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THE PUZZLE OF FREE CHOICE DISJUNCTION IN ADULTS WITH DYSLEXIA AND POOR READERS

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Introduction

The problem of Free Choice permission was first discussed by Hans Kamp in 1973. This single published work triggered decades of ongoing academic debates, reflections, experimentations, and discussions in the field of semantics and pragmatics. In his book chapter called "Free choice permission", Kamp relates the following statements:

> *(1) 'You may go to the beach or go to the cinema',*
>
> *I almost told my son Michael. But I thought better of it, and said:*
>
> *(2) 'You may go to the beach.'*
>
> *Boys shouldn't spend their afternoons in the stuffy dark of a cinema, especially not with such lovely weather as today's.* (Taken directly from Kamp, 1973)

While the second permission is entailed by the first one, the first is not entailed by the second one. In other words, if Michael is told that he is allowed to go to the beach or to go to the cinema, he will understand that he is allowed to go to the beach. Instead, if he is told (2), (1) is not maintained. However, the logical rule of the disjunction (corresponding to English "or") states that if P is true, then P or Q is automatically true. This problem has since then been explored by many scholars and no common agreement has been reached. The current work aims at entering the discussion around the computation of disjunction in Free Choice (FC) contexts.

The first chapter provides a detailed examination of the FC phenomenon and reviews various theoretical frameworks that attempt to explain it. Ultimately, a new account to the problem is discussed.

The second chapter introduces dyslexia in adulthood. In exploring this phenomenon, it is also essential to consider how different populations might process the disjunction. In particular, this work will focus on adults with dyslexia. Developmental dyslexia is a condition which is characterized by a language deficits in writing and reading, but also in conversational abilities. While much of the research on dyslexia has traditionally

focused on children, there is growing interest in understanding how dyslexia affects adults.

The third chapter presents the experimental component of our study, which investigates how adults with dyslexia process FC inferences compared to their non-dyslexic peers. In our experiment, we tested 21 control participants and 19 adults with dyslexia and poor readers, examining their accuracy and response times when interpreting FC statements versus truly disjunctive statements. Our findings, consistent with our hypothesis, indicate no significant difference in the processing of these conditions between the two groups in RTs. This result suggests that, despite the reading difficulties associated with dyslexia, the ability to process FC inferences remains intact, which challenges other popular views.

Finally, our findings indicate that the logical reading is not only present but also well accessible both to neurotypical participants and to adults with dyslexia, if they are provided with a pragmatically supportive context.

Chapter 1

Free-choice Permission

Free-choice (FC) inferences are a case of discrepancy between natural language and logic. When derived logically, two disjuncts following a permission modal *(is permitted to)* maintain their disjunctive value. However, in natural language, we observe something different. The following example: "You may eat a pear or an apple" is equivalent to "You may eat a pear AND you may eat an apple". Naturally, the question raised given the problem is simply: why is that the case? Boolean logic does not explain this gap between human language and logic. Thus, scholars have provided different accounts to this problem. This chapter will start by providing a brief introduction on propositional logic. Then, we will focus on the main empirical explanations which have been given to explain this discrepancy and the experimental results of the studies that have been conducted thus far. Finally, a promising new account of the FC problem will be related.

1. 1 Defining disjunction and the puzzling phenomenon of Free-choice.

Logic is a tool that serves to disambiguate meaning in natural language. Logic helps in formalizing the rules and patterns underlying natural language expressions, allowing for clearer communication and more precise interpretation (Posthoff, 2019).

In terms of propositional logic, a proposition is an expression in language which can be assigned a value of TRUE or FALSE. For instance, the sentence "Brussels is the capital of Belgium." is a true proposition, which can be verified if the speaker is aware of the definition of "capital" and has a knowledge of "Brussels" and "Belgium". Other propositions can contain operators like OR, AND, NOT can be analyzed accordingly. The OR operator, also called disjunction, identifies with the symbol ∨ (Posthoff, 2019).

