

# Number Mismatch and Intervention in the Absence of Lexical Restriction: An Investigation of *celui/celle* Headed Relatives in French

Anamaria Bentea and Stephanie Durrleman

## 1. Introduction

In this paper we focus on the comprehension of relative clauses headed by the demonstrative pronouns *celui/celle* (this+masc/this+fem) in French with the aim to uncover whether a mismatch in number between the demonstrative pronoun and the relative clause internal noun modulates comprehension of this type of relative clause. In addition, we aim to reveal whether the difficulties previously attested with these structures stem from difficulties in accessing the referent of the demonstrative.

A robustly attested finding for children's acquisition of relative clauses in a variety of languages (Adani 2011; Belletti 2014; Bentea, Durrleman & Rizzi 2016; Friedmann, Belletti & Rizzi 2009; Haendler, Kliegl, & Adani 2015; a.o.) is the presence of an asymmetry between the comprehension of subject relatives (SRs) and object relatives (ORs), exemplified in (1) and (2) below. The head of the relative in these examples is *the ant* and the underscore indicates the position in the relative clause where this noun has moved from and where it is interpreted, namely the subject position in (1) and the object position in (2):

- (1) Show me the ant that \_\_\_ is following the ladybug.
- (2) Show me the ant that the ladybug is following \_\_\_.

One prominent account, put forth by Friedmann et al. (2009) and following earlier work by Grillo (2008, 2009), explains this asymmetry in SR and OR comprehension in terms of intervention effects, subsumed by the locality principle of Relativized Minimality (RM) (Rizzi 1990, 2004, 2013; Starke 2001). Given a configuration like in (3), where a constituent X is moved from its original position (gap) and crosses an intervener Z, RM states that a local relation between X and Y cannot hold if Z hierarchically intervenes between X and Y and is of the same type as X. As such, an intervener (Z) bearing the same morphosyntactic features as X would block the dependency created by X and Y.

- (3) X ... Z ... Y

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\*Anamaria Bentea, University of Konstanz, [anamaria.bentea@uni-konstanz.de](mailto:anamaria.bentea@uni-konstanz.de); Stephanie Durrleman, University of Geneva, [stephanie.durrleman@unige.ch](mailto:stephanie.durrleman@unige.ch).

According to RM, X and Z can enter into three types of relations: (i) **identity**, when there is an identical featural overlap between X and Z; (ii) **inclusion**, when there is a partial featural overlap with the features on Z being included in the featural set characterizing X; (iii) **disjunction**, when there is no featural overlap between X and Z. Friedmann et al. (2009) explain the SR-OR asymmetry by showing that ORs instantiate an inclusion configuration in which the subject (*the ladybug* in (2)) intervenes between the moved object (*the ant*) and its gap position (as object of the verb *follow*) and in which the featural specification of the subject (identified as [+N] or “lexical restriction”) is included in the featural specification of the moved object (an additional [+R] feature is the scope-discourse or ‘criterial’ feature attracting the head of the relative clause). This is schematically represented in (4):

- |   |    |   |
|---|----|---|
| X   | Z  | Y |
| (4) Show me the ant that the ladybug is following ____. |    |   |
| +R +N   | +N |   |

Such a configuration leads to intervention effects in child grammar that make structures like (4) difficult to parse for children, who mainly interpret ORs of the type in (4) as SRs. However, the difficulty children have with ORs involving lexical restrictions can be alleviated by the manipulation of certain more fine-grained features. For example, a number mismatch between the lexically-restricted head of the relative and the embedded lexically-restricted subject (5) has been shown to improve comprehension of ORs for Italian-speaking children (Arosio, Guasti, & Stucchi (2010); Adani, van der Lely, Forgiarini & Guasti (2010) with ages between five and nine, but also for six to eight year-old French-speaking children (Bentea & Durrleman, 2017). This would give rise to an (iv) **intersection** relation (i.e. where features between the head and the intervener intersect), apparently easier for children.

