# Accentuation, Pitch and Duration as Cues to Focus in Dutch 4- to 5-Year-Olds

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## 1    Introduction

   Dutch speakers use prosody to highlight new or important information, and focal constituents are typically realized with a falling pitch accent (Gussenhoven, 2004). Non-focal constituents are treated differently depending on whether they appear before or after focal ones; accentuation is common for pre-focal constituents, whereas de-accentuation is the major pattern post-focally (Nooteboom & Kruyt, 1987; Rump & Collier, 1996; Chen 2007). In order to distinguish focal from non-focal constituents in initial position, adult speakers have been shown to increase pitch range and duration within focal accents, as compared to non-focal ones (Chen, 2009). Previous studies of prosodic focus marking in Dutch 4- to 5-year-olds have shown that they use accent placement correctly for marking final focus, but that they are not yet adult-like in terms of pitch accent choices finally and phonetic cues for distinguishing focal from non-focal information initially (Chen, 2009). In a recent study we investigated the relationship between pause length and focus in Dutch 4- to 5-year-olds, and found a systematic relationship between pre-target pause durations and focus (Romøren & Chen, to appear). In this study we extend the analysis of prosodic focus marking presented in Romøren & Chen (to appear) by looking at the use of accentuation and phonetic realisation in Dutch 4- to 5-year-olds, asking how these parameters are used relative to the pausing patterns.

   The current study extends previous work on prosodic focus marking in Dutch in two ways. Firstly, most of the earlier research on prosodic focus marking in Dutch has been conducted using SVO sentences, thus little is known about whether the prosodic patterns found for these sentences can be generalized to other sentence types. In our study, we include SVO +adverbial (hereafter SVOA) sentences, in addition to SVO sentences, asking whether adults and children mark focus differently in the two sentence types. Secondly, existing

studies on prosodic focus marking in Dutch have compared focus versus non-focus in final and initial positions. In our setup, the locations investigated are medial and final, and we ask whether prosodic focus marking in medial position differs from what has been described sentence initially and finally.

 The rest of the paper is structured as follows: In section 1.1. we define some essential terms related to the way focus is operationalized in the current study, and in section 1.2 we briefly review previous literature on prosodic focus marking in adult and child Dutch. We end section 1 by presenting our research questions, before moving on to describing the method chosen for answering them in section 2. In section 3 we present our results, and in section 4 we discuss how they provide new insight into the acquisition of prosodic focus marking in Dutch.

## 1.1    Information packaging

Information packaging or information structure relates to the way speakers structure their sentences in accordance with their assumptions about the knowledge of the listener. In this paper we limit ourselves to how sentences can be partitioned into parts containing given information and parts that contain new information, the latter which we refer to as 'focus'. Multiple information structural primitives have been proposed to account for how sentences can be partitioned, but most accounts share the basic idea that one part of a sentence anchors it to the previous discourse (given information) while another part makes a contribution to this discourse, thus updating the common ground between speaker and hearer (Vallduví & Engdahl, 1996).

Three sub-types of focus are relevant for this study. The first is 'narrow focus', where one constituent in a sentence is new while the rest of the information is given (as in (1) where brackets mark focal information). The second term is 'contrastive focus', used for cases where alternative candidates to the focal constituent are explicitly mentioned in the speech context (2). The final term is 'broad focus', referring to sentences in which all the information is new, as in (3).


(1). Experimenter: Look, a dog. And there is also a cake. It looks like the dog is doing something with the cake. What is the dog doing with the cake?
Child: The dog [is throwing] the cake.

(2). Experimenter: Look, a dog. And there is also a cake. It looks like the dog is doing something with the cake. I'll make a guess: The dog [is eating] the cake.
Child: The dog [is throwing] the cake.

