

On the production of restrictive pied-piping relative clauses in Italian: evidence from populations with typical and atypical language development

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Received: 20-04-2022
Accepted: 04-08-2022
Published: 01-11-2022

How to cite: Volpato, Francesca. 2022. On the production of restrictive pied-piping relative clauses in Italian: evidence from populations with typical and atypical language development. RLLT19, eds. Marco Bril, Martine Coene, Tabea Ihsane, Petra Sleeman & Thom Westveer. Special Issue of *Isogloss*. *Open Journal of Romance Linguistics* 8(5)/16, 1-25.

DOI: <https://doi.org/10.5565/rev/isogloss.234>

Abstract

Restrictive relative clauses are among the most frequently studied structures in language development across different languages and different populations. While much literature is devoted to the acquisition and use of subject and object relatives introduced by *that*, pied-piping (prepositional and genitive) relatives have been less studied. This paper offers an overview of some recent studies in which these structures were investigated in Italian typically developing (TD) individuals and in individuals with learning difficulties (LD) using the same procedures, namely repetition and/or elicited production. Early studies found that pied-piping relatives are acquired not earlier than 10 years of age. Much

subsequent research on Italian found that the rate of production of these structures increases with age increase, but it never reaches ceiling effects. Although percentages increase for both populations, the level of accuracy for individuals with LD is lower than for TD individuals. This is expected, since pied-piping relatives are typical of a formal, written register, to which people with LD have difficult access. However, low frequency in speech cannot be the only explanation for the low rate of production. Syntactic complexity, agreement phenomena, and number of arguments that receive thematic role explains the difficulties with these structures.

Keywords: genitive relatives, prepositional relatives, Italian, production, repetition.

1. Introduction

Since the second half of the 20th century, much crosslinguistic research has focused on the acquisition of subject (SR) and object relative clauses (OR) introduced by the complementizer *that*, highlighting an asymmetry between the two types of relatives. SRs are easier to comprehend and to produce than ORs (Adani 2011; Arosio et al. 2012; Author XXX; Belletti & Contemori 2010; Bentea, et al. 2016; Contemori & Belletti 2013; Costa et al. 2011; De Villiers et al. 1994; Friedmann et al. 2009; Gavarró et al. 2012; Tavakolian 1981, among many others). Fewer studies have turned their attention to complex (pied-piping) relative clauses introduced by a preposition and a relative pronoun (Costa et al. 2014, 2015; Diessel & Tomasello 2005; Guasti & Cardinaletti 2003). Starting from these studies, this paper offers a review of the recent research carried out for Italian on the repetition and elicited production of prepositional and genitive relatives, which are typical of the formal register and written language and are learnt at school age via reading and through formal teaching. The analysis will focus on pied-piping relative clauses in populations of typically developing (TD) individuals and individuals with learning difficulties (LD), in particular, a diagnosis of developmental dyslexia.

Learning difficulty is a cover term to identify a condition in which children fall behind their peers in the development of literacy or other skills developed during early school years. Among learning difficulties, dyslexia is a disorder that involves a failure in acquiring age-appropriate reading skills. People with dyslexia typically experience difficulties with reading accurately and fluently, with rapid word recognition, spelling, writing, and pronouncing words, despite normal intelligence, good instruction, and adequate learning opportunities. In addition to difficulties in reading, the oral language may also be impaired in individuals with LD, despite early exposure to good language and learning models. Nonphonological language problems have been identified in the lexical domain, with difficulties in lexical information access and with rapid automatized naming speed (Manis et al. 2000, Jones et al. 2016), as well as difficulties in acquiring and internalizing spoken vocabulary. As for the syntactic domain, difficulties emerge in syntactic processing of spoken language (Robertson and Joanisse 2010), as well as in comprehension and production of specific syntactic structures. People with dyslexia showed weaknesses in the production of clitic pronouns (Arosio et al. 2016; Avram et al. 2013; Delage & Durrelman, 2018; Vender et al. 2018; Zachou et al. 2013), relative clauses (Arosio et al. 2017; Cardinaletti & Volpato 2015; Cardinaletti et al. 2022; Guasti et al. 2015; Pivi & Del Puppo 2015; Pivi et al. 2016; Sevcenco et al. 2014), *who*- and *which*-object questions (Guasti et al. 2015;

Stanford & Delage 2019), difficulties in the interpretation of pronominal elements (Waltzman & Cairns 2000), reduced sensitivity to subject-verb agreement violations (Cantiani et al. 2013), and difficulties with the comprehension of negation and relative clauses (Arosio et al. 2017; Bar-Shalom et al. 1993; Cardinaletti & Volpato 2015; Vender & Delfitto 2010; Tagliani 2021).

With this paper, two issues will be addressed. On the one hand, data on TD populations and populations with LD will be presented in order to determine whether the former perform better than the latter in the production and repetition of structures that are typical of the formal register and the written language, and that are learnt at school. On the other hand, we will investigate whether a gradient of accuracy exists among the different types of pied-piping relatives in the two populations, also comparing these complex relatives with the simpler relatives introduced by *that*. We will discuss these data using recent linguistic approaches based on frequency and syntactic constraints that hinder the correct computation of complex relative constructions.

The paper is organised as follows: section 2 introduces the structures under investigation, section 3 briefly presents cross-linguistic research on the acquisition of pied-piping relatives in TD children, section 4 focuses on Italian and offers an overview of the recent studies on the production and the repetition of pied-piping relative clauses in TD individuals and individuals with LD. Section 5 discusses the main results emerged from the presentation of the studies on relative clauses.