However, the human brain isn't purely logical; it is influenced by the analysis of context, conversation, and tone. Consequently, there are many disconnects between

human language and logic. Disjunction, which is the primary object of interest in the current work, is a prime case of that disconnect. The logical rule of the disjunction (corresponding to English "or") states that if P is true, then P or Q is automatically true. When applied to human language, few people would agree that the following statement is true: "Snow is white or Julia Gillard is the current Prime Minister of Australia". This sentence is not compelling pragmatically to humans, because since both the disjunct are true, the speaker should have used the more informative 'and' operator (referred to as the conjunction). This can be explained by the fact that humans draw their understanding not only from logic but also from the context of the conversation. Therefore, "Snow is white or Julia Gillard is the current Prime Minister of Australia" is pragmatically awkward. On the other hand, logic would regard that proposition as true (Crain, 2012).

1.2 So why use disjunctions in language?

Disjunction is a tool of natural language and logic to express a somewhat partial knowledge of a situation. Let us look at how disjunction behaves, both in logic and natural language (Posthoff, 2019)

1. John has 2 or 3 kids.
2. If I go on vacation in June or July, I will be happy.

As demonstrated in these examples, there is a strong connection between the disjunction and lack of certainty. In (1), the entailment is that the speaker cannot remember how many kids, exactly, John has: it could be 2 or it could be 3. In (2), the speaker also does not have the certainty of when they will go on vacation.

If we take a look at the truth conditions associated with the logical disjunction, we observe that for the statement to be true, we need at least one of the propositions to be true, possibly both. The only situation in which the proposition would be false is if both antecedents are also false.

p	q	p ∨ q
T	T	T
T	F	T
F	T	T
F	F	F

Table 1. Truth conditions of OR (inclusive)

However, when looking at sentence (1), we can observe that, going back to natural language, only one of the propositions can be true, because it would be difficult to imagine a situation in which John could simultaneously have 2 kids and 3 kids. Sentence (1) is an example of 'exclusive or' (also called XOR), in which for the sentence to be true, either of the disjuncts can be true, but not both. In natural language, our knowledge of the condition of the world we live in allows us to interpret the disjunction as being exclusive rather than inclusive, since we use *either… or* and *or* interchangeably. This is a case of a pragmatic influence on our understanding of the language. In other words, hearers of (1) can make calculations that match their understanding of the world. Since they know that at any given point in one's life, a person has a constant number of children, they are able to compute that 'John has 2 or 3 kids' means that he has '2 or 3, but not both'.

However, 'or' can also be interpreted as inclusive in natural language. For instance, the utterer of sentence 2 would certainly be happy in 3 conditions:

3. a. If they went on vacation in June, they would be happy.

b. If they went on vacation in July, they would be happy.

c. If they went on vacation in June AND in July, they would also be happy.

The only condition in which they would not be happy is if both propositions were false, so their vacation was NOT in June and also NOT in July. Therefore, this is an example of 'inclusive or', for which the truth conditions are expressed in table 1.

As mentioned earlier, disjunctions are used in natural language to express a lack of certainty. Crucially, the disjunction does not commit the speaker to either of the propositions, just one of them, but we ignore which it is.

4. a. John has 2 or 3 kids

   b. $\nRightarrow$ John has 2 kids.

   c. $\nRightarrow$ John has 3 kids.

The sign $\nRightarrow$ is used to denote that there is no entailment. Namely, we cannot infer that John has 2 kids from (4) a. Similarly, we cannot infer anything for certain from (2). In other words, the disjunction has little informative power, since when using it, there are either 2 scenarios in which the proposition could be true (for the XOR) and 3 scenarios in which the proposition could be true (for the inclusive OR): thus, nothing is certain when using the disjunction.

1.3 A stronger alternative.

The conjunction (AND, denoted as $\wedge$) is a stronger operator than the disjunction, since it is more informative; When using the conjunction, the proposition is true ONLY if both conjuncts are true, as seen in the following truth table.

p	q	p$\wedge$q
T	T	T
T	F	F

F	T	F
F	F	F

Table 2. Truth conditions of the conjunction.

As a result, language users have more certainty when using the conjunction. For example, compare:

5. a. John loves visiting France *and* England.

    b. John loves visiting France *or* England.

When hearing (6) a., one would access the meaning that John loves both France and England. If John were to say that he despises France, the proposition would be false. In (6) b, there is uncertainty. The hearer would not know which of the two John likes; it could be France, it could be England, or possibly both, but crucially, there are more than one situation in which the proposition would be true. Instead, in (6) a, the only way we could verify the proposition to be true is if both the antecedents are true, which allows a certainty of exactly which countries John loves visiting.

Grice's conversation principles state that a speaker should make the strongest statement that you are in a position to make (Grice, 1975). This principle alone tremendously affects the disconnect between natural language and logic. While in logic there is nothing wrong with P or Q if both are true, in natural language, we observe something different, and here is why.

The conjunction is logically stronger, and therefore more informative than the disjunction, since it can only be true in one scenario: if both conjuncts are true. As a result, using the conjunction signals certainty about the situation. On the other hand, the disjunction, which is less informative since it could be true in three scenarios, offers much less certainty.

Since the speaker should, according to Grice, make the strongest statement, it is assumed that using the disjunction means that it would not be in the speaker's ability to use the stronger "and", otherwise they would have. This assumption forces the hearer to negate the circumstances in which both P and Q are true (for which the conjunct is more appropriate) and be left with the interpretation in which P might be true, or Q might be true, both not both. This interpretation is referred to as the "exclusive interpretation", as seen above in sentence 1.

Most importantly, regardless of the inclusive or the exclusive interpretation, the disjunction entails a lack of certainty. As mentionned above, p ∨ q does not commit to the truth of either p nor q.

1.4. A puzzling disconnect: When OR means AND.

However, the free-choice (FC) phenomenon offers a problem that defies what we know about the disjunction. Here is the key problem: when following a permission modal, the strong link between the disjunction and ignorance seems to disappear in most contexts.

6. a. John *may* have pancakes or waffles.

   b. ⇒ John may have pancakes.

   c. ⇒ John may have waffles.

   d. ⇒ John may have pancakes AND John may have waffles.

In this sentence, which options are permitted to John? As indicated above, (5).a. can be understood as entailing that John is allowed to have pancakes AND John is also allowed to have waffles. Both of the options are permitted to John. The problem here is two-fold. First, there is no longer a lack of certainty, which is fundamental to the disjunction: When hearing that he is allowed to have pancakes or waffles, John will look at the options before him and choose freely based on his intuition. Second, the interpretation of the disjunction in the case of FC is one of a conjunction as demonstrated above in (5). d.

As anticipated here, propositional logic is a tool to provide a clear interpretation of natural language. Logic, more precisely Boolean Logic does not, however, explain everything about language. It does not, for instance, explain how we can derive a conjunctive meaning from a disjunction, as demonstrated above in (5).

It is also possible to obtain a 'truly disjunctive' meaning of a permission modal followed by a disjunction by modifying the context of the sentence. For example, if one tells John : "Tomorrow we'll be having brunch with your cousins. You may have pancakes or waffles, though I don't know which yet.". In this case, John doesn't know which option is permitted, he will have to wait until tomorrow to find out. It seems like the 'truly disjunctive' nature can be strengthened by adding a context of uncertainty, mainly of some situations that will be confirmed in the future.

To illustrate the possible interpretations, let us look at the following sentence:

7. a. John may have pancakes or waffles, (though I don't know which yet). (logical)

   b. $\nRightarrow$ John may have waffles.

   c. $\nRightarrow$ John may have pancakes.

8. a. John may have pancakes or waffles, (he is free to choose). (FC phenomenon)

   b. $\Rightarrow$ John may have pancakes.

   c. $\Rightarrow$ John may have waffles.

For the purpose of the current work, the terms logical and FC are used to refer respectively to the 'truly disjunctive' interpretation and the 'conjunctive interpretation'. The first striking difference between the two readings is that in the FC reading, John has permission to do two things. In the logical reading, he essentially doesn't have permission to do anything: he must wait for further instructions. Interestingly, the reading with the most options (FC) is found frequently in natural

language. In fact, it would be unlikely for John to hear the sentence and wait for further instructions. In other words, (7), as intended logically, would be unfelicitous.

While it is possible to create a context in which the 'uncertain nature' of the disjunction is maintained when following a permission modal, fundamentally, there is no definite answer to why this lack of certainty disappears naturally.

The following parts of this chapter will explore different explanations for this puzzle in semantics.

1.5. The Scalar Implicature account

The first perspective worth discussing here is Chemla and Bott's. A key concept in their proposal is the concept of scalar implicature. In scalar implicature, the meaning of an utterance has to be interpreted with an addition from the context. More precisely, standard scalar implicature enriches the meaning of an utterance by negating some alternatives. For example, if the speaker said "some", the alternative "all" should be negated. Observe the following:

9. John read some of the books.

In this sentence, the entailment is that John did not read all of the books. Otherwise, according to the Maxim of Quantity by Grice, the speaker should have said the most informative option. In other words, the speaker would have said 'all' if John had read all the books. Therefore, processing the phrase 'John has read some of the books' requires the hearer to negate the 'all' alternative, and ultimately understand that 'some but not all books' were read, rather than 'some and possibly all'. Scalar implicature, as widely demonstrated in literature, carries a cognitive cost (Noveck, 2001; Noveck and Posada, 2003; Bott and Noveck, 2004; Breheny et al., 2006). For that reason, children tend to understand the quantifier 'some' as 'some and possibly all' which is easier and faster to process. Other populations with limited processing abilities such as dyslexic children (Vender, Lavarini, Delfitto, 2013) also tend to struggle with the processing scalar implicature. A classic example of literature that demonstrates the cognitive cost of scalar implicature is Bott and Novek (2004). In their experiment, participants were

asked to interpret sentences with the quantifier 'some' meaning either 'some and possibly all' (logical) or 'some but not all'(pragmatical). Using behavioural measures such as reaction times, their goal was to investigate the relative cognitive cost of scalar implicature. In other words, is it easier for humans to process 'some' meaning 'some and possible all' or 'some but not all'? When Tarzan asks Jane "Do you like my friends?" and her response is "Some of them", Tarzan understands that Jane doesn't like ALL of his friends. Is this interpretation the fastest (and therefore has the least cognitive cost)? Bott and Novek show us the opposite. When participants had to interpret sentences with either the logical interpretation or the pragmatic interpretation, they were consistently quicker and made fewer mistakes when going for the logical interpretation. Thus, this experiment provides further confirmation that Scalar implicature, or rather the implicature calculation that comes with negating an alternative, carries a cognitive cost.

Going back to the matter of FC, Chemla and Bott (2013) provide an account in which FC results from second-order scalar implicature. Just like with the quantifier 'some', FC disjunction might be the result of negating an alternative. However, second order scalar implicature implies negating an already enriched alternative. Consider the following:

The sentence "Mary is allowed to eat an apple or a pear" gives the alternatives:

10. a. Mary is allowed to eat an apple.

    b. Mary is allowed to eat a pear.

    c. Mary is allowed to eat an apple AND a pear.

At this point, we must negate the 3rd alternative, since only one of them is allowed, giving rise to the exclusive meaning of the disjunction. This step alone is expected to carry a cognitive cost. In this case, the most informative alternative 'and' is negated when uttering 'or', so the interpretation which arises from the scalar implicature is 'an apple or a pear, but not both' (similarly to the quantifier 'some'). However, we cannot negate both the first and the second alternative, since there would be nothing

permitted, but we can also not negate one over the other, since we do not have any reason to do so. Therefore, we are left with having to accept both 1 and 2 simultaneously which gives the interpretation "Mary is allowed to eat an apple AND Mary is allowed to eat a pear." with both options permitted, but not together (negation of 3).

According to this account, FC is a complex process of implicature calculation. Therefore, it follows that it should have a cost, predictively the same or higher than standard scalar implicature. This hypothesis has many advantages. It allows an economical understanding of implicature calculation since it allows to maintain standard assumptions about disjunctions and modals. In contrast, other models require the modification of some basic semantic assumptions about disjunction and modals. Therefore, Chemla and Bott suggest that this hypothesis is both probable and economical.

They have designed 4 experiments which have the aim to test this very hypothesis. The design is very similar to the one developed by Bott and Noveck (2004) since they wanted to test if participants understood the sentences with a FC interpretation or a Literal interpretation. They predicted that if FC is a result of scalar implicature the results would follow the experiment by Bott and Noveck (2004), or in other words, Free-choice permission would be cognitively costly.

In all of their experiments, a cover story was provided: The destruction of the world was approaching. Thankfully, certain people were allowed to save certain objects. The story mentioned that zoologists were allowed to save living creatures, such as lions, and engineers were allowed to save man-made objects, such as hammers. When shown the following sentence: "Derek-the engineer is allowed to save a hammer or a lion.", participants had to decide if the sentence was true or false. If participants went for the Free-choice interpretation, they would declare the proposition as false (engineers are not allowed to save lions). If they went for the literal interpretation, they would declare the sentence as true (engineers are allowed to save one of the two).

In their first experiment, participants had to classify the experimental sentences as true or false. Reaction time was tested for the true response (literal) and the false response (FC). Results from this first experiment showed two things: first, the FC responses were most often chosen by the participants and second, reaction time were faster for the free-choice interpretation than the literal.

In their second experiment, the design was similar, but this time the participants received feedback after each response. The participants were divided in two groups: one were encouraged towards the FC interpretation, and the other group was encouraged towards the literal interpretation. The results from this second experiment followed the ones from the first experiment: significantly faster responses were found for the free-choice interpretation.

In experiment 3, participants had to complete a scalar implicature task (from Bott and Noveck, 2004, but modified to fit the cover story) and a FC task (exactly like in the first two experiments, with feedback). The results from this experiment found that there was no difference in reaction times between FC and literal interpretations. In comparison, the results from the scalar implicature test demonstrated, in line with previous findings, that scalar implicature needed more time to verify than literal interpretations.

In their final experiment, Chemla and Bott wanted to know if the proportion of FC was reduced if participants had a restricted time window to process the sentences (900ms). The results did not show the expected outcome, which would have been that FC inferences, similarly to scalar implicature, would show a decrease in accuracy under a time constraint. Rather, this was not observed, and the proportion of FC remained consistent.

As previously mentioned, Chemla and Bott's account of FC as a result of double scalar implicature is appealing in the way that it is economical. However, the results from these rather thorough experiments simply demonstrate that this is not the case. In other words, FC is not the same as scalar implicature. Instead, the results seem to indicate quite the opposite: *not* deriving FC is a costly phenomenon. Thus, further

investigation is needed to understand this phenomenon. According to the authors, basic assumptions on disjunctions, modals, and quantifiers may be revisited to provide a sustainable answer. In the next parts of this chapter, two other valuable accounts by Zimmermann and by Aloni will be discussed.

1.6. A Purely Semantic Account

Zimmermann suggests a different account which has the advantage of being purely based on semantics, contrary to other approaches that rely on the influence of pragmatics. In this section, we will explore this account.

One of the central idea to Zimmermann's proposal is the idea of disjunctions as lists of epistemic possibilities. Simply put, when one expresses a sentence using a disjunction, such as "Mr. X is in Regent's Park or in Victoria or in the City", one is expressing a list of the existing possibilities of where Mr. X could be found.

Zimmermann's idea relies on the Authority Principle, which states that a speaker behaves somewhat as an authority on the sentence they utter meaning that they possess the required knowledge to make their claim. If we assume the speaker to have the authority, then the claim must be true. When applied to FC permission, the speaker must have the authority when they say "you may have an ice-cream or a burger". Therefore, it follows that both options are possible, since the speaker is assumed to have the knowledge that they are.
Zimmermann notes that the Authority Principle can be canceled, if the speaker overtly states not to have the required knowledge, therefore disqualifying themselves as an authority. For instance, by uttering "You may have an ice-cream or a burger, though I don't remember which." the speaker is no longer an authority, and the FC permission does not hold anymore.

Contrary to other accounts, Zimmermann does not make use of pragmatics, which has the advantage of being aligned with the experimental results found in Chembla and Bott (2013), which showed that deriving FC did not carry any specific cognitive cost. However, his theory forces the modal of permission to be reevaluated semantically.

1.7. The pragmatic intrusion account.

In a recent article published in 2022, Aloni offers an account that significantly differs from the scalar implicature account. Contrary to the Gricean approach, Aloni sees FC inferences not as the result of scalar implicature, since, as demonstrated above, FC inferences do not have the processing cost of scalar implicature (Chemla & Bott 2014). Thus, the author demonstrates that the standard implementations of Grice's view are inadequate when applied to FC.

She suggests a different account, one that is centered around the notion of *pragmatic intrusion.* According to her model, language users tend to pragmatically neglect empty configuration to understand a statement. In other words, the human brain prefers concrete possibilities rather than empty, abstract ones. Therefore, both the conjuncts in a statement would have to be Non-Empty (Non-emptiness atom= NE) to satisfy that preference in humans. She explains that language users tend to neglect zero-models because they are cognitively costly, and thus, FC inferences would be the result of that tendency.

According to Aloni, Free Choice inferences are not cases of scalar implicatures, even though they are both pragmatically derived, since applications of Grice's Quantity Maxim derive Scalar implicatures and FC inferences cannot be derived from the same process. Instead, she suggests that FC is the result of the natural tendency of speakers to interpret a sentence by integrating it within a picture of reality, which naturally drives them to neglect any empty configuration (she calls it neglect-zero). Empty sets, which she called 'zero-models' are cognitively taxing, and therefore are usually avoided. This could explain the results cited above from Chembla and Bott, which found that *not* choosing the FC interpretation is costly.

Aloni, similarly to Zimmermann, suggests that when one utters "A or B" one means that each part of the disjunction is an open *epistemic possibility*, which gives rise to the conjunction meaning.

Her approach is logic-based and doesn't distinguish between pragmatics and semantics. According to her model, which she refers to as 'non-classical state-based modal logical model', meanings are interpreted from the literal meaning and a pragmatic intrusion process, which can be denoted with and [ ]+. For that reason, FC cannot be explained in terms of truth-conditions, because it is not the result of logic but of a speech act, it is created pragmatically. So, in this model, the meanings free of pragmatic intrusion behave classically (and therefore, can be explained by Grice). In this sense, FC inferences are possible, but they can't be derived classically, they have to be derived in conversation.

1.8. A potential compromise

As previously discussed, the scalar implicature account of FC has the advantage of building up from a strong and well-known approach and extending it to our current problem. However, the experimental evidence simply does not match this hypothesis. Contrary to the calculation of scalar implicature, FC seems to be faster and more accessible than its logical counterpart. Thus, we have to conclude that FC inferences are not the result of scalar implicature.

Zimmerman suggests a purely semantic solution, which relies on laws of epistemic logic. While this idea follows with the experimental results found by Chembla and Bott, it has the disadvantage of modifying the semantics of modals. His work suggests that the modals be analyzed as epistemic, which should be treated as a list of epistemic possibilities.

Aloni suggests another explanation based on pragmatic intrusion, in which language users tend to ignore empty substrates. In response to her work, Delfitto and Vender (2024) mention the following problem: if it is true that humans carry a cognitive constraint that leads to systematically ignoring all empty sets in semantics computations, then it follows that the logical interpretation would be nearly impossible to derive. Instead, as demonstrated above, it is possible to access the classical disjunctive reading, if we strengthen it with a pragmatic context of an 'uncertain future' The current work will develop on the relative cognitive cost of the

logical reading. The hypothesis that will be tested below is that the logical interpretation is possible with no particular difficulty.

In their recent 2023 article, Delfitto and Vender suggest an alternative account to explain the phenomenon of FC. Their work is entering the conversation of the previous work cited above. Their alternative will be discussed here and tested in the experimental part of the current work.

They argue that the FC reading is the result of a non-Gricean process of pragmatic intrusion that slightly affects the interpretation of propositional operators to ensure that two distinct scope assignments be associated with distinct truth-conditions. In this setting, the key to FC computation is local compositional semantics and, more particularly, the availability, within the same sentence, of two competing construals of relative scope assignment. It follows that, even though the FC interpretation is most common, the 'purely disjunctive' reading can also be found in natural language, provided this reading is pragmatically supported. Therefore, if a supportive context is provided for both the FC and the 'standard disjunction' reading, the FC reading should not have any additional cost compared to the purely disjunctive one. The reason is that, though the FC crucially depends on pragmatic intrusion, it is NOT a consequence of any process of implicature calculation (it is not based on the cognitively costly process of negating a complex set of alternatives). Rather, the relevant computations are strictly local, i.e. they do not extend beyond the lexical resources provided by a single sentence.

Let us see the steps to arrive at the FC reading according to their account.

First, the mechanism of relative scope assignment, and then, second, a constraint of accessibility. Let us start with exploring the first step. In a sentence such as "John is permitted to have an apple or a pear.", the permission modal (is permitted) has an ambiguous scope which gives rise to slightly different readings.

(5) $\lozenge (p \lor q)$: wide scope

(6) $(\lozenge p \lor \lozenge q)$: narrow scope

The sentence in (5) would give the reading "it is permitted that John eats an apple or a pear" while (6) reads "it is permitted that John has a pear OR it is permitted that John has an apple". To arrive at the FC reading, the first step is to assign the second reading (narrow scope) to our sentence, in which the modal of permission applies locally to each disjunct. However, this is not enough to arrive to our FC conjunctive meaning. Applying the narrow scope leads to a similar "ignorance" interpretation to the wide scope, in which one of the two is permitted, but we do not know which. Thus, we need another step.

The second step is to add a constraint that states that the antecedents cannot be false, which automatically leads to transforming ($\Diamond$p $\lor$ $\Diamond$ q) into ($\Diamond$p $\land$ $\Diamond$ q), which gives rise to the FC inference. Essentially, for a disjunction to be true, it requires to be in a world in which both the disjuncts are accessible. This solution has the advantage of being intuitive. When we utter 'you may have ice cream or cake', it seems reasonable that both the options (ice cream and cake) are available in the world in which the sentence is uttered. Similarly to Zimmerman's idea, this relies on the assumption that the speaker has the necessary knowledge to make their claim.

This transformation, which gets triggered by a relative scope assignment from wide to narrow is pragmatically motivated.

Crucially, Delfitto & Vender's (2023) proposal is not far from Aloni's, since they are both borne out of a pragmatic explanation, but the former gets triggered by scope assignment, and the latter considers each disjunct as an open epistemic possibility.

According to their proposal, the FC reading should not have an additional cost compared to the logical reading, even though FC relies on pragmatics, since the interpretation, contrary to implication calculation, does not require the negation of an alternative. Rather, the required operations are maintained in the same sentence, through the two steps explained above.

1.9. Conclusion

This chapter has delved into the intriguing phenomenon of FC and explored various theoretical accounts proposed to explain it. Beginning with an examination of the discrepancy between natural language and logic in the interpretation of disjunctions, we have seen how the FC phenomenon challenges traditional assumptions about the meaning of "or" in linguistic contexts.

Different accounts have been reviewed. While Chemla and Bott's proposal builds upon the concept of scalar implicature, Zimmermann's semantic account emphasizes the role of epistemic logic, and Aloni's pragmatic intrusion model highlights the influence of cognitive preferences in language processing.

Delfitto and Vender's alternative account introduces a two-step process involving relative scope assignment and a constraint of accessibility. By assigning narrow scope to permission modals and imposing a constraint that antecedents cannot be false, their proposal elegantly generates free-choice inferences. This transformation, triggered by pragmatic considerations, aligns with speakers' intuitive understanding of available options.

Crucially, Delfitto and Vender's proposal bridges elements of Aloni's and Zimmerman's theories, emphasizing pragmatic reasoning triggered by scope assignment. Unlike scalar implicature, their approach maintains coherence within the sentence structure, avoiding the need to negate alternatives. Consequently, their hypothesis suggests that the cognitive cost of FC interpretations may be comparable to logical readings, offering a promising avenue for further experimental investigation.

Chapter 2

Developmental dyslexia from childhood to adulthood

In this chapter, we will delve into developmental dyslexia, focusing on dyslexia in adulthood. While much of the research has traditionally been centered around dyslexia in children, the understanding of its evolution into adulthood has only recently been studied within the field of psycholinguistics.

First, this chapter will attempt to define developmental dyslexia and look over some key statistics in Italy and in the world.

Subsequently, we explore the neuroscience of dyslexia, to examine the distinctive features that set dyslexic brains apart from neurotypical ones.

Then, we will explore some of the challenges that adults with dyslexia face, shedding light on the nature and complexity of their struggles. This section will discuss important findings regarding the pragmatic abilities of adults with dyslexia, which will be crucial for the current research.

 Finally, this chapter will describe the reality of dyslexia in adulthood, by drawing from uplifting research and sharing the compelling story of individuals with dyslexia. Indeed, receiving a diagnosis is often incredibly empowering, and in many cases, a sigh of relief. For this reason, this chapter will include real-life examples of adults with dyslexia and their experiences before and after the diagnosis.

2.1. Definition

Offering a single definition of developmental dyslexia is a difficult task since dyslexia is an umbrella term for a range of learning disabilities. There also isn't just a single list of symptoms that all people with dyslexia share; it is a diverse experience. However, there is a consensus that developmental dyslexia is a disability that mostly affects one's literacy skills and language abilities. The diagnosis of dyslexia, as any other disability, starts with a notable difference; when school-age children start to

learn reading and spelling, the dyslexic child will have difficulties that go beyond normal development. In the case of dyslexia, these difficulties cannot be explained by other factors, such as sub-normal intelligence, environmental factors, hearing or seeing inadequacies, and therefore dyslexia is diagnosed by exclusion. By eliminating all other factors that could explain reading difficulties, we are left with a group of individuals which can be classified as having dyslexia (Lyon, 2003)

However, having a consensus on a definition of dyslexia has been a goal both for research and clinical treatment. **The International Dyslexia Association** suggests the following:

> *"Dyslexia is characterized by difficulties with accurate and / or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge."*

As mentioned in the definition above, the difficulties typically surrounding developmental dyslexia are not related to visual impairment or low cognitive abilities. Rather, dyslexia is a language-based disorder, specifically rooted in phonological processing. Phonological processing is one's ability to analyze speech and language, identify words or syllables, and recognize speech sounds, also called phonemes (Moats, 2008)

The cause of dyslexia is currently unknown. However, brain imaging studies have shown notable differences in the brains of people with dyslexia compared to neurotypical individuals. Moreover, dyslexia is known to be a largely genetic-based disorder (Moats, 2008).

 It is said that 5 to 15 percent of the world population is affected by dyslexia. However, the actual statistics of diagnosed individuals in each country vary greatly.

Such a discrepancy cannot be explained by population genetics; there is no variation in humans of different populations which could cause a population to have a greater percentage of the population with a diagnosis of dyslexia. The answer is two-fold: first, some languages, like Italian and Spanish have a writing system which is said be transparent. In most cases, the script has a clear correspondence to how a word is pronounced (Wydell, 1999). