A clinical model VI: Medical semantics.

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Abstract

Background

Diagnoses are the foundation for clinical work, treatment and follow up. Diagnoses can be generated from a formula and an equation that hold the syntax of diagnoses. This study derives the semantics of diagnoses by interpreting them into a clinical model (CM) and a formal CM (fCM). There is a linguistic and logical version of semantics. Both versions should hold true for clinical medicine. Accordingly, we also need an understanding of medical truth.

Results

The formula and equation are shown to be isomorphic. The formula is readily interpreted into CM and fCM. Since the equation is isomorphic to the formula the former is immediately interpreted into CM and fCM as well. True predictions of events are predicted events that are repeatably observed.

Conclusions

A clinical model interprets the syntax of diagnoses successfully. The syntax of medical diagnoses has a semantic. The formula, equation and models make out a coherent theory that may be useful in clinical decision-making, classification and teaching.

Key words

Diagnoses, syntax, semantics, clinical model, medical informatics.

Background

Some social scientists and informaticians and hold that semantics is about arbitrary models and that there is no one data model (Strauss 1998, Hebeler 2009). This view is incompatible with natural science. There is no empirical evidence for equations like E=mc and $F=ma^3$. The only equations that model the facts are $E=mc^2$ and F=ma. In the clinical model there is no evidence that a reverse virulence morphism is representative for infections, and the same holds for all other etiological agents. Likewise, the pathogenetic morphisms cannot be reversed. It is an empirical fact that T4 emerges from the thyroid (the domain) and influences the pituitary (co-domain). Thus, the morphism P_{SP}=*T4*:Thyroid →Pituitary cannot be reversed. Also, the morphism cannot be eliminated from the medical curriculum. Empirical facts severely constrain the number of scientific models. Accordingly, school medicine rejects models that are not compatible with empirical results.

Two other conceptions of meaning dominate the semantics of natural language (Kamp 2002). To linguists, psychologists and scientists meaning is foremost what a language user understands from the words they hear or read. Referents are in the real world. For logicians, mathematicians and philosophers the conditions for truth are determined solely by models. Truth-theoretic and model-theoretic semantics stem from the latter view. My studies on a clinical model (CM) combines the latter two views on semantics.

Universal diagnosis syntax (UDS)

Informal language can hide aspects of meaning and lend intuitive credibility to invalid arguments. This can be avoided by making the hidden meanings explicit. The validity of formal languages are judged by interpreting the constants, variables and formulas against a model (Gamut 1991a, Gamut 1991b).

The formula d:=e&o&p aspires to valid diagnoses (Bassøe 2018c). The variables of the formula are instantiated with terms that name etiological agents, disorders and pathogenetic mechanisms. In this investigation validity of the formula is checked by interpreting into CM, which gives the semantics of the formula.

Their surface structure suggests that *fibromyalgia* and *myalgic encephalopathy* are proper diagnoses. However, *fibro* in fibromyalgia may literally refer to collagen, connective tissue, nerve- or muscle fibers. The term *fibro* is clearly ambiguous. *Myalgia* indicates muscle pain, but pain is a symptom and symptoms are not part of UDS. The

category mistake is obvious. Also, the two diagnoses *fibromyalgia* and *myalgic encephalopathy* are mixtures of names of symptoms (*myalgia*), pathology (*pathy*), tissue or fibers (*fibro*), and organ (*encephalo*) form different clinical domains. The surface structure of these “diagnoses” hides an ambiguous semantics.

Medical scientist concede on medical terms and physicians agree on them internationally. They are learned ostensively during bedside teaching, laboratory exercises and resident practice using the teacher-apprentice principle. This method allows for minimal disagreement. But lay people, nurses and physicians attach different meanings to some medical terms (Johannessen 1985). In my experience, many physicians do not discriminate between *inflammation* and *infection*. In psychiatry, medical terms like *orality* and *thought disorder* cannot be taught by ostension and may remain unclear. Also, many psychiatric terms are not interpreted as in linguistics and logic. For example, does *thought disorder* refer to logic, syntax, semantics, pragmatics, reference between language and reality, or their combinations? (Kendell 1982, Rector 2007). Thus, in many cases the correspondence between clinical terms and their reference may be unclear. Standardizing medical terms against an unambiguous reference is of major importance.

