              <ref target="#Padgett-2017">(Padget, 2017)</ref>
            </cit>
                <!— other cognates here —>
          </etym>
…
```

Etymological Markup: Derrivation

MIX

ntasaxeen

‘to sharpen’

Derrivation

nta- + sa- + xeen

ITER + CAUS + dangerous

```
<entry xml:id="sharpen">
  <form type="lemma">
    <orth>ntasaxeen</orth>
  </form>
  <gramGrp>
    <pos>verb</pos>
    <gram type="transitivity">transitive</gram>
    <gram>causative</gram>
    <gram>iterative</gram>
  </gramGrp>
  <sense>
    <cit type="translation" xml:lang="en">
      <quote>sharpen</quote>
    </cit>
  </sense>
  <etym type="derivation">
    <cit type="etymon">
      <oRef>nta<pc>-</pc></oRef>

    </cit>
    <cit type="etymon">
      <oRef>sa<pc>-</pc></oRef>

    </cit>
    <cit type="etymon">
      <oRef>xeen</oRef>
      <gramGrp>
        <pos>adj</pos>
      </gramGrp>
      <gloss>dangerous</gloss>
    </cit>
  </etym>
</entry>
```

Etymological Markup: Sense-based lexical innovation in Mixtec

Analysis of polysemy (*particularly body-part terms*) in Mixtecan languages (Brugman,1983), (Brugman and Macaulay,1986), (Hollenbach, 1995) provides evidence to support several key theoretical questions regarding patterns of lexical innovation; particularly, those involving:

(i) Lexical and cognitive strategies responsible for certain semantic changes (*i.e. Metaphor & Metonymy*);

(ii) Diachronic directionality, both on the semantic, and grammatical levels of the language (concrete > abstract)

for specific, indepth analysis of this phenomena see: (Bowers, 2016): http://bit.ly/2FnsKPU

Etymological Markup:
Examples of Mixtec Polysemy- **nuu** ‘*face’*

nuu
‘face’

nu-u̲
face\1sg
‘my face’

nuu ve’e
[face+house]
‘front (part) of the house’

intu’u saa-ka **nu-u̲**
sit[3SG.INF] bird-TPC **face\1SG**
‘the bird is sitting in front of me’

nuu tsa’a ña’a
[face] foot woman
‘..on the woman’s foot’

nuu yuku inkaa-yu
[face] forest cop.loc-1sg
‘I am in the forest’

ntava chumi-ka **nuu** yutu
CMPL/fly owl-TPC [face] tree
‘the owl flew into the tree’

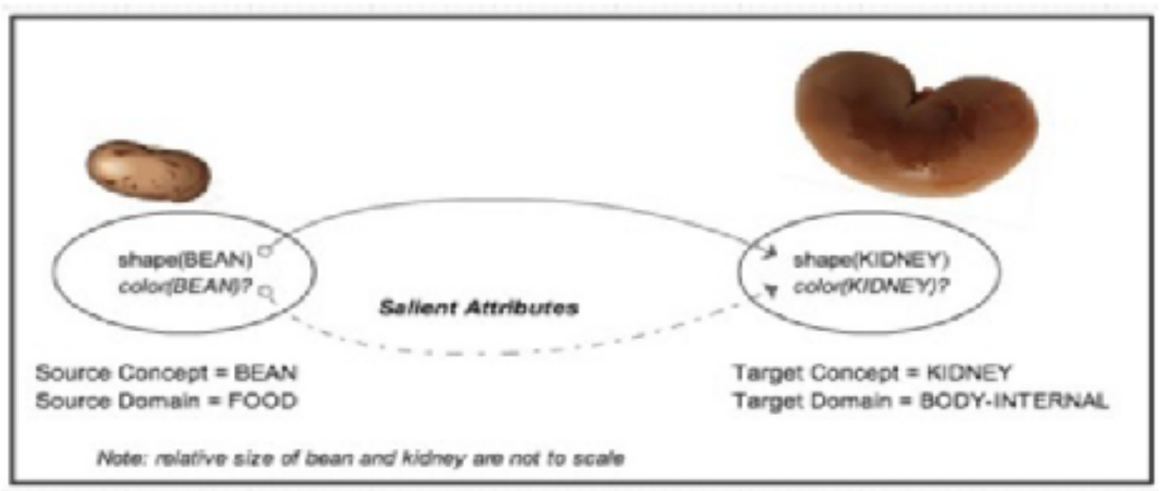
ntakoo chumi-ka **nuu** yutu
CMPL/get.up owl-TPC [face] tree
‘the owl got up, left the tree

Etymological Markup: Metaphor

Metaphor is the means through which we understand one concept in terms of others through partial and asymmetrical mappings across domains (Lakoff & Johnson, 1980), (Lakoff, 1993).

The driving forces are ontological correspondences between the attributes or internal structures of entities in the source domain, which correspond to those of the target domain (Lakoff, 1993).

Where this is true, the potential for mapping is activated, or is rendered salient on the conceptual level, which in turn, enables the linguistic encoding of these structures for communicative purposes.



Etymological Markup: Metaphor

