



## Preschoolers' interpretation of habitual and deontic conditionals: a delayed mapping between concept and language

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### Abstract

By investigating Dutch children's interpretation habitual and deontic conditionals, this paper explores their mapping of the concepts of hypotheticality and conditionality into a corresponding linguistic form of IF-conditionals. Results of 46 children (20 girls; age range = 3;11-6;00; mean = 4;11) in a truth value judgment task with three types of stimuli, i.e. habitual conditionals, deontic conditionals, and conjunctive/additive constructions, show the following. First, the preschoolers do not exhibit different interpretation performances with the two types of conditional stimuli and the conjunctive/additive type. Second, the preschoolers show more target-like interpretation performances with deontic conditionals than habitual conditionals when it comes to the concept of conditionality. These results suggest a delayed mapping of the two concepts investigated into the corresponding linguistic construction. In other words, the syntactic construction of IF-conditional in Dutch is first acquired before the two concepts are assigned to it. Taking into consideration different factors, this paper discusses possible explanations for the delay.

**Keywords** Conditional constructions, conditionality, Dutch, hypotheticality, truth value judgment task

### 1. Introduction

The way in which we conceptualize the world surrounding us is reflected in the language we speak. Gender is one example, the distinction of which is made by different linguistic means, e.g. by pronouns. Countability is another example, which can be realized in some languages by means of plural morphemes, for instance. The mapping between our mental and linguistic representations does not only exist for these concrete and simple concepts, but is also applicable for abstract and/or complex concepts like hypotheticality and conditionality. In many languages, both these concepts can be mapped into a two-clause construction marked by a conditional connective like *if* in English (Traugott, 1985), which is further referred to as IF-conditionals in this paper.

If the mapping between hypotheticality and IF-conditionals is established, one is expected to accept both the scenarios in which the event or situation referred to in the IF-clause may and may not take place, respectively. Take

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(1) as example. Both possibilities of Jong being ill and John not being ill should be admitted by both the speaker and the addressee.

(1) If John is ill, he stays at home.

If the mapping of conditionality and IF-conditionals is established, one is then expected to interpret the event or situation referred to in the IF-conditionals as merely a sufficient condition for what is referred to in the main clause to take place. Thus, John being ill in (1) is an only sufficient but crucially not a necessary condition on which he stays at home.

The syntactic complexity of IF-conditionals (i.e. two-clause structure) together with their mappings with the two conceptual representations mentioned above, gives rise to several questions from the perspective of child development. Do children first acquire the linguistic form of IF-conditionals, or do they first develop and grasp the concept of hypotheticality and that of conditionality? When both the linguistic form and the concepts are developed, how do children then establish the mapping between the two? Is the mapping immediately target-like, as described above in terms of interpretations? Or is it rather subject to development during the childhood? What facilitates the mapping, and what counts as a delaying factor?

It is hardly possible to address all these questions in one single study. Nevertheless, in order to gain some insight in some of these respects, this paper explores the mapping between hypotheticality and conditionality, and IF-conditionals in Dutch acquiring children. Since so far, little has been reported on Dutch children's syntactic, semantic or concept knowledge of conditional constructions, the current investigation moreover fills a knowledge gap. Before describing the current research and presenting the results, some common semantic types of IF-conditionals in Dutch will be first introduced, which is followed by a summary of previous findings on children's production and comprehension of IF-conditionals.

### 1.1. Background

#### 1.1.1. Some common semantic types of conditionals in Dutch

The literature so far exhibits different proposals on the classification of conditional constructions in natural languages (including IF-conditionals) (Arregui, 2007; Athanasiadou & Dirven, 1997; Bryant & Mok, 2003; Celce-Murcia et al., 1983; Comrie, 1986; Dancygier, 1993; Dancygier & Sweetser, 2005; Declerck & Reed, 2001; von Stechow, 2011; Huddleston & Pullum, 2002; Jespersen, 1961; Nieuwint, 1992; Quirk et al., 1985; Rescher, 2007; Stalnaker, 1968; Sweetser, 1990; among many others). Since hypotheticality is one of the two concepts that the current research focuses on, the hypotheticality continuum of Comrie (1986) is adopted, which can be illustrated as in Figure 1.

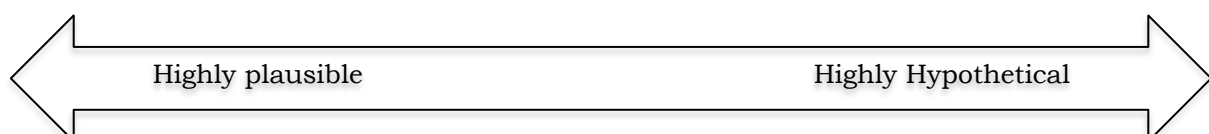


Figure 1. The hypotheticality continuum



Comrie interprets hypotheticality as a gradual concept, which refers to “the degree of probability of realization of the situations referred to in conditional, and more especially in the protasis” (Comrie, 1986: 88-89). By interpreting hypotheticality as such, factual clauses like *John speaks Dutch*, for instance, represents the lowest degree of hypotheticality, whereas counterfactual clauses like *I wish I wasn't ill* represent the highest degree of hypotheticality. Alongside the continuum, from the end of highly plausible, some commonly used conditional types in Dutch, marked by *als* ‘if’ will now be briefly introduced.

In Dutch, the conditional type that represents the highest degree of plausibility, and thus the lowest degree of hypotheticality, are those that express a mere temporal relationship between two future events or situations (Pollmann, 1975; Reilly, 1986: 300). The speaker is certain that the “condition” described in this type of *als*-clause is going to take place at a time following the utterance time, as a consequence of which, the event or situation referred to in the main clause follows in time in the future. Given the extremely high probability of the *als*-event/situation, we may call this conditional type *non-hypothetical future predictives*, as illustrated in (2).

- (2) a. Als we thuis zijn, mag je weer spelen.  
if we home are may you again play  
‘When we are home, you may play again.’
- b. Als je klaar bent met eten, gaan we tekenen.  
if you finish are with eat go we draw  
‘When you finish eating, we will draw.’

The conditional type of a slightly higher degree of hypotheticality than the non-hypothetical type are *low-hypothetical future predictives* (Bowerman, 1986), or *future predictives* (Dancygier, 1993). This type expresses a conditional relationship between two possible events or situations in the future, which have not taken place at the utterance time. The event or situation described in the *als*-clause are very likely to take place in the time span following the speaking moment; the event or situation referred to in the main clause, then, generally follows the *als*-event/situation as a consequence in time, as shown in (3).

- (3) Als ik een baan vind, koop ik een nieuwe iPhone.  
if I a job find buy I a new iPhone  
‘If I find a job, I will buy a new iPhone.’

*Habitual conditionals*, *generic conditionals*, and *deontic conditionals* are three conditional types that represent an even higher degree of hypotheticality than those two types introduced above. They all describe events or situations that may possibly but not necessarily take place, although they display other semantic differences. Habitual conditionals describe events or situations as a usual but definitely not an inevitable consequence of a certain condition being satisfied, which repeatedly take place but is still subject to uncertainty

(Bowerman, 1986; Huddleston & Pullum, 2002; Reilly, 1982; Schouten, 2000). See (4).

- (4) Als papa op kantoor zit, drinkt hij koffie.  
 if dad on office sit, drinks he coffee  
 'Every time when dad is at his office, he drinks coffee.'

Generic conditionals are used to express a relationship between situations or events, which either appears to be a scientific truth or have the force of a physical law (e.g. (5a)), or belongs to part of the speaker's knowledge based on past experience (e.g. (5b)) (Dancygier, 1999; Dancygier & Sweetser, 2005). In both cases, the *als*-event/situation is to some extent hypothetical: It is possible that what is described in the *als*-clause is not going to happen.

- (5) a. Als het boven nul is, gaat het ijs smelten.  
 if it above zero is goes the ice melt  
 Lit. 'If it is above zero-degree, ice will melt.'  
 'Ice melts above zero degree Celsius.'
- b. Als ik vijf uur slaap, krijg ik hoofdpijn.  
 if I five hour sleep get I headache  
 'If I sleep five hours, I get a headache.'

Different from habitual and generic conditionals, deontic conditionals are in fact a subtype of *speech-act* conditionals (Haegeman, 1984; Sweetser, 1990; Van der Auwera, 1986). This type of conditionals normally combines a certain action or behavior referred to in the subordinate clause, and the speaker's judgment, attitude or evaluative value described in the main clause (Akatsuka & Clancy 1993). As such, this conditional type typically expresses deontic modality in a sense that it describes what the speaker thinks should or should not take place. One example in Dutch is given in (6).

- (6) Als je je bordje leegeet, krijg je een ijsje.  
 if you your plate empty eat get you one ice-cream  
 'If you eat your plate empty, you will get an ice-cream.'

According to the speaker, the addressee should eat his or her plate empty. However, he or she is not sure whether this is indeed going to happen. The plausible but uncertain state of the *als*-event/situation here is similar to what is illustrated for habitual and generic conditionals. Therefore, habitual, generic, and deontic conditionals are considered representing a similar degree of hypotheticality.

Conditional types that exhibit higher degrees of hypotheticality are those that are generally referred to as *unreal conditionals*. These types of conditionals normally describe an imagined condition that can hardly take place, including *hypothetical conditionals* (Athanasiadou & Dirven, 1997; Comrie, 1986; Edgington, 2011; Nieuwint, 1992; Palmer, 1971; Quirk et al., 1985; among many others) and *counterfactuals* (see e.g. Athanasiadou &

Dirven, 1997; Bennett, 1988; Comrie, 1986; Dancygier & Sweetser, 1996; Edgington, 2011; Goodman, 1947; Lewis, 1973; Wierzbicka, 1997). Examples of such types will not be given since they are beyond the current research aim.

Recall Comrie's interpretation of hypotheticality as the degree of probability of realization of the event or situation described in the conditional clause. The above-introduced conditional types can be presented alongside the hypotheticality continuum as shown in Figure 2.

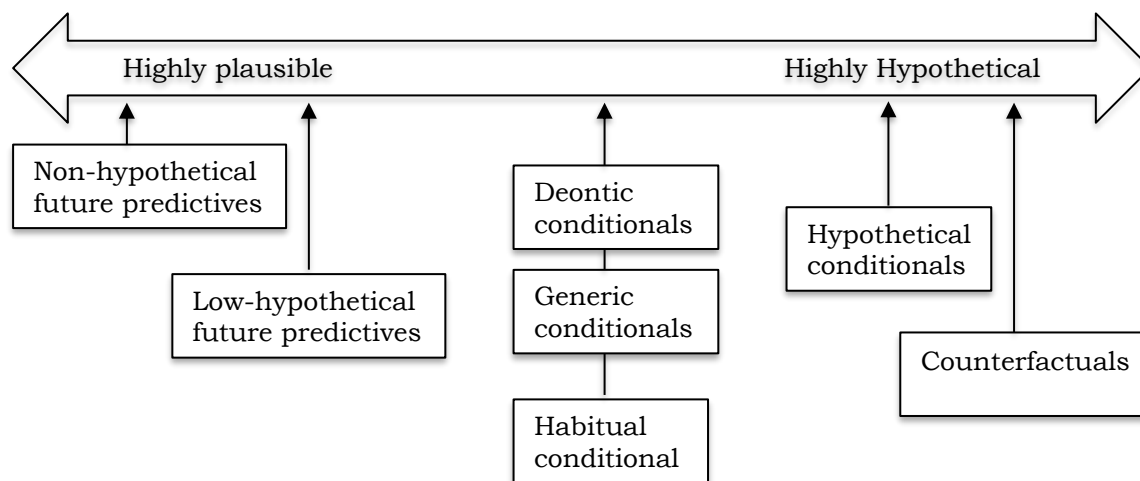


Figure 2. Commonly used conditional types on the hypotheticality continuum

### 1.2. Children's production and perception of IF-conditionals

Cross-linguistically, conditional constructions explicitly marked by a conditional connective like English *if* first arise around the age of two and a half years old. Data supporting this finding are collected from children's spontaneous speech, longitudinally recorded or cross-sectionally analyzed, in but definitely not restricted to the following languages: Italian (Bates, 1976), German and Turkish (Clancy et al., 1976), English (McCabe et al., 1983; Bowerman 1986; Reilly 1982, 1986), Polish, (Smoczyńska, 1986), French (Bowerman, 1986), Japanese and Korean (Akatsuka & Clancy, 1993), Chinese (Erbaugh, 1992), and Dutch (Lin, under revision), among others. There thus seems to be a clear cross-linguistic picture of the acquisition of the two-clause syntactic form of IF-conditionals.

However, the semantic types that children first acquire differ from language to language. In English, French, and Italian, for instance, the first emerged type is low-hypothetical future predictives. Although the low-hypothetical type predominates among children's early production of IF-conditionals in these languages, other conditional types are used as well. For example, English three-year-olds are able to use *if*-conditional constructions to describe habitualized activities in the present (Bowerman, 1986; Reilly, 1986). Generic conditionals are attested with three-year-olds as well (Bowerman, 1986; Reilly, 1986). According to Bowerman (1986), the observed similarities in cross-linguistic research on the production of IF-



conditionals should be explained in terms of some linguistic universality. She argues that children start the acquisition by cutting into the semantic range of IF-conditionals with a universal meaning of low-hypothetical future predictives, and then extend their usage to more particular meanings of conditionals based on linguistic experience.

Akatsuka and Clancy's (1993) investigation of the spontaneous speech of Japanese and Korean children, however, shows a different picture. Different from their English peers, for instance, the first conditionals used by Japanese and Korean children are not low-hypothetical future predictives, which refer to an uncertain but predictable event or situation in the future, but rather deontic conditionals, i.e. a subtype of speech-act conditionals. Akatsuka and Clancy propose that deontic conditionals may be the starting point for children to acquire the semantics of IF-conditionals in Japanese and Korean because deontic conditionals combine a certain behavior referred to in the subordinate clause with an evaluative value described or inferred in the main clause. As such, this conditional type can be considered involving reinforcement, which is very common in children's communication with caregivers. Therefore, deontic conditionals are conceptually speaking very easy for young children to grasp, explaining their early emergence in child language.

Recently, by analyzing Dutch children's spontaneous speech, Lin (under revision) reports that the conditional type that first emerges in child Dutch is non-hypothetical future predictives, which are already attested before 2;06. As already introduced, this type of conditionals describes a temporal relationship between two propositions, and exhibits the lowest degree of hypotheticality, which is explained by the temporal layer in the semantics of the Dutch conditional connective *als* 'if'. Similar to their English peers, Dutch toddlers are reported to be able to produce some other conditional types in their spontaneous speech as well, such as habitual conditionals, which first appeared around 2;06, low-hypothetical future predictives and generic conditionals, both of which first emerge around 2;11. In order to explain the emergence pattern of different conditional types in Dutch, Lin adopts the notion of concept complexity. She argues that the order in which different conditional types emerge in child Dutch development represents the degree of complexity of the concepts underlying different conditional types: the more concepts a conditional type involves, the more complex the involved concepts are, the later this conditional type emerges in child language.

Let's now look at some crucial findings on children's interpretation of IF-conditionals. A substantial body of research on this topic can be found in the literature (Brainerd, 1977; Dias & Harris, 1988, 1990; Ennis, 1971, 1975, 1976; Evans, 1982; Knifong, 1974; Kuhn, 1977; Markovits, 1984, 1985; Matalon, 1962; O'Brien et al., 1989; Overton, 1990; Paris, 1973; Staudenmayer & Boume, 1977; Taplin et al., 1974; Ward & Overton, 1990; among many others). Due to space limitations, only crucial findings reported for English-acquiring children will be summarized below.

A majority of the previous research in which children's interpretation of IF-conditionals is investigated has aimed to explore the development of logical reasoning in children from the perspective of material conditionals, which is associated with the truth table of conditionals presented in Table 1.



Table 1  
 The truth table of IF-conditionals (i.e. *If John is ill, he stays at home.*)

Condition	$p$ : John is ill	$q$ : he stays at home	$IF\ p, q.$
1	T	T	T
2	T	F	F
3	F	T	T
4	F	F	T

Viewing IF-conditionals as such, a great number of the previous studies have employed a truth value judgment task (Badger & Mellanby, 2018; Crain & McKee, 1985; Crain, 1991; Crain & Thornton, 1998; Gordon, 1998; Thonton, 2017; among others) or some variant of it, e.g. the prediction mode (Chierchia et al., 1988) to investigate children’s interpretation of  $IF\ p, q$  by manipulating the truth-values of the propositions  $p$  and  $p$  as described in Table 1. For example, children were asked to give a truth-value judgment, which was either true or false, to a conditional sentence having of the form of  $IF\ p, q$ , after seeing some pictures or a video clip illustrating a certain manipulation of the truth-values of  $p$  and  $q$  (Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; O’Brien & Overton, 1982; O’Brien et al., 1989; Paris, 1973; Taplin et al., 1974; among others).

Results collected in these previous studies all show that children, both preschoolers (e.g. Dias & Harris, 1988, 1990) and adolescents (e.g. Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; Paris, 1973; Taplin et al., 1974) perform poorly on tasks that require them assigning or selecting a truth-value to conditional statements that have the form of  $IF\ p, q$ , when they are confronted with different truth-values of the propositions  $p$  and  $q$ . In particular, there is a lack of a target-like interpretation response in Condition 3, and Condition 4 (if applicable) in Table 1. Children below eight years old treat IF-conditionals as either conjunctions or biconditionals, since instead of a target-like reasoning pattern of conditionals (i.e. Table 1), they either display an interpretation pattern of conjunctions as presented in Table 2, or that of biconditionals as illustrated in Table 3. Although a target-like conditional interpretation pattern gradually supersedes the conjunctive or biconditional interpretation patterns when children grow older, there does not seem to be convincing evidence showing that children have developed the target-like interpretation pattern of IF-conditionals until sixteen years old.

Table 2  
 The truth table of AND-conjunctions (i.e. *John is ill and he stays at home.*)

Condition	$p$ : John is ill	$q$ : he stays at home	$P\ AND\ q.$
1	T	T	T
2	T	F	F
3	F	T	F
4	F	F	F

Table 3

The truth table of IFF-biconditionals (i.e. *If and only if John is ill, he stays at home.*)

Condition	$p$ : John is ill	$q$ : he stays at home	IFF $p, q$ .
1	T	T	T
2	T	F	F
3	F	T	F
4	F	F	T

How can we then understand the late emergence of a target-like interpretation pattern of IF-conditionals, which does not even seem to be developed around the age of sixteen years old? Different explanations have been proposed in this respect. Whereas some scholars claim that the child's general cognitive development is responsible for the delayed emergence of a logical interpretation pattern of conditionals that have the form of  $IF\ p, q$  (Inhelder & Piaget, 1958; Matalon, 1962; Taplin et al., 1974), others argue that the child's interpretation is (negatively) influenced by their limited working memory capacities (Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; 2011; Evans, 2006; 2008). From a more linguistic perspective, Reilly (1986), for instance, tries to link the delay of a target-like interpretation pattern of IF-conditionals to the semantic overlap shared by conditional connectives like *if* and temporal connectives like *when* in English (König 1985; Harris 1986). As discussed in O'Brien et al. (1998), it has also been questioned whether conditional reasoning performance based on material implication (i.e. Table 1) represents one's interpretation of conditionals in real life scenarios.

Summarizing the previous results presented so far, it is clear that there is a large age gap between the production and the comprehension of IF-conditionals, which is also confirmed by a recent study by Badger & Mellanby (2018). On the one hand, children seem to have acquired the linguistic form of IF-conditionals as early as two and a half years old. On the other hand, a fully target-like interpretation pattern of this conditional construction does not seem to arise until sixteen years old.

## 2. Methodology

### 2.1. Design

Recall that the aim of the current study is to explore Dutch children's mapping of conditionality and hypotheticality into IF-conditionals. Based on what has been introduced in 1, examining the mapping between the two concepts and the corresponding linguistic structure in fact amounts to examining the comprehension of IF-conditionals in terms of their hypotheticality and conditionality. The current research therefore followed the previous studies on children's comprehension of IF-conditionals (see relevant references in 2.2) in employing the truth value judgment task (hereafter TVJT), in particular, the prediction mode of the TVJT (Chierchia et al. 1988; see also Gualmini & Crain, 2005; Su & Crain, 2013). Moreover, the current research also adopted the perspective of material implication in





investigating children’s comprehension of IF-conditionals. Therefore, the four truth-value conditions in Table 1 were all included in the current design.

The current TVJT took the form of a game with Mickey Mouse and his friends, to make it interesting and accessible to preschoolers. In order to maximize the ecological validity of the experiment, a context was first introduced to the child. Mickey Mouse and his friends were just back from vacation. They had a lot of fun. However, Mickey forgot what he and his friends had planned to do. The task of the child was whether he or she could help Mickey finding it out. First, children heard a conditional stimulus having the form of *IF p, q*, presented as a prediction. They then saw two pictures on a laptop screen illustrating the truth-values of the propositions *p* and *q*, respectively. After the presentation of the visual stimulation, children were asked to assign a truth-value to the conditional stimulus by giving a Yes- or No-response, representing a true or false truth-value judgment, respectively.

Two conditional types were examined in the current study, namely habitual conditionals (e.g. (4) in 2.1), and deontic conditionals (e.g. (6) in 2.1). Habitual and deontic conditionals first appear at 2;05:03 and 2;11:09, respectively (Lin, under review: Table 2). The early emergence of these two conditional types in child Dutch helped exclude the possibility that the child would be confronted with unknown or unfamiliar constructions. More relevant and crucial for the current research, the two conditional types express similar degrees of hypotheticality (see Figure 2 in 2.1). Thus, possible differences between children’s interpretations of habitual and deontic conditionals should not be a consequence of different hypotheticality degrees.

In addition to the two conditional types motivated above, the current experiment also had a third sentence type, namely *AND*-conjunctions, marked by *en* ‘and’ in Dutch (see also Table 2). Conjunctions do not involve the concept of conditionality; nor do they require children’s understanding of hypotheticality. They therefore functioned as a baseline sentence type, further referred to as *additive* due to their conjunctive meaning. Since the additive stimuli differed from the two conditional types in both syntax and semantics, they also functioned as distracters in the current experiment.

Each sentence type was manipulated for four test conditions, based on the truth-values of the two propositions of a stimulus: a TT-condition in which both *p* and *q* were true, a TF-condition in which *p* was true and *q* was false, an FT-condition in which *p* was false whereas *q* was true, and an FF-condition in which both *p* and *q* were false. The current design is given in Table 4, and examples of the stimuli follow in 3.3.

Table 4  
*The experimental design*

Sentence type	Test condition	Number of stimuli
Habitual	TT-condition	3
	TF-condition	3
	FT-condition	3
	FF-condition	3

Sentence type	Test condition	Number of stimuli
Deontic	TT-condition	3
	TF-condition	3
	FT-condition	3
	FF-condition	3
Additive/Distracters	TT-condition	6
	TF-condition	2
	FT-condition	2
	FF-condition	2
Total		36

By comparing children's interpretation responses in TT- and TF-conditions, and their comprehension performances in FT- and FF-conditions of the conditional stimuli, we may obtain insight into their knowledge of hypotheticality encoded in the linguistic construction in question. By investigating children's interpretation of *If p, q* in each of the four truth-value conditions, we may learn more about their knowledge of conditionality as mapped into IF-conditionals.

The number of the conditions in TT is 6, as it is seen in Table 4. There were two reasons for this. First, the TT-condition of additive/distracter functioned as the most important indicator for whether the experiment went as it should. Thus, this indicator category contained a relatively large number of stimuli. But on the other hand, we could not enlarge the number of other conditions too much as the pre-schoolers normally only have 15 minutes of good attention. Increasing the stimuli number in all other conditions too much would give us a larger number of unusable results. We therefore opted for this "non-logical" design regarding the stimuli number.

## 2.2. Participants

A total of 49 monolingual Dutch children, all typically developing, as reported by their teachers, recruited via two primary schools in the Province of Noord-Holland in the Netherlands, participated in the current experiment (20 girls; age range = 3;11-6;00; mean = 4;11). Although children as young as two years old are reported to be able to participate in TVJTs (Crain & McKee, 1985), two- and three-year-olds were not included in the current experiment as they may have difficulties with stimuli containing a complex syntactic structure, due to e.g. the presence of two clauses.

Ten adult native speakers of Dutch also participated (6 females; all 18 years old). They were bachelor students at the Faculty of Humanities of the University of Amsterdam (non-linguistic majors), and formed the control group.

## 2.3. Stimuli

Bearing the limited working memory capacity of preschoolers in mind, which has been reported as a confounding factor in explaining their interpretation behavior in similar experiments (e.g. Barrouillet et al., 2008; Gauffroy & Barrouillet, 2009; 2011), the length of the stimuli – both conditional ones and additive ones – was restricted to a maximum of ten words. Words appearing in the stimuli were familiar to Dutch preschoolers, excluding the



possibility that the child would have difficulty comprehending a stimulus due to the lack of lexical knowledge of a certain word.

Whereas some examples of the employed stimuli are given below, the reader is referred to Appendix I for a complete overview of the test stimuli. Examples (7) and (8) represent the habitual and the deontic type, respectively. Example (9) is an additive stimulus.

- (7) Als Mickey ziek is, eet hij ijs.  
if Mickey sick is eats he ice cream  
'When Mickey is ill, he eats ice cream.'
- (8) Als Pluto bijt, moet hij buiten slapen.  
if Pluto bites must he outside sleep  
'If Pluto bites, he'll have to sleep outside.'
- (9) De zon schijnt en Minnie voetbalt.  
the sun shines and Minnie plays football  
'The sun is shining and Minnie is playing football.'

To ensure that the participants' performance was not influenced by the audio presentation of the stimuli, all stimuli were pre-recorded using a smartphone with a young female native Dutch speaker. The stimuli were pronounced as naturally as possible, avoiding any special intonation or stress on a particular word. The order was counterbalanced.

#### 2.4. Procedure

The experiment was structured as a PowerPoint presentation on a laptop and was conducted individually. The procedure is as follows. First, a child was invited from the classroom for a game by a female experimenter. She then explained to the child how the game proceeded and what he or she was expected to do by the instruction in (10):

- (10) *Hallo daar! Welkom bij Mickey en zijn vrienden! Mickey is vergeten wat hij en zijn vrienden deze vakantie gedaan hebben. Kan je hen helpen? Vertel Mickey of het plaatje klopt met de zin!*

*"Hi there! Welcome to Micky and his friends! Micky forgets what he and his friends have done in their holiday. Can you help them? Tell Micky whether the picture matches the sentence!"*

Each participant underwent two trials to become familiar with the experimenter and the experiment. If the participants appeared to understand that they were expected to give either a Yes- or No-response (representing the true and false truth-value, respectively), the experiment continued. Two experimenters (both female) were present during the experiment: one for communicating with and testing the child and the other for recording the child's responses for later transcription and taking notes. The procedure with the adult participants was similar, except that they were aware that they formed the control group in a child experiment. The experiment lasted

an average of ten minutes per child, and approximately seven minutes per adult.

### 2.5. Response categorization

Responses were divided into three categories: Yes-responses, No-responses, and non-responses. Yes-responses referred to responses in which the participants answered “Yes” to a stimulus, whereas No-responses referred to those in which the participants answered “No” to a stimulus. Non-responses referred to situations in which neither “Yes” nor “No” was given by the child. Non-responses were further treated as missing values.

### 2.6. The target-like interpretation pattern

Different truth-value judgments were expected for different stimulus types in different truth-value conditions. Habitual and deontic conditionals both belong to the category of conditionals and are associated with the truth table in Table 1, whereas additive sentences belong to the category of conjunctions and are associated with the truth table in Table 2. These two truth tables together give rise to the following target-like response pattern. See Table 5.

Table 5

*The target-like interpretation responses*

	Target-like interpretation response		
Test condition	Habitual	Deontic	Additive
TT-condition	Yes-response	Yes-response	Yes-response
TF-condition	No-response	No-response	No-response
FT-condition	Yes-response	Yes-response	No-response
FF-condition	Yes-response	Yes-response	No-response

### 2.7. Data analysis

In order to investigate Dutch preschoolers’ comprehension of the three tested sentence types manipulated in four truth-value conditions over time, which provides us with insight into their mapping of conditionality and hypotheticality into the linguistic IF-conditionals, a general linear mixed-effect logistic regression model was employed. R (Version 3.6.0; R Core Team, 2019) was used. Packages *ggplot 2* (Version 3.2.0; Wickham, 2016), *lme4* (Version 1.1-21; Bates et al., 2015), and *sjPlot* (Version 2.7.0; Lüdtke, 2019) were employed.

There were three fixed factors: Age, Type, and Condition. Age, coded in terms of months, centered, was a continuous factor. Type, representing the different stimulus types, was a categorical factor. Condition, representing the different truth-value conditions, was a categorical factor as well. Type had three levels: Habitual, Deontic, and Additive, representing the three sentence types. Condition had four levels: TT, TF, FT, FF, representing the four truth-value conditions. Participant and Stimulus were modeled as random factors. The main effect of the fixed factors, together with the interaction effects of the two categorical fixed factors, was included in the model. The predicted variable was the interpretation performance of the participants, in terms of adult-likeness, i.e., Adult-like response, coded as 1 or 0, representing an adult-like or a non-adult-like response, respectively. It will become clear in



the next section why adult-likeness but not target-likeness was used when interpreting the child responses.

Since both of the two categorical fixed factors had more than two levels, contrasts needed to be manually set in order to obtain theoretically informative interpretation of the regression results. Two contrasts were set for the three-level factor Type. The first was set between Habitual and Deontic on the one hand, and Additive on the other. The reason was straightforward: Additive sentences were the baseline in the experiment. This gave rise to the second contrast between Habitual and Deontic. Table 6 shows the two contrasts for Type.

Table 6  
*Two contrasts for Type*

Contrast (Ctr.)	
1	(Habitual, Deontic) vs. (Additive)
2	(Habitual) vs. (Deontic)

Condition was a four-level categorical factor, suggesting three contrasts. Since one of the aims of the current study was to explore the mapping of hypotheticality into IF-conditionals, which was examined by manipulating the truth-value of the proposition  $p$  being either true or false, the first contrast for Condition was set between the two truth-value conditions in which  $p$  was true (i.e. the TT- and TF-conditions), and those two in which  $p$  was false (i.e. the FT- and FF-conditions). This first contrast being made, the other two contrasts logically followed, which were set between the TT- and TF-conditions, and the FT- and FF-conditions, respectively. The three contrasts made for the fixed factor Condition are summarized in Table 7.

Table 7  
*Three contrasts for Condition*

Contrast (Ctr.)	
1	(TT, TF) vs. (FT, FF)
2	(TT) vs. (TF)
3	(FT) vs. (FF)

As for the adult results, only the frequencies of different response types were counted in each test condition. No further statistical analysis was run on the adult results given the current research aim.

### 3. Findings

#### 3.1. Adult results

The percentages of target-like responses with adult controls are presented in Table 8, which clearly shows few variations. Depending on the sentence type and the test condition, the adult participants gave either almost always (between 90% and 100% of the time) or virtually never (0% to 7% of the time)



target-like responses. This first impression of the control group results strongly suggests that in the current experiment, target-likeness is not the same as adult-likeness.

Table 8  
*Percentages of target-like responses with adult controls*

	TT-condition	TF-condition	FT-condition	FF-condition
Habitual	100%	97%	7%	7%
Deontic	100%	97%	0%	7%
Additive	100%	90%	100%	90%

Zooming in at the percentages of target-like responses of each sentence type, it becomes clear that the control group only showed a target-like interpretation pattern with additive stimuli. Since the additive type also functioned as baseline in the experiment, the extremely high percentages of target-like responses of the adult control group with this sentence type at least indicate that the experiment went as expected.

As for the two conditional types, i.e. habitual and deontic conditionals, target-like responses of the adult controls are only found in the TT- and TF-conditions. In the other two conditions, the adult participants gave exactly the opposite truth-value judgments, echoing previous findings reported for English adolescents, for instance (see further 2.2). Table 9 presents the adults' interpretation pattern found in the current experiment.

Table 9  
*The adults' interpretation responses*

Test condition	Habitual	Deontic	Additive
TT-condition	Yes-response	Yes-response	Yes-response
TF-condition	No-response	No-response	No-response
FT-condition	No-response	No-response	No-response
FF-condition	No-response	No-response	No-response

Comparing Table 5 with Table 9, it is clear that the adult participants, instead of a target-like Yes-No-Yes-Yes-pattern, show a Yes-No-No-No-pattern when interpreting the conditional stimuli. Now the question arises as how the differences between these two interpretation patterns can be explained. After presenting first the child results, possible answers to this question will be discussed in Section 5.

### 3.2. *Child results*

As introduced in 3.2, a total of 49 monolingual Dutch children, all typically developing, participated in the experiment (20 girls; age range = 3;11-6;00; mean = 4;11). However, three out of these children were excluded from the dataset and further statistical analyses as they either always gave a Yes-response to all the stimuli, or always answered "No" to all the stimuli, irrespective of the type or the condition. Thus, only the results of the



remaining 46 child participants were considered. Since even the adult participants did not exhibit an entirely target-like interpretation pattern, the child results were encoded in terms of adult-likeness.

Table 10 reports the results of the logistic regression analysis. Note that only the results of the three fixed factors (including the interaction effect) are included. Results regarding the two random factors, i.e. Participant and Stimulus, are given in Appendix II.

Table 10  
*Results of the regression analysis*

Predictor	Adult-like response					
	OR	CI (95%)	Coef. $\beta$	SE $\beta$	$z$	$P$
(Intercept)	1.88	1.49-2.36	0.63	0.12	5.38	<.001
Age	1.01	0.98-1.04	0.01	0.01	0.84	0.40
Condition (Ctr.1)	0.17	0.09-0.33	-1.79	0.34	-5.26	<.001
Condition (Ctr.2)	0.99	0.63-1.56	-0.01	0.23	-0.05	0.96
Condition (Ctr.3)	4.07	2.51-6.59	1.40	0.25	5.71	<.001
Type (Ctr.1)	0.81	0.56-1.17	-0.21	0.19	-1.13	0.26
Type (Ctr.2)	1.05	0.59-1.90	0.05	0.30	0.18	0.86
Type (Ctr.1):Condition (Ctr.1)	0.90	0.21-3.85	-0.10	0.741	-0.14	0.89
Type (Ctr.2):Condition (Ctr.1)	0.17	0.02-1.77	-1.79	1.201	-1.45	0.14
Type (Ctr.1):Condition (Ctr.2)	0.58	0.22-1.52	-0.55	0.490	-1.11	0.27
Type (Ctr.2):Condition (Ctr.2)	5.48	1.01-29.79	1.70	0.864	1.97	0.04
Type (Ctr.1):Condition (Ctr.3)	1.40	0.47-4.16	0.34	0.555	0.61	0.54
Type (Ctr.2):Condition (Ctr.3)	7.42	1.45-38.11	2.00	0.835	2.40	0.02

As is summarized in Table 10, not each (contrast) of the three main factors has a significant effect on the participants' responses in terms of adult-likeness. In fact, only Ctr.1 of Condition (i.e. (TT, TF) vs. (FT, FF)) and Ctr. 3 of Condition (i.e. (FT vs. FF)) are significant. As for the interaction effects, only two out of the six are significant, namely that between Type (Ctr.2) and Condition (Ctr.2), and that between Type (Ctr.2) and Condition (Ctr.3). In the next section, these regression results will be further described and interpreted.

### 3.3. Interpretation

As reported in 3.1, there is a lack of target-likeness when we look at the adult participants' interpretation responses to the two types of conditional stimuli manipulated in the FT- and FF-conditions. This section will first propose some possible explanations in this respect. Before doing that, let's use (15) as example to illustrate the relevant test conditions: *Als Mickey ziek is, eet hij ijs* 'If Micky is ill, he eats ice-cream'.

In the FT-condition, participants first saw a picture showing Mickey happily playing outside, representing the false truth-value of the proposition  $p$ , after which they saw a picture showing Mickey eating an ice-cream, representing the true truth-value of the proposition  $q$ . Recall that in the FT-condition, the adult participants almost always gave a No-response (representing a false

truth-value judgment) to the conditional stimuli, irrespective of their semantic types. This non-target-like performance reflects a phenomenon which is commonly observed in real life communications and is explained as a consequence of language speakers' application of a pragmatic mechanism, usually referred to as Conditional Perfection in the literature (Geis & Zwicky, 1971; Horn, 2000; van Canegem-Ardijns & Van Belle, 2008; van der Auwera, 1997; among others). As introduced at the beginning of the paper, the proposition  $p$  in IF-conditionals merely expresses a sufficient but not a necessary condition under which the proposition  $q$  takes place. This means that the conditional is logically true when  $p$  is false and  $q$  is true. However, when  $p$  is not only a sufficient but moreover a necessary condition for  $q$  to take place, like in biconditionals introduced by *if and only if* in English, for instance, the conditional sentence is false when  $p$  is false and  $q$  is true, as in the FT-condition in the experiment.

The non-target-like performance of adults in this test condition then strongly suggests that they "perfected" the conditional stimuli to the corresponding biconditional stimuli, by upgrading  $p$  from being merely the sufficient condition for  $q$  to take place to being a not only sufficient but moreover necessary condition for  $q$  to happen. Since this is a common observation in real-life conditional reasoning (e.g. Horn, 2000; van Canegem-Ardijns & Van Belle, 2008), it is not unexpected that the adult participants were applying Conditional Perfection to the conditional stimuli in the current experiment too.

As for the lack of target-likeness in the adult participants' responses to the conditional stimuli in the FF-condition, let's again use (15) as example to illustrate the manipulation. After hearing *Als Mickey ziek is, eet hij een ijsje* 'If Mickey is ill, he eats an ice-cream', participants first saw a picture showing Mickey happily playing outside, representing the false truth-value of the proposition  $p$ , after which they saw a picture showing Mickey drinking lemonade, representing the false truth-value of the proposition  $q$ . Recall that in this FF-condition, the adult participants almost always gave a non-target-like No-response. Why did they fail to perform target-like in this condition? A possible answer is that the adult participants were not viewing the conditional stimuli through the lens of material implication, as previously noticed in O'Brien et al. (1998). Instead, they took absence of evidence as evidence of absence, and thus gave a false truth-value judgment to the stimuli in the FF-condition. Such a finding strongly suggests that conditional reasoning based on material implication (i.e. as presented by means of the truth table in Table 1) is not the same as conditional reasoning in real life scenarios.