- |   |
|---|
| (5) Show me the ant that <i>the ladybugs</i> are following ____ . |
| +SG                      +PL                                      |

Similarly, a gender mismatch between the head of the relative clause and the embedded subject plays a role in children’s comprehension of ORs, although this role varies cross-linguistically. Belletti, Friedmann, Brunato & Rizzi (2012) show that a gender mismatch between the OR head and the embedded subject has a significant effect on OR comprehension in Hebrew (see example (6) taken from Belletti et al., 2012: 1057), whereas this same mismatch does not significantly affect children’s comprehension of ORs in Italian.

- |  |
|--|
| (6) Tare li    et ha-yalda    she-ha-rofe                      mecayer.        |
| Show to-me ACC the-girl( <b>fem</b> ) that- <b>the-doctor(masc)</b> draws-masc |
| ‘Show me the girl that the (male)doctor draws.’                                |

Belletti et al. (2012) postulate that gender *per se* has no effect on comprehension and that the mere presence of a feature on the nominal constituent, like in Italian, does not suffice to overcome children's difficulties with intervention configurations and to guide them in assigning the correct interpretation to the sentence. The idea that Belletti et al. (2012) put forth is rather that the relevant features alleviating the processing of intervention configurations are those that trigger movement and have a morphological reflex in the tensed verb inflection. For instance, in the Hebrew example above (6), the verb agrees in gender with the subject, a state of affairs which does not apply to Italian where a mismatch in gender does not impact children's performance. In support of the view where only features triggering movement are relevant for locality, Friedmann, Rizzi & Belletti (2017) report the absence of an effect of case mismatch on the comprehension of *which*-questions in Hebrew speaking children. In sum, morphologically marked features outside of the verbal inflectional domain are not used in the computation of intervention.

It is worth noting that all the dependencies considered in this literature contain phi-features realized alongside a lexical N restriction. Thus, the underlying source of difficulty is assumed to be the overlap in +N and the alleviation would result from manipulation of finer-grained features, providing they are relevant for movement. However note that according to this view, the computation takes place on two levels: one being categorical (i.e. N). A question that such an account raises is whether these two levels are required, or rather whether one can do away with the categorical level altogether. Put differently: how would children fare with structures in which the head of the dependency does not contain a lexical +N restriction at all, while this head is nonetheless specified for (relevant) morphosyntactic features that partially overlap with the set of features on the intervening subject? In this study, we aim to address this question, and thus investigate whether the inclusion of the lexical +N feature constitutes the underlying source of difficulty for parsing headed dependencies, or whether instead finer-grained features suffice to create an inclusion configuration in the absence of lexical restriction.

Relative clauses headed by the demonstrative pronouns *celui/celle* in French are the perfect candidates to explore the relevance of the N feature because these elements do not contain a lexical restriction, as they consist of a demonstrative *ce* ('this') and a pronominal element *lui /elle* (him/her) (Gross 1968; Kayne 2008, 2011). While they mismatch in lexical restriction with full nouns, so *celle* versus *la coccinelle* ('the ladybug') in (7), *celui/celle* can match on other phi-features with an intervening subject, as both *celle* and *coccinelle* here are specified for number (3<sup>rd</sup> person singular) and gender (feminine).

- (7) Voici deux fourmis. Montre-moi celle que la coccinelle tire.  
 here two ants. show-me this+fem that the.sg.fem ladybug pulls  
 'Here are two ants. Show me the one that the ladybug is pulling.'

In previous work on the comprehension of ORs headed by *celui/celle* in French, Bentea, Durrleman & Rizzi (2016) found that French-speaking children aged five to eleven show similar performance for these structures as compared to ORs headed by a lexically restricted constituent like in (8).

- (8) Montre-moi la fourmi que la coccinelle tire.  
 ‘Show me the ant that the ladybug is pulling.’

