The developmental path of phonological encoding of focus in Dutch

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Abstract

This paper gives an overview of recent studies on the use of phonological means (accent placement and choice of accent type) to encode focus in Dutch-speaking children aged between 1;9 and 8 in both spontaneous and elicited production. It is argued that learning to use the phonological means to encode focus is a gradual process. In the light of current findings, a first proposal was put forward on the developmental path to adult-like phonological encoding of focus in Dutch.

1. Introduction

Focus is primarily marked by means of intonation in many languages. For this reason, focus is sometimes treated as an intonational category in the literature. In this contribution, the term focus is used to refer to an information structural category and defined as the constituent that carries the new information in a sentence to the receiver (e.g. Lambrecht, 1994; Gundel, 1999). Focus is often discussed in theories of information structure together with the concept topic. Topic refers to the discourse entity about which new information is provided. Focus can be contrastive if it is chosen from a closed set of alternatives in the discourse (Chafe, 1974). It can also have different scopes, i.e. a single lexical word (narrow focus) vs. larger than one lexical word (broad focus) (Ladd, 1980). Contrastive focus usually has a narrow scope. In Germanic and Romance languages, both the placement of pitch accent and the type of pitch accent (i.e. the phonological cues) can be essential to the marking of focus. Further, gradient variations in pitch, duration and peak alignment (i.e. the phonetic cues) also play an role, in particular in distinguishing different focus conditions (i.e. broad focus, narrow focus, contrastive focus), where the phonological marking is similar (e.g. Baumann, Becker, Grice & Mücke, 2007, Hanssen, Peters & Gussenhoven, 2008).

Research on early intonational development has shown that children acquiring Germanic and Romance languages have developed the inventory of pitch accents and boundary tones in the adult model by the late two-word stage (e.g. Balog & Snow, 2007 for English; Prieto & Vanrell, 2007 for Catalan; Frota & Vigário, 2008 for Portuguese, Chen & Fikkert, 2007a for Dutch). The questions that arise are thus whether children can use the phonological means to mark focus early on and if not, how they acquire this over time. In this contribution, I will consider in detail three recent studies on the phonological marking of non-contrastive narrow focus in child Dutch (Chen, submitted a; Chen & Fikkert, 2007a), and show that learning to use the phonological means to mark focus is a gradual process. In the light of findings from these studies, I will make a first proposal on the developmental path of phonological encoding of focus in Dutch. The studies to be discussed concern focus marking in both spontaneous and elicited production by typically developing monolingual Dutch-speaking children aged between 1;9 and 8.

In the rest of the introduction section, I first briefly consider the phonological marking of focus in adult Dutch (section 1.1) and then review previous work on focus marking in child language (section 1.2).

1.1. Phonological encoding of focus in Dutch

Chen (submitted b) investigated the phonological and phonetic marking of focus as well as topic in naturally spoken SVO sentences elicited as answers to WH-questions. As regards the phonological marking of focus, it was found that focus is nearly always accented independent of its position in the sentence and the preferred accent type is H*L. In sentence-final position, focus is also relatively frequently realised with !H*L. On the other hand, non-focal nouns are realised differently depending on their position in the sentence. Pre-focus nouns (i.e. sentence-initial topics) are mostly accented, like focus, but for rhythmic motivation. The preferred accent type is also H*L. Post-focus nouns (sentence-final topics) are preferably realised with no accent but can be realised with !H*L. It was suggested that the use of !H*L sentence-finally is probably a means to express lack of interest in any further discussion on the current point.