Let us now turn to the regression results summarized in Table 11. As can be clearly read, among the three main factors included in the regression model, only two contrasts of Condition, i.e. Ctr. 1 and Ctr. 3, turn out to be significant. The non-significance of Age (Coef.  $\beta = 0.01$ ) suggests that there is no evidence showing that the child participants became more adult-like when growing older. This may seem unexpected at first sight, as we know that both children's language and cognitive abilities do develop over time. How should we then interpret the non-significance of Age? Adopting Meyer et al. (2016, 2018), who investigate Dutch children's knowledge of cardinality



and number words, a language-concept interface phenomenon as well as that explored in the current study, it can be assumed that when it comes to the mapping of conditionality and hypotheticality into IF-conditionals, each Dutch child follows a distinct trajectory.

Like Age, Type is non-significant either. In particular, neither contrasts made for Type (Coef.  $\beta = -0.21$  for Ctr. 1; Coef.  $\beta = 0.05$  for Ctr. 2) are significant. There is thus no evidence showing that the children's interpretation responses in terms of adult-likeness were likely to vary across the different sentence types. It thus seems that Dutch four- and five-year-olds have assigned the same conceptual representation to the different sentence types, i.e., habitual, deontic, and additive. This suggests the same semantic analysis of both conditional *als* 'if' and conjunctive *en* 'and' in the child grammar. A conclusion that can be drawn here is that neither the concept of hypotheticality nor that of conditionality has been mapped to IF- conditionals in Dutch before the age of six.

The main factor Condition, of which Ctr.1 (Coef.  $\beta = -1.79$ ), i.e. (TT, TF) vs. (FT, FF) and Ctr. 3 (Coef.  $\beta = 1.40$ ), i.e. (FT vs. FF) are significant, whereas Ctr. 2 (Coef.  $\beta = -0.01$ ), i.e. (TT vs. TF) are not, can be interpreted as follows. First, the child participants were likely to show different performances in terms of adult-likeness between the two truth-value conditions in which the truth-value of  $p$  was true, and those in which the truth-value of  $p$  was false (i.e. Ctr. 1). The negative sign of the corresponding  $z$ -value, i.e.  $-5.26$ , further indicates that the children were less likely to give adult-like responses to the stimuli in the two  $p$ -false conditions (i.e. the FT- and FF-conditions) than the two  $p$ -true conditions (i.e. the TT- and TF-conditions) – irrespective of their semantic type. The preschoolers thus exhibited more difficulties interpreting the stimuli in an adult-like way in the FT- and FF-conditions than the TT- and TF-conditions. Recall that Ctr. 1 of Condition was set to examine the mapping between the concept of hypotheticality and the conditional stimuli. If the mapping was established, the participants, when confronted with the conditional stimuli, should not only allow the interpretation of  $p$  being true but also accept that of  $p$  being false. The significance of Ctr. 1 of Condition therefore gives rise to the conclusion that Dutch preschoolers have not mapped the concept of hypotheticality into the corresponding IF-conditionals, in line with the conclusion drawn based on the non-significant effect of Type. Second, the significant effect of Ctr. 3 of Condition, together with the corresponding  $z$ -value of  $5.71$ , suggests that the child participants were more likely to show adult-like interpretation performance with the stimuli in the truth-value condition in the FF-condition than in FT-condition. The Dutch preschoolers had thus more difficulties giving adult-like responses in the FT- than the FF-condition, irrespective of the sentence type. In the case of additive sentences, which had the logic form of  $p$  AND  $q$ , this significant difference seems to suggest that it was easier for the child to give an adult/target-like No-response when both the propositions  $p$  and  $q$  were false (representing the FF-condition) than when merely one of the two was false (representing the FT-condition).

As for the conditional stimuli, the significant effect of Ctr. 3 of Condition is interpreted differently. Recall that with the two types of conditional stimuli, the adult-like responses were exactly the opposite of the target-like

responses in the FT- and FF-conditions. Thus, the significance of Ctr. 3 of Condition actually suggests that the Dutch four- and five-year-olds were more likely to give target-like interpretation responses to the conditional stimuli in the FT-condition than the FF-condition. In order to understand this difference, we need to revisit Conditional Perfection, a pragmatic mechanism that plays a crucial role in explain the lack of target-likeness in the adults' interpretation response to the conditional stimuli in the FT-condition. In particular, the adult participants "perfected" the conditional stimuli to the corresponding biconditional stimuli and interpreted the proposition  $p$  as not only a sufficient but moreover a necessary condition for  $q$  to take place. The more target-likeness in the child's interpretation responses to the conditional stimuli in the FT-condition thus indicates less often application of Conditional Perfection by the child, which does not seem to be surprising given the four- and five-year-olds' underdeveloped pragmatic knowledge.

Finally, the non-significant result with respect to Ctr. 2 of Condition suggests that we cannot report any likely differences in the children's performances in terms of adult-likeness between the TT- and TF-conditions – irrespectively of the type.

Now let's look at the two interaction effects that turn out to be significant. One is the interaction between Ctr. 2 of Type and Ctr.2 of Condition (Coef.  $\beta = 1.70$ ). Recall that Ctr. 2 of Type was set between the two conditional types, i.e. habitual and deontic conditionals, and that Ctr.2 of Condition was set between the TT-condition and the TF-condition. Given the positive sign of the relevant z-value, which is 1.97, the significance of this interaction effect means that in the TF-condition, the child participants were more likely to show more adult-like performances with the deontic conditional type than with the habitual conditional type, than in the TT-condition. Figure 3 visualizes this interaction effect. The black circles indicate the probabilities of adult-like responses in each truth-value condition when the participants were confronted with habitual conditionals; and the red triangles demonstrate the probabilities of adult-like responses in each truth-value conditions when the participants were provided with deontic conditionals.

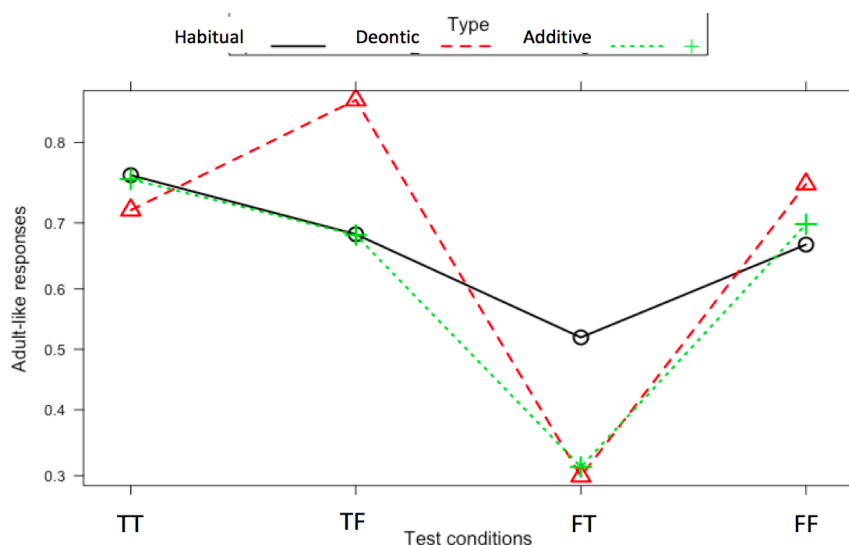


Figure 3. Interaction effect between Type and Condition





As illustrated in Figure 3, the significant interaction effect under discussion is in fact related to the extremely high probability of adult/target-like performance of the participants with deontic conditionals in the TF-condition (the red triangle above TF in Figure 3). This means that the child participants were the most adult/target-like with the deontic conditional stimuli manipulated in the TF-condition. In other words, the preschoolers had the least difficulties with the deontic conditionals in the TF-condition.