2. The investigated structures

In Italian, two main types of restrictive relative clauses can be distinguished: subject and object relative clauses introduced by the complementizer *che* ‘that’ and pied-piping relatives (Cinque 1978, 1982, 2020; Guasti & Cardinaletti 2003).

Subject (SR) and object (OR) *that*-relatives show a gap in the subordinate clause in which the subject (1) or the object (2) are first-merged (marked by *<>*) before moving to a higher position in Spec-CP.

- (1) La mamma che *<mamma>* pettina i bambini
the mum that *<mum>* combs the children
- (2) I bambini che la mamma pettina *<bambini>*
the children that the mum combs *<children>*

Pied-piping relatives are introduced by a preposition or an article and a relative pronoun. They include prepositional relatives (dative relatives (3) and locative relatives (4)), genitive relatives (5), and prepositional genitive relatives (6).

- (3) il cane [a cui <cane>] i bambini danno il cibo <a cui cane>
the dog [to whom <dog>] the children give the food <to whom dog>
‘The dog to whom the children give the food.’

(4) la sedia [su cui <sedia>] il cane sale <su cui sedia>
 the chair [onto which <chair>] the dog gets <onto which chair>
 ‘The chair onto which the dog gets.’

(5) il cane [il [cui <cane>] padrone <cui cane>] <il padrone cui cane>
 the dog [the [whose <dog>] master <whose dog>] <the master whose dog>
 cucina
 cooks
 ‘The dog whose master cooks.’

(6) il cane [a <cane> il [cui <cane>] padrone <cui cane>] i bambini
 the dog [to <dog> the [whose <dog>] master <whose dog>] the children
 danno i biscotti <al padrone cui cane>
 give the cooks <to-the master whose dog>
 the dog to whose master the children give cooks
 ‘The dog to the master of which the children give cooks.’

Pied-piping relatives involve the displacement of a sentence constituent to a non-argument position, similarly to what happens with SRs and ORs. They are derived in more than one step. Following Kayne’s (1994) and Bianchi’s (1999) proposals on the syntactic representation of prepositional relatives, dative (3) and locative relatives (4) are derived in two steps. Following Cardinaletti’s (1998), genitive relatives are derived in three steps, and prepositional genitives are the relatives that involve the highest number of movements in their derivation.

In prepositional relatives, the relative pronoun is either *cui* ‘who/which’ (7) or *art+quale* ‘who/which’ (8).

(7) Il bambino a cui la mamma dà un biscotto <a cui bambino>
 the child to whom the mum gives a biscuit <to whom child>
 ‘The child to whom the mum gives a biscuit.’

(8) La bambina alla quale i nonni danno
 the child.F to-the-SG.F whom.SG the grandparents give a
 un bacio <alla quale bambina>
 a kiss <to-the-SG.F whom.SG child.F>
 ‘The teacher to whom they are giving a kiss.’

Cui is the non-agreeing relative pronoun, whereas *quale* agrees in number with the relativized noun. The article as well shows number and gender agreement with the noun (*al quale* to-the.SG.M which/who.SG; *alla quale* to-the.SG.F which/who.SG; *ai quali* to-the.PL.M which/who.PL; *alle quali* to-the.PL.F which/who.PL).

Whereas locative and dative relatives can be constructed with either *cui* or *quale*, genitive relatives are only possible with the pronoun *cui*.

3. Crosslinguistic studies on the acquisition of pied-piping relatives

Different approaches to language acquisition tried to account for children's performance on pied-piping relatives across different languages. Following an input-based approach (Tomasello 2003), Diessel & Tomasello (2003) investigated the repetition of different types of relative clauses in preschool English- and German-speaking children ranging in age from 4;3 to 4;9 years. They assessed subject relatives (*the man who saw the farmer*), direct object relatives (*the cat that the dog chased*), indirect object relatives (*the girl who the boy gave his ball to*), oblique relatives (*the boy who the girl played with*), and genitive relatives (*the man whose cat caught a mouse*). The children performed accurately on SRs, whereas the other types of relatives were often turned into subject constructions. The higher level of accuracy on SRs was mostly explained by the frequency with which these structures occur in the adult input. SRs are more frequent than non-SRs in the language environment and conform to the most frequent syntactic patterns found in simple non-embedded sentences. For this reason, subject relatives are learnt earlier than object and genitive relatives. Genitive relatives are the most complex structures for children. The reason why genitive relatives are not correctly produced by children is that these structures are rare in adult speech.

Within the generative framework, Costa et al. (2014) carried out a study on preschool children speaking Hebrew (HEB, age range 4;4-6;8) and European Portuguese (EP, age range: 4;0-5;11). They assessed the comprehension and production of SRs with a PP complement of the embedded verb (examples (9) and (10)), PP object relatives (examples (11) and (12)), and DP object relatives (examples (13) and (14)) in both languages.

(9) European Portuguese

Mostra-me o menino que toca no macaco.
'Show me the boy that touches in-the monkey.'

(10) Hebrew

Tar'e li et ha-yeled she-noge'a b-a-kof.
Show to-me ACC the-boy that-touches in-the-monkey
'Show me the boy that lays a hand on the monkey.'

(11) European Portuguese

Mostra-me o rapaz para que o pai olha.
'Show me the boy at whom daddy looks.'

(12) Hebrew

ha-yeled she-aba c'aak *(al-av)
the-boy that-dad yelled on-him
'The boy dad yelled at.'

(13) European Portuguese
 Mostra-me o rapaz que o pai vê.
 ‘Show me the boy that daddy sees.’

(14) Hebrew
 ha-yeled she-aba nishek
 ‘The boy that-dad kissed.’

Besides assessing sentences with different grammatical categories (DP or PP), Costa et al. (2014) also included prepositional sentences with either complement ((11) and (15)) or adjunct PPs (16), in order to determine which grammatical functions play a role in the comprehension and production of relative clauses.

(15) Mostra-me o rapaz para que o cozinheiro olha.
 ‘Show me the boy at whom the chef looks.’

(16) Mostra-me o rapaz para que o cozinheiro cozinha.
 ‘Show me the boy for whom the chef cooks.’

Children’s difficulties were discussed in terms of intervention effects due to feature similarity, along the lines of Relativized Minimality (Friedmann et al. 2009; Rizzi 1990, 2004). In both comprehension and production, an asymmetry is observed between SRs and ORs, while the participants’ performance on DP object relatives is not different from that on PP object relatives. This led the authors to conclude that intervention of the lexically restricted embedded subject causes difficulties, but categorical features are not relevant for the intervention configuration. The intervention of the embedded subject hinders the displacement of the direct and the indirect object to the same extent. As for the role of grammatical functions, children’s performance in complement and adjunct PPs was similar. Hence, the grammatical function of the relativized PP did not play a facilitating role in the comprehension and production of PP relative clauses.

4. The acquisition of pied-piping relatives in Italian

The first study addressing the acquisition of pied-piping relative clauses in Italian was carried out in 2003 by Guasti & Cardinaletti. Using an elicited production task (Mulas 2000), they assessed subject relatives, object relatives, dative, locative, and genitive relatives in a group of Italian-speaking typically developing children ranging in age from 5;1 to 10;0. While subject relatives were correctly produced by young children, object relatives were in most cases avoided in favour of subject passive relatives (17), a finding that was later replicated by a large number of studies (a. o., Belletti & Contemori 2010; Contemori & Belletti 2013; Volpato 2019; Volpato & Cardinaletti 2015; Volpato & Vernice 2014):

(17) a. Target Tocca il cammello che il bambino ha comprato.
 touch the camel that the child has bought
 ‘Touch the camel that the child bought.’

b. Production Tocca il cammello che è stato comprato dal bambino.
 ‘Touch the camel that has been bought by the child.’

As for pied-piping relatives, Guasti & Cardinaletti (2003) found that these structures are produced not earlier than 10 years of age. When dative relatives were targeted, Italian-speaking children sometimes used more colloquial forms, by producing sentences introduced by the complementizer *che* and including resumptive pronouns:

(18) a. Target Tocca l’ippopotamo a cui il padrone dà il cibo.
 ‘Touch the hippo to whom the owner gives food.’

b. Production Tocca l’=ippopotamo che il=suo padrone gli
 touch the=hippo that its owner to=him
 dà il cibo.
 gives the food.
 ‘Touch the hippo to which its owner gives food.’

In Guasti & Cardinaletti (2003), children avoided genitive relatives producing two subject relatives instead, as the example in (19) shows.

(19) a. Target Tocca il bambino il cui leone ruggisce.
 ‘Touch the child whose lion roars.’

b. Production Tocca il bambino che ha il leone che ruggisce.
 ‘Touch the child that has the lion that roars.’

Guasti & Cardinaletti (2003) attributed the low percentage of target sentences (7%) and the preference for more colloquial alternatives to the fact that pied-piping relative clauses belong to the formal register, which requires explicit teaching at school. Children have to learn the complex system of relative pronouns and their syntax, and this happens during school years through formal teaching and through exposure to written texts (Guasti & Cardinaletti 2003; Cardinaletti et al., 2022; Piccoli 2018).

Taking inspiration from the findings in Guasti & Cardinaletti (2003), much recent research explored the issue of the age of acquisition of pied-piping relatives in Italian in more depth. These studies were carried out using repetition tasks and/or elicited production tasks in populations with typical language development (Del Puppo & Volpato 2016; Grasso 2017; Galvani 2020; Marchegiani 2020; Frescura 2021; Cardinaletti et al. 2022) and in populations with dyslexia (Grasso 2017; Tambosi 2019; Galvani 2020; Marchegiani 2020; Frescura 2021). Interestingly, these studies used the same tasks with different age groups. This makes it possible to draw a picture of the developmental trajectories of prepositional and genitive relatives across different age groups, covering the age range from 11 to 36 years.

In the next sections, the results of these studies will be presented. We will first focus on the studies presenting data collected from the repetition task and then those concerning elicited production.

4.1. The repetition of pied-piping relatives

The repetition of pied-piping relatives was assessed using the task by Del Puppo et al. (2016). The task contains sentences assessing prepositional (dative) relatives with

quale (20) and *cui* (21), genitive relatives (22), and prepositional genitive relatives (23).¹

(20) Il cane morde i ragazzi ai quali il nonno compra il gelato.
 the dog bites the boys to-the.PL.M whom.PL.M the granddad buys the ice-cream
 ‘The dog bites the boys to whom the granddad buys the ice-cream.’

(21) La bambina lava il cane a cui il padrone dà i biscotti.
 ‘The girl washes the dog to whom the owner gives the biscuits.’

(22) Il postino saluta la signora il cui figlio disegna.
 ‘The postman greets the lady whose son draws.’

(23) La mamma bacia la bambina al cui fratello piacciono le tigri.
 the mum kisses the girl to whose brother please the tigers
 ‘The mum kisses the girl the brother of whom likes tigers.’

In addition to relative clauses, control sentences of the same length as the experimental ones were included in the task. The inclusion of control sentences makes it possible to distinguish between difficulties due to syntactic computation and difficulties due to memory deficits.