However, in all of Bentea et al.’s (2016) examples, the referents for *celui/celle* matched in gender and number features with the intervening subject and therefore children’s difficulties with *celui/celle* headed ORs could have been driven by this match in featural specification between the fronted object and the intervener (see Durrleman, Bentea & Guasti (2016) for the effect of a mismatch in animacy on the comprehension of *celui/celle* ORs). Another possible interpretation for Bentea et al.’s findings is that the lower accuracy with *celui/celle* ORs could have been driven by children’s difficulties in retrieving the antecedent for the demonstrative. Specifically, when assigning an interpretation to the OR in 7, children not only have to establish the corresponding dependency between *celle* and the verb *tire* (‘pull’), but they must also link the demonstrative to a previously-mentioned antecedent, an operation that could itself pose difficulties. Therefore, with this study, we extend the investigation of *celui/celle* ORs and examine (i) whether a mismatch in number, a feature realized on the verbal inflectional head in French, modulates comprehension in the absence of a lexical N and (ii) whether difficulties in accessing the referent of the demonstrative impact the comprehension of both subject and object relatives, as previous studies have only looked at the comprehension of ORs headed by *celui/celle*.

If intervention is triggered by finer-grained features than lexical N, children should have difficulties with ORs as compared to SRs, as the former contain an intervention configuration while the latter do not. Moreover, selective difficulty should arise with ORs involving a number match between the object and the subject, as this should create an inclusion configuration. The difficulty should dissipate when the relative head mismatches in number with the intervening subject, yielding an intersection relation. If antecedent retrieval impacts comprehension children should have difficulties comprehending both SRs and ORs, as both structures require identifying the referent of the demonstrative.

## 2. Participants

We recruited thirty-nine typically-developing French-speaking children (age range 4;6 – 5;11, mean age 5;2, SD 5.7 in months) at various schools in Geneva, Switzerland. Informed parental consent was obtained for each child prior to testing and each child was tested in a quiet room at the school during one thirty-minute session. The study was approved by the ethics commission of the University of Geneva and by the Service de la Recherche en Éducation of the canton of Geneva.

### 3. Method and materials

The study used a 2 x 2 design which included Type of Structure (*SR* versus *OR*) and Number (*match* versus *mismatch*) as independent variables, yielding a total of four conditions, illustrated in examples (9) to (11). There were ten trials in each condition, yielding a total of forty target sentences. These were interspersed with twenty fillers, which consisted of either simple declarative sentences (*Montre-moi la tortue.* ‘Show me the turtle.’) or simple subject questions (*Qui tape le chat?* ‘Who is hitting the cat?’). Each target trial was also preceded by a lead-in introducing the referents for *celui/celle*. Half of the test trials in the number were introduced by *celui* and half by *celle* and the demonstratives appeared either in the singular or in the plural. In addition, for the number mismatch conditions (examples (10) and (11) below), we also manipulated the direction of the mismatch, such that half the items contained a singular head and a plural embedded noun (10) and half contained a plural head and a singular embedded noun (11). Examples (10) and (11) also show that the verb agrees in number with the subject, one particularity of number agreement on the verb in French being that it can be either silent or audible depending on the verb. In light of previous results reported for the effect of number mismatch in French relative clauses (Bentea & Durrleman, 2017) which have shown that the audibility or inaudibility of the number cue on the verb does not impact comprehension, we have not controlled for audibility of number agreement in the present study.

#### (9) *Number match (singular – singular)*

	Voilà des fourmis. ‘Here are some ants.’	Lead-in
a.	Montre-moi celle qui tire la coccinelle. show-me dem.sg.fem QUI pulls the.sg.fem ladybug ‘Show me the one that is pulling the ladybug.’	SR
b.	Montre-moi celle que la coccinelle tire. show-me dem.sg.fem QUE the.sg.fem ladybug pulls ‘Show me the one that the ladybug is pulling.’	OR

#### (10) *Number mismatch (singular – plural)*

	Voilà des poules. ‘Here are some hens.’	Lead-in
a.	Montre-moi celle qui pousse les souris. show-me dem.sg.fem QUI pushes the.pl mice ‘Show me the one that is pushing the mice.’	SR
b.	Montre-moi celle que les souris poussent. show-me dem.sg.fem QUE the.pl mice push ‘Show me the one that the mice are pushing.’	OR

(11) *Number mismatch (plural – singular)*

Voilà des éléphants.

Lead-in

‘Here are some elephants.’

- a. Montre-moi ceux qui arrosent le garçon. SR  
 show-me dem.pl.masc QUI splash the.masc.sg boy  
 ‘Show me the ones that are splashing the boy.’
- b. Montre-moi ceux que le garçon arrose. OR  
 show-me dem.pl.masc QUE the.sg.masc boy splashes  
 ‘Show me the ones that the boy is splashing.’