1.2. Focus marking in child language

Studies on the intonational realisation of focus in child language are rather few and are mostly concerned with contrastive focus or contrast. In a picture-description task, Hornby and Hass (1970) asked English-speaking children aged between 3;8 and 4;6 to describe pairs of pictures that differed by one feature (e.g. a boy is riding a bike vs. a girl is riding a bike). They found that children frequently use 'contrastive stress' (i.e. emphatic accentuation) to pronounce the word that carries the contrastive information in the description of the second picture (e.g. a GIRL is riding a bike) but they rarely use contrastive stress in the description of the first picture. Using a similar method, MacWhinney and Bates (1978) found that the use of contrastive stress is well established around the age of three but still increases across time in English-speaking children aged between three and six. Müller, Höhle, Schmitz and Weissenborn (2005) elicited SVO sentences with a contrast either in the subject or in the object from German four- to five-year-olds by means of a question-answer task. In this task, children repeated the answer from a puppet to a question about a series of comic strips (e.g. Eva and Peter want to bake something for their mother's birthday. Eva wants to bake cookies. What does Peter bake?); the puppet's speech lacked sentence-level prosody. They found that children, like adults, utter the words carrying the contrast with a higher mean pitch than the words carrying no contrast with the same syntactic function and in the same sentence position. As accentuation is typically implemented as pitch increase, probably the children in Müller et al.'s study have used more pronounced accentuation in contrastive focus. Accentuation has also been shown to be used in corrections, a modified version of contrast,

by five-year-old English-speaking children, although misplacement of accentuation can occur in non-phrase final corrections (Wells, Peppé & Goulandris, 2004). Taken together, these studies show that children acquiring a Germanic language can use accentuation to realise contrastive focus from the age of three onwards.

The studies on children's use of accentuation in marking contrastive focus are limited in their implications for the intonational marking of focus in children in general. Accentuation can be used for two types of highlighting in a sentence, i.e. horizontal highlighting and vertical highlighting (Hetland, 2000). Horizontally, the accented part is singled out and conveys what is new in relation to the rest of the sentence. The horizontal highlighting thus corresponds with notions like non-contrastive narrow focus. Vertically, accentuation marks a specific word as 'especially important compared to relevant alternatives ... (and) chosen at the expense of something else' (164). The vertical highlighting thus corresponds with the notion of contrastive focus. Accentuation in the vertical highlighting tends to be realised with more acoustic prominence (e.g. a wider pitch range, a longer duration). The three studies reviewed above show that children have acquired the vertical usage of accentuation at the age of three or four. It remains to be examined when children can use accentuation to mark non-contrastive narrow focus.

There appears to be one published study that discusses the use of accentuation in marking non-contrastive narrow focus. Wieman (1976) observed in recordings made during natural play sessions with two-year-olds that accent placement in the two-word stage is in the first place governed by the semantic relation between the two words. For example, in Verb-Locative utterances (e.g. play museum), the accent is almost always assigned to the locative (e.g. museum). However, the default pattern breaks down if the non-default accent-bearing word carries new information or is in focus. For example, a child accented 'firetruck' in 'firetruck street' when answering his mother's question 'what is in the street'. This suggests that two-year-olds can strategically assign accents to mark focus. However, this result is based on a group of 14 sentences in the database only. Wells and Local (1993) justifiably question the generality of Wieman's claim and suggest that there may be substantial variability among young children in accent placement. In a case-study on the prosodic and syntactic organisation of a German-acquiring child's two-word utterances, Behrens and Gut (2005) analysed the intonation of the child's two-word utterances produced over a period of three months. They found that the child frequently uttered both words with accentuation in this period of time. There is thus no conclusive evidence that children can use accentuation to mark non-contrastive narrow focus in the two-word stage.

Furthermore, earlier studies tell us little about the types of accent that children use to mark focus. This is an important issue given the fact that choice of accent type matters greatly to the marking of focus. Moreover, these studies suggest conflicting effects of position of focus on intonation. Specifically, Hornby and Hass (1970) found a significant decrease in the use of contrastive stress in object contrast. They argued that this may be caused by children's sensitivity to the role of word order in distinguishing focus from topic. Assuming that new or contrastive information occurs far less frequently in the subject than in the VP, they suggested that contrastive stress may be a more useful means to draw attention to the subject than to the object in English. However, Müller et al. (2005) found a bigger increase in mean pitch height in sentence-final contrast than in sentence-initial contrast, suggesting a stronger intonational realisation of contrast in sentence-final position. There is thus an obvious need for more research on how position of focus affects the phonological marking of focus in children. Effect of position is interesting also because position does not influence the phonological marking of focus but the phonological marking of topic in adult Dutch. It would be interesting to see whether such a difference in the adult model of the ambient language influences children's production.