Several studies assessed the repetition of pied-piping relatives in typically developing individuals using this sentence repetition task across different age groups. The data are reported in Table 1. In all performance analyses, only trials that were repeated verbatim were counted as correct. In children aged from 6;5 to 8;7 years, the rate of sentences correctly repeated is quite low, 23%.² As children grow older, between the age of 10 and 15 years, this rate increases noticeably, although slightly different percentages are reported depending on the study considered. Accuracy increases also at high school age. A slight increase is observed between 20 and 22 years (78%) and between 23 and 36 years, the percentage of accuracy reaches 88%.

The following table summarizes the overall percentages of accuracy for pied-piping relatives that the above-mentioned studies reported for the different age groups.

¹ In addition to relative clauses, the repetition task includes other movement-derived sentences (left dislocations, long *wh*- questions, and clefts). However, since in this paper we focus on relative clauses, only this structure will be taken into consideration.

² The data on repetition confirm what was attested in elicited production by Guasti & Cardinaletti (2003), i.e., very poor performance.

Table 1. Rate of accuracy across different age groups reported by studies assessing the repetition of pied-piping relatives in typically developing individuals

Studies on TD individuals	N. Participants	Age groups	Overall accuracy
Del Puppo & Volpato (2016)	38	6;5-8;7	23%
Del Puppo & Volpato (2016)	23	10-11	57%
Marchegiani (2020)	64	11;4-15;3	53%
Frescura (2021)	39	11-15	56%
Galvani (2020)	15	15-16	44%
Cardinaletti et al. (2022)	43	15-20	57%
Grasso (2017)	16	17-19	69%
Galvani (2020)	7	20-22	78%
Del Puppo & Volpato (2016)	9	23-36	88%

Most of these studies (Cardinaletti et al. 2022; Frescura 2021; Galvani 2020; Grasso 2017; Marchegiani 2020) also distinguish the level of accuracy in the different types of relative clauses. for each of the four relative clause, Table 2 shows the percentages reported by each study types and the average among the works on the same age groups.

Table 2. Rate of accuracy across different age groups (TD individuals) in the different types of pied-piping relatives

Studies	Age groups	Dative <i>Cui</i>		Dative <i>Quale</i>		Prep. genitives		Genitives	
Marchegiani (2020)	11-15;3	30%	38%	36%	38%	44%	54%	67%	71%
Frescura (2021)	11-15	46%		39%		63%		74%	
Galvani (2020)	15-16	47%	43%	32%	49%	33%	53%	80%	82%
Cardinaletti et al. (2022)	15-20	51%		49%		51%		83%	
Grasso (2017)	17-19	31%		67%		75%		84%	
Galvani (2020)	20-22	33%	33%	75%	75%	75%	75%	92%	92%
Mean		40%		50%		57%		80%	

For TD individuals, a consistent finding across the different age groups is that dative relatives introduced by either *cui* or *quale* are the least accurate, followed by prepositional genitive relatives. The highest level of accuracy is observed in genitive relatives. This tendency emerged both considering each study separately and considering the mean derived from the different studies. In addition, except for some results, there is an increasing level of accuracy as age increases.

In individuals with LD, the level of accuracy shows an increasing tendency, similarly to TD individuals. However, percentages are lower for all age groups. In the age group from 11 to 15 years, the rate of sentences correctly produced is very low (18%). It increases in adolescence and adulthood, but it never exceeds 50% even in adult participants. Table 3 shows the percentages of sentences correctly produced that the various studies reported for students with LD.

Table 3. Rate of accuracy across different age groups reported by studies assessing the repetition of pied-piping relatives in individuals with LD

Studies on LD individuals	N. participants	Age groups	Overall accuracy
Frescura (2021)	7	11-15	18%
Tambosi (2019)	15	14;1-18;4	32%
Grasso (2017)	11	16;3-18;9	38%
Galvani (2020)	9	18-21	47%

For each of the four relative clause types, Table 4 shows the percentages reported by each study and the average among the works on the same age groups.

Table 4. Rate of accuracy reported by different studies for individuals with LD in the different types of pied-piping relatives

Studies	Age groups	Dative <i>cui</i>		Dative <i>quale</i>		Prep. genitives		Genitives	
		14%	14%	7%	7%	14%	14%	36%	36%
Frescura (2021)	11-15	14%	14%	7%	7%	14%	14%	36%	36%
Tambosi (2019)	14;1-18;4	40%	52%	13%	18%	40%	41%	33%	49%
Grasso (2017)	16;3-18;9	64%		23%		41%		65%	
Galvani (2020)	18-21	44%	44%	39%	39%	33%	33%	72%	72%
Mean		41%		21%		32%		52%	

For individuals with LD, the pattern of performance is not uniform. This might be due to the fact that the LD groups are more homogeneous than the TD groups (albeit quite small). However, overall, dative relatives introduced by the relative pronoun *quale* are the most difficult to repeat, followed by prepositional genitives and relatives introduced by *cui*. Similarly to the pattern which was observed for TD individuals, for students with LD, the highest rate of accuracy was found in the repetition of genitive relatives, although percentages are much lower for these participants.

