An Annotation of Semantic Change based on Usage Relatedness

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  - collect a set of words displaying semantic change in a specific corpus in an annotation study

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> reductive meaning change
> loss of a fully-established meaning

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- meaning change corresponds to the emergence or reduction of polysemy
- → leads to up or down movement on proximity scale

Identity

My <u>arm</u> hurts.

Identity

> *My <u>arm</u> hurts.*

vs.

Identity

My <u>arm</u> hurts.

vs.

She grabbed my <u>arm</u>.

Context Variance

My <u>arm</u> hurts.

Context Variance

My <u>arm</u> hurts.

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Context Variance

My <u>arm</u> hurts.

vs.

Look at the <u>arm</u> of the statue.

Polysemy

My <u>arm</u> hurts.

Polysemy

My <u>arm</u> hurts.

vs.

Polysemy

My _arm_ hurts.

vs.

An _arm_ of the sea.

Homonymy

My <u>arm</u> hurts.

Homonymy

My <u>arm</u> hurts.

vs.

Homonymy

My <u>arm</u> hurts.

vs.

The number of men under <u>arms</u> is no longer the decisive factor in warfare.

Semantic Proximity in Practice

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  ▶ Brown (2008): semantic relatedness ('1' = unrelated, '4' =
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  ▶ Erk et al. (2009, 2013): semantic similarity ('1' = completely
    different, '5' = identical)

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Example – Polysemization
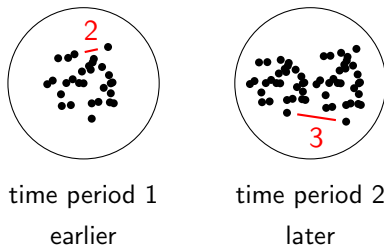

time period 1

earlier

time period 2

later

Figure 1: 2-dimensional use spaces in two time periods of a target word w undergoing polysemization. Dots represent uses of w and lines represent the semantic proximity of two such uses (measured by the number written next to it).

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  - **graduality**: distinction of different strengths of change
- relatedness:
  - **intersubjectivity**: previous studies high annotators' agreement on semantic relatedness
  - **feasibility**: non-experts can annotate semantic change

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- intelligibility of historic language
- ...

Annotation Scale

4: Identical
3: Closely Related
2: Distantly Related
1: Unrelated

0: Cannot decide

Table 1: Four-point Scale of Relatedness derived from Brown (2008, p. 250).

Identity

	A	B	C	D
1	**target sentence 1**	judgment	comment	**target sentence 2**
2	Ihr treibt das Geben noch weiter als ich das Naschen. **Schon der vorige Kuchen, den ich allein esse, wiegt 10 Geburttagtorten auf.** Ich nehme diesen von deiner Liebe gar an; aber der Ultima-Kuchen aus Hof — dieser ist Penultima- und der erste Antepenultima-Kuchen — kann, soll etwas davon für mich abgeschnitten werden, auf mein h. Wort, nur für gleiche Bezahlung angenommen werden.	4		Der Benediktiner hatte eine Schüssel der schönsten und größten Pfirsichen zum Geschenk erhalten, die er zum Nachtisch auftragen ließ, und dem Prinzen die köstlichste mit einer lächelnden und frommen Miene hinreichte. **Der Prinz theilte sie mit seiner Geliebten, und sie aßen** beyde die Pfirsiche ohne Verdacht. Man stund auf.

Table 2: rating 4 (Identical).

Contextual Variance

	A	B	C	D
1	**target sentence 1**	judgment	comment	**target sentence 2**
3	Hier schlug er seine Bude auf, und rief den Pöbel zusammen, seine schöne Raritäten zu schauen. **Das Volk drang hinzu, Mägde und Knechte, Jungfrauen und Wittwen, Kinder und Greise.** Der Teufel gaukelte ihnen allerley Histörchen vor, die er mit frommen Erläuterungen und moralischen Sprüchen begleitete.	3		Zum Namenstag. **Die sechs nächsten Wesen sind ihr Mann und die fünf Kinder.** 260.

Table 3: rating 3 (Closely Related).

