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# Prosodic disturbances in autistic children speaking French

Marie-Thérèse Le Normand<sup>1</sup> Sarah Boushaba<sup>2</sup> Anne Lacheret-Dujour<sup>2</sup>

<sup>1</sup>INSERM, Hôpital Robert Debré & Hôpital de la Salpêtrière, France

<sup>2</sup>U. Paris X Nanterre, France ;

[lenormand@rdebre.inserm.fr](mailto:lenormand@rdebre.inserm.fr) [boushabasarah@yahoo.fr](mailto:boushabasarah@yahoo.fr) [anne@lacheret.com](mailto:anne@lacheret.com) ;

## Abstract

The present study investigated prosody, particularly prominence and prosodic contours in relation to speech acts that carry useful information to maintain and regulate communicative intent and conversational skills. Participants were eight autistic French-speaking children aged from 4 to 6. Spontaneous speech samples were collected in a free play situation. Results revealed important prosodic disturbances in relation to declaratives, exclamations and questions. Such patterns of results, to a certain extent, support the hypothesis that abnormal prosody is identified as a core deficit in individuals with autism.

## 1. Introduction

Autism is a pervasive developmental disorder (PDD). It has been defined as a triad of impairment: atypical development in reciprocal social interaction; atypical communication; and restricted, stereotyped and repetitive behaviours (Wing & Gould 1979). It is a disorder that begins in the first 36 months of life (DSM-IV1994) and social impairment is now seen by many as the primary symptom (Baron-Cohen, 1995). Autism is a spectrum disorder ranging from low-functioning autism (individuals may be non-verbal) with associated learning difficulties to high-functioning autism (HFA) and Asperger's syndrome (AS). The distinction between HFA and AS is controversial. AS is also a PDD with impaired social interaction and repetitive, restricted and stereotyped behaviours, but the most recent diagnostic criteria holds that individuals with AS do not demonstrate a general language delay (DSM-IV1994).

### Abnormal Prosody in autistic children

Abnormal prosody has been frequently identified as a core feature of the syndrome for individuals with autism who speak. Children with autism show "oddness in their tone of voice" "echolalia" and "stereotyped verbal behaviours". Despite important literature describing prosodic disturbances of these children, little is known about expressive prosody of speech acts. These abnormalities have been reported anecdotally to include monotonic or machine-like intonation, deficits in the use of pitch and control of volume, deficiencies in vocal quality, and use of aberrant stress patterns (Ornitz & Ritvo, 1976 ; Fay & Schuler, 1980 ; Fine & al, 1991; Hargrove, 1997; Tager-Flusberg, 1981 ; Baltaxe & Simmons, 1985, 1992, Loveland et al, 1988; Paul et al, 2005).

### Pragmatic Prosody

Pragmatics prosody is concerned with conversational behaviour in terms of general principles that seek to account for how speakers decide they will done in the conversation, a

decision based on what is required at the time, after interpreting what the previous speakers have done.

The use of prominence is generally considered a pragmatic function (Halliday, 1975) as it serves to focus attention on an aspect of the discourse that the speaker intends to mark as new or important. Chafe (1970) has argued that languages contain devices used not only to encode meaning but also to point out which constituents refer to material that should be foregrounded in consciousness. One of these devices for foregrounding is contrastive.

Prosody interacts with other levels of language: phonetics, phonology, syntax and pragmatics. At the phonetic level, prosody includes variations in pitch/fundamental frequency, loudness/intensity, duration, pause/silence in which perceptual correlates are respectively melody, sony and rythm. At the phonological level, prosody organizes these parameters in a tonal and metric structure which is underlying by two major constraints : (i) a syntactic structure which organize demarcation and segmentation into syntagms and (ii) a pragmatic context which organize speech acts as well as emotions, attitudes and mood (Lacheret & Beaugendre, 1999, Lacheret & Victorri, 2002).

Much of the literature on prosody in autism has focused on affective or pragmatic purposes and upon the observation that the speech of a child with autism is often characterized by poor inflection and excessive or misassigned prominence. Of the small number of studies (16 between 1980 and 2002) according to MacCann & Peppé, 2003) dealing with prosody in autism, prominence is the most comprehensively investigated area. All of the studies which investigated prosody found the use of prominence to be problematic in autism but little studies so far examined prosodic contours in relation to speech acts

It is currently unclear to what extent prosodic contours affected speech acts in such children. If young learners do not rely on communicative intent and emotion, it would be expected that they show inappropriate prosodic rising, flat falling contours associated with their speech acts.

The purpose of this study focuses on communication in its epistemic component (i.e discourse and speech acts). The rationale is to establish whether or not speakers with autism are disturbed in the ability to produce prosody. The hypothesis is that speakers with autism will show difficulties not only with prominence, but also with prosodic contours (rising, flat or falling) in relation to speech acts (declarative, exclamation, question).