4.2. Response strategies produced in the sentence repetition task

When target sentences were not correctly repeated, several types of responses were found in the considered studies. Across the different age groups, ungrammatical sentences were produced in most cases. However, it is not possible to directly compare the rate of responses provided in the different studies, due to slightly different coding strategies. Most of the time, the errors involved the use of relative pronouns. For instance, in the sentences (24a) and (25a), the genitive relative pronoun *cui* was incorrectly replaced by *quale*, as shown in (24b) and (25b):

(24) a. Il postino saluta la signora il *cui* figlio disegna.
 the postman greets the lady the.SG.M whose son draws
 ‘The postman greets the lady whose son draws.’
 b. *Il postino saluta la signora il *quale* figlio disegna.
 the postman greets the lady the which son draws.

(25) a. La mamma bacia la bambina a-1 *cui* fratello piacciono
the mum kisses the girl to-the.SG.M whose brother please.PL
le tigri.
the tigers
'the mum kisses the girl the brother of whom likes tigers.'
b.* La mamma bacia la bambina al *quale* fratello
the mother kisses the girl to-the.SG.M which.SG brother
piacciono le tigri.
please.PL the tigers

Other incorrectly repeated sentences are shown in (26b) and (26c) instead of the target sentence (26a), in which the relative pronoun *cui* is the complement of the preposition *a* ‘to’. In the incorrect repetition in (26b), the preposition was omitted, and an article was used instead (26b). In this way, the dative relative was turned into a genitive relative in which the goal argument was omitted. In other cases, the target sentence was replaced by a prepositional genitive relative (26c) in which *il padrone* ‘the owner’ is no longer the subject of the embedded verb *dà* ‘gives’, but the complement of the preposition, and the subject is null (the # signals that the sentences are not ungrammatical per se, but have a very different meaning from the target sentences):

(26) a. La bambina lava il cane a cui il padrone dà i biscotti.
‘The girl washes the dog to whom the owner gives the biscuits.’

b. #La bambina lava il cane il cui padrone dà i biscotti.
‘The girl washes the dog the whose owner gives the biscuits.’

c. #La bambina lava il cane a-l cui padrone
the girl washes the dog to-the.SG.M whose owner [he/she]
dà i biscotti.
gives the biscuits
‘The girl wases the dog to the owner of which [he/she] gives the biscuits.’

When prepositional genitive relative clauses were targeted (e.g., 27a), in some cases, the genitive pronoun *cui* became the complement of the preposition *a* ‘to’, as in (27b); the DP *il fratello* ‘the brother’ does not receive any theta role, and the sentence is ungrammatical. In (27c), the strategy is the same except for the fact that instead of *cui*, the agreeing relative pronoun *quale* preceded by the article is used:

(27) a. La mamma bacia la bambina a-l cui fratello piacciono
the mum kisses the girl to-the.SG.M whose brother please.3.PL
le tigri.
the tigers
'The mother kisses the girl the brother of whom likes tigers.'

b. *La mamma bacia la bambina a cui il fratello piacciono le tigri.
the mum kisses the girl to whom the brother please.3.PL the tigers
'The mum kisses the girl to whom the brother likes tigers.'

c. *La mamma bacia la bambina al-la/ al quale
 the mum kisses the girl to-the.SG.F/ to-the.SG.M which.SG
 il fratello piacciono le tigri.
 the brother please.3.PL the tigers
 'The mum kisses the girl to whom the brother likes tigers.'

Other ungrammatical productions involved the use of incorrect number features on the article and the relative pronoun (28b) instead of the correct features (28a).

(28) a. Il cane morde i ragazzi a-i quali il nonno compra
 the dog bites the boys to-the.PL.M whom.PL the grandfather buys
 il gelato.
 the ice-cream.
 'The dog bites the boys to whom the grandfather buys the ice-cream.'
 b. *Il cane morde i ragazzi a-l quale il nonno compra
 The dog bites the boys to-the.SG.M whom.SG the grandfather buys
 il gelato.
 the ice-cream.

In addition to ungrammatical sentences, also non-target grammatical sentences were produced. In this case, in dative relative clauses like (29a), the agreeing relative pronoun *quale* was replaced by the non-agreeing form *cui* (29b). In (30), the target sentence in (30a) was replaced by a more colloquial form, containing a resumptive clitic pronoun (30b).

(29) a. Il cane morde i ragazzi a-i quali il nonno
 The dog bites the boys to-the.PL.M whom.PL the grandfather
 compra il gelato.
 buys the ice-cream.
 'The dog bites the boys to whom the grandfather buys the ice-cream.'
 b. Il cane morde i ragazzi a cui il nonno compra il gelato.
 'The dog bites the boys to whom the grandfather buys the ice-cream.'

(30) a. La bambina lava il cane a cui il padrone dà i biscotti.
 'The girl washes the dog to whom the owner gives the biscuits.'
 b. La bambina lava il cane a cui il padrone *gli* dà i
 The girl washes the dog to whom the owner him.CL gives the
 biscotti.
 biscuits.
 'he girl washes the dog to whom the owner gives him the biscuits.'

In some studies, it was found that the participants produced simplified constructions in which some parts of the sentence or some arguments were omitted, or sentences were interrupted. For instance, for the target sentence in (31a), the participants either produced a sentence in which an argument is omitted (*il papà* 'the father') (31b) or they did not complete the whole sentence.

(31) a. Il lupo tocca il ragazzo a-1 quale il papà porta un
 the wolf touches the boy to-the.SG.M whom.SG the father brings a
 regalo.
 gift.
 'The wolf touches the boy to whom the father brings a gift.'

b. Il lupo tocca il ragazzo al quale porta un
 the wolf touches the boy to-the.SG.M whom.SG (it) brings a
 regalo.
 gift.
 'The wolf touches the boy to whom (it) brings a gift.'

c. Il lupo tocca il ragazzo al quale...
 the wolf touches the boy to-the.SG.M whom.SG
 'The wolf touches the boy to whom...'

