Topic in dialogue: prosodic and syntactic features

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Abstract

We investigate the relationship between phonetic phrasing, tonal pattern and phrase structure in left peripherical sentence topic. Our corpus consists of three task-oriented Italian dialogues. The results of prosodic analysis show that topics are usually associated to the highest pitch values in the Tone Unit, regardless to their actual syntactic position. Syntactic analysis shows that, while topic phrase structure is rather variable, topic function is quite stable, i.e., topics have mostly circumstantial-locative function, and less frequently subject function. Finally, phonetic phrasing, prominence placement and phrase structure shows clearly regular relationships.

1. Introduction

The present work deals with the relationship which connects syntax, prosody and information structure in dialogues. These interactions have been investigated from several points of view, i.e. taking into account all these linguistic levels [1, 2], or focussing on the relations existing between syntactic and information structure [3] or between prosodic and information structure [4, 5]. Before going into the details of our investigation, some methodological remarks are needed.

1.1. Methodological premise

In our view, the investigation of the interactions between different linguistic levels requires an autonomous approach to the analysis of each level involved. This is in fact necessary to avoid circularity between hypotheses and results. Circularity can derive from the assumption *a priori* of the interactions which should be under investigation. In order to prevent this circularity, two facts are crucial:

1) the units of analysis of each linguistic level must be defined according to principles referring to that specific level.

2) the annotation of each linguistic levels must be executed separately and independently.

Seen in this perspective, several definitions of information and prosodic units are very problematic. These units, in fact, have often been reckoned as being so deeply related to be defined with respect to one another [6]. Similarly, a long tradition bases the definition of prosodic unit on syntax [7].

In the present investigation, we did not assumed a parallel segmentation for the informative, syntactic and prosodic level: topics were isolated as a constituent solely on a pragmatic basis (see §1.2); the correspondence between informative level and prosodic constituency was not postulated on the basis of a phonological model but was observed after the isolation of phonetic units. Similarly, syntactic structures and prosodic constituents (intonation phrase, phonological phrase, clitic group [7]) were not supposed to be isomorphic (see §3).

Moreover, our methodology is inspired by the current practice of corpus annotation [8], where each level or tier is usually labelled separately, to keep the annotations as independent as possible from one another.

The data presented in this paper were elaborated by means of a structured multilevel database, SpIt-MDb [9], implemented by annotation of the three linguistic levels taken into account (cf. § 3.3). We took the information structure as pivot level, viz. our pivotal unit is the topic, on which we based the analysis of possible interactions.

1.2. Domains of topicality: sentence topic

The goal of the present paper is to investigate the phrase structure of sentence topics [10] and their relationships with melodic phrasing and tonal movements in a sample of Italian dialogues. The study deals with topics occurring on the left extremity of the sentence. Other types of topics, such as right peripherical, sentence internal (pronominalised) topics, are therefore excluded from the present work.

In linguistic literature the notion "topic" is used in studies which refer to texts or domains of different extent, e.g. sentence, speech act, dialogue, sub-dialogical parts. Beside their specific characters, all these kinds of topics seem to share a common aspect, i.e. they are the basis for what is said, or the frame wherein the most relevant part of the message is inscribed.

In this paper we focus only on sentence topic. We follow the approach proposed by Gundel [11], which has been adopted also in other studies on the relationship between information structure and prosodic realization. For instance, Hedberg e Sosa [6] followed this approach to investigate the prosody of topic in a corpus of talk-show conversations. Following Gundel [11, p.210], we analyse the sentence as composed of two semantic-conceptual units, viz. topic and comment:

- **Topic**: An entity, E, is the topic of a sentence, S, iff, in using S, the speaker intends to increase the addressee's knowledge about, request information about or otherwise get the addressee to act with respect to E.

- **Comment**: A predication, P, is the comment of a sentence, S, iff, in using S the speaker intends P to be assessed relative to the topic of S.

2. Corpus

The corpus we analysed consists of 3 task-oriented dialogues collected in different Italian cities (Rome, Naples and Palermo). The dialogues are part of the corpus CLIPS [12]. The dialogues have been provided with prosodic, syntactic and information annotations. The annotations have been coded with the standard AGTK [13], which is designed to manage different types of annotations (cf. §3). Via the implementation of an AGset, the annotation data have been structured in a database (SpIT -MDb), which allows queries on the relationships between different annotation levels [9].