(3). Experimenter: Look! I can't see anything on this picture. What's happening in the picture?
Child: [The dog is throwing a cake]

### 1.2 Prosodic focus marking in adult and child Dutch

Dutch speakers can use a range of different pitch accent types to mark focus, like sustained high pitch 'H*', fall 'H*L' or low pitch 'L*', to mention some, but the most frequent pattern for marking focus is the falling pitch accent 'H*L', regardless of sentence position (Chen, 2007). Dutch children have been found to master the complete set of Dutch pitch accents by the age of 24 months (Chen & Fikkert, 2007), and to de-accent post-focal material in sentence-final position around the age of 4 to 5 (Chen, 2011a). However, where adults show a preference for falling pitch accents (e.g. H*L) for sentence-final focus, 4- to 5-year-olds' accent choices are reported to be more variable. Sentence initially, children accent initial topics with H*L, but unlike adults they do not phonetically differentiate the accents between focal and non-focal conditions (Chen, 2009, 2011b).

To summarize; at 4 to 5 Dutch children are well on their way to prosodic focus marking in terms of accent placement, but their choice of accent type and their use of phonetic cues when accent placement and choice do not suffice for distinguishing topic from focus is still not adult-like at this stage (Chen, 2009, 2011b).

Against this background, we ask the following research questions: (1) Do Dutch adults and 4- to 5-year old children use accentuation systematically for marking focus medially and finally in SVO and SVOA sentences? (2) Do the adults and children manipulate the phonetics within accents for marking focus in cases where their accentuation patterns are ambiguous? (3) How does their use of canonical cues to focus relate to their use of pausing?

## 2 Method
### 2.1 Participants

Ten Dutch children (6 boys, 4 girls, age range: 4;4-5;11, mean 5;2) and 9 female Dutch adults (mean 23;10) participated in the study. These were the same participants that participated in Romøren & Chen (to appear). The participants were all native speakers of Dutch without any history of language disorders, hearing problems or other known developmental disorders. The children were recruited from a local school close to the city Utrecht, and parents gave written consent for their children to be tested and for their speech to be recorded. The adult participants were recruited from the participant pool at the Utrecht Institute of Linguistics, Utrecht University. They were all university students, and none of them were studying linguistics at the time of testing.

### 2.2 Procedure and materials

The participants were tested individually in a quiet room; the children in a designated testing room at their school, and the adults in a sound-attenuated booth at the Linguistics lab at Utrecht University. A female native speaker of Dutch was trained to conduct the testing according to a detailed instruction, and

all sessions were video recorded to control for consistency across sessions. The experiments were audio recorded using a portable ZOOM H1 handy recorder with 44.1 kHz sampling rate and 16-bit accuracy.

SVO and SVOA sentences were elicited through an interactive picture-matching game, adopted from Chen (2011a). The picture-matching game was preceded by a picture-naming task. Detailed instructions were created for both tasks, including a script on how to explain the tasks, how to respond to unexpected situations and how to control the context for each trial of the picture-matching game.

### 2.2.1 The picture-naming task

The picture-naming task was constructed to familiarize the participants with the nouns and verbs appearing in the picture-matching game, in order for them to use the intended words when playing. In this task participants were instructed to name figures and objects appearing on 17 pictures. The scripted spoken context for each trial was "this is a...", after which the participants could provide a response. In the case of incorrect naming (e.g. calling the cat a dog), the experimenter explained what the relevant figure/ object should be called in this particular game, directing the participants' attention to relevant details of the depicted figure or object (e.g. "it's not a dog, it's a cat, do you see the whiskers?").

### 2.2.2 The picture-matching game

In the game, the participant's task was to help the experimenter find correct combinations of picture pairs by answering the experimenter's questions about her pictures.
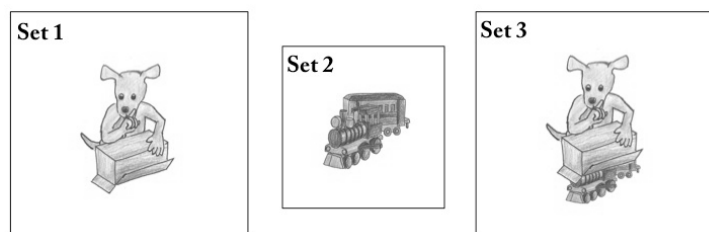


**Figure 1: Picture set for the sentence "The dog hides the train"**

The materials consisted of three separate sets of pictures (figure 1). The experimenter's first set (set 1) was piled face down in front of her. These pictures lacked one constituent, e.g. the subject, the verb, the object or the adverbial. The experimenter's second set (set 2) consisted of pictures representing what was missing in set 1, but these were scrambled face up in a box between the participant and the experimenter. The participant's set (set 3) consisted of pictures displaying complete actions, and these were piled face

down in front of him/her. Sets 1 and 3 were always pre-ordered before each session, so that corresponding pictures always appeared together in the same trial. In the introduction to the game, the random appearance of the pictures from set 2 made the purpose of the game clear, namely to find correct combinations between sets 1 and 2.

Each trial was conducted as follows: The experimenter picked up a picture from set 1, drawing the participant's attention to it, following the script presented in tables 1 and 2[1]. After the target question was asked, the participant could look at his/her complete picture in order to answer the question. Questions where repeated when needed, in order for all target sentences to directly follow the target questions. When the question was correctly answered, the experimenter could  look for the "missing piece" of her picture in the box, unite the two and move on to the next trial. In the instruction to the game, participants are told to always answer with a full sentence as a rule of the game.

The game consisted of 30 test trials and 10 practice trials, conducted in two sub-sessions. One session contained SVO sentences, the other SVOA sentences. Within each session, test trials were spread over five sentence conditions: narrow focus on the initial constituent (NF-i), narrow focus on the medial constituent (NF-m), narrow focus on the final constituent (NF-f), contrastive focus on the medal constituent (CF-m) and broad focus on the whole sentence (BF) (see tables 1 and 2 below). For the current study analysis, only data from the four first conditions were included.

**Table 1: Examples of trial context for the five sentence conditions, SVO**

| Sentence condition | Example context/ question |
|---|---|
| Narrow focus, initial constituent (NF-i) | Look, the carrot! It looks like someone is drawing the carrot. Who is drawing the carrot? |
| Narrow focus, medial constituent (NF-m) | Look, the carrot! And there is also a girl. It looks like the girl is doing something with the carrot. What is the girl doing with the carrot? |
| Narrow focus, final constituent (NF-f) | Look, the girl! It looks like the girl is drawing something. What is the girl drawing? |
| Contrastive focus, medial constituent (CF-m) | Look, the carrot! And there is also a girl. It looks like the girl is doing something with the carrot. I'll guess: The girl COOKS the carrot. (What do you say?) |
| Broad focus (BF) | Look, a ghost-picture. I can't see what's happening at all. What happens in the picture? |

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[1] In the English translation of the script we have used the present continuous form, but in the Dutch script we used present tense.

**Table 2: Examples of trial context for the five sentence conditions, SVOA**

| Sentence condition | Example context/ question |
|---|---|
| Narrow focus, initial constituent (NF-i) | Look, the flower! And there is also a basket. It looks like someone is throwing the flower in the basket. Who is throwing the flower in the basket? |
| Narrow focus, medial constituent (NF-m) | Look, the baker! And there is also a basket. It looks like the baker is throwing something in the basket. What is the baker throwing in the basket? |
| Narrow focus, final constituent (NF-f) | Look, the flower! And there is also a baker. It looks like the baker is throwing the flower into something. Where is the baker throwing the flower? |
| Contrastive focus, medial constituent (CF-m) | Look, the baker! And there is also a basket. It looks like the baker is throwing something in the basket. I'll guess: The girl is throwing A CAKE in the basket. (What do you say?) |
| Broad focus (BF) | Look, a ghost-picture. I can't see what's happening at all. What happens in the picture? |

For the experimental trials, three medial and three final target constituents were carefully spread across the five conditions so that each medial and final target occurred once in every condition, but each combination of initial, medial and final constituent only occurred once in the whole set. The trials were semi-randomly assigned to two different trial orders such that two consecutive trials never realized the same condition, and they always differed by minimally two constituents. Because we also randomised the order of the SVO and SVOA sets, this rendered a total of four trial orders, to which the participants were randomly assigned.

## 2.3    Data selection and coding

After testing, the recordings were segmented into trials using Praat (Boersma & Weenink, 2010). Each response was then evaluated, and only responses produced within the scripted context were included in the analysis. We also excluded responses with deviant word orders, deviant word choices or elided constituents, as well as responses containing self-repairs, hesitations, or background noise. Because of our strict inclusion criteria, the average response inclusion rate was 65% (range 40.0-86.7) in the children, compared to 92,2% (range 83.3-100) in the adults. The final dataset consisted in a total of 443 sentences.