The strategies reported in (24)-(31) were found in all the studies considered in this analysis for both TD individuals and participants with atypical language development. Although it is not possible to directly compare the rate of sentences that fall in the different categories, some studies highlighted a higher percentage of ungrammatical sentences in individuals with LD than in TD individuals (Frescura 2021; Grasso 2017). In addition, most studies highlighted a higher number of incomplete or simplified structures in the students with LD (Frescura 2021; Grasso 2017), as well as several sentences in which the agreeing pronoun '*quale*' was replaced by the non-agreeing form '*cui*'. This phenomenon might suggest that some difficulties arise when gender and number agreement are checked more than once in the sentence, as is the case of relatives containing the relative pronoun '*art+quale*'. This hypothesis is further confirmed by the high number of sentences containing feature agreement errors in the productions by individuals with LD (Grasso 2017; Tambosi 2019).

4.3. The elicited production of pied-piping relatives

The elicited production task used to assess complex relative clauses was developed by Piccoli (2018) following the model proposed by Mulas (2000) and Guasti & Cardinaletti (2003). The task by Piccoli (2018) consisted of 20 trials which aim at eliciting subject (28), object (29), dative (30), locative (31), and genitive relative clauses (32), with 4 trials for each sentence type. In each trial, the characters were either individuals or animals; all noun phrases were masculine and singular. The task was administered through a Power Point presentation. For each trial, the pictures of two people or two animals were shown to the participant, as shown in Figure 1. The experimenter described the pictures (*There are two dads and one child*), and a blindfolded puppet (Carolina) was also present in the experimental setting.

Figure 1. Example of a trial eliciting an object relative

Source: Piccoli (2018)

After the description was completed, an arrow appeared in the presentation pointing to one of the two referents (in this trial, the arrow pointed to the dad on the right). At this point, the experimenter asked the participant the question *What would you tell Carolina, if you want her to touch this dad*. The participant was expected to produce a relative clause to discriminate between the two characters and to refer to the one pointed to by the arrow, in this case an ORs (*Touch the dad that the child is kissing*). (32)-(36) show and example for each sentence type.

- (32) Tocca il bambino che salta.
‘Touch the boy that jumps.’
- (33) Tocca il gattino che il cane lecca.
‘Touch the kitten that the dog licks.’
- (34) Tocca lo studente a cui il professore spiega un argomento di storia.
‘Touch the student to whom the professor teaches a history topic.’
- (35) Tocca lo scatolone in cui/nel quale entra il lupo.
‘Touch the box into which/into-the.MS.SG which.MS.SG the wolf goes.’
- (36) Tocca il papà il cui figlio gioca a calcio.
‘Touch the father whose son plays football.’

The studies by Cardinaletti et al. (2022), Galvani (2020), and Marchegiani (2020) present data of TD individuals belonging to different age groups who were administered this elicited production task. As Table 5 shows, the overall rate of production of relative clauses increases with age increase. This increase is also evident when pied-piping relatives are considered.

Table 5. Rate of target sentences in studies on the production of relative clauses in TD individuals.

Studies on TD individuals	Age groups	Overall accuracy	Accuracy in pied-piping RC
Marchegiani (2020)	11;4-15;3	32%	21%
Galvani (2020)	15-16	44%	41%
Cardinaletti et al. (2022)	15-20	42%	37%
Galvani (2020)	20-22	56%	60%

Table 6 shows the rate of relative clause production distinguishing among the 5 relative clause types. For each sentence type, the table shows the rate of target structures for each study and an average among the works on the same age groups.

Table 6. Rate of target sentences across the different age groups (TD individuals) in the different types of relatives (SR = subject relative; OR = object relative)

Studies	Age groups	SR		OR		Dative		Locative		Genitive	
Marchegiani (2020)	11;4-15;3	92%	92%	4%	4%	18%	18%	38%	38%	7%	7%
Galvani (2020)	15-16	93%		6%		34%		52%		36%	
Cardinaletti et al. (2022)	15-20	96%	95%	4%	5%	25%	30%	56%	54%	31%	34%
Galvani (2020)	20-22	96%	96%	4%	4%	54%	54%	58%	58%	67%	67%
Mean		94%		5%		33%		51%		35%	

The well-known asymmetry between SRs and ORs was found in all studies. Subject relatives were the sentences with the highest rate of production, and object relatives were almost always avoided. As for pied-piping relatives, between 11;4 and 15;3 years, genitive relatives are the most difficult to produce, but at the age of 20-22, they are the sentences with the highest rate of production. Whereas genitives show the lowest rate of occurrence before the age of 15, after that age, dative relatives are the least produced. Overall, the structure with the lowest percentage of occurrence was the dative relative, followed by genitive relative, and the least problematic was the locative relative.

The production task eliciting pied-piping relatives was also proposed to individuals with LD. Data on this population are reported by Galvani (2020) and Tambosi (2019). The two studies show an increasing rate of production across age groups. However, overall percentages were not much high and remained well below 50% (see Table 7), confirming previous findings that people with LD may show low grammatical skills. When considering only pied-piping relatives, percentages are below 40%.

Table 7. Rate of target sentences in studies on the production of relative clauses in individuals with LD.

Studies	Age groups	Overall accuracy	Accuracy in pied-piping RC
Tambosi (2019)	14;1-18;4	35%	28%
Galvani (2020)	18-21	41%	37%

Table 8 shows the rate of production of the different relative clause types.