In a set-up inspired by Adani (2011), children saw images with two identical characters on the sides and a third different character in the middle. The images corresponding to the number match trials (example (9) above) contained only one character in each position, as illustrated in Figure 1. The images corresponding to the number mismatch conditions contained pairs of characters which appeared either in the middle position for the singular – plural mismatch (10), as shown in Figure 2, or on the sides for the plural – singular trials exemplified in (11) and associated with images like in Figure 3.



Figure 1. Example of image corresponding to a number match trial



Figure 2. Example of image corresponding to a singular – plural trial

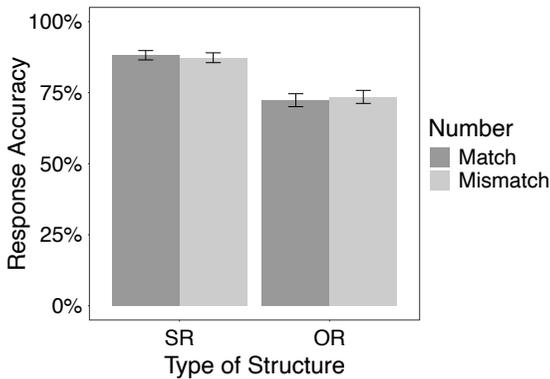


Figure 3. Example of image corresponding to a plural – singular trial

The images were presented on a computer screen and after each sentence, children had to point to the correct character, as identified by the relative clause. The correct answer for the target sentences was always a character on the sides. The position of the correct character was counter-balanced among trials, as was the direction of the action. The correct answer for the filler sentences was always a character in the middle, in order to ensure that children did not develop an answer strategy by pointing only to the side characters.

#### 4. Results

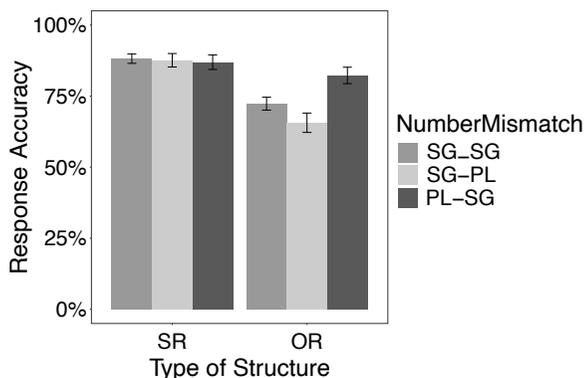
The results obtained show that French-speaking children aged 4 to 5 have no difficulties with the comprehension of SRs introduced by the demonstrative *celui/celle* and that there is no difference in performance between SRs with a number match (88% accuracy,  $SE = 0.016$ ) and SRs with a number mismatch (87% accuracy,  $SE = 0.017$ ). Children display lower accuracy for ORs headed by *celui/celle* as compared to SRs, but show similar performance in both number match (72%,  $SE = 0.022$ ) and number mismatch (74%,  $SE = 0.021$ ) conditions. Figure 4 plots the proportion of accurate responses obtained overall for SRs and ORs. The bars represent the standard error.



**Figure 4. Mean response accuracy for SRs and ORs in the number match (dark grey bars) and number mismatch (light grey bars) conditions**

The results for the number mismatch conditions reveal, however, that there is a difference in the impact of number mismatch on the comprehension of ORs headed by *celui/celle*, depending on the direction of mismatch, that is, depending on whether the RC head is plural or singular (Figure 5). While children are equally accurate with SRs, irrespective of whether the head is plural or singular (88%,  $SE = 0.026$  versus 87%,  $SE = 0.023$ ), an asymmetry surfaces in ORs, as children's response accuracy is lower with ORs containing a singular head and a plural subject (66%,  $SE = 0.034$ ) relative to their accuracy for ORs containing a plural

head and a singular subject (83%,  $SE = 0.027$ ), which are comprehended on a par with SRs.



