TempPO: towards a conceptualisation of pathology in speech and language therapy

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Context

• Speech and Language Therapists (SLTs) use
  • Diagnostic labels to name all of their patients’ difficulties using an official and presumably consensual manner
• Help SLTs better reflect the patients’ reality in order to
  • Give a label to patients’ difficulties
Naming Pathology: labelling process

Patients’ reality

Results of their assessment tests

Pathology representations

If one element is inconsistent = creation of different complex terms and collocations

Terms available

Classifications based on a biomedical conceptualisation of language
SNOMED, ICDH, DSM-5

National regulations (CCAM, CSARR, NGAP)

MESH

Term = dysarthria
Why current classifications are not sufficient?

• Classifications do not take into account
  • Terminological variations
    • From one language to another
      • At a formal level: dysphasie (F) ≠ dysphasia (UK)
      • At a lexical level: cf slide 5
      • At a conceptual level: cf slide 6
  • Meaningful SLT Perspective
    • Dyslexie ≠ troubles d’acquisition de la lecture ≠ trouble de la compréhension des énoncés (FR)
    • Temporal aspects which may help differential diagnosis: retard simple de langage vs dysphasie (eg. durability)
    • Language and communication (the focus of SLTs) are complex issues (anatomical, but also functional and sociological and systemic compounds)
<table>
<thead>
<tr>
<th>Termes génériques</th>
<th>Termes relatifs aux troubles de la lecture et de l’orthographe</th>
<th>Formulations contenant des relations causales ou comorbidité</th>
<th>Termes étiquetant des sous-types de troubles de la lecture et de l’orthographe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning difficulties (Poland)</td>
<td>Disorder of written expression: DSM-IV criteria (Canada)</td>
<td>Language based reading disability (Canada)</td>
<td>Phonological dysgraphia (Russia)</td>
</tr>
<tr>
<td>Literacy impairment (USA)</td>
<td>Dysgraphia-dyslexia (Bulgaria)</td>
<td>Language learning disabilities (USA)</td>
<td>Phonological subtypes (Germany)</td>
</tr>
<tr>
<td>Poor academic skills (India)</td>
<td>Legasthenie (Austria, Switzerland)</td>
<td>Oral and written language impairment/disability (USA)</td>
<td>Regulatory dysgraphia (Russia)</td>
</tr>
<tr>
<td>Specific academic needs (Bulgaria)</td>
<td>Reading and writing disorders (Slovenia)</td>
<td>Reading and writing disabilities due to insufficient development of the language system (Latvia)</td>
<td>Visual-spatial dysgraphia (Russia)</td>
</tr>
<tr>
<td>Specific impairments of academic skills (Bulgaria)</td>
<td>Reading disorder (Bulgaria, Canada, Latvia)</td>
<td>Specific language impairments (Sweden)</td>
<td></td>
</tr>
<tr>
<td>Specific Learning Difficulties (Malta)</td>
<td>Reading retarded (Denmark)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Learning Disabilities (Slovakia)</td>
<td>Specific disorders of the written language (France)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific learning disabilities in reading/writing (Australia)</td>
<td>Specific reading disabilities (Latvia)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific learning Impairments (Bulgaria)</td>
<td>Word blind (Denmark)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Written language disorder (Australia)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Written language Impairment (Malta)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Why temporality / evolution?

• Previous research showed
  • Syntactic and semantic differences revealing more or less durable symptoms
    • trouble d’articulation (NdN) vs trouble de l’articulation (N+de+Dét+N)
  • Inconsistent use of affixes
    • In English: dysphasia is a less severe aphasia (although some SLTs want to abandon the term e.g. Worrall 2016) → severity
    • In French: aphasie is acquired and dysphasie is developmental → onset time
  • Temporal aspects help to identify the pathology
    • Language delay was wrongly relating to something that can recover. Now part of a generic term: developmental language disorder (discussed and grouped in the generic term developmental language disorders (international consensus CATALISE, Bishop 2017)
TemPO

- Termino Ontological Resource for the French Speech and Language Therapy
  - [Reymonet, Thomas, Aussenac-Gilles, 2007]
  