Polysemy

	A	B	C	D
1	**target sentence 1**	judgment	comment	**target sentence 2**
4	Die Fraw aber / gleichsamb ob sie nichts von der Fabel wiste / fragte fleissig nach allem / wer das Kind were / warumb man es verstossen / vnd den jungen Knaben / von solcher Schönheit daß die Natur nichts an jhm vergessen / also weggeworffen hette. Er gab für / jhm were weiter nichts wissendt / **als dass er jhn auff einem Scheidwege am Wald /** da niemandt als Hirten vnd Jäger hin kämen / gefunden; dahin er entweder vnbarmhertziger weise / oder auß höchstdringender Noth müßte gelegt worden seyn. Also nam Sicambre das weinende Kindt / vnd schweigte es / in dem sie jhm zu trincken gab.	2		Auf der Erde werden Kinder Gottes geboren, die von den Menschen Genies genannt werden. Ein jedes von ihnen wird in früher Jugend an einen **Scheideweg** gestellt und muß seine Wahl treffen. Seine Gabe ist ihm verliehen für andere sowohl wie für sich selbst.

Table 4: rating 2 (Distantly Related).

Homonymy

	A	B	C	D
1	**target sentence 1**	judgment	comment	**target sentence 2**
5	Ferner: solange der einzelne Geschäftsmann alle Zahlungen unmittelbar aus seiner Kasse leistet, bezw. in dieselbe einnimmt, muss er zu den Zeiten, wo regelmässig grössere Summen fällig werden, einen erheblichen Barbestand beschaffen und andrerseits in den Zeiten überwiegender Eingänge dieselben sogleich zweckmässig unterzubringen wissen. **Die Konzentrierung des Geldverkehrs in den grossen Banken enthebt ihn dieses periodischen Zwanges zur Aufhäufung und Drainierung;** Endlich ein letztes Beispiel.	1		Ich fand lat. 43 ° 14 ', long. wahrscheinlich 51°¼. **Auf der Bank haben wir keinen Seetang gesehen, auch nicht westlich seit dem 8ten Juli.** Wenige Tage, ehe wir die Bank von Neufundland berührten, waren, was in dieser Jahreszeit (Mitte Juli's) sehr ungewöhnlich ist, grosse Eismassen gesehen worden, die sich nach Südwest bewegten, während der gewöhnliche Strom auf dem südlichen Theil der Bank nach Norden gerichtet ist.

Table 5: rating 1 (Unrelated).

Bibliography

Blank, A. (1997). *Prinzipien des lexikalischen Bedeutungswandels am Beispiel der romanischen Sprachen*. Tübingen: Niemeyer.

Brown, S. W. (2008). Choosing Sense Distinctions for WSD: Psycholinguistic Evidence. In *Proceedings of the 46th Annual Meeting of the Association for Computational Linguistics on Human Language Technologies: Short Papers* (pp. 249–252). Stroudsburg, PA, USA: Association for Computational Linguistics.

Eckardt, R. (2011, 01). Semantic reanalysis and language change. , *5*, 33–46.

Erk, K., McCarthy, D., & Gaylord, N. (2009). Investigations on word senses and word usages. In *Proceedings of ACL-09*.

Erk, K., McCarthy, D., & Gaylord, N. (2013). Measuring word meaning in context. *Computational Linguistics*, *39*(3), 511-554.

Frermann, L., & Lapata, M. (2016). A bayesian model of diachronic meaning change. *TACL*, *4*, 31–45.

Fritz, G. (2006). *Historische Semantik*. Stuttgart/Weimar: Metzler.

Gulordava, K., & Baroni, M. (2011). A distributional similarity approach to the detection of semantic change in the Google Books Ngram corpus. In *Proceedings of GEMS*.

Koch, P. (2016). Meaning change and semantic shifts. In P. Juvonen & M. Koptjevskaja-Tamm (Eds.), *The lexical typology of semantic shifts*. De Gruyter Mouton.

McMahon, A. (1994). *Understanding language change*. Cambridge University Press.

Paul, H. (1886). *Prinzipien der Sprachgeschichte*. Halle: M. Niemeyer.

Soares da Silva, A. (1992). Homonímia e polissemia: Análise sémica e teoria do campoléxico. In *Actas do xix congreso internacional de lingüística e filoloxía románicas* (Vol. 2, pp. 257–287). La Coruña: Fundación Pedro Barrié de la Maza.

Steen, G. (2010). *A Method for Linguistic Metaphor Identification: From MIP to MIPVU*. John Benjamins Publishing Company.

Zlatev, J. (2003). Polysemy or generality? Mu. In H. Cuyckens, R. Dirven, & J. R. Taylor (Eds.), (Vol. 23, p. 447 - 494). Mouton de Gruyter.