**Figure 5. Mean response accuracy for SR and OR by mismatch direction**

We analysed the data using the *lme4* package (Bates, Maechler, Bolker, & Walker 2015) in the R environment (R Development Core Team 2015), specifying the optimizer ‘bobyqa’ to sustain model convergence. Given the binary nature of our dependent variable (a response was coded as 1, if correct, as 0, if incorrect), the accuracy data were fit into a generalized linear mixed model, including Type of Structure (SR versus OR) and Number (singular-singular versus singular-plural versus plural-singular) as fixed factors, Age as a continuous covariate and intercepts for random effects of subjects and items. We used repeated contrast coding for the fixed predictors, such that each factor level was compared to the following level. The statistical analysis revealed a main effect of Structure Type (coef = -1.01,  $SE = 0.16$ ,  $z = -6.074$ ,  $p < 0.001$ ). Overall, response accuracy for OR was significantly lower than response accuracy for SRs. The main effect of Number was not statistically significant (coef = -0.25,  $SE = 0.25$ ,  $z = -1.000$ ,  $p = 0.317$ ), suggesting that performance was overall similar for relative clauses matched and mismatched in number. The analysis also revealed an interaction between Type of Structure and Number, which surfaces when we split the number mismatch conditions (coef = -0.77,  $SE = 0.36$ ,  $z = -2.123$ ,  $p = 0.033$ ). Subsequent pairwise comparisons indicate that children are significantly more accurate with SRs than with ORs in the number match (singular – singular) conditions (coef = 1.18,  $SE = 0.21$ ,  $z = 5.566$ ,  $p < 0.001$ ) and in the number mismatch conditions in which the head was singular and the RC-internal noun was plural (coef = 1.47,  $SE = 0.28$ ,  $z = 5.181$ ,  $p < 0.001$ ). In contrast, there is no significant difference between SRs and ORs in the number mismatch condition where the head was plural and the intervener singular (coef = 0.40,  $SE = 0.31$ ,  $z = 1.291$ ,  $p = 0.196$ ), showing that ORs in the plural-singular condition are comprehended significantly better, on a par with SRs.

## 5. Discussion

This study examined whether a number mismatch between the head of the relative clause and the intervening subject impacts comprehension of object relative clauses in French in the absence of lexical restriction. The particular structures under investigation were subject and object relative clauses introduced by the demonstrative pronoun *celui/celle* in French. Although these constituents do not contain a full lexical noun, they are however specified for morphosyntactic features like gender and number, which also have a reflex on the form of these pronouns (*celui* and *ceux* designate masculine referents, in the singular and plural, respectively; *celle* and *celles* designate feminine referents, either in the singular or in the plural). As such, *celui/celle*-headed relatives in French allow to assess if a mismatch in number modulates OR comprehension in the absence of a lexical N. Moreover, while previous studies have only tested comprehension of *celui/celle* ORs, we compared comprehension of both SRs and ORs headed by *celui/celle* in order to determine if the difficulties associated with *celui/celle* ORs indeed stem from intervention effects (as suggested in Bentea et al. 2016) or whether these structures pose problems for comprehension because children find it hard to access the referent of the demonstrative.

First of all, our results show that children comprehend *celui/celle* SRs very well, indicating that they do not have problems identifying the correct referent of the demonstratives. The results show instead that problems emerge specifically in configurations of matching number features between the *celle/celui* head and the intervening subject, which create inclusion configurations in the absence of a lexical restriction. Children perform better with SRs than with ORs in the number match conditions. This follows from the internal structure of *celui/celle*, consisting of *ce* and the pronominal element *lui/elle* which shares other morphosyntactic features (in this specific case, the number feature) with the intervener. As such we have an inclusion relation in examples like (7), repeated here as (12) for convenience:

- (12) Montre-moi celle            que la            coccinelle tire.  
 show-me    dem.sg.fem that    the.sg.fem ladybug    pulls  
 ‘Show me the one that the ladybug is pulling.’