After cutting and saving included responses as individual sound files, the sentences were orthographically transcribed and segmented into words. When segmenting we relied on changes in the waveform in addition to formant transitions on the spectrogram (see Turk, Nakai, & Sugahara, 2006). Because the segmental transitions were the same for all the target sentences, conventions were established for how to treat particularly challenging boundaries.

All medial and final target words were annotated using ToDI (Gussenhoven, 2005). Landmarks were also inserted at minimum and maximum

F0 combining the automatic F0 max/min detecting function in Praat with manual adjustments. When placing landmarks, care was taken to avoid areas where microprosodic effects originating from segment or word-transitions could influence our measurements, as well as areas with creaky voice quality. All measurements and ToDi labels were printed to excel sheets using scripts; values were checked for tracking and measuring errors, and corrected where necessary.

## 3 Analysis and results
## 3.1 Procedure

Linear Mixed Effect Modelling (LMER) was used to assess the effect of focus on a range of measures, using the factor 'focus' (two levels: focus vs. no focus) as fixed factor and participant, trial number and target word as random factors. All analyses were conducted using R. Previous research on focus marking in Dutch has found relatively subtle differences between contrastive and narrow focus (Hanssen et al., 2008), so in order to increase the amount of data points we collapsed narrow and contrastive focus into a common focus-condition for all analyses of medial targets. Because pre-focal constituents tend to be accented, the no-focus condition was always a situation where the target word was post-focal, e.g. NF-i for medial and NF-m for final comparisons (see tables 1 and 2). For the analysis of accentuation and accent choice we used Generalized Linear Mixed Effect Models (GLMER), as the dependent variable for these analyses was categorical rather than numeric.

Each analysis of the effect of focus on a relevant parameter involved three separate models, one LMER containing only the random factors, one LMER containing both the fixed factor and the random factors and an ANOVA over these two LMERs. A p-value below .05 from the ANOVA was then taken to indicate that the fixed factor had a significant effect on the parameter investigated.

## 3.2 Accentuation
## 3.2.1 Adults

As can be seen from figure 2 (below), the adults accented focal targets more frequently than post-focal targets in the same position, even if they also frequently accented post-focal targets. For both medial and final position in SVO there was a main effect of focus (medial: p=0.001, final: p=0.004) on accentuation. For SVOA there was a main effect of focus in the final position (p=0.003), but not in the medial position.
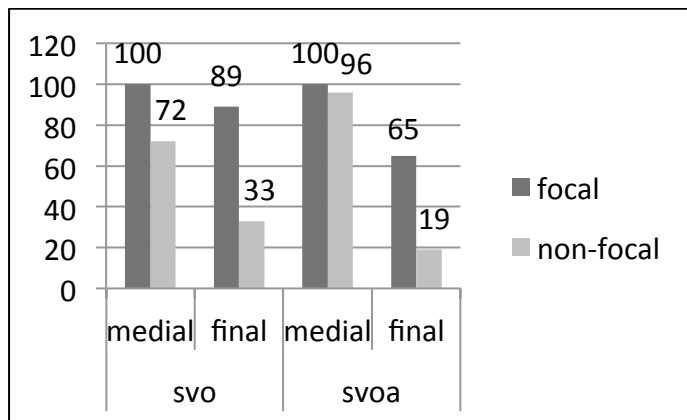
**Figure 2: Adults, percentage accentuation across focus condition, sentence position and sentence type**

Looking into the accent type choices *within* the accented targets, the most frequent accent for marking focus among the adults was a fall (H*L) for medial targets (57 % in SVO and 63% in SVOA), and a downstepped fall (!H*L) for final targets (58% in SVO and 67% in SVOA).