## 2. Method

### 2.1. Participants

Eight young children with autism (six boys, two girls) participated in this study. The participants with autism were recruited from two Paris Children's hospitals. Their age ranged from 4 to 6 years. All children had been diagnosed with autism by a professional with expertise in autism not associated with this project. Diagnoses were confirmed by the second author using DSM-IV-TR (APA, 2000) criteria. The Childhood Autism Rating Scale (CARS; Schloper, Reichler, DeVellis & Daly, 1980); was also administered by the first author to determine the range of autism severity in the participants with autism. Their mean CARS score was 35.8 (S.D. = 4.1), placing the children in the mild-moderate range of autism severity.

Table 1 : Participant characteristics

Participants	Gender	Age (yrs)	Play session duration
P1	M	6	45'83''
P2	M	6	21'63''
P3	M	6	15'03''
P4	M	4	20'87''
P5	M	6	10'
P6	M	6	24'74''
P7	F	6	24'2''
P8	F	6	42'74''

### 2.2. Procedure

Participants were seen individually by clinicians in two children Hospitals (Salpêtrière and Robert Debré Hospitals, Paris). The child is involved in a standardized free play session with a familiar speech pathologist. The set-up included Fisher-Price toys, a house and figurines, as well as replicas of household items (Le Normand, 1986). During the procedure, children were asked to verbalize as many manipulations and actions as possible with toys and objects in and around the house. The speech samples were recorded and later transcribed by the second author with CHILDES tools integrating Praat softwares (McWhinney, 2000 & Boersma & Weenink, 2007).

## 3. Results

Twenty two play sessions were audio-recorded lasting three hours and forty minutes.. 2103 utterances were transcribed from the children. The listener first made perceptual judgements for each utterance and assessed them in terms of prominence. The listener then labelled them into speech acts according to interactive contexts (declaratives, exclamations and questions) and prosodic contours (rising, flat and falling)

### 3.1. Perceptual rating of Prominence (PP)

In order to assess prominence, (i.e to identify syllable when the syllable appear as a figure emerging from its background) the listener has to rate the prominence according a three point scale (low PP = 1, good PP = 2, exaggerated PP = 3)

Figure 1 illustrates the mean percentage of PP rating for the group. Results indicate significant differences between Low PP (Mean = 0.61, SD = 0,17) vs Good PP (Mean = 0.21, SD = 0,12) and exaggerated PP ( $p < .001$ ) but no difference is found between good PP and exaggerated PP (Mean= 0.18, SD = 0,20 ( $p > .05$ )).

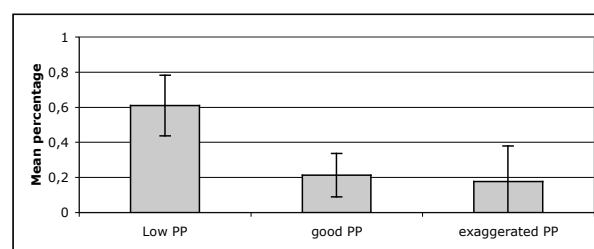


Figure 1 Mean percentage of perceived prominence rating for the group

### 3.2 Instrumental measures: prosodic contours

Speech signals from children were analyzed by the second author (SB), who played the audio signal into the Praat editor which is used to measure three pitch prosodic contours

Figure 2 illustrates the mean percentage of prosodic contours for the group. Results indicate that significant differences were found across children between rising/falling (Mean = 0.30, SD = 0,11 and Mean = 0.25, SD = 0,06 respectively) and flat (Mean = 0,45, SD = 0,22,  $p < .01$ )

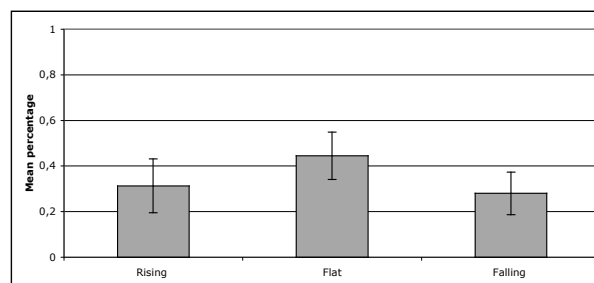


Figure 2. Mean percentage of prosodic contours used by the group

### 3.3 Speech acts

Speech acts can be served by prominence into the contrastive or emphatic function. This usage of prominence involves highlighting a particular word within a sentence to mark it as salient or to point out its contrast with a previous element in discourse.

Three speech acts were taken into account in this study :

- (a) Declaratives example : c'est un lit (here is a bed)
- (b) Exclamations example : oh lit ! (oh bed !)
- (c) Questions example : il est où le lit ? (where is the bed ?)

Figure 3 shows the mean percentage of speech acts used by the group of eight autistic children. Results indicate that significant differences were found between declarative and

exclamation, declarative and question as well between exclamation and question ( $p < .01$ ). Declarative is predominantly used by autistic children (Mean = 0.68, SD = 0.24) in comparison to exclamation (Mean = 0.26, SD = 0.22) and question (Mean = 0.06, SD = 0.006).