The other significant interaction effect is found between Ctr. 2 of Type and Ctr. 3 of Condition (Coef.  $\beta = 2.00$ ,  $z = 2.40$ ). Given that Ctr. 2 of Type was set between habitual and deontic conditionals, and that Ctr.3 of Condition was set between the FT-condition and the FF-condition, the significance of this interaction effect means that when  $p$  and  $q$  were both false, the child participants were more likely to show more adult-like responses with the deontic stimuli than the habitual stimuli, than when  $p$  was false and  $q$  was true.

If we look at Figure 3, in which the interaction effects of the current regression model are visualized, it is not hard to see that the significant interaction effect between Ctr. 2 of Type and Ctr. 3 of Condition is actually related to the extremely low probability of adult-like performance with the deontic stimuli in the FT-condition. This means that between the two conditional types manipulated in the FT- and FF-conditions, the Dutch preschoolers were the least adult-like with the deontic conditional stimuli in the FT-condition. Since the adult-like responses to the conditional stimuli in the FT-condition were exactly the opposite of the target-like responses, we can also say that the Dutch preschoolers were the most target-like with the deontic conditional stimuli in the FT-condition.

The interaction effects interpreted so far gives rise to the conclusion that the preschoolers were more target-like in comprehending deontic conditionals than habitual conditionals in two out of the four truth-value conditions (i.e. TF- and FT-conditions). Although there is no statistical evidence showing any differences in the child's interpretation performances between deontic and habitual conditionals in the other two conditions, we may still conclude that Dutch children become first target-like with deontic conditionals. This, together with the absence of any significant effect of the main factor Age, suggests that the concept of conditionality is first mapped to deontic conditionals in child language, which seems to have already taken place before the age of four, i.e. the lower boundary of the tested age range. Along this line of reasoning, we may further draw the conclusion that at least until the age of six, i.e. the upper boundary of the tested age range, Dutch children have not yet mapped the concept of conditionality into habitual conditionals.

Summarizing the regression results interpreted so far, it seems that the concept of hypotheticality is not mapped to IF-conditionals in child Dutch, at least not before the age of six years old. Since the linguistic IF-structure is first attested in child Dutch already before the age of three (see 2.2), there is a clear delay in children's mapping of the conceptual representation of hypotheticality into the corresponding linguistic representation. As for the concept of conditionality, there also seems to be a delay, although this delay

turns out to be only attested with one of the two examined conditional types, namely with habitual but not with deontic conditionals.

#### 4. Discussion

A straightforward way to understand the delayed mapping of hypotheticality and conditionality into the corresponding linguistic construction in Dutch preschoolers is to assume that Dutch four- and five-year-olds have not yet developed the concept of hypotheticality or that of conditionality. If that is the case, it is far from surprising that they show a delay in mapping the two concepts into the corresponding linguistic structure. However, Bowerman (1986) reports evidence showing that the cognitive basis underlying different conditional types (thus including hypotheticality and conditionality) are already present in toddlers. This means that at the moment that the child can linguistically utter his or her first explicitly marked conditional construction, which, cross-linguistically speaking, takes place around two and a half years old (see 2.2), he or she has already grasped the relevant cognitive basis. How shall we then explain the delay?

As presented in 2.1, Dutch IF-conditionals can be divided into different types depending on their meanings and functions. One of these types is termed non-hypothetical future predictives (see (2) and (3) in Introduction), which, although categorized as conditionals, express a mere temporal relationship between two future events or situations (Pollmann 1975; Reilly 1986: 300). As can be inferred from its term, this type of conditionals is associated with little hypotheticality, as there is little chance that the event or situation referred to in the subordinate clause will not take place. This means that even in the adult's grammar, hypotheticality is not necessarily present in this conditional type. Let us assume the same for the child grammar.

Recall that non-hypothetical future predictives are the first conditional type used by Dutch-acquiring children, which emerge already before the age of two and a half (see 2.2; see also Lin, under revision: Table 2). As also reported in Lin (under revision: Table 1), non-hypothetical future predictives are moreover one of the two most frequently used conditional types by Dutch two- and three-year-olds. The early acquisition of this conditional type, in which the concept of hypotheticality is not necessarily present, may hinder Dutch children's development of hypotheticality for the connective *als*. This in turns explains the delayed mapping of hypotheticality into IF-conditionals as found in the current study.

Another possibility in this respect is to assume that the so-called delay is caused by the children's difficulties in processing a conditional stimulus in the two *p*-false conditions. This explanation is inspired by Dancygier & Sweetser's proposal (1997, 2005), in which the notion of mental space play a central role. They authors illustrate that when hearing a conditional sentence having the form of *If p, q*, the addressee sets up a mental space containing only the possible worlds in which *p* is true. By doing so, the addressee is not considering all possible worlds in which *p* can be either true or false but disregards those in which *p* is false. This may be what happened with the preschoolers in the current experiment. When hearing a conditional stimulus, irrespective of its semantic type being either habitual or deontic, the child participants immediately set up a mental space that only contained



the possible worlds in which  $p$  was true. This prevented them from considering other possible worlds in which  $p$  was false. When confronted then with a scenario in which  $p$  indeed took place, i.e. the TT- and TF-conditions in the experiment, which “validated” the already set-up mental space, the preschoolers displayed little difficulties in giving an adult/target-like truth-value judgment to the stimulus. However, when confronted with the FT- and FF-conditions, which represented possible worlds in which  $p$  was false, the preschoolers showed difficulties in giving a target/adult-like truth-value judgment to the stimulus since these two test conditions “falsified” the already set-up mental space.

In terms of Evans (2007), the above-sketched explanation can be also formulated as follows. When the participants encountered a conditional stimulus, they placed  $p$  being true into their stock of knowledge and judged the truth-value of the stimulus based on the assumption that  $p$  had to be true. This was compatible with the two  $p$ -true conditions, i.e. the TT- and TF-conditions. The FT- and FF-conditions, representing the scenarios in which  $p$  was false, were therefore considered irrelevant, and then disregarded. This gave rise to difficulties in giving target/adult-like truth-value judgments to the conditional stimuli in the relevant conditions, resulting in an apparent delay of the mapping of hypotheticality into IF-constructions in child Dutch.

Turning to the concept of conditionality, the question that we need to address is why this concept is mapped into deontic conditionals before the age of four whereas there is a delay of such a mapping when it comes to habitual conditionals. As already argued in Akatsuka and Clancy (1993) (see also 2.2), conditional constructions expressing deontic modality are conceptually speaking very easy for young children to grasp. This is because such conditionals normally link certain behaviors of the addressee to certain evaluative values or judgments of the speaker, involving reinforcement as shown by (8), which is very common in parental speech, for instance. This reinforcement layer in the semantics of deontic conditionals may facilitate the child’s mapping of the concept of conditionality into the corresponding conditional type.

Turning to habitual *als*-conditionals, which describe events or situations as a usual but definitely not an inevitable consequence of a certain condition being satisfied that may repeatedly take place, such a layer of reinforcement is clearly missing in the semantics. Instead, habitual *als*-conditionals are more like temporals than conditionals in their meanings and functions, as they describe habits, to which the notion of condition may seem less crucial than that of temporality. It can therefore be assumed that the semantic overlap of habitual conditionals with temporals may hinder Dutch children’s mapping of conditionality into habitual *als*-conditionals. This, together with the conceptual ease of the deontic type, may explain the current finding with respect to the mapping between conditionality and IF-conditionals in Dutch preschoolers.

The findings reported in this paper strongly suggests that the mapping between our conceptual representations and the language we speak is not influenced by just one single factor. Language-specific properties, our pragmatic knowledge, conceptual transparency or ease, together with the function or meaning of a particular linguistic construction with respect to

the rest of its category all seem to influence the mapping pace. On top these, the current study also shows that the way in which the mapping is examined also matters, which calls for further exploration of similar language-concept interface phenomena using different test paradigms.

