SFB-Networking-Workshop Saarbrücken 15./16. 07.2021

Relation of Prominence, Surprisal and Information Structure

Thursday, 15.07.2021

9.30 – 10.00 Opening

10.00 – 10.20 Mark Ellison, SFB 1252/C09 (Köln): A Bayesian Model Prominence in Reference Interpretation

The fundamental result in information theory is Shannon's theorem which connects optimal encodings with probabilities. This is based on a model in which a transmitter encodes information unambiguously in static representations and transmits it to a receiver who decodes it unerringly. The optimal encoding minimises the number of bits the transmitter uses to encode their message.

In this talk, I present work in which this basic model is extended to consider the case where the codings are ambiguous, and the receiver interprets them using a psychologically plausible model (compare Pickering & Garrod's 2007 forward modelling account of listener interpretation), in which Bayes' Theorem brings together predictions with the interpreted signal.

I show that in such a model, it is efficient for speakers to manipulate the signal to direct listener attention more towards the prediction or more towards the signal. This manipulation offers a formal account of one possible role for prominence in language.

10.20 – 10.40 Marjolein van Os, Vera Demberg, Jutta Kray, SFB 1102/A4 (Saarbrücken): Recognition of minimal pairs in (un)predictive sentence contexts in noise

Language comprehension in noise can sometimes lead to mishearing, due to the noise disrupting the speech signal. Some of the difficulties in dealing with the noisy signal can be alleviated by drawing on the context – indeed, top-down predictability has shown to facilitate speech comprehension in noise. Rogers et al. (2012) have furthermore shown that strong reliance on the top-down predictions can lead to increased rates of mishearing, especially in older adults, and attribute these to general deficits in cognitive control in older adults. We here propose that the observed mishearing may be a simple consequence of rational language processing in noise. To test this hypothesis, we extend earlier studies by carefully controlling the target and direct competitor in our stimuli and showing that mishearing is directly related to the perceptibility of the signal.

10.40 – 11.00 Tatjana Scheffler SFB 1287/A03 (Potsdam, Bochum), Michael Richter (Universität Leipzig), Roeland van Hout (Radboud University): Tracing and classifying German intensifiers through information theory

Intensifiers such as 'very', 'really', 'so' are used to express additive intensity to an utterance. There are many intensifying lexical items in a language and they are easily subject to language change and innovations. Our aim is to investigate the fairly open class of intensifiers that operate on predicative adjectives in German. We investigated how large the class of intensifiers is and whether we can give an answer to the question why this class is large and constantly changing. Not all its members seem to have an equal functionality. Some are extremely frequent, others are infrequent, even new, and seem to be meant to trigger a stronger intensifying effect than more common intensifiers.

We use two information theoretic notions to model two supplementary views on the surprisal/expressiveness of an intensifier in a given sentence. The first is the local information content of an intensifier, the surprisal of this word being used as an intensifier. The second notion is the transitional information an intensifier contributes, i.e. how strictly it constrains following intensifiers or adjectives. We test two hypotheses on a large corpus of intensified adjectives from German Twitter data: Hypothesis 1 states that the local information and the transitional information are strongly (anti-)correlated: The more common an intensifier is, the less intense/expressive it is and the less it constrains following adjectives. Hypothesis 2 states that stackings of more than one intensifier are frequent and are used to increase the expressiveness of the intensification: Therefore, we predict that stackings prefer to have an incremental surprisal order, from low to high, in predicative adjective phrases.

11.00 – 11.15 Coffee Break

11.15 – 12.30 Discussion

12.30 – 13.45 Lunch Break

13.45 – 14.05 Robin Lemke, Lisa Schäfer, Heiner Drenhaus, Ingo Reich, SFB 1102/B3 (Saarbrücken): Ellipsis: Above and beyond information structure

Information structure licenses ellipsis (Merchant 2001, Reich 2007), but it does not explain why speakers choose a (non)elliptical utterance in situations where ellipsis is licensed. We explore whether information theory (Uniform Information Density, Levy & Jaeger 2007) provides an account of the choice between ellipses and full forms at the example of sluicing, verb phrase ellipsis and topic drop. UID makes two predictions with respect to ellipsis, which our studies support. First, we find a stronger preference for ellipsis the more redundant the potentially omitted expression is. Second, the nonelliptical form is preferred when ellipsis would cause information peaks on unpredictable words.