In all three studies to be discussed here, both accent placement and choice of accent type in marking of non-contrastive narrow focus (hereafter focus) are examined in detail. In the study on children aged between four and eight, the effect of position of focus is addressed.

2. General methodological issues

In each of the three studies, the sentences included for intonational analysis were first segmented at the word level using the speech analysis software Praat (Boersma, 2001). A textgrid was created for each sentence. On the word tier (interval tier) of each textgrid, landmarks were inserted to demarcate the boundaries of each word and the words were transcribed orthographically. Then each sentence was intonationally transcribed following ToDI (Transcription of Dutch Intonation, see Gussenhoven, 2005) on the intonation tier (point tier) by the (first) author without access to the context in which the utterance was produced. In ToDI, five basic accent types are recognised, H* (typically a high level contour or a rise without a distinct low plateau in the stressed syllable), L* (a sustained low pitch), H*L (a fall), L*H (a rise), and H*LH (a fall-rise). There are modified versions of these accents. For example, !H* and !H*L are downstepped versions of H* and H*L, and characterised with a pitch level (in !H*) or pitch peak (in !H*L) noticeably lower than the preceding high tone. The fall of !H*L typically starts in the preceding word.

As ToDI was initially developed to describe intonation contours in adult speech, applying ToDI to children's intonation may run the risk of shoehorning children's intonation contours in adults' intonational categories. To minimise such a risk, we gave a phonetic description of the accent using a ToDI-like label (e.g. H*LHL in compound nouns) when the shape of an accent did not fit with the description of any of the pitch accent types in ToDI. This however turned out to be necessary only in a very small number of cases (< 2%). Moreover, extra symbols were introduced to code observable variations in pitch scaling and peak alignment in H*L and !H*L in utterances produced in the late two-word stage. The was done to find out whether these kinds of variations were functional in focus marking. For example, the '^' and '~' signs preceding H*L indicated a substantial increase and decrease in peak height (> 70 Hz), respectively. The '>' sign demarcated that the fall started only after the stressed syllable; the '<' sign demarcated that the fall started right at the onset of the voiced portion of the word.

A second ToDI transcriber checked all labels and gave alternative analyses if necessary; disagreements were resolved in a second round of transcription. Measures of inter-rater agreement were taken in the studies on older children (Chen, submitted a). Accent labels (including 'no accent') were automatically extracted from each utterance using a Praat script and supporting programs.

3. Study 1: two-year-olds

Chen and Fikkert (2007a) examined the effect of information status on accent placement in two-word utterances produced after the vocabulary size of 160 unique recorded words was reached (defined as late two-word stage by the authors) by three children (aged 1;9-2;1). The utterances were selected from longitudinal data of three children available in the CLPF database (Fikkert, 1994; Levelt, 1994). They found that both words were accented in most of the utterances regardless of information status. The utterances were mostly children's answers to an adult interlocutor's question or comments about a toy or an ongoing activity in the direct surroundings. The focus in many of the utterances can thus be reliably identified in the corresponding context. For the purpose of this paper, I identified the focus in the Noun+Verb utterances (N=31) and reanalysed the distribution of accentuation and different types of accents.

In 20 of the Noun+Verb utterances, focus can be reliably identified. In 5 of these utterances, focus was on the noun (e.g. *appel eten* 'apple eat' uttered as the answer to the question 'what is the boy eating?'). The noun was accented with H*L or H* in all five cases;