Although Friedmann et al. (2009) examined the effect of pronouns on OR comprehension and reported improvements captured in terms of a mismatch in lexical N restriction, their study from Hebrew in fact included an arbitrary pronoun as an intervener in the OR, which displays important differences to *celui*; *ce-elle*. Indeed this null pronominal triggers plural verbal inflection, while the head of the OR in their experiment was a singular noun. As a result, the experimental material contained both a mismatch in lexical restriction and in number, while according to our findings, a mismatch in number would suffice to attenuate RM effects. Under this view, the mismatch in N was not necessarily the source of children’s higher scores in Hebrew ORs with intervening (plural) pro

subjects in Friedmann et al. (2009). Pursuing the idea that finer grained features than N are those that are relevant for locality, another study with German-speaking children (Haendler et al., 2015) shows that pronominal subjects do not seem to improve performance when the head of the chain is a lexically restricted element matching for number.

Now, if a match in number suffices to complicate parsing, then a mismatch in number between the RC head *celui/celle* and the intervening subject should also suffice to enhance comprehension as compared to cases in which the two elements matched in phi-features. This is indeed what we find, namely when children hear *ceux* or *celles*, they pick up on its relevant number feature and are able to capitalize on the number mismatch to arrive at an intersection relation between the features of the head and those of the intervener.

Interestingly, the effect of this number mismatch only surfaces when the head of the relative is plural and the intervener is singular, and not when the head is singular and the intervener plural. While this result does not immediately follow from an RM account, it does not contradict previous work. Firstly, for French, Bentea et al. (2016) reported no effect of number mismatch for the same age group examined here, i.e. 5 year-old children. However, the stimuli in Bentea et al. only included ORs with a singular head and a plural intervening subject, namely the same conditions that did not elicit an effect in this study. Then for Italian, Adani et al. (2010) and Adani et al. (2017) show a facilitatory effect of number mismatch, however these studies do not report the results for each direction of mismatch.

One study that does delve into details of directionality is a self-paced listening study by Contemori & Marinis (2015), which investigated the effect of number mismatch on the comprehension of ORs in 6 to 8 yo English-speaking children, thus a slightly older age group than the one in our study. Although Contemori & Marinis (2015) report similar accuracy for singular-plural and plural-singular conditions, they also find an effect of plurality, with shorter reaction times (RTs) whenever a plural noun was encountered, both as the head of the relative clause or as the subject within the relative clause compared to instances where these constituents were nouns in the singular. In addition, they found overall shorter RTs for conditions in which the head of the relative was a plural noun as compared to conditions in which the head was a noun in the singular.

What we observe from our data is a higher degree of distinctness when the target X is the carrier of the marked value of the mismatching feature (13), and a weaker degree of distinctness when the target is the carrier of the unmarked value of the mismatching feature (14).

- +R+D+PI                    +N+Sg
- (13) Montre-moi **ceux** que le garçon arrose.  
 ‘Show me the ones that the boy is splashing.’

- +R+D+Sg                    +N+PI
- (14) Montre-moi celle que **les souris** poussent.  
 ‘Show me the one that the mice are pushing.’

Plural, as the marked value of the number feature, seems to be more salient when expressed on the first referential constituent than when expressed on the second. The improved performance when number mismatch is marked on the target, while number on the intervener is unmarked, is also reminiscent of results from agreement attraction errors in adults. For example, Wagers, Lau, & Phillips (2009) found that the head of an OR can act as a strong attractor for agreement, but only when the head was PL and the subject SG. Their findings show that the presence of a PL head reduced the disruption due to ungrammatical subject-verb agreement between a SG subject and a PL verb. This attractor effect did not appear when the RC-head was SG and the subject PL. Coupled with findings from Contemori & Marinis (2015), these results show an on-line sensitivity to the marked form of the noun in both children and adults and are in line with studies employing agreement-error elicitation tasks with English-speaking adults. Although PL nouns entail morphological number information, which should add complexity with respect to SG nouns, PL forms seem to be processed faster than SG ones and to lead to illusions of grammaticality (when associated with the RC head) in agreement attraction.

## 6. Conclusion

To conclude, we see that difficulties with *celui/celle* RCs stem from intervention effects and not problems accessing a referent for the demonstrative. Moreover, intervention effects arise in the absence of a lexical N. The computation of intervention is thus more fine-grained than categorical N. Subtler features of the head, in this case number, suffice for establishing both inclusion and intersection relations.

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