In the medial position in SVOA, where the adults hardly ever de-accented non-focal constituents, we ran a separate analysis over the falls in this position to see whether focus significantly predicted whether the medial targets would carry H*L or !H*L respectively. The model showed a main effect of focus (p=.000), indicating a a preference for H*L over !H*L for focal medial targets.
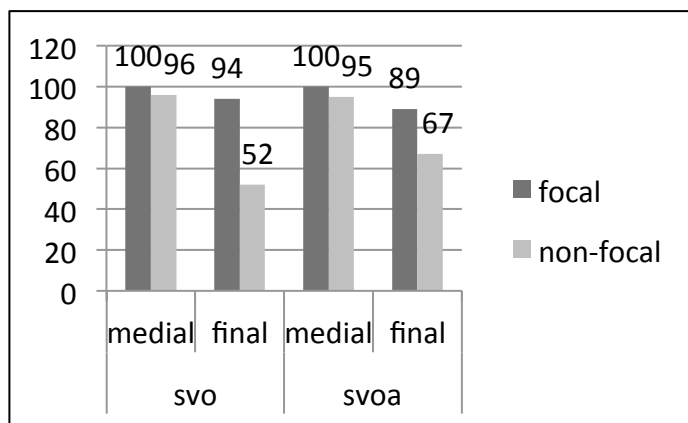
### 3.2.2 Children



**Figure 3: Children, percentage accentuation across focus condition, sentence position and sentence type**

Running the same models for the children's data revealed no main effects of focus in the SVOA sentences, and similarly for the medial position in SVO. Conversely, for the final position in SVO there was a main effect of focus (p=0.004), similar to that found in the adults. The accent type choices among the children were more variable than those of the adults, even if the preferred accent choices for focus were similar, with falls being preferred for medial focus and downstepped falls preferred finally. For medial focus, H*L was used in 41% of the cases in SVO and in 57% in SVOA. For final targets, !H*L was used 76% of the time in SVO and 76% in SVOA. Because the effect of focus only predicted accent placement significantly for the final targets in SVO, we ran a parallel analysis to the one we did for the adults, investigating the effect of focus on choice of H*L versus !H*L, but this analysis revealed no main effects.

### 3.3 Phonetic cues to focus in the children: pitch, duration and pausing

Because the children differed from the adults by making less use of accentuation and accent type to mark focus, we looked closer at a set of phonetic measures to see if any of these were related to focus in cases where accentuation was not used. The dependent variables for these analyses were F0 minimum (F0 min), F0 maximum (F0 max), F0 range, and word duration. The results are presented below.

### 3.3.1 Pitch and duration

Starting with pitch, focus had a significant effect on F0 max and F0 range, but not F0 min, in medial position in both SVO (F0 max: p=0.039, F0 range: p=0.043) and SVOA (F0 max: p=0.022, F0 range: p=0.058). For the final position, there was a similar main effect of F0 max (p=0.023) and F0 range (p=0.010), but not F0 min, for SVO, and no main effects whatsoever for SVOA. There were no significant effects of focus on word duration for any position in any sentence type.

In table 3 we summarize the findings from the current study, in addition to the findings on focus and pausing from Romøren & Chen (to appear).

**Table 3: Summary of findings**

| Target | Group | Accent placement | Accent type | Pitch range | Duration | Pausing |
|---|---|---|---|---|---|---|
| SVO medial | Children | No | No | Yes | No | Yes |
|  | Adults | Yes |  |  |  | Yes |
| SVO final | Children | Yes |  |  |  | Yes |
|  | Adults | Yes |  |  |  | No |
| SVOA medial | Children | No | No | Yes | No | Yes |
|  | Adults | No | Yes |  |  | No |
| SVOA final | Children | No | No | No | No | Yes |
|  | Adults | Yes |  |  |  | No |

## 4    Discussion

With reference to our first two research questions, the results of the current study suggest that both sentence location and sentence type influence prosodic focus marking in both groups. The adults marked focus by accenting focal targets more than non-focal ones, in both locations and sentence types, with one exception; in medial position in SVOA, where they used H*L for focus and !H*L for non-focus. Previous findings of sentence-initial pre-focus accentuation have been explained in terms of a rhythmic preference (e.g. Chen, 2007; Horne, 1991), whereby accentuation across conditions preserve a preferred strong-weak-strong pattern in SVO sentences with final focus. We suggest that rhythmic preferences might similarly explain why adults accent post-focal objects in the SVOA sentences. For medial comparisons, the no-focus condition was NF-i, where subjects were focal and objects post-focal. Between the object target and the focal subject in the SVOA sentences there was a verb that was not included in our measurements. The verbs were often de-accented in the NF-i condition, leading to a strong-weak-strong rhythm if accenting the object. As the final constituent was also non-focal in NF-i, de-accenting everything after the initial focus would leave a rather long stretch un-accented, which seems dispreferred by the adults, who solve the potential ambiguity of non-focal accentuation by downstepping non-focal accents.