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## Appendices

### Appendix I: Test items

Trials:

- (1) De zon schijnt en Minnie voetbalt.  
the sun shines and Minnie plays football  
'The sun is shining and Minnie is playing football.'
- (2) Als de zon schijnt, danst Goofy.  
if the sun shines dances Goofy  
'If the sun shines, Goofy dances.'

Deontic conditional stimuli:

- (1) FF-condition  
Als Donald schreeuwt, moet hij in de hoek staan.  
if Donald shouts must he in the corner stand  
'If Donald shouts, he'll have to stand in the corner.'
- (2) TT-condition  
Als Pluto gaat liggen, krijgt hij botten.  
if Pluto goes lie gets he bones  
'If Pluto lies down, he'll get bones.'
- (3) FT-condition  
Als Minnie een kus geeft, krijgt ze bloemen.  
if Minnie a kiss gives gets she flowers  
'If Minnie gives a kiss, she'll get flowers.'
- (4) TT-condition  
Als Mickey appels plukt, krijgt hij een taart.  
if Mickey apples picks gets he a cake  
'If Mickey picks apples, he'll get a cake.'
- (5) FT-condition  
Als Mickey schoonmaakt, krijgt hij een lolly.  
if Mickey cleans gets he a lollipop  
'If Mickey cleans, he'll get a lollipop.'
- (6) FF-condition  
Als Minnie koekjes bakt, krijgt ze een cadeautje.  
if Minnie cookies bakes gets she a present  
'If Minnie bakes, she'll get a present.'
- (7) TF-condition  
Als Goofy in een zwembadje springt, krijgt hij een  
if Goofy in a swimming pool jumps gets he an  
appel.  
apple  
'If Goofy jumps into a swimming pool, he'll get an apple.'
- (8) FT-condition  
Als Donald een foto maakt, krijgt hij snoepjes.  
if Donald a picture makes gets he candies  
'If Donald makes a picture, he'll get candies.'
- (9) TF-condition  
Als Mickey gaat voetballen, krijgt hij een banaan.  
if Mickey goes play football gets he a banana  
'If Mickey plays football, he'll get a banana.'

- (10) TT-condition  
 Als Pluto bijt, moet hij buiten slapen.  
 if Pluto bites must he outside sleep  
 'If Pluto bites, he'll have to sleep outside.'
- (11) TF-condition  
 Als Donald boos wordt, moet hij binnen blijven.  
 if Donald angry becomes must he insidestay  
 'If Donald loses his temper, he'll have to stay inside.'
- (12) FF-condition  
 Als Donald zijn bord leeget, krijgt hij een ijsje.  
 if Donald his plate empty eat gets he an ice cream  
 'If Donald eats his plate empty, he'll get an ice cream.'

## Habitual conditional stimuli:

- (1) TF-condition  
 Als Pluto uitgelaten is, gaat hij slapen.  
 if Pluto go for a walk is goes he sleep  
 'When Pluto is back from a walk, he goes to sleep.'
- (2) TF-condition  
 Als Mickey ziek is, eet hij ijs.  
 if Mickey ill is eats he ice cream  
 'When Mickey is ill, he eats ice cream.'
- (3) TT-condition  
 Als de chocopasta op is, pakt Minnie kaas.  
 if the chocolate spread finished is takes Minnie kaas.  
 chees  
 'When the chocolate spread is finished, Minnie takes chees.'
- (4) FF-condition  
 Als er een regenboog is, gaat Minnie vliegen.  
 if there a rainbow is goes Minnie fly  
 'When there is a rainbow, Minnie flies a kite.'
- (5) FT-condition  
 Als de thee op is, krijgt Katrien limonade.  
 if the tea finished is gets Daisy lemonade  
 'When the tea is finished, Daisy gets lemonade.'
- (6) FT-condition  
 Als Donald pannenkoeken bakt, eet hij ze op.  
 if Donald pancakes bakes eats he them up  
 'When Donald bakes pancakes, he eats them.'
- (7) FF-condition  
 Als het regent, blijft Donald thuis.  
 if it rains stay Donald home  
 'When it rains, Donald stays at home.'
- (8) TT-condition  
 Als de trein vol is, rijdt Mickey in de auto.  
 if the train full is drivesMickey in the car  
 'When the train is full, Mickey drives the car.'





- (9) FT-condition  
Als de zon schijnt, gaat Minnie rolschaatsen.  
if the sun shines goes Minnie roller skate  
'When the sun shines, Minnie roller skates.'
- (10) FF-condition  
Als het sneeuwt, gaat Mickey sleeën.  
if it snows goes Mickey sleigh  
'When it snows, Mickey sleighs.'
- (11) TT-condition  
Als Mickey buiten is, krijgt hij een kus.  
if Mickey outside is gets he a kiss  
'When Mickey goes outside, he gets a kiss.'
- (12) TF-condition  
Als Mickey jarig is, krijgt hij twee taarten.  
if Mickey birthday is gets he two cakes  
'When it's Mickey's birthday, he gets two cakes.'
- Additive stimuli (baseline):
- (1) TT-condition  
Mickey heeft appels geplukt en Mickey krijgt een  
Mickey has apples picked and Mickey gets a  
taart.  
cake  
'Mickey has picked apples and Mickey gets a cake.'
- (2) TF-condition  
Mickey is jarig en Mickey krijgt twee taarten.  
Mickey is birthday and Mickey gets two cakes  
'It's Mickey's birthday and Mickey gets two cakes.'
- (3) TT-condition  
De trein is vol en Mickey rijdt in de auto.  
the train is full and Mickey drives in the car  
'The train is full and Mickey drives the car.'
- (4) FF-condition  
Het sneeuwt en Mickey gaat sleeën.  
it snows and Mickey goes sleigh  
'It is snowing and Mickey is going to sleigh.'
- (5) TT-condition  
Mickey is buiten en Mickey krijgt een kus.  
Mickey is outside and Mickey gets a kiss  
'Mickey is outside and Mickey gets a kiss.'
- (6) FF-condition  
Donald eet zijn bord leeg en Donald krijgt een  
Donald eats his plate empty and Donald gets an  
ijsje.  
ice cream  
'Donald eats his plate empty and Donald gets an ice cream.'
- (7) TT-condition  
Pluto gaat liggen en Pluto krijgt botten.  
Pluto goes lie and Pluto gets bones  
'Pluto lies down and Pluto gets bones.'

- (8) FT-condition  
 Minnie geeft een kus en Minnie krijgt bloemen.  
 Minnie gives a kiss and Minnie gets flowers  
 ‘Minnie gives a kiss and Minnie gets flowers.’
- (9) TT-condition  
 De chocopasta is op en Minnie krijgt  
 the chocolate spread is finished and Minnie gets  
 kaas.  
 chees.  
 ‘The chocolate spread is finished and Minnie gets chees.’
- (10) TF-condition  
 Mickey gaat voetballen en Mickey krijgt een  
 Mickey goes play football and Mickey gets a  
 banaan.  
 banana  
 ‘Mickey plays football and Mickey gets a banana.’
- (11) FT-condition  
 De thee is op en Katrien krijgt limonade.  
 the tea is finished and Daisy gets lemonade  
 ‘The tea is finished and Daisy gets lemonade.’
- (12) TT-condition  
 Pluto bijt en hij moet buiten slapen.  
 Pluto bites and Pluto must outside sleep  
 ‘Pluto bites and Pluto has to sleep outside.’

## Appendix II: Results of the random parts of the regression model

Random Effects	
$\sigma^2$	3.29
$\tau_{00}$ Participant	0.29
$\tau_{00}$ Stimulus	0.12
ICC	0.11
$N$ Participant	46
$N$ Stimulus	36
Observations	1648
Marginal $R^2$ / Conditional $R^2$	0.121 / 0.220