3. Methods

3.1. Information analysis and annotation

The annotation of the information level segmented topic and comment units, labelled as TOP and COM. However, the data presented in this work concerns only topics, and in particular, left peripherical topics.

3.2. Prosodic analysis and annotation

Our prosodic annotation was based on phonetic criteria. We split the annotation in two different levels: a phrasing level, where the time-aligned sequence of Tone Units (TU) was marked, and a tone level, which reported the sequence of tonal targets within the TUs.

A TU was isolated when a number of phonetic boundary markers co-occurred, i.e. presence of a (potential) final pause; f_0 declination of both f_0 and energy; parametrical reset at the beginning of a new TU; prepausal lengthening.

Tonal events were labelled following the INTSINT [14]. Phonetic TU boundaries and tones were labelled as follows:

Phrasing: [= left TU boundary;
        ] = right TU boundary
Tones: T = Highest f_0 value in the TU (Top)
        B = Lowest f_0 value in the TU (Bottom)
        H = Tonal target higher than the preceding and the following targets (Higher).
        L = Tonal target lower than the preceding and the following targets (Lower).
        S = Tonal target which shows no f_0 variations in relation to the preceding target (Same).
        D = Tonal target in a falling sequence (Downstep)
        U = Tonal target in a rising sequence (Upstep)

3.3. Syntactic analysis and annotation

Syntactic annotation was based on a fine-grained analysis of the clause-internal structure. For the annotation we used the XML tag set AN.ANA.S [15]. For the present work we took into account only the clausal elements labelled as: CLA(use), N(oun)P(hrase), V(erb) P(hrase), P(repositional)P(hrase), P(redicative)NP, Adv(erbial) P(hrase).

3.4. Queries

Syntactic and prosodic structures of topics were explored via querying the SpIt-MDb database (cf. §2). We investigated:

1) the phrase structure of topic (relationship between information unit and syntactic structure);
2) the correspondence between topic and TU (degree of prosodic autonomy of the topic);
3) the global tonal pattern of topic, and the tonal targets occurring on the head of the topic (relationship between information unit, syntactic structure and prosodic realization).

4. Results

The following sections summarize the results emerging from the examination of the data. Our corpus contains 103 syntactic phrases with topic function.

4.1. Syntactic features of topics

For the analysis of the relationships between topic and syntactic level, we divided the phrase structures in two groups: *light*, and *heavy* [16]. *Light* phrase structures (LPS) consist of NP and PP, preceded by (optional) determinants or prepositions, possibly accompanied by disfluencies.

ex. 1: *l'antenna* (the antenna)   [Det + N]

ex. 2: *sulla parete* (on the wall)   [Prep [Det + N]]

NPs and PPs followed by one or more embedded PP, or by other modifiers were considered "heavy" (HPS):

ex. 3: *il polsino della manica della signora*
   (the cuff of the sleeve of the lady)   [NP + [PP + [PP]]]

ex. 4: *la nuvola più grande*   [NP + [mod]]
     (the biggest cloud)

HPSs include also NP and PP coordinated (ex. 5, 6), which may be eventually modified by adverbs (ex. 7), or by a short relative clause (ex. 8):

ex. 5: *sulla destra e sulla sinistra*   [PP + PP]
     (on the right and on the left)

ex. 6: *il cavaliere e tutto il cavallo*   [NP + NP]
     (the knight and the entire horse)

ex. 7: *lo specchietto invece*   [NP + AdvP]
     (the little mirror instead)

ex. 8: *quella che sta per terra* [NP + [RelCLA]]
     (the one which lies on the ground)

In §4.3.2, we point out interesting relationships emerging from the phrasal "weight" and the prosodic pattern of topics. In connection with the phrase structure (cf. § 3.4, point 1), most topics (52%) are realized as light NPs (see table 1 and ex.1). Instead, about 23% of topics are heavy NPs. Another 23% of topics are realized as PPs. The group of PP topics is almost equally divided in HPSs and LPSs.

Phrase structure	N°topic/Phrase	%
NP	**78**	**75,7%**
Light NP	54	52,4%
Heavy NP	24	23,3%
PP	**23**	**22,3%**
Light PP	11	10,7%
Heavy PP	12	12,7%
AvvP	**2**	**2%**

Table 1 - topic phrase structure

4.2. Prosodic features of topics

The analysis of the correspondence between topic and TU (cf. § 3.4, point 2), i.e. of the degree of prosodic autonomy of the topic, shows that more than half of the topics (53%) corresponds to a phonetic TU. In the other half, however, topics are followed by a weak but audible prosodic break.