14.05 – 14.25 Clara Huttenlauch, Kathleen Schneider, Carola de Beer, Isabell Wartenburger, Sandra Hanne, SFB 1287/B01 (Potsdam): Limits of variability in the prosodic realization of locally ambiguous OVS and SVO sentences

We explore the variability between speakers in their productions of prosodic cues to prosodically disambiguate morphosyntactically locally ambiguous sentences such as "Das Kind sucht den/der Mann" (The/NOM/ACC/ child to-look-for/3rdPsSg/ the/ACC-///or-NOM//man)/. /That is, the determiner in the second NP serves as a disambiguating morphosyntactic cue in all sentences while none of the NPs contain an additional overt case marker at the noun itself. Our question was whether speakers use prosodic cues to already disambiguate the structures on the first NP, thus before the disambiguating determiner. A few speakersproduced differential *f0*-contours to distinguish OVS from SVO, while most speakers show a rather consistent production of prosody (i.e., the *f0*-contours and durational parameters of the SVO sentences match those of the OVS sentences).

We further ask whether different *f0*-contours can be used by listeners as early disambiguating cues in perception. If these *f0*-cues help to predict the syntactic structure, participants should be able to judge whether a sentence would belong to the OVS vs. SVO structure before encountering the disambiguating morphosyntactic cue (den/der) in the second NP. We will present and discuss our preliminary results.

14.25 – 14.45 Heiko Seeliger, SFB 1252/A06 (Köln): Speech act meets information structure: On the interaction of different requirements for prosodic prominence in exclamatives and polar questions

We present the results of a prosodic production experiment investigating the interplay of two factors that have been shown to influence the prosodic prominence relations in an utterance: illocutionary force (speech act) and information structure. The speech acts that we investigated (polar exclamatives, polar questions) express surprise or not, and impose different requirements for prosodic prominence on the utterance. The information-structural categories that we investigated (contrast, focus, given) are known to result in different degrees of prosodic prominence in assertions.

Our results show that there are speech-act-specific differences: exclamatives had a lower speaking rate than questions, had a lower pitch range, and contained more accented syllables, that is more local prominences. Furthermore, exclamatives had low boundary tones, while questions had high boundary tones. Finally, L* nuclear accents occurred exclusively in questions.

With respect to information structure, the results show that contrastive focus is consistently marked in both speech acts, both through an increase of prosodic prominence on the object itself, as well as through a decrease of prosodic prominence on another element in the utterance (the d-pronoun subject in exclamatives and a DP-internal adjective in questions). Given information, on the other hand, did not differ systematically from new information: there were no significant phonetic differences in either speech act, and given objects were accented slightly less often than new objects only in questions. Even with this reduction, they still carried the nuclear accent in over 85% of utterances.

We propose that the result can be explained on the assumption that prosodic constituents need to be headed so that deaccentuation of an element requires accentuation of another element: an accent shift is required within the constituent. Importantly, from a semantic-pragmatic point of

view, accent shifts are not 'innocent' because a shift away from the default nuclear accent position (the object) can have meaning effects beyond signaling the given status of the element that the accent shifts away from. For example, an accent shift to the finite verb in questions signals VERUM focus. If VERUM focus is not licensed in the context, this accent shift is not possible. We show that an accent shift away from the object was not possible for a variety of subtle semantic-pragmatic reasons in the questions of our experiments, but would indeed have been possible in exclamatives. A lack of prosodic givenness marking can thus be argued to represent a genuine property of the speech act exclamative.

14.45 – 15.00 **Coffee Break**

15.00 – 16.30 Discussion

16.30 – 17.30 **Keynote1: Michael Wagner, McGill University**
Why predictability is not predictive without a linguistic theory

If one thing is firmly established it is that redundancy/predictability/surprisal affect both the way a message is encoded and the way the encoded message is pronounced. This has usually and plausibly been attributed to an interplay of the principle of least effort and the goal to successfully transmit a message, starting with Zipf (1949). When looking at specific phenomena, however, different information theoretic rationales can be imagined which diverge in their predictions about where we should see predictability effects, and sometimes even with respect to which direction these effects should take. This talk presents two case studies that look at current ideas about how predictability shapes an utterance. The first case study looks at prosodic boundaries and sandhi phenomena (such as liaison and nasal assimilation), and compares the predictions of the Production Planning Hypothesis (Wagner 2012; Tanner et al. 2017; Kilbourn-Ceron 2017; Tamminga 2019, i.a.) with the information-structural account in Hall et al. (2018) and Turnbull et al. (2018). The second case study is about prosodic prominence, and looks at how accounts in terms of predictability/redundancy (e.g. Hirschberg & Pan 2000 or Aylett & Turk, 2004) compare with grammatical accounts of accent placement. In both cases, we will look at evidence that the understanding of predictability effects can be improved once relevant additional linguistic factors are taken into account.