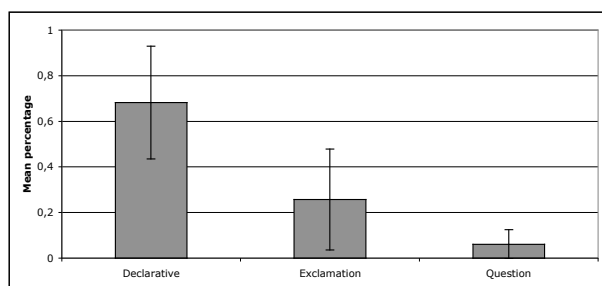


Figure 3. Mean percentage of speech acts used by eight children with autism.

### 3.4 Speech acts and prosodic contours

Figure 4 shows the mean percentage of speech acts in relation to rising, flat and falling contours, for eight children with autism. Results indicate that rising contours are equally used in declaratives and exclamations (Mean = 0.4, SD = 0.11) by contrast to flat and falling contours which are more used in declaratives (Mean = 0.59, SD = 0.11 and Mean = 0.77, SD = 0.09 respectively) than exclamations (Mean = 0.20 SD = 0.06 and Mean = 0.17, SD = 0.08 respectively) and questions (Mean = 0.7, SD = 0.03 and Mean = 0.5, SD = 0.02 respectively)

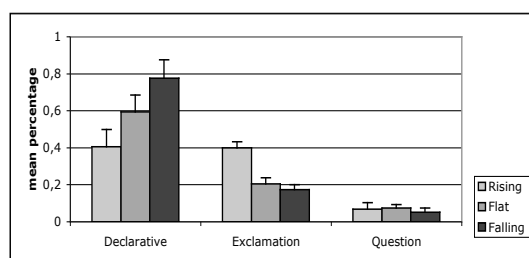


Figure 4. Mean percentage of speech acts in relation to prosodic contours used by eight children with autism

## 4 Discussion and Conclusions

Investigating prominence, prosodic contours and its relationship to speech acts in autism is clinically important because abnormal prosody add an additional social and communication barrier for these children and problems are often life-long even when other areas of language improve.

### Prominence

The findings on prominence revealed that there were significant differences in the ability to produce appropriate speech perceived by listeners as prominent and less prominent in all play sessions. The most striking abnormal prosody found in autistic children from typical development is the high frequency mean percentage of low prominence (Mean percentage = 0.61), which is in agreement with other studies dealing with prominence in speakers with autism (MacCann & Pepper, 2003, Paul et al, 2005).

### Prosodic contours

Instrumental analysis revealed that there were significant differences in prosodic contours produced within syllables among children; As a group, all speakers with autism produced many words with flat contours. (Mean percentage = 0.45). This demonstrates disturbances of prosodic system in autistic children and their difficulty to acquire prosodic cues. Many pragmatic studies conducted in the field of autism support the view that delayed, abnormal prosodic contour is very often associated to many speech acts relative to typically developing children. Researchers have claimed that prosody develops significantly by the onset of first words at 18–20 months. However, more recent research indicates that prosodic contours remain difficult for infants and toddlers to produce in a stable manner (Flax, Lahey, Harris, & Boothroyd, 1991; Furrow, Podrouzek, & Moore, 1990; Galligan, 1987; Marcos, 1987, Snow, 1994, 2002, 2003, 2004a, 2004b). For example, research has shown that 2-4-year-old children use adultlike intonation contours, at least in falling intonation (Snow, 1998, Snow & Balog, 2002).

### Speech acts and prosodic contours

At the communicative level, the matching form/function mapping prosodic contours is also impaired in children with autism according to the modality.. The relatively high use of flat contours. (Mean percentage = 0.59) in relation to declaratives support the hypothesis that autism, involves a fundamental problem of understanding the minds of others. People with autism fail to solve even quite simple problems that require empathy and the ability to put themselves in someone else's place Such results provide new evidence to the Theory of Mind (ToM), dominant theoretical understanding relevant to the social features of autism. A Theory of Mind signifies an understanding that other people have minds that differ from one's own and that one can learn from others by reading their social signals and listening to what others say. Exclamation seems to be less impaired, but it includes mainly screams out of pitch range. Therefore, this speech act should be considered as a non-communicative act, a difficulty with voice register control and the interpersonal use of language in social contexts.. Concerning questions, no clear pattern of prosodic contours emerge. This phenomena could be explained because of low percentage of questions produced by children with poor level of syntactic complexity (MLU stage <4.00). Such results bring evidence that autistic children are atypical speech learners exhibiting difficulties of abnormal prosody (self-talk, whispers, screams out of range, echolalia and verbal stereotypes.) to adjust their communicative intent.

However, the relevance of these preliminary patterns of results found in this study, should be taken with caution not only, because the population is very heterogeneous but also because the form/function coding of prosodic contours, we used in order to be able to distinguish the appropriate vs inappropriate matching at the communicative level, need to be refined. Further investigations labelling better variables of prosodic contours is therefore necessary to understand better the speech acts of atypical populations such as Autism.

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