Linguistic semantics

Linguistic semantics concerns natural languages and their grammars. They refer to ontological objects and processes that are represented by some sign. (Yule 1985:91-103, Chapman 2005, Morris 2012). Chomskyan generative grammar is useful for language production and language understanding and the linguistic faculty is inherent in the brain (Chomsky 1972, Chomsky 1986). Gottlob Frege argued against such mentalism (Kenny 1995). The present study assumes that medical terms and diagnoses are part of natural language and have to be interpreted directly into CM.

Logical semantics

The semantic notion of logical validity has a heavy ontological commitment in that knowing the world is said to be its starting point (Allwood 2001). But is this true? Logical semantics refers to models that interpret logical expressions (Barendregt 2012, Carnap 2008, Kanterian 2012, Watt 1991). This kind of semantics is often called model-theoretic semantics. But there are many different logics (Haack 1993). In this context

truth can be defined by (a=b)=True⇔(a≠b)=False.[1] The problem is that *a* may be symbol or phrase and *b* is some mental experience from sensory impressions (Blackburn 2000). This category mistake is overcome elsewhere (Bassøe 2018f, Bassøe 2018g). The results are used in this study.

Another problem is the close relation between logical semantics and possible worlds (Putnam 1992, Stalnaker 1999, Jacob 1982). Model theory assumes that a language refers to a possible world and describes the minimal conditions that possible worlds must satisfy in order to assign an appropriate meaning to expressions in the language (Hayes 2012). Models can be seen as abstract specifications of actual and possible worlds (Gamut 1991b). Such formalisms play symbol games (Smoryński 2012). Clinical practice does not allow possible worlds. Luckily, CM is derived from empirical medicine (Bassøe 2019, Bassøe 2019a) even though realism poses serious philosophical problems (Hale 1999). This study will show that UDS represents the actual world and no other possible worlds.

Without discriminating between an object language and its metalanguage sentences such as

1) Sentence 1) is not true.

are contradictory under every interpretation. Tarski's convention **T** offers a definition of the truth predicate of a language. A theory **T** satisfies the requirement *IFF every instance of the schema 's is true* IFF p' is derivable within it, where *s* is a description within the object language and *p* is its translation into the metalanguage (Blackburn 2008:79, Gómez-Torrente 2017). However, the meta-meta… levels result in infinite regress. The present work solves this problem by removing the metalevels.

The present study relies on isomorphism for judging diagnoses and clinical models and their relations. A model **M** for a language **L** consists of a domain model **CM** and an interpretation function *I*:**L**→**CM** (Gamut 1991a, Gamut 1991b). Isomorphism is well defined in category theory (CT). In CT **L** is the domain of *I* and **CM** is the codomain of *I* (Barr 1990, Lawvere 2003, Walters 1991). The interpretation function switches the domain and codomain and the terminology is unfortunate. This study abides by CT and

[1] Without changing the argument, the constant symbol '=' within parenthesis may be replaced by symbols of isomorphism '≅' or equivalence '≡' or similarity '≈' and their negations.

holds **L** and **CM** as the domain and codomain, respectively of the interpretation morphism *I*:**L**→**CM**. Therefore, the meaning of domain and codomain are appropriate in the present study.

Philosophical propositions are said not to be empirical since they are about concepts. In contrast, the present medical propositions are concerned with empirical medical concepts. In contrast, the rules giving rise to medical expressions cannot be based on mere belief or crafted at will.

School medicine is empirical. Each term in a medical language needs a real-world reference and the meaning of a complex expression should be determined uniquely by the meaning of its component terms (García-Álvarez 2005). A theory is uniquely determined by the set of all its valid sentences (Tarski 2010). The present study investigates the semantics of diagnoses by interpreting individual medical terms into an informal and a formal clinical model. An informal CM (Bassøe 2018, Bassøe 2018a) and a formal clinical model (fCM) (Bassøe 2018c) is available. This study investigates the semantics of diagnoses by interpreting them both into CM and fCM.

References

Allwood J, Andersson L-G, Dahl Ö. Logic in linguistics. Cambridge, Cambridge, 2001, p. 72-3.

Barendregt HP. The lambda calculus, its syntax and semantics. College Publications, London, 2012.

Barr M, Wells C. Category theory for computing science. New York: Prentice Hall; 1990.

Bassøe C-F. A clinical model. I: Health. 2019.

Bassøe C-F. A clinical model II: Disorder, syndrome and disease. EkviMed Clinical Informatics. 2019a.

Bassøe C-F. A clinical model III: Universal diagnosis syntax. EkviMed Clinical Informatics. 2019b.

Bassøe C-F. A clinical model IV: The formal version. EkviMed Clinical Informatics. 2019c.

Bassøe C-F. A clinical model V: A clinical problem space. EkviMed Clinical Medical Informatics. 2019d.

Bassøe C-F. A clinical model VII: Clinical decidability. EkviMed Clinical Informatics. 2019e.

Bassøe C-F. A clinical model VIII: The mind and its brain in health and disease. EkviMed Clinical Informatics. 2019f.

Blackburn S, Simmons K. Introduction. In: Blackburn S, Simmons K (Eds.): Truth. Oxford: Oxford UP; 2000. p. 1-28.

Carnap R. Empiricism, semantics, and ontology. In: Martinich AP, Sosa D. Analytic philosophy. An anthology. Blackwell publishing, Malden, 2008, pp. 425-35.

Chang CC, Keisler HJ. Model theory. Dover, Mineola, 2012.

Chapman S, Routledge C. Key thinkers in linguistics and the philosophy of language. Edinburgh UP, Edinburgh, 2005.

Chomsky N. Knowledge and language. New York: Praeger; 1986.

Chomsky N. Language and the mind. San Diego: Harcourt Brace Jovanovich; 1972.

Frege G (1892). On sense and reference. In: Moore AW (Ed.): Meaning and reference. Oxford UP, Oxford, 1993:23-42.

Gamut LTF. Logic, language and meaning. Volume 1. Chicago: University of Chicago Press. 1991a, p.116.

Gamut LTF. Logic, language and meaning. Volume 2, Intensional logic and logical grammar. Chicago: University of Chicago Press. 1991b.

García-Álvarez I. Gottlob Frege. In: Chapman S, Routledge C. (Eds.): Key thinkers in linguistics and the philosophy of language. Edinburgh UP, Edinburgh, 2005, p. 92-8.

Hale B. Realisms and its oppositions. In: Hale B, Wright C (Eds.) A companion to the philosophy of language. Oxford: Blackwell; 1999, p. 271-308.

Hayes P. RDF Semantics. http://www.w3.org/TR/2004/REC-rdf-mt-20040210/ (Accessed 2017/2/25)

Hebeler J, Fisher M, Blace R, Perez-Lopez A. Semantic web programming. Indianapolis: Wiley; 2009.

Haack S. Philosophy of logics. Cambridge: Cambridge UP; 1993.

Jacob F. The possible and the actual. University of Washington Press, Seattle,1982.

Johannessen T, Hafstad PE, Kristensen P, Løge I, et al. Begrepsforvirring i gastroenterologien. Tidsskr Nor Legeforen. 1985;105:754-6.

Kamp H. A theory of truth and semantic representation. In: Portner P, Partee BH (Eds.) Formal semantics. Oxford: Blackwell; 2002. p. 189-222.

Kanterian E. Frege. A guide for the perplexed. London: Continuum, 2012, p. 12.

Kendell RE. The choice of diagnostic criteria for biological research. Arch Gen Psych. 1982;39:1334-9.

Kenny A. Frege. London: Penguin Books; 1995.

Lawvere FW, Rosebrough R. Sets for Mathematics. Cambridge: Cambridge UP, 2003.

Morris M. An introduction to the philosophy of language. Cambridge UP, Cambridge, 2012.

Putnam H. Reason, truth and history. Cambridge UP, Cambridge, 1992.

Rector A. Medical informatics. In. Baader F, Calvanese D, McGuinness DL, Patel-Schneider PF. The description logic handbook. Cambridge: Cambridge University press; 2007. p. 436-57.

Smoryński C. Adventures in formalism. London: College publications; 2012.

Stalnaker R. Reference and necessity. In: Hale B, Wright C, editors. A companion to the philosophy of language, Blackwell, Oxford, 1999, pp. 534-554.

Strauss A, Corbin J. Basics of qualitative research. London: SAGE publications; 1998.

Tarski A. A general method in proofs of undecidability. In: Tarski A, Mostowski A, Robinson RM (Eds.) Undecidable theories. New York: Dover; 2010. p. 3-35.

Walters RFC. Categories and computer science. Cambridge: Cambridge UP, 1991, 110.

Watt DA. Programming language syntax and semantics. Prentice Hall, New York, 1991.

Wulff HR, Pedersen SA, Rosenberg R. Philosophy of medicine. Oxford: Blackwell Scientific Publ; 1986.

Yule G. The study of language. Cambridge: Cambridge UP; 1985. p.*** .