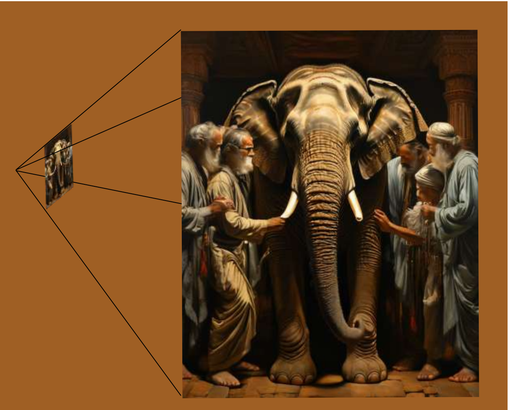
Building An Ecological Mental Functioning Ontology: An Informatics Perspective

Guy Divita*, Maryanne Sacco, Kathleen Coale, Rebecca Parks and Elizabeth Rasch
Rehabilitation Medicine Department, National Institutes of Health, Bethesda, MD USA



INTRODUCTION

This ontology is a needed resource for clinical natural language processing (cNLP) designed to highlight *mental functioning* in clinical records. The lack of a standard shared language related to *mental functioning* is a barrier to interdisciplinary communication and research. However, the body of work related to mental functioning ontologies is sparse and has focused on *body-level* mental functions and behavioral health. Existing standardized terminologies are also limited in conceptualizing *mental functioning* beyond biomedical or pathological perspectives[1].

Our work provides a complementary perspective of *mental functioning* at the level of *activities and participation*[2]. The domain of *mental functioning*, from the perspective of an observer, as opposed to the patient, is less codified in medical terminologies. We endeavor to better codify *mental functioning* through the curation of a domain ontology as part of our pursuit to find mental functioning mentions in clinical text.

METHODS

Cognitive Curation

- By a group from behavioral health, rehabilitation, medicine, computer science, and health services researchers
- Started with classes from the ICF's activities and participation
- Explored the use of ICF codes to annotate ***mental functioning mentions*** within clinical text
- Found ***mental functioning mentions*** not aligned with existing ICF codes due to
  - ➢Lack of classification of personal factors [1].
  - ➢Gaps and ambiguities resulting from different constituencies' labeling
- *Interpersonal Interactions and Relationships* (IPIR) added
- *Communication and Cognition* (ComCog) added
- The underlying theoretical model integrates
  - – open systems theory,
  - – social-ecological theories,
  - – ICF

The Ontology Perspective

- As observed behaviors
- From an observer, i.e., clinician
- With language that describes *functioning*
- Impairments described as attributes of functioning not diagnoses or pathologies

MAIN FINDING

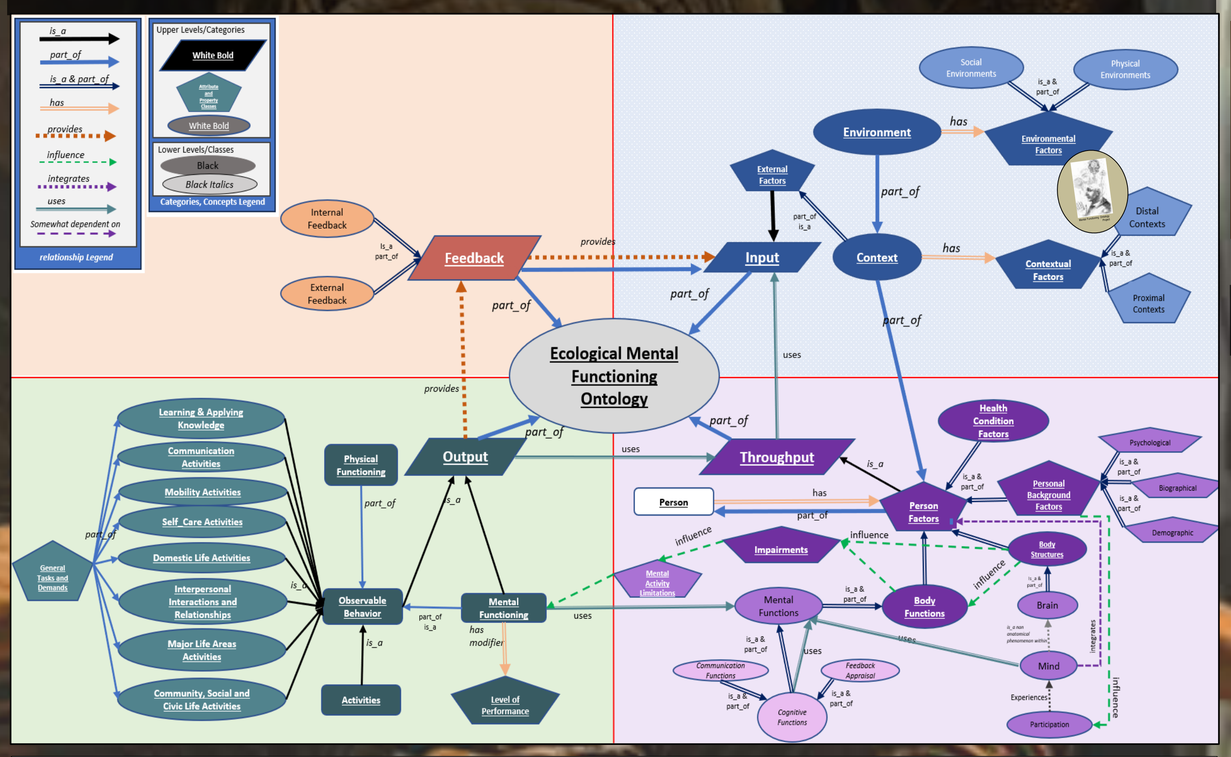


Figure 1: The Ecological Mental Functioning Ontology (EMFO)

Derived Terminologies

- Gathered from top-level UMLS classes mapped to the EMFO
- Manual annotations identifying IPIR and ComCog
- 162 VerbNET classes [13]

Content Validation

- Received feedback from
  - ➢Practicing clinicians
  - ➢SSA
  - ➢Maryland Occupational Therapy Association (MOTA)
  - ➢AMIA's Mental Health Informatics Working Group
- A set of clinical inquiries
  - ➢ Sufficient content and coverage to satisfy all the clinical inquires

Other's Prior Efforts

- 2021: Ontological modeling of the International Classification of Functioning, Disability and Health (ICF): Activities & Participation and Environmental Factors components, by Silvia Cozzi, et al [9]
- 2012: Mental Functioning Ontology by Janna Hastings et al [10]
- 1998: Desiderata for Controlled Medical Terminologies in the Twenty-First Century by James Cimino [11]
- 2006: Desiderata for domain reference ontologies in biomedicine by A. Burgun [12]

An Introduction to the EMFO

- The EMFO differentiates the concept` of mental functioning from mental functions.
  - ➢*Mental functions* are internal processes that occur within the brain, at the anatomical, physiological system levels of function
  - ➢***Mental functioning*** is observed as outward behaviors the person does
- EMFO merges classes from the
  - ICF [2], functioning
    - social-ecological perspectives of human functioning [3] [4] [5],
    - person-environment-activities transactive open systems models [6] [7] [8]
- The EMFO is organized with top-level quadrant classes
  - ➢***Input***: sensory information received from the external environment or internally
  - ➢***Throughput***: sensory information received from the external world and internally is processed using person factors
  - ➢***Output***: actions observed
  - ➢***Feedback***: the sensory information provided to the person as they interact within their environment

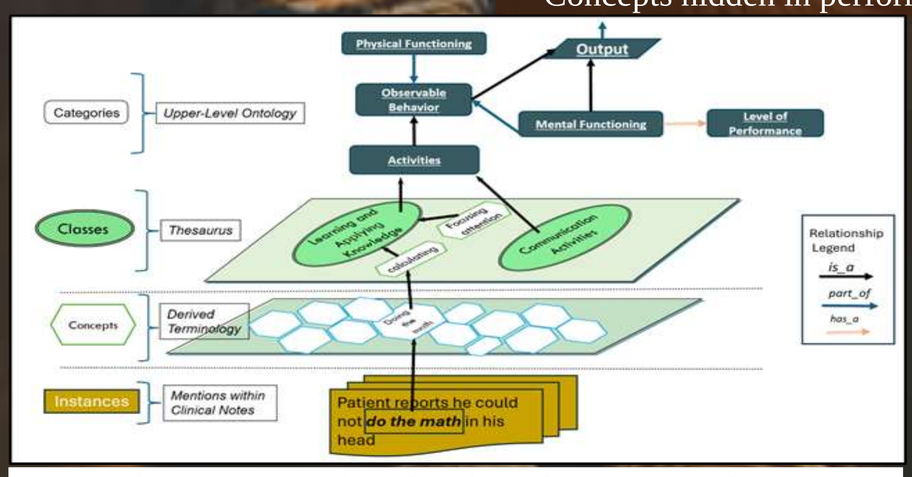


Figure 2: Inherent Semantics of the Ecological Mental Functioning Ontology

DISCUSSION

- *Mental functioning* is not currently standardized within medical terminologies.
- Concepts hidden in performance tests and surveys

Our desire is to better characterize the language and influence standardized clinical documentation

Future Work

- Foster dialogue from *mental functioning* stakeholders
  - behavioral health practitioners
  - clinical NLP community
  - ontology community
  - Release rule-based NER's
  - Submit it to the OBO Foundry

Availability

https://github.com/CC-RMD-EpiBio/EcologicalMentalFunctioningOntology

ACKNOWLEDGEMENTS

This work was supported by the Intramural Research Program of the National Institutes of Health and the U.S. Social Security Administration.

Conclusions

The EMFO

- is an effort to foster consensus about *mental functioning*
- is characterized by explicitly noted perspectives
- adheres to most of the prescribed ontology and terminology desiderata
- its semantics are similar to that adopted by the UMLS

REFERENCES

[1] M. J. Sacco, G. Divita and E. Rasch, "Development of an ontology to characterize mental functioning," Disability and Rehabilitation, p. 1, 2023.
[2] International Classification of Functioning, Disability and Health, Geneva: World Health Organization, 2001.
[3] von Bertalanffy, L. General system theory: Foundations, development, applications, Aldine Publishing Co., 1968.
[4] M. G. Stineman and J. E. Streim, "The biopsycho-ecological paradigm: a foundational theory for medicine," PM&R, vol. 2, no. 11, pp. 1035-1045, 2010.
[5] Van Assche, K et al., "The social, the ecological, and the adaptive. Von Bertalanffy's general systems theory and the adaptive governance of social-ecological systems.," Systems Research and Behavioral Science, vol. 36, no. 3
[6] Dean, E.E. et al. "Adaptation as a transaction with the environment perspectives from the ecology of human performance model," in Adaptation through occupation: multidimensional perspectives, Danvers, MA, SLACK Incorporated, 2019, pp. 141-155.
[7] W. Dunn, C. Brown and A. McGuigan, "The ecology of human performance: A framework for considering the effect of context," The American Journal of Occupational Therapy , vol. 47, no. 7, pp. 595-607, 1994.
[8] M. law et al. "The person-environment-occupation model: A transactive approach to occupational performance," Canadian journal of occupational therapy, vol. 63, no. 1, pp. 9-23, 1996.