17.50 **Jürgen Trouvain: Virtual guided tour through the exhibition "Writing systems" curated by Jürgen Trouvain and students**

Friday, 16.07.2021

9.45 – 10.45 **Keynote2: Rory Turnbull, Newcastle University**
Prominence in Lexical Networks

It is well-established that the pronunciation of words, morphemes, and other meaning-bearing units is sensitive to their relative predictability. In general, items which are less predictable tend to be pronounced with more prominence – longer, louder, higher in pitch, with more spectral clarity – than more predictable items. "Predictability" here is often defined in relation to the discourse context of an utterance. Equally important, however, are lexical factors which are invariant across contexts. These factors include lexical frequency, phonological neighbourhood density, and phonotactic probability, and can be thought of as characterizing the "prominence" of a given item within the lexicon. Therefore, prominence in the lexicon is negatively correlated with prominence in pronunciation.

In this presentation, I provide an account of prominence in pronunciation and prominence in the lexicon by conceptualizing the lexicon as a complex network. In this network, words are represented as nodes, and related words are linked to each other. The advantage of this approach is that it allows us to apply the well-studied techniques of network science and graph theory to derive further insight from a network. Applying these methods to the lexicons of natural languages can give us new insights about the interactions between lexical prominence and phonetic prominence.

10.45 – 11.05 Dorothea Pregla, Paula Lissón, Shravan Vasishth, Frank Burchert, Nicole Stadie, SFB 1287/B02 (Potsdam): Sentence comprehension difficulty in language impaired and unimpaired adults in German: Implications for surprisal and adaptation accounts

In a relatively large-sample study, we investigated sentence processing difficulty in unimpaired controls (n=50) and individuals with aphasia (n=21), using a variety of syntactic constructions and three experimental methods. We also recorded test-retest data by bringing back each participant after several weeks and exposing them to the same items as in the test phase.

The principal focus of this study was to evaluate the sources of variability and impairment in IWAs vs controls (Pregla et al., 2021), and to use computational modeling in order to evaluate competing accounts of sentence processing in aphasia (Lissón et al., 2021). One interesting finding in this study that is relevant for surprisal research is that although controls showed adaptation effects (reduction in processing difficulty at retest; cf. Wells et al., 2009) between the test and retest phase, IWA seem to not show adaptation effects. If the IWA do not in fact have any adaptation effects, this could have implications for treatment: IWA may not be able to improve in their processing of syntactically challenging constructions like object relative clauses even after repeated exposure but may rather profit from the application of impairment-specific invervention protocols (Adelt et al., 2018).

11.05 – 11.25 Barbara Höhle, Adamantios Gafos, SFB 1287/C03 (Potsdam): Reflections of entropy and surprisal in infants‘ looking times

The habituation-switch paradigm is a standard method in testing young infants' ability to associate labels with simultaneously presented objects. Infants are first habituated to pairings of visually presented unfamiliar objects together with acoustically presented labels (e.g., /dih/ and /bih/). During the following testing phase, infants' looking times to the object when presented with the habituated label (same trial) is compared to the looking time to the same object when presented with the other label (switch trial). Longer looking times in the latter than the former trial type indicate the establishment of an association between the visual and the acoustic stimulus. However, outcomes in infant research relying on this measure are highly variable and the reasons why this may be so have been the subject of considerable discussion (Werker et al. 2002; Werker & Curtin 2005; Rost & McMurray 2009; Apfelbaum & McMurray 2011; Gerken et al. 2014; Quam et al. 2017; Archer & Curtin 2018; Höhle et al. 2020). Our project aims to contribute to a better understanding of the causes of variability in infants‘ looking times. Our broad hypothesis is that uncertainty (entropy) as well as surprise are two major determinants of performance in this paradigm. The concepts underlying these notions of uncertainty and surprise can be operationalised and modulated, using concepts from information theory, in two ways: distributional properties of alternatives and the number of alternatives. We describe how this approach can be used to model existing results from our and others' work and outline our future experiments aimed at further developing our approach.

11.25 – 11.45 Ivan Yuen, Omnia Ibrahim, Bistra Andreeva, Bernd Möbius, SFB 1102/C1 (Saarbrücken): Effects of Surprisal and Boundary Strength

The present study examines the interaction of information density and prosodic boundary types on phrase-final syllable duration in a subset of the DIRNDL Radio News Database. DIRNDL is manually annotated for pitch accents and prosodic boundaries following the autosegmental intonation model. Each data point in our analysis is the last syllable before an intermediate phrase boundary (ip) or an intonational phrase boundary (IP). We analysed a total of 2382 ip and 2393 IP final syllables in monosyllabic and polysyllabic words. In our analysis, Information density (ID) was measured as trigram syllable surprisal and estimated from language models based on DeWaC as the inverse log probability of a syllable to occur in the context of two preceding syllables. As expected, trigram surprisal and boundary type significantly lengthen the phrase-final syllable duration in monosyllabic and polysyllabic words. However, we also observed an additional main effect of the presence vs. absence of accent on the target syllable and its interaction with surprisal in polysyllabic words.

11.45 – 12.00 Coffee Break

12.00 – 13.30 Discussion

13.30 Group photo and closing