Phrase type	tot	%	
Light NP	30	55%	**NP=80%**
Heavy NP	14	25%	
Light PP	4	7%	**PP=20%**
Heavy PP	7	13%	

Table 2 - correspondence between topic and TU

Table 2 outlines the data on topics coextensive with TUs. Information and prosodic boundaries correlate when the topic is a light or heavy NP in 80% of the cases, and in about 20% of the cases when the topic is a PP (usually locative expressions). As for the NP topics, in our data they are mostly hanging topics or anacolutha (ex. 9, 10), despite the well known correspondence between subject and topic in languages such as Italian:

ex. 9:   *la papera, la pupilla dove ce l' ha?*
        The duck, the pupil[1], where there it[1] has?

ex. 10:   *L'altra nuvola* invece, la punta no?
        The other cloud instead, the top, right?

The global phonetic tonal pattern of topic, and the tonal phonetic targets occurring on the head of the topic (cf. § 3.4, point 2) were described by means of the analysis of the INTSINT labels. The analysis focussed on:

1) tonal pattern of the head of the topics;
2) presence of the highest f_0 value in the TU (Top) on the head of the topic or of other high tones, such as H and U.

We considered as "heads of topic" the syntactic head (sH) of a NP (i.e. a lexical head), even if it is embedded in a PP.

When a single head of the topic can be identified (which is not the case, for instance, of coordinated structures), it carries in 31% of the cases a static high tone and in 13% of the cases a dynamic rising movement (see Table 3): then, about 44% of the heads of the topics carries a static or a dynamic high tone. In another 42% of the cases a falling tonal movement is found on the head, consisting in a T or H tone followed by a descent. Furthermore, the Top, i.e. the highest f_0 value in the TU, is found on 86 % of syntactic heads. High static, rising and falling movement can be generally considered as "peaks" which show different time alignments to text. Only in 3% of the cases no peak is found (S tone).

Tonal pattern type	tot
High tones (T, H)	31%
Falling patterns (TB, TL, TD, HB, HL, HD)	42%
Rising patterns (UT, ST, LT, BH, BU, LH, SU)	13%
Rising-Falling (UTB, LTB, LHB, UTD, LTL)	8%
Falling-Rising (TLH, TBH, HBU)	3%
Flat (S)	3%

Table 3 – tonal pattern of the topic head

The following examples show a number of peak patterns, which recur across the corpus:

ex. 11:   *high tone*
        il collare dell'uomo   (**the collar** of the man)
            T   L H

ex. 12:   *falling pattern*
        i **fari**   (the **headlights**)
           TB

ex. 13:   *rising pattern*
        sul **muso**   (on the **muzzle**)
            UT

4.3. Syntax and prosody of topics

4.3.1 Prosodic and syntactic heads

In order to get further details on the relationship between syntax and prosody in realization of topics, we investigated the function of the tonal patterns described in the preceding section. We verified if the high tones, and the rising or falling patterns correspond to prosodic heads and, possibly, to nuclear accents. We call "prosodic head" (pH) *a stronger stress that may be considered hierarchically higher than a lexical stress.* Its domain can be considered coextensive to the TU or to a smaller constituent within the TU, which has weaker boundaries (cf. § 4.2)[1]. The relationship between sH

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and pH changes according to the type of syntactic phrase observed:

1) sH corresponds to pH when the topic is a LPS (NP or PP)
2) sH does not correspond to pH when the topic is a HPS (NP or PP).

Furthermore, if the topic is a LPS and it is also coextensive with a TU, then the pH is a nuclear accent (nA, ex. 14). If instead the topic is included in a larger TU and is followed only by a weak, but still audible boundary, then the pH is a metrical accent hierarchically higher than the lexical stress, but it is not a nA (ex. 15). The following abbreviations are used in the examples: *Italics= sH = syntactic Head*; underline = pH = prosodic Head: **bold = nA = nuclear Accent.**

ex. 14   [*i fari*]TU   [the *headlights*] TU
        sH=pH=**nA**

ex. 15   [[sul *muso*] c'ha sei **puntini**]TU
            sH=pH   ≠   **nA**

        [[on the *muzzle*] it has six **dots**]TU

In the ex. 14 and 15 the pH corresponds in fact to a lexical stress. However, it is worth notice that when more than one lexical stress is present in the prosodic unit, then pH and sH coincide, as in ex. 16.