Table 8. Rate of target sentences across the different age groups (individuals with LD) in the different types of relatives

Studies	Age groups	SR	OR	Dative	Locative	Genitive
Tambosi (2019)	14;1-18;4	85%	5%	25%	38%	22%
Galvani (2020)	18-21	92%	0%	42%	47%	22%
Mean		89%	3%	34%	43%	22%

The asymmetry between subject and direct object relatives is also confirmed for this population, although the mean percentage of subject relatives is lower than in TD individuals. As for pied-piping relatives, the most produced sentences are locative relatives, replicating the studies on the TD population (Table 6). However, a different pattern is observed for dative and genitive relatives. Indeed, the latter are the sentences with the lower percentage of occurrence.

4.4. Response strategies in the elicited production task

When target sentences were not produced, a number of strategies were found in the corpus. Different types of responses were provided in addition to the target answers, among which non-target grammatical sentences and ungrammatical constructions.

Object relatives as in (37a) were mainly replaced by grammatical passive relatives, as in (37b). Passive constructions were also found when dative relatives were elicited (38).

(37) a. Tocca il gattino che il cane lecca.
 ‘Touch the kitten that the dog licks.’
 b. Tocca il gattino che viene leccato dal cane.
 ‘Touch the kitten that is licked by the dog.’

(38) a. Tocca lo studente a cui il professore spiega un argomento di storia.
 ‘Touch the student to whom the professor explains a history topic.’
 b. Tocca lo studente a cui è stato spiegato l’argomento di storia.
 touch the student to whom has been explained the topic of history.
 ‘Touch the student to whom the history topic has been explained.’

The sentences in (39) shows an example in which a target dative relative clause (39a) is replaced by a subject relative (39b), with a verb change which also involves different theta roles assignment:

(39) a. Tocca il maiale a cui il coniglio dà l’uovo di Pasqua.
 ‘Touch the pig to which the rabbit gives the Easter egg.’
 b. Tocca il maiale che ha ricevuto l’uovo di Pasqua dal coniglio.
 ‘Touch the pig who has received the Easter egg from the rabbit.’

When genitive relatives were elicited (40a), in most cases a non-target grammatical sentence was produced (40b), consisting in two subject relatives embedded into one another. Ungrammatical sentences were sometimes produced instead. In (40c), for instance, the relative pronoun was preceded by a preposition:

(40) a. Tocca il papà il cui figlio gioca a calcio.
 ‘Touch the dad whose son plays football.’
 b. Tocca il papà che ha il figlio che gioca a calcio
 ‘Touch the dad who has the son who plays football.’
 c. *Tocca il papa a cui il figlio gioca a calcio.
 ‘Touch the dad to whom the son plays football.’

In some locative relatives (41a), the relative pronoun was either replaced by the *wh*-element *dove* ‘where’ or it was preceded by the wrong preposition (*on* or *in* instead of *from*) (41b). In all cases presented in (41b), the sentence is ungrammatical. These productions were mainly found in the students with LD (Tambosi 2019).

(41) a. Tocca il tetto da cui/ dal quale lo spazzacamino
 touch the roof from which/from-the.SG.M which.SG the chimney-sweep
 scende.
 descends
 ‘Touch the roof from which the chimney sweep descends.’
 b. *Tocca il tetto dove/ su cui/ nel quale lo
 touch the roof where/ on which/ in-the.SG.M which.SG the
 spazzacamino è sceso.
 chimney sweep has descended.
 ‘Touch the roof where/on which/in which the chimney sweep has
 descended.’

In addition to non-target grammatical and ungrammatical structures, relative clauses typical of informal, colloquial registers were observed, in which relative pronouns preceded by either the article (42) or the preposition (43) were replaced by the complementizer *che* ‘that’.

(42) a. Tocca il papà il cui figlio gioca a calcio.
 ‘Touch the dad whose child plays soccer’
 b. Tocca il papà che il figlio gioca a calcio.
 ‘Touch the dad that the child plays soccer.’

(43) a. Tocca lo scatolone in cui/ nel quale entra il lupetto.
 touch the big box in which/ in-the.SG.M which.SG enters the wolf cub
 ‘Touch the big box which the wolf cub enters.’
 b. Tocca lo scatolone che c’è dentro il lupetto.
 ‘Touch the big box that there is inside the wolf cub.’

This strategy was found in the groups of TD individuals, especially in adolescent participants (Galvani 2020, age group: 15-16 years) and in the groups of individuals with LD.

5. Discussion and conclusion

In this paper, recent research on the repetition and elicited production of pied-piping (prepositional and genitive) relative clauses in Italian-speaking TD individuals and individuals with LD has been reviewed to analyse the developmental trajectory of relative clause production in these populations.

In Guasti & Cardinaletti (2003), it was observed that at the age of 10 years, TD children have not yet acquired the complex syntax of relative pronouns contained in pied-piping relative clauses. In this paper, studies that include participants belonging to older age groups were considered, in order to check whether in adolescence or adulthood, i.e., after several years of exposure to formal and written language, these structures are fully mastered. The analysis of repetition and production rates shows that the level of accuracy and occurrence of prepositional and genitive relatives increases with age, but percentages never reach ceiling effects in adulthood (88% in repetition and 60% in elicited production). The same trend towards an increase in accuracy and in the rate of production is also observed in individuals with LD, for whom percentages also increase in both tasks. However, LD participants always displayed lower scores than TD across age groups. The fact that the participants with LD show lower percentages than TD participants can be expected based on the findings of previous studies on this population. Several studies have demonstrated that children and adults with dyslexia perform lower than their age-matched peers in comprehension and/or production of relative clauses (Bar-Shalom et al. 1993; Cardinaletti & Volpato 2015; Guasti et al. 2015; Pivi & Del Puppo 2015).