The children used accent placement in similar ways as the adults for medial targets in SVOA and final targets in SVO. Yet, for the medial targets in SVOA there was no effect of focus on the children's choice between H*L and !H*L, thus different from the adults the children did not use accent choice to mark focus in this location. For the final targets in SVO however, the children patterned more closely with the adults in accenting significantly more when the targets were focal than when they were not (see Chen, 2011a for similar findings).

Medially, in the SVO-sentences, we found no effect of focus on accentuation or accent choice, but the pitch analysis showed the children to produce focal verbs with a larger pitch range than non-focal ones. Due to their use of accent placement, the adults' medial verbs were similarly produced with a larger pitch range when focal then non-focal. We interpret this difference between the two groups as one in degree rather than category, and suggest that, similar to what is described for initial position (Chen, 2009), consistent prosodic focus marking seems harder to acquire sentence medially than sentence finally. One possible reason for this could be that, as seen for the medial targets in SVOA, adults seem to adjust their focus marking strategies according to rhythmic in addition to information structural constraints. This could make medial focus more variably marked in the children's input, possibly making the correct cues harder to detect. Another reason for final focus marking being easier than medial, could be that the pitch tends to decline toward the end of sentences, possibly making focal accentuation in this position particularly salient.

Another way in which complexity plays a part in our data is for the children's SVOA productions. As already mentioned, there were no effects on accent placement or type in medial position, and the same holds finally. Still, our phonetic analysis of the medial SVOA targets revealed the children to expand the pitch range for focus, thus using phonetic adjustments rather than accentuation. For the final targets in SVOA we found no effects of focus whatsoever in the children's data. In light of this finding, it seems like the generalization that final position is easier than medial only holds for relatively simple sentences. The SVOA sentences were rather long, and a comparatively larger amount of excluded productions from this part of the data suggests that the children also found them harder to produce. Our findings suggest that sentence complexity affects the children's ability to mark focus adequately, and that findings from studies using SVO sentences only cannot necessarily be expected to hold for more complex constructions.

A few words should be said about word duration, which in our analyses seemed unaffected by focus for both groups, both sentence types and both positions. This is striking, considering that previous studies have found an effect of focus on duration for both adults and children (Chen, 2007, 2009, 2011a; Hanssen et al., 2008). We ran the models over duration twice, using both raw and log-transformed values, but both analyses rendered no effects. For now we have no explanation for this difference between our study and what others have found, but we are currently exploring our duration data in more detail in order to understand what might cause our results to differ from previous ones.

Finally, the results reported for pausing in Romøren & Chen (to appear) suggest that 4- to 5-year-old children make use of pausing to mark focus in both SVO and SVOA sentences, medially and finally. The average pause durations were longer in SVO then in SVOA, and longer medially than finally, but the children do not seem to use pausing more in locations where their mastery of canonical cues to focus are more limited (e.g. final position in SVOA).

The current study confirms earlier descriptions of Dutch 4- to 5-year-olds not yet mastering the canonical cues to focus in Dutch. We also add to previous work by showing how the children's proficiency is affected by both sentence location and sentence complexity. As the children are still working to disentangle the complexity of prosodic focus marking, pausing for focus might be a useful strategy, particularly in the light of reports suggesting that adult listeners make use of pausing as a cue to emphasis (Dahan & Bernhard, 1996).

Finally, in order to formulate a proper theory of the developmental road to prosodic focus marking one should not ignore the listener-side of the coin. To know whether children's ways of marking focus are actually meaningful to listeners, future investigations should also include perception experiments looking not only at adults' perception of adult cues, but also into how adults interpret children's prosodic focus marking at stages where they are not yet fully proficient.

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