```
<entry xml:id="kidney" xml:lang="mix">
 <form type="lemma">
  <orth>ntuchi</orth>
  <pron notation="ipa">nduɻʧiʌ</pron>
   <gramGrp>
    <pos>noun</pos>
   </gramGrp>
 </form>
 <sense corresp="http://dbpedia.org/resource/Kidney">
  <usg type="domain"corresp="http://dbpedia.org/resource/Human_body">Body</usg>
  <usg type="domain" corresp="http://dbpedia.org/resource/Human_organs">InternalOrgans</usg>

   <etym type="metaphor">
    <cit type="etymon">
     <oRef corresp="#bean">ntuchi</oRef>
     <pRef notation="ipa" corresp="#bean">nduɻʧiʌ</pRef>
     <ref type="sense" corresp="http://dbpedia.org/resource/Bean"/>
     <usg type="domain" corresp="http://dbpedia.org/resource/Category:Edible_legumes">Legume</usg>
     <gloss>bean</gloss>
    </cit>
   </etym>
   <cit type="translation" xml:lang="en">
    <quote>kidney</quote>
   </cit>
  </sense>
</entry>
```

MIX

ntuchi

'kidney'

[bean]

metaphor

source domain: FOOD, LEGUME

target domain: BODY, ANATOMY

Etymological Markup: Metonymy

Metonomy is a cognitive process in which one conceptual entity, the vehicle, provides mental access to another conceptual entity, the target within the same domain. The cognitive process is reflected in linguistic innovation; (Kövecses and Radden, 1998);

formula: B for A; where B is the vehicle & A is the target

Particularly common with part-whole, whole-part relationships (Meronymy)

Hyponymy (member-category)

In spatial domain often metonymy is used to refer to adjacent space to object (or a region thereof)

Etymological Markup: Metonymy

Polysemy

animal = kiti, [kìt̪í]

horse = kiti, [kìt̪í]

metonymy

horse isA animal

Category (ANIMAL)

Member (HORSE)

```
<entry xml:id="animal-horse"xml:lang="mix">
  <form type="lemma">
    <orth>kiti</orth>
    <pron notation="ipa">kìt̪í</pron>

    <gramGrp>
      <pos>noun</pos>
    </gramGrp>
  </form>

  <sense corresp="http://dbpedia.org/resource/Horse">
    <usg type="domain" corresp="http://dbpedia.org/resource/Animal">Animal</usg>

    <cit type="translation" xml:lang="en">
      <quote>horse</quote>
    </cit>
    <cit type="translation" xml:lang="es">
      <quote>caballo</quote>
    </cit>