On the one hand, students with LD may have impaired oral language and problems in several linguistic domains, also including syntax, and the development of complex syntactic properties may be hindered. On the other hand, pied-piping relative clauses are complex syntactic structures that are acquired at school through formal teaching or can be accessed through reading activities. Reading skills are impaired in people with a diagnosis of dyslexia. Although the pattern of development shows an increasing tendency in both groups, some differences between the two groups can be highlighted. Individuals with LD produced more ungrammatical sentences than TD individuals (Frescura 2021; Galvani 2020; Grasso 2017). Sometimes the group of individuals with LD used more colloquial strategies, like the production of *che* 'that' in place of the relative pronoun, and this strategy was also found in the group of TD adolescent. This phenomenon suggests that strategies used by younger TD students persist in individuals with LD also in adulthood. It is well known in the literature that the interpretative behavior of individuals with dyslexia is often in line with that displayed by younger typically developing individuals and that this impairment tends to persist into adulthood.

Crosslinguistic research showed that prepositional and genitive relatives show low level of accuracy and low rates of occurrence also in other languages, like Hebrew, European Portuguese (Costa et al. 2014), and English (Diessel & Tomasello 2005). On the perspective proposed by Diessel and Tomasello (2005), based on data from English and German, children's competence is shaped by the frequency with which a certain structure is present in the linguistic input. Low-frequency structures, such as pied-piping relatives, are often avoided and sentences that adhere to frequent patterns in which the first NP is the agent are used instead. Italian pied-piping relatives are not so frequent in the (colloquial) input. However, low frequency cannot account for the

difficulties that individuals with typical and atypical language development face with these structures. In addition to pied-piping relatives, in Italian, direct object relatives (*il bambino che i nonni baciano* ‘the child that the grandparents kiss’) are also avoided in elicited production tasks and are in almost all cases, replaced by passive relatives (*il bambino che è baciato dai nonni* ‘the child that is kissed by grandparents’). In order to find an explanation for this phenomenon, Belletti & Chesi (2011) investigated which type of relatives are frequent in corpora of standard Italian. They found that passive relatives are not frequent constructions in the ambient language. Adults indeed use them quite rarely. In the corpus of spontaneous speech they analysed, the percentage of passive relatives ranges from 0.1% to 4%, while in the elicitation of object relatives, adults use them at very high rates (above 90%) (Volpato 2019; Contemori & Belletti 2013).³ In addition, Table 6 and Table 8 show that target pied-piping relatives are produced at a higher rate than direct object relative clauses. Another finding that further undermines the usage-based hypothesis concerns the analysis of errors. Although in some trials, the participants seemed to prefer simpler structures, turning target relative clauses into subject relatives, most errors in prepositional sentences consisted in the selection of the incorrect preposition, in the selection of the non-agreeing relative pronoun *cui* instead of the agreeing relative pronoun *quale*, in the use of incorrect gender and number features when the sentence contained the pronoun *quale*, but the target word order was in most cases maintained.

Along the lines of Relativized Minimality (Rizzi 1990, 2004; Friedmann et al. 2009), Costa et al. (2014) suggested that the difficulties that children face with prepositional relatives are due to intervention effects: the direct or indirect object move across the embedded subject sharing some morphosyntactic features. Since object relatives were as (in)accurate as prepositional relatives, the authors concluded that intervention of the lexically restricted embedded subject is problematic in children, regardless of either the categorial features of the moved elements or the grammatical functions. In this paper, the rate of object relatives reported in the analysed studies is very low (below 4%), since most participants preferred producing a passive relative instead. For pied-piping relatives, the percentage of occurrence is higher than for object relatives. In addition, the errors made by both populations do not seem to be directly linked to intervention effects.

Let’s now focus on the performance of the two populations in the prepositional and genitive relatives comparing repetition and production. In repetition, genitive relatives are the most accurate structures for both populations. In the group of TD individuals, the structure with the lowest percentages of accuracy is the dative relative introduced by *cui*, whereas in the group of individuals with LD, the most problematic structures are dative relatives introduced by *quale*, followed by prepositional genitives. For individuals with LD, difficulties seem to be due to the presence of a higher number of derivational movements/steps and to the necessity of establishing feature (gender and/or number) agreement between articles, relative pronouns, and the constituents to which these elements refer.

In production, the target structures with the highest percentage of occurrence were locative relatives for both populations. For TD individuals, genitive and dative relatives show a comparable percentage of occurrence. For students with LD, target

³ In the corpus of spontaneous speech (Belletti & Chesi 2011), passive relatives are even less frequent than object relatives, whose rate of production is 20%.

genitives were the least produced type of relative, followed by datives. Although dative and locative relatives are both introduced by prepositions and are derived through the same number of movements, the highest percentage of occurrence of the latter as opposed to the former might be attributed to the number of arguments that require theta role assignment (three vs. two, respectively).

Surprisingly, genitive relatives are the structures with the highest level of accuracy in repetition and the least used in the elicited production task. This difference may be due to the characteristics of the tasks. In the repetition task, the target structure is presented to the participants. In the production task, when genitives are elicited, other structures may also be produced, such as subject relatives, and this is indeed the strategy for which the participants often opted.

In conclusions, for both populations, the degree of difficulty in the repetition and production of pied-piping relatives has to be measured in terms of syntactic complexity (namely, the number of movements involved in the derivation due to the presence of relative pronouns), combined with agreement phenomena and the number of arguments that are assigned thematic roles.

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