the verb was accented in four out of five cases and with !H*L. In eight utterances, both the noun and the verb were in focus (e.g. *tanden poetsen* 'teeth clean' uttered as the answer to the question 'what is the boy doing?'). The noun as well as the verb was accented in all 8 utterances, whereas adults typically accent the noun only in such cases. Six utterances were repetitions of what an adult said. The verb was accented in all six utterances; the noun was accented in five out of the six utterances. In one utterance, the verb was in focus (i.e. *poes huilen*, 'cat cry', uttered as the answer to the question 'what does the cat do?'). The verb was accented and the noun was unaccented, as found in adults' speech. Thus, except for the 'poes huilen' utterance, accentuation was placed independent of focus condition and both words were accented in all but two utterances. The most common tunes were H* !H*L L% and H*L !H*L L%. The phonetic realisation of H*L and !H*L played no role. Thus, children do not use accent placement to mark focus in the two-word stage, contra Wieman's (1976) claim but in line with Behrens and Gut's (2005) finding.

However, this may not be the whole picture on the phonological marking of focus in two-year-olds. Children of this young age are known to have an immature pitch-control system. They may therefore experience difficulty in lowering pitch over the length of a word. This is in fact evidenced by their use of almost complete devoicing to accomplish the effect of unaccenting instead of lowing the pitch. In this light, the use of !H*L may be considered an alternative strategy in addition to devoicing when no accentuation should be produced. Interestingly, when reanalysing the intonation by grouping !H*L and devoicing together as the acoustically weak sound patterns, a different picture emerged. It turned out that largely the focal word was accented with a non-downstepped accent whereas the non-focal word was spoken with a weak sound pattern. In whole-sentence focus and repeated Noun+Verb utterances, the noun was accented but the verb was downstepped. These results show that in the late two word stage, children may use non-downstepped accents to realise the focal word but a downstepped accent or devoicing to realise the non-focal word. The same patterns were found in Adj+Noun utterances with focus on the adjective produced as answers to questions about an attribute of the nouns by children aged 3;0 and 3;4 (Chen & Fikkert 2007b).

It should be noted that the use of non-downstepped accents on the focal word in both the Noun+Verb utterances and the Adj+Noun utterances is confounded by the fact that the focus was on the first word and downstepped accents cannot occur on the first word. If the observation on the mapping of acoustically strong patterns to focus and weak patterns to non-focus is correct, we predict that the first word will be devoiced or realised with a very weak rise (not qualified as a H*) when the focus is on the second word. Further analysis on two-

word utterances with focus on the second word produced by young children is thus needed to verify the observed relationship between acoustically strong and weak patterns and focus marking.

4. Study 2: four- to five-year-olds

Study 2 is concerned with four- to five-year-olds' phonological marking of focus in full sentences (Chen, submitted a). The marking of focus was studied relative to the marking of topic. SVO declaratives were elicited as answers to WH-questions on either the subject or the object. Both subjects and objects were realised by nouns. In half of the SVO sentences, the subject noun was the focus and the object noun the topic. In the other half of the SVO sentences, the subject noun was the topic and the object noun the focus. The variation in the position of focus and topic made it possible to study the effect of position on intonation. Each noun served both as both focus and topic in different sentences, as shown in (2).

(2)   Experimenter: Kijk! Een biet. *Wie eet de biet?*

          "Look! A beet. Who eats the beet?"

    Participant: *[De poetsvrouw]$_{focus}$ eet [de biet]$_{topic}$.*

          "The cleaning-lady eats the beet."

    Experimenter: Kijk! Een poetsvrouw. *Wat pakt de poetsvrouw?*

          "Look! A cleaning-lady. What does the cleaning-lady pick (up)?"

    Participant: *[De poetsvrouw]$_{topic}$ pakt [de vaas]$_{focus}$.*

          "The cleaning-lady picks (up) the vase."

Considering the simpler mapping of intonation to focus in such declarative sentences, as found in Chen (submitted b) and its similarity to the mapping of accentuation to contrast, it was hypothesised that four- to five-year-olds would be adult-like in marking focus but not in marking topic (Hypothesis 1). However, from a structural perspective, the intonation of sentence-initial noun is less variable than the intonation of sentence-final noun. The sentence-initial noun is mostly accented with a fall regardless of whether it is topic or focus, whereas the sentence-final noun is realised differently in topic and focus. The alternative hypothesis was then that 4- to 5-year-olds would be adult-like in marking topic and focus in sentence-initial position but not in sentence-final position (Hypothesis 2).