  Resource containing
  - Conceptual Component: Ontology
  - Lexical Component: Terminology

- TemPO Aim
  - Definition of PATHOLOGIE ORTHOPHONIQUE concept based on
    - Shared Vocabulary
    - Temporality

- TemPO Usage
  - End-User: Speech and Language Therapists (SLTs)
  - Access to lexical entities and their definitions
  - Reasoning from ontology
Process leading to Tempo

1. Semantic and syntactic analyses of terms from written corpus in SLT (French)  
   [Maniez 2009 ; Née, Sitri & Véniard 2014 ; Desmet 2006 ; ...]

2. Extraction of relevant characteristics (e.g. temporality)

3. First conceptual model
   Ortocorpus Toth 2014 -> Toth 2016

4. Ontological resource (TemPO)
   MOColang project (Université De Lorraine, ATILF, Clunl, Fédération des orthophonistes, CHU de Bar le Duc)
Methodology Framework

• Neon [Suarez-Figuora, Gomez-Perez & Fernandez-Lopez, 2015]

[Uschold & Gruninger, 1996 ]

• Scenarios of use
  • Specific tasks a persona performs using the system based on the ontology to be designed
  • The SLT gives the patient some information on the pathology they are dealing with

• Competency Questions
  • Questions the ontology is able to answer
  • The wife of a person with Alzheimer’s disease asks his SLT whether his reading skills will improve or not with therapy
Conceptualization

• Hybrid Approach for the Conceptual Model Building
  • Onomasiological approach
    • Starting point: concept are given by experts
    • Aim: defining the concept and discriminating it from the concepts within the same network
    • Finding the term comes later
    • Resource: Frederique Brin as the domain expert
  • Semasiological approach
    • Starting point: term that indicates the existence of a concept shared between the members of a group of experts
    • Aim: use linguistic analysis to identify the terms used by the group who shares common knowledge
    • Resource: using semi-automatic methods on 2 corpora
      • First corpus 460 SLT reports in French [Brin-Henry et al., 2011]
      • Second corpus 957 articles written between 1997-204 [Brin-Henry et al., 2018]
Characteristics for Pathology in SLT

They are identified from the use of linguistic units to understanding characteristics.

<table>
<thead>
<tr>
<th>Property</th>
<th>Characteristics of the pathology in SLT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evolution</td>
<td>progressive or non progressive</td>
<td>the patient’s condition will get better or worse, the patient’s condition is stable</td>
</tr>
<tr>
<td>Start</td>
<td>onset time</td>
<td>the time when the pathology starts or happens</td>
</tr>
<tr>
<td>Structure</td>
<td>impairs the structure/or the use of the structure</td>
<td>when particular system, such as the visual system, is impaired in itself,</td>
</tr>
<tr>
<td></td>
<td>impairs the use of the structure</td>
<td>when it is the way the system is used which is impaired</td>
</tr>
<tr>
<td>Type of structure</td>
<td>motor</td>
<td>affecting motor abilities, e.g. the movement of the tongue</td>
</tr>
<tr>
<td></td>
<td>or neuropsychological</td>
<td>affecting neuropsychological abilities, e.g. our memory</td>
</tr>
<tr>
<td>Language-driven</td>
<td>impairs language</td>
<td>affects linguistic skills, e.g. the way a person pronounces words,</td>
</tr>
<tr>
<td></td>
<td>impairs non-linguistic abilities</td>
<td>affects skills not directly involving linguistic abilities, e.g. the ability to concentrate on a particular task</td>
</tr>
<tr>
<td>Modality</td>
<td>written language</td>
<td>when pathology involves oral language</td>
</tr>
<tr>
<td></td>
<td>oral language</td>
<td>when pathology involves written language</td>
</tr>
</tbody>
</table>
Temporality Central for the Pathology Model

Pathologie du langage

- P. Evolutive
  - P. Développementale
  - P. Dégénérative
- P. Non Evolutive
  - P. Congénitale
  - P. Acquise
First Version of the Pathology Model