ex. 16:   [[sopra allo *stivale*] c'è un pezzo di **gamba**]TU
            sH=pH   ≠   **nA**

        [[above the *boot*] there is a part of his **leg**] TU

In cases such as the following (ex. 17-18) sH and pH usually do not coincide, because pH falls on the right extremity of the phrase, i.e., on the elements which add "weight" to the phrase.

ex. 17:   [[il *mare* alla fine]è **diritto**?]TU
            sH   ≠   pH   ≠ **nA**

        [[the *see* at the end] is it **flat**?]TU

ex. 18:   [il *polsino* della manica della **signora**]TU
            sH   ≠   pH=**nA**

        [the *cuff* of the sleeve of the **lady**] TU

4.3.2 Heads, tones, accents

The data of the previous sections show that the prosodic realization of the topics results from the interaction of a number of factors. Falling tonal patterns are prevailing in LPSs (NP, PP), particularly when they coincide with TUs. These cases realize the following equivalence:

        sH =pH = **nA** (i.e., main accent of the TU)

The most common pattern for nuclear accents in non-interrogative utterances in Italian [17] is a falling sequence HL, which is phonologically described as H+L* tone. Hence, the frequency of falling patterns when pH, sH and nA coincide can be explained in this light.

ex. 19:   i *fari*   (the *headlights*)
            TB

High or rising tones are more frequent a) in the case of sHs of NP and PP which do not correspond to a TU:

        sH = pH ≠ **nA**

ex. 20:   [il *mare* alla fine] è **diritto**?]TU
            T   B
        [the *see* at the end]is it **flat**?]TU

or b) in the case of HPS NPs and PPs, when the f_0 descent is realised on the elements which follow the sH:

        sH ≠ pH= **nA**

ex. 21:   [il *polsino* della manica della **signora**]TU
            LT   D   D   BH

[the *cuff* of the sleeve of the **lady**] _TU_

The presence of high or rising tones (LH) is in these cases linked to the linear position of the topical sH.

5. Discussion

The results of our investigation can be compared to the current literature concerning the sentence topic. Several authors [18, 19] support the idea of the topic accent, i.e. the idea that the topic has a specific phonological realization (pitch accents, boundary tones, or pitch accents followed by boundary tones). Our analysis of sentence topic supports the general assertion that topics are associated to a prominence and to a weak or strong intonation boundary. On the one hand, our data show, in agreement with previous analyses of regional Italian [20, 21] that high/rising tones are frequently associated to topics. This data can be explained referring to the linear position of the topic in the TU, i.e. the presence of high/rising tones can be related to the declination. Moreover, it can be argued that the prosodic properties of the left side of the TU, i.e. the expanded pitch range, can be in fact exploited for prosodic marking of topic. On the other hand, the analyses show also a widespread presence of falling tones (42%), which occurs when topic and TU are coextensive. In these cases the nA of the TU and the pH of the topic coincide, and the falling nA can be explained as a default non-interrogative accent. Interestingly, topic and the highest pitch value of the TU, i.e. the Top, correlate in 86% of the cases, regardless to the actual linear position of the topic in the TU. It can be argued that this correlation constitutes a prosodic feature which distinguishes left topics from other types of topics (for ex., topics occurring after the comment or the nA) and from other information units, i.e. the comment. In conclusion, topics seem to exhibit both delimitative prosodic features, i.e. boundaries, and culminative ones (pH, i.e. a lexical or stronger metrical stress including, in some cases, nuclear accent).

Concerning the relation with syntax, topic units, understood as a handle of informative predication, predominantly have circumstantial-locative function, and less frequently, subject function. The large presence of locative expressions can be explained as a consequence of the task carried out in the dialogues. Furthermore, the syntactic structure of these constituents is highly variable. In particular, the relationship between sH and pH is not guaranteed and depends on the actual phonetic phrasing.

The main goal of our work was an inductive investigation of syntactic and prosodic features of sentence topic. The analysis, which was carried out autonomously and at the same time on several levels, gives results observable from various points of view. It also provides *a posteriori* evidences of the interactions between different grammatical levels. We believe that, above all, the data confirms the role of interface with syntax and information played by prosodic phrasing, which for this reason constitutes a crucial cue for interpreting the structure of the message.

6. References

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