4.1. Data elicitation

A picture-matching game was used to elicit the SVO sentences. Prior to the game, the experimenter showed each child two boxes full of pictures. The child was told that a picture from one box went together with a picture from the other box and that the experimenter needed his/her help to sort the pictures out. The procedure of the game is as follows. First, the experimenter took a picture (e.g. a picture of a cleaning-lady) from one box. She then drew the child's attention to the picture and established what the picture was by saying '*Kijk! Een poetsvrouw!*' "Look! A cleaning-lady!" with either H*L or L*H on the verb and H*L on the noun. In the picture, the cleaning-lady seemed to be picking up something. The experimenter then asked a question about the picture (e.g. '*Wat pakt de poetsvrouw?*' "What does the cleaning-lady pick up?"), again in a prescribed intonation contour. The WH-word was spoken with H*L; the noun was spoken with either no accent or H*L with a reduced F0 excursion. Second, the child turned to a robot for help by clicking on a picture of the robot displayed on his/her computer screen. The child received the answer (in SVO word order) from the robot via a headphone set such that the experimenter could not hear it.[1] Third, the child then used the same words as the robot to answer the experimenter's question but in his/her own intonation (e.g. '*De poetsvrouw pakt de vaas.*' "The cleaning-lady picks up the vase."). Finally, the experimenter looked for the matching picture from the other box and handed both pictures over to the child.

Twenty-eight four- to five-year-olds participated in the experiment. The children were tested individually in a quiet room at their school during school time. Each session was recorded with an external high-quality microphone connected to a portable DAT recorder at 48 kHz sampling rate with 16-bit resolution. The microphone was placed 10-15 cm away from the mouth of the participant. Thirty-six SVO sentences were elicited from each child.

4.2 Intonational analysis

A selection of the data was made on the basis of level of background noise, quality of segmental articulation, speaking style (natural vs. playful), and whether there were known speaking or hearing deficits. In total, 418 sentences from 12 children (age range: 4;5 – 5;7, mean age 5;1) were intonationally transcribed.

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[1] The robot's answer sentence was generated by splicing together the words (with a 200 ms pause in between) recorded in a wordlist reading, as in Müller et al. (2005). The original intonation was then erased and the pitch level was set at 200 Hz to obtain a flat intonation.

The percentage distribution of the patterns (including no accent) found in the nouns was then obtained in SPSS. A number of nouns were not included in this count because of problems that could affect choice of intonation pattern, including misplacement of word stress, false start, breaking a word into two parts, phrasing, and laughing while speaking. In total, intonation patterns in 300 sentence-initial nouns and 276 sentence-final nouns were included in the distributional count.

4.3 Results

The mean percentage distribution of an intonation pattern in focus and topic is shown in Table (1) for different sentence positions separately. It was computed by averaging the percentages of the nouns spoken with the intonation pattern in a condition from all the twelve children.

In sentence-initial position, focus was accented in 94% of the cases; topic was accented in about 89% of the cases. The most frequent accent type was H*L, followed by H* in both focus and topic. There was little difference in the distribution of the intonation patterns between focus and topic. On the other hand, in sentence-final position, focus was accented in over 90% of the cases, most frequently with L*H, followed by !H*L and H*L, whereas topic was most frequently realised with no accent (about 37%), followed by L*H, !H*L and H*L. These observations suggest that information structure matters to the choice of intonation patterns only in sentence-final position.

Table 1 Mean % distributions of intonation patterns in topic and focus in four- to five-year-olds (N =12)

(a)

	H*	H*L		OTHER		no accent
			H*LH	H*L^HL	L*H	
initial focus	27.3%	55.6%	4%	1.3%	6%	5.8%
initial topic	18.9%	61.8%	2.6%	0.6%	5.1%	11.1%

(b)

	H*L	!H*L	L*H	OTHER		no accent
				H*	L*	
final focus	18.6%	33%	49%	5%	0	9.3%
final topic	9.9%	28.5%	31.3%	4.7%	9.5%	36.7%

To verify the observations on the relationship between intonation and information structure in different sentence positions, a number of multinomial logistic regression analyses were carried out at the significance level of 0.05 on the intonation patterns in sentence-initial nouns and sentence-final nouns separately. The dependent variable in these analyses was the intonation patterns in the nouns, consisting of four categories (H*, H*L, OTHER, and no accent) in sentence-initial position and five categories (H*L, !H*L, L*H, OTHER, and no accent) in sentence-final position. The OTHER category consisted of intonation patterns with a very low frequency. This merge was done to ensure reliable statistical results. In each model, the variable INFORMATION STRUCTURE (two levels: topic and focus) was the predictor; the variable SPEAKER (12 levels) was used to define the subgroups of the data in the model. The reference category was determined for each model separately.

Sentence-initial topic and focus: The multinomial logistic regression analysis with 'no accent' as the reference category showed that the model fitting was not significantly improved after adding INFORMATION STRUCTURE as the predictor (χ^2 = 6.558, df = 3, p = 0.087). This confirmed the absence of a relationship between intonation and information structure in sentence-initial nouns.

Sentence-final topic and focus: The multinomial logistic regression analysis with 'no accent' as the reference category showed that the model fitting was significantly improved after adding INFORMATION STRUCTURE as the predictor (χ^2 = 32.973, df = 4, p < .001). This result indicated that there was an overall relationship between intonation patterns and information structure. Wald statistics showed that each accent pattern was significantly more likely than 'no accent' to occur in focus (Table 2). The Exp(B) values in the focus condition indicated that H*L, !H*L and L*H were about 8 times, 5 times, and 7 times respectively more likely than 'no accent' to occur in focus. The Exp(B) values in the topic condition for H*L, !H*L and L*H indicated that H*L, !H*L and L*H were about 97% (1-Exp(B) of H*L), 78% (1-Exp(B) of !H*L), and 85% (1-Exp(B) of L*H) less likely than 'no accent' to occur in topic. These results indicated a clear preference to realise focus with accentuation and topic with no accent in sentence-final position.

Table 2. Wald statistics and Exp(B) values in sentence-final topic and focus with 'no accent' as the reference category (four- to five-year-olds)

	Wald	df	p-value	Exp(B) (focus)	Exp(B) (topic)
H*L	17.817	1	p<.001	7.833	12.77%
!H*L	15.444	1	p<.001	4.602	21.73%
L*H	23.102	1	p<.001	6.609	15.13%

To find out whether there was a difference in likelihood of H*L, !H*L and L*H in sentence-final focus, a second multinomial logistic regression analysis was conducted with H*L as the reference category. Wald statistics showed that 'no accent' was significantly less likely to occur in focus than H*L (Wald = 18.543, df =1, p < 0001, Exp(B) = 0.128) but there was no significant difference between H*L and !H*L (Wald = 1.652, df = 1, p = 0.558) and between H*L and L*H (Wald = 0.165, df = 1, p = 0.684). The likelihood of the three accent types to occur in focus relative to topic was thus similar.

In summary, the results show that four- to five-year-olds accent focus as well as topic in sentence-initial position in declaratives and they use H*L most frequently, like adults. In sentence final position, they prefer to realise focus with an accent but topic with no accent, like adults. This indicates that adult-like use of accentuation in the marking of no-contrastive focus is in place by the age of four or five. However, unlike adults, four- to five-year-olds show no preference for H*L over !H*L, H* and L*H in sentence-final focus. They use H* and L*H preferably in focus than in topic, to the same extent that they prefer to use H*L in focus than in topic.

The findings lend partial support to Hypothesis 2 but no support to Hypothesis 1. The predicted late mastery of adult-like intonational realisation of topic and focus in sentence-final position is borne out regarding focus. The intonational realisation of sentence-final topic is however already mastered at the age of four or five. This asymmetry in the acquisition of topic and focus marking in sentence-final position may be caused by the difference in the intonational variability between sentence-final topic and sentence-final topic in Dutch. Although !H*L can be used, 'no accent' is clearly the preferred pattern in sentence-final topic. In contrast, in sentence-final focus, H*L is more favoured than !H*L but !H*L occurs relatively frequently. This can pose difficulty for four- to five-year-olds in figuring out the preferred accent type.

Four- to five-year-olds' use of H* and L*H can be explained by two factors. First, various non-information structure related meanings are usually expressed in sentence-final position, such as checking and confirmation seeking. It is possible that four- to five-year-olds sometimes felt the need to check with or seek confirmation from the experimenter on the answers, especially on the answers with the new information at the end. This need overran the need to encode focus and led to the choice for L*H or even H* instead of H*L. Indeed, when listening to the answer sentences with a final H* and L*H out of context, some of these sentences sounded like a checking question. Second, informal observation suggests that some children from this age range habitually speak with a final rise at the end of a sentence. This accords with the impression that the children did not sound like checking or seeking conformation in spite of the final rise in a majority of the sentences.

5. Study 3: seven- to eight-year-olds

To find out when children will become adult-like in the marking of focus as well as topic, a follow-up study (Chen, submitted a) was conducted on seven- and eight-year-olds.

5.1 Method

Twenty-three seven- and eight-year-olds were tested using the same method as in Study 3. Following the same data selection procedure as described above, 425 sentences from 12 seven- and eight-year-olds (age range: 7;5 – 8;10, mean age 8;0) were intonationally transcribed.

5.2 Results

Intonation patterns in 391 sentence-initial nouns and 368 sentence-final nouns were included in the distributional count. As can be seen in Table 3, in sentence-initial position, focus was accented in about 99% of the cases; topic was accented in 90% of the cases. The most frequent accent type was H*L, followed by H* in both focus and topic, as in four- to five-year-olds' production. There was again little difference in the distribution of the intonation patterns between focus and topic. On the other hand, in sentence-final position, focus was accented in over 93% of the cases, most frequently with H*L, followed by !H*L and L*H, whereas topic was most frequently realised with no accent (about 40%), followed by H*L, !H*L, L*H. These observations suggest that information structure matters to the choice of intonation patterns only in sentence-final position, as in four- to five-year-olds' production.

Table 3. Mean % distributions of intonation patterns in topic and focus in seven- to eight-year-olds (N = 12)

		H*	H*L	!H*L	L*H	OTHER	no accent
initial	focus	22.7%	64.8%	n.a[a]	7.5%	3.5%	1.5%
	topic	27%	53.3%	n.a	6.6%	3%	10%
final	focus	4.2%	59.8%	15.1%	14%	0	6.9%
	topic	3.6%	29.9%	22.5 %	4.2%	0	39.8%

[a] 'n.a' means that the accent type does not occur in the sentence position that the cell corresponds to.

Multinomial logistic regression analyses were carried out at the significance level of 0.05 to verify the observations on the relationship between intonation and information structure in different sentence positions. The dependent variable in these analyses was the intonation patterns in the nouns, consisting of five categories (H*, H*L, L*H, OTHER, and no accent) in sentence-initial position and six categories (H*, H*L, !H*L, L*H, and no accent) in sentence-final position. In each model, the variable INFORMATION STRUCTURE (two levels: topic and focus) was the predictor; the variable SPEAKER (12 levels) was used to define the subgroups of the data in the model. The reference category was determined for each model separately.

Sentence-initial topic and focus: The multinomial logistic regression analysis with 'no accent' as the reference category showed that the model fitting was not significantly improved after adding INFORMATION STRUCTURE as the predictor (χ^2 = 16.47, df = 4, p = 0.067). This confirmed the absence of a relationship between intonation and information structure in sentence-initial nouns.

Sentence-final topic and focus: The multinomial logistic regression analysis with 'no accent' as the reference category showed that the model fitting was significantly improved after adding INFORMATION STRUCTURE as the predictor (χ^2 = 74.323, df = 4, p < .001). This result indicated that there was an overall relationship between intonation patterns and information structure. Wald statistics showed that each accent pattern was significantly more likely than 'no accent' to occur in focus, as can be seen in Table 4. The Exp(B) values in the focus condition indicated that H*, H*L, !H*L and L*H were about 6 times, 11 times, 4 times and 19 times respectively more likely than no accent to occur in focus. The Exp(B) values in the topic conditions indicated that H*, H*L, !H*L, and L*H were about 94%, 90%, 75% and 95% less likely than 'no accent' to occur in topic. There was thus a clear preference to realise focus with accentuation and topic with no accent in sentence-final position.

Table 4. Wald statistics and Exp(B) values in sentence-final topic and focus with 'no accent' as the reference category (seven- to eight-year-olds)

	Wald	df	p-value	Exp(B) (focus)	Exp(B) (topic)
H*	9.641	1	P =.002	6.418	15.58%
H*L	46.964	1	p<.001	10.529	9.5%
!H*L	12.725	1	p<.001	3.972	25.18%
L*H	34.255	1	p<.001	18.952	5.28%

The multinomial logistic regression analysis with H*L as the reference category showed that, like 'no accent', !H*L were significantly (about 96%) less likely than H*L to occur in focus, as shown in Table 5. However, there was no significant difference between H*L and H* and between H*L and L*H, suggesting that the likelihood for H* and L*H to occur in focus relative to topic was not different from H*L. Because the small number of instances of H* and L*H occurred mostly in the production of four out of the twelve children, this result may suggest a speaker-specific choice of H* and L*H over H*L in focus in certain trials.

Table 5. Wald statistics and Exp(B) values in sentence-final topic and focus with 'H*L' as the reference category (seven- to eight-year-olds)

	Wald	df	p-value	Exp(B) (focus)	Exp(B) (topic)
H*	.830	1	P =.362	.610	
!H*L	11.019	1	P=.001	.377	2.65
L*H	1.824	1	P =.177	1.800	
no accent	46.964	1	P <.001	.095	10.53

To sum up, seven- to eight-year-olds are not only adult-like in sentence-initial position but also largely adult-like in sentence-final position, in line with their general intonational competence in production (Wells et al., 2004). In sentence-final focus, they show a preference for H*L over !H*L, unlike four- to five-year-olds. There are nevertheless traces of

use of intonation typical in four- to five-year-olds' production but not contested in adults' production. Namely, a small number of seven- to eight-year-olds use H* and L*H sometimes in sentence-final position.

6. Conclusions

Together findings from the three studies show clearly that children acquire the use of accent placement and accent type to mark focus in Dutch gradually. In the late two-word stage, children appear to use intonation to mark focus, but in a non-adultlike way due to difficulty with pitch control. They associate non-downstepped patterns with focal words but downstepped patterns and devoicing with non-focal words. There seems to be no clear progress from the age of two to the age of three. At the age of four or five, children are adult-like in marking sentence-initial focus as well as sentence-initial topic, and in preferring accentuation over no accentuation in focus but preferring no accentuation over accentuation in topic in sentence-final position. However, unlike adults, they show no clear preference for H*L over L*H and !H*L in marking sentence-final focus. It seems that children at this stage are still trying to figure out the preferred choice of accent type in focus marking. At the age of seven or eight, children become largely adult-like in the phonological marking of focus and topic.

Many languages are however not like Dutch, where choice of accent type plays a significant role in encoding focus. For example, in Parisian French the shape of accent patterns seems to play no role in encoding focus (Jun & Fougeron, 2000). Similarly, in tone languages like Mandarin Chinese (e.g. Xu, 1999; Y Chen, 2006), the shape of the pitch contour is lexically determined and the intonational encoding of focus is mainly implemented as variations in pitch range of a lexical tone and word duration. The question is then whether children acquiring such languages would go through a somewhat different developmental path regarding prosodic marking of focus. Future work can be directed to such cross-linguistic comparisons to shed light on language-specific acquisition challenges that children face in the process of acquiring the prosodic marking of focus.

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