Pathologie du langage

P. Evolutive

P. Développementale
- S. Système
  - S. Motrice
    - Langage
  - S. NP
    - Langage
- F. Système
  - F. Motrice
  - F. NP

P. Dégénérative
- S. Système
  - S. Motrice
    - Langage
    - L. Oral
    - L. Ecrit
  - F. NP
    - Langage
    - L. Oral
    - L. Ecrit

P. Non Evolutive

P. Congénitale
- S. Système
  - S. Motrice
  - F. Système
  - F. NP

P. Acquise
- S. Système
  - S. NP
  - F. Motrice
  - F. NP

[Brin-Henry, 2018]
Qualification of PathologieOrthophonique by means of the object property aPourDynamique

Enumerated concept definition
DynamiquePathologie = {*evolutive, *nonEvolutive}
* : individus disjoints

Object property definition
aPourDynamique
domain: PathologieOrthophonique
range: DynamiquePathologie
Formalisation

- Four subconcepts of PathologieOrthophonique are defined and qualified by means of temporal properties:
  - PathologieCongenitale
  - PathologieAcquise
  - PathologieDeveloppementale
  - PathologieDegenerative
Formalisation

• **Temporal qualification of** PathologieOrthophonique

<table>
<thead>
<tr>
<th>objectProperty</th>
<th>domain</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td>start</td>
<td>aDebutInstallation</td>
<td>PathologieOrthophonique</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DureePathologie = {*durable, *temporaire}</td>
</tr>
<tr>
<td>duration</td>
<td>aDureePathologie</td>
<td>PathologieOrthophonique</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DebutInstallation = {*accidentVie, *debutVie, *developpementApprentissage}</td>
</tr>
</tbody>
</table>

• Not possible to reuse of the Time Ontology
Defined classes

- PathologieDurable ≡ PathologieOrthophonique AND aDureePathologie value durable)
- PathologieEvolutive ≡ PathologieOrthophonique AND aDynamiquePathologie value evolutif)
- PathologieNonEvolutive ≡ PathologieOrthophonique AND aDynamiquePathologie value nonEvolutif)
- PathologieTemporaire ≡ PathologieOrthophonique AND aDureePathologie value temporaire)
Formalisation

- **Qualification of** PathologieOrthophonique

<table>
<thead>
<tr>
<th>objectProperty</th>
<th>domain</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td>aPourCible</td>
<td>PathologieOrthophonique</td>
<td>Cible = { *communication, *fonctionnementOromyofaciale, *langageEcrit, *langageOral }</td>
</tr>
</tbody>
</table>
Reasoning on Pathology in SLT

• Asserted hierarchy

• Inferred hierarchy
First Evaluation of of TemPO

- DL Query

Query (class expression)
aDureePathologie value temporaire

Query results
Instances (1 of 1)
- aprosodie

Query (class expression)
aDureePathologie value temporaire and aDynamiquePathologie value evolutif

Query results
Subclasses (2 of 2)
- PathologieDevelloppementale
- owl:Nothing
Conclusion

• TemPO
  • RTO from which export to SKOS are possible
  • Clinical practice are the model base
  • Temporality is central and guide the building of the model
  • Interdisciplinary approach adopted for its building

• Ongoing project: based on previous work but still needs a lot

• Decisive project for SLT: impact on European discussions on common concepts.
Perspectives

• Use the OntoLex-Lemon model
  • a concept is expressed in natural language and the formal description of the concept in the ontology is kept separated
Expert validation in context of MOCOLANG

• 46 terms in French SLT terminology were listed
  • Selection by experts (students and professionals)
  • Verification of existence in Dictionnaire d’orthophonie (35/46) and bibliographical database (ScienceDirect) and indexation MESH
  • Overall frequency and most frequent « forme fléchie » (esp. Plural/sing form)


• Variations listed (ex: trouble de la parole/trouble de la production de la parole, anarthrie/syndrome de désintégration phonétique) as well as subclasses (agnosie > prosopagnosie, agnosie visuelle, anosognosie)

• Currently being translated into En and Portuguese with native language expert validation
  • Trouble de la parole/speech disorders/deficiências da fala