    <etym type="metonymy" subtype="categoryForMember">
      <date notBefore="1492"/>
      <cit type="etymon">
        <oRef corresp="#animal">kiti</oRef>
        <pRef corresp="#animal">kìt̪í</pRef>
        <gloss>animal</gloss>
      </cit>
      <note resp="#JB">In this lexical item, the language reflects the history, since there were
no horses in Mexico until the arrival of the Spanish, there was no Mixtecan word for 'horse', thus
they categorical noun for 'animal' was used to describe the unnamed animal.</note>
    </etym>
  </sense>
</entry>
```

Etymological Markup: Compounding & (multiple processes)

MIX

nta’a yutu

[ARM/HAND+TREE]

‘branch’ (of a tree)

compounding

metaphor

source domain: BODY

target domain: TREE

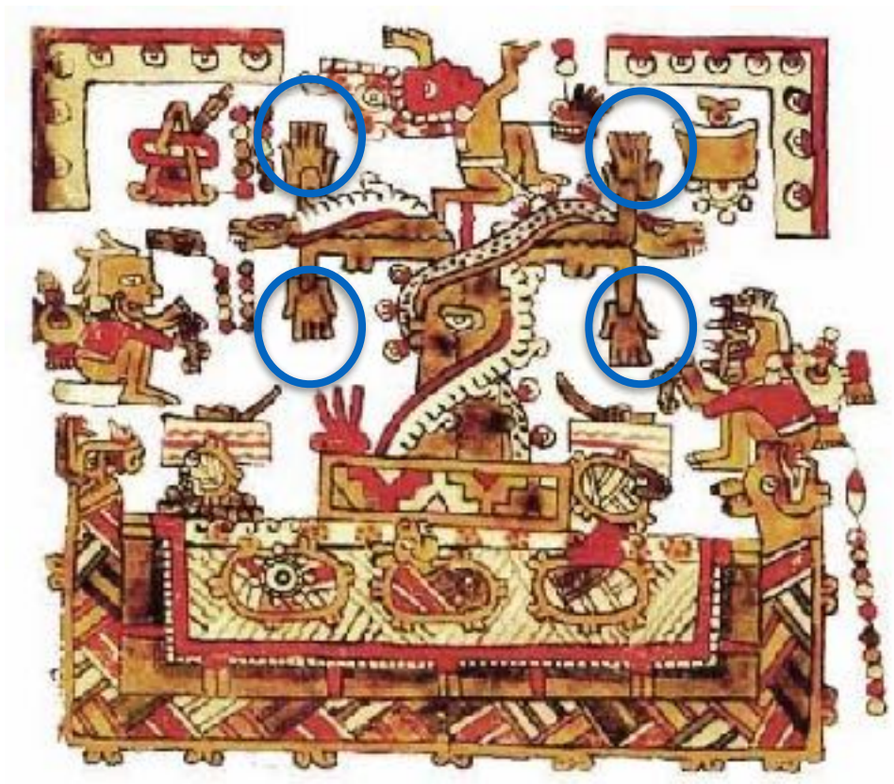


Image source:
Pohl, J. (n.d.). FAMSI - John Pohl’s - Ancient Books - Mixtec Group Codices.

```
<entry xml:id="body-face-eye" type="compound">
  <form type="lemma">
    <orth>nta’a yutu</orth>
    <pron notation=“ipa”>ndà?á jùṯú</pron>
    <gramGrp>
      <pos>noun</pos>
    </gramGrp>
  </form>
  <sense corresp=“http://dbpedia.org/resource/Branch">

    <usg type=“domain”
corresp=“http://dbpedia.org/resource/Branch”>Tree</usg>
                    <!—meronymOf(Tree) —>

    <etym type=“compounding">

      <etym type=“metaphor">
        <cit type="etymon">
          <oRef corresp=“#hand-arm“>nta'a</oRef>
          <gloss>hand, arm</gloss>
        </cit>
      </etym>

      <cit type="etymon">
        <oRef corresp="#tree">yutu</oRef>
        <gloss>tree</gloss>
      </cit>
    </etym>
    <cit type="translation" xml:lang="en">
      <quote>branch</quote>
    </cit>
    <cit type="translation" xml:lang="es">
      <quote>rama</quote>
    </cit>
  </sense>
```

Etymological Markup:

Compounding (multiple processes)

MIX

ntuchinuu

ntuchi+nuu

‘eye(s)’

[bean+face]

compounding

metaphor

source domain: FOOD

target domain: BODY, ANATOMY

```
<entry xml:id="body-face-eye" type="compound">
  <form type="lemma">
    <orth>ntuchinuu</orth>
    <pron notation="ipa">ndùʧínǔ́ú</pron>
    <gramGrp>
      <pos>noun</pos>
    </gramGrp>
  </form>
  <sense corresp=“http://dbpedia.org/resource/Category:Eye">
    <usg type=“dom"
corresp="http://dbpedia.org/ontology/AnatomicalStructure">Anatomy</usg>
    <etym type=“compounding">

      <etym type="metaphor">
        <cit type="etymon">
          <oRef corresp="#bean">ntuchi</oRef>
          <gloss>bean</gloss>
        </cit>
      </etym>

      <cit type="etymon">
        <oRef corresp="#face">nuu</oRef>
        <gloss>face</gloss>
      </cit>
    </etym>
    <cit type="translation" xml:lang="en">
      <quote>eye</quote>
    </cit>
    <cit type="translation" xml:lang="es">
      <quote>ojo</quote>
    </cit>
  </sense>
</entry>
```

Next Steps (near future)

- Make use of/ implement the @lemma in <w> to link all inflected word forms/ phrases with their common lemma
- Implement Predicate Logic-Based linguistic structual descriptions
- Establish more refined translation typology
- Improve/standardize automatic processing, markup programming
- Publish in open repository (dataverse) & disseminate the corpus in CC-BY
- Register with OLAC
- Enhance translated content by linking to wiktionary
- Produce conversion scripts to make convertible to LOD (Lemon-ONTOLEX & LMF reserialzation)
- Create and publish new MIX content
- Produce corpus based studies of polysemy and etymological processes (particularly in Body-part terms):
  - *upcoming paper in publication for procedings of PUCP (2016)*
- Define concepts taxonomy for senses and domains
- Make data output compatible with FLeX toolkit used by SIL Mixtec researchers

Inria
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Further Development (longer term)

- Create new materials in Mixtec
- Create permanant online hub for hosting, accessing, and adding data (*possibly including crowd sourcing*)
- Online website where users can read and view the original content and access the translations and annotations as well
- Enhance dictionary with MIX language definitions of entry content (to improve the usability for native speakers)
- Attempt automatic annotation of phonetics in Praat using build-in machine learning capacity
- Produce systematic studies comparing the speech of MIX speakers who reside only in Mexico and those who live in the US
- Integrate dataset into LD ontology for the concepts observed in etymology, integrate into model (e.g. *Framester*?)
- Extract & integrate available vocabulary for related Mixtec varieties
- Extract & integrate historical dictionary (from 1590's into dataset)
- Expand project to enable onomasiological-based collection and storage of all Mixtec varieties

Further work: Codex-based materials

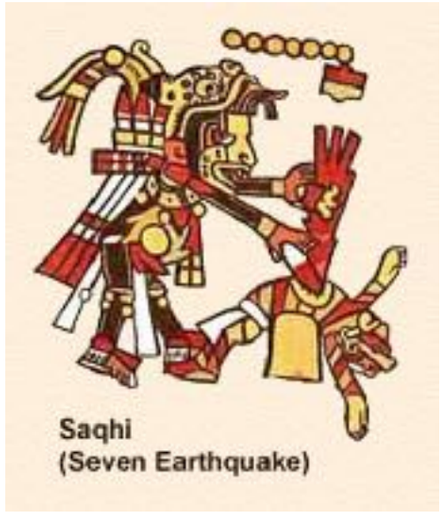
A major goal is to develop more materials in Mixtec, an ideal and un-tapped resource to use for this are the Mixtec codexes (….)

These can be used for both the creation of materials for adults, children and language learners;

img source: FAMSI

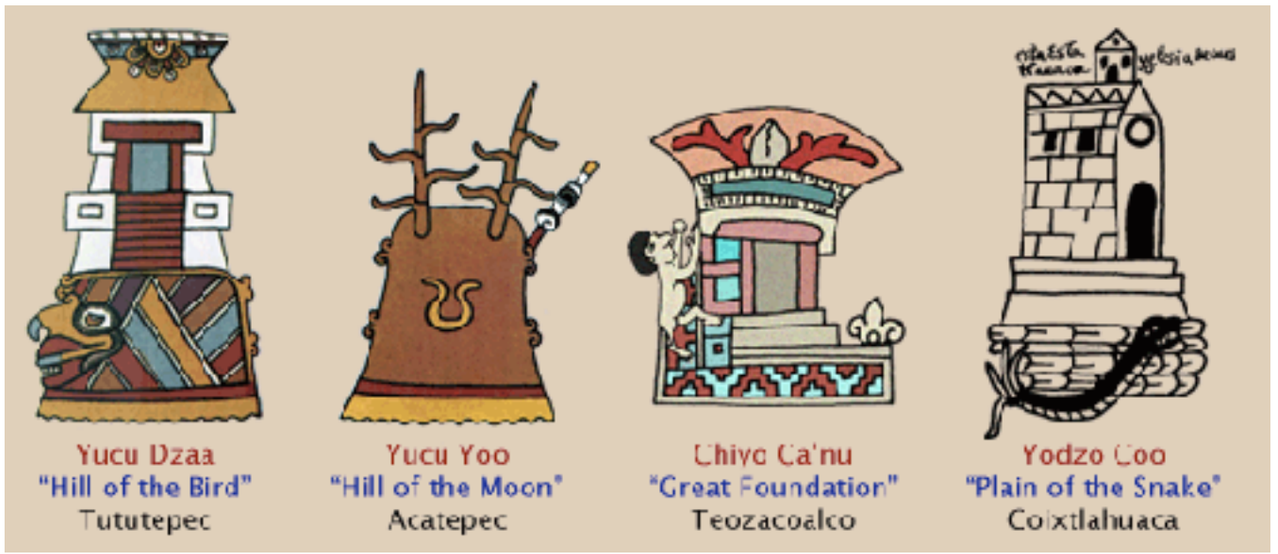
Image source: Pohl, J. (n.d.). FAMSI - John Pohl's - Ancient Books - Mixtec Group Codices. Retrieved March 6, 2018, from http://www.famsi.org/research/pohl/jpcodices/pohlmixtec8.html

Codex-based materials: translation of codex snippet



Utsa Taàn

Ntanta'a (lord)? Una Tachi ka tsi (Na'a) Utsi Isu



Yuku Saa Yuku Yoo ? ?

Image source: Pohl, J. (n.d.). FAMSI - John Pohl's - Ancient Books - Mixtec Group Codices. Retrieved March 6, 2018, from http://www.famsi.org/research/pohl/jpcodices/pohlmixtec8.html

Codex-based materials: onomasiological data
TEI <conceptEntry>

Given that the codeces are not specific to any local variety of Mixtec, any material created for one variety could be extended to another.

Pernes, Bowers & Romary (2017) presented the <conceptEntry> as a proposed addition to the TEI to accomodate the encoding of onomasiological datasets for various purposes:

Academic Papers: Pike & Ibach (1978)

Paper is the benchmark for the language's tonal system

Contains a significant amount of vocabulary examples and their tones

However a lack of standardization in both their phonetic alphabet and their tone characterization creates an enormous amount of work to normalize and integrate into project's data model (IPA & TEI)

The amount of data is too small to justify automation but it is important content both for comparing my results and in maximizing the quantity of data collected

Non-IPA

¢ = t͡s
š = ʃ
č = t͡ʃ
ʒ́ = t͡ʒ́
ǰ = d͡ʒ
ɡ = k̬

Tone levels are reversed from conventional description

^{3} = Low
^{2} = Mid
^{1} = High

Strings are often interrupted

š[i.]^{2}ši^{3}-¢i^{2} '

ko^{1}lo^{1}-ko^{1} 'our (excl.) male turkey', š[i.]^{2}ši^{3}-¢i^{2} 'his or her (child) aunt', s[o.]^{3}ko^{3}-yu^{3} 'my (polite) collarbone', z,[i.]^{3}¢a$^{3\text{-}1}$ 'sandal' ti^{3}k^{w}[a.]^{3}a^{2} 'butterfly'; but, laʔ^{2}la^{2}-¢i2 'his or her (child) mucus', ǰa^{1}ʔa^{1}-ni^{1} 'your (sing, polite) gravy'.

**I still need to decide the best way to represent tone… in my phonetic transcriptions*

Academic Papers: Pike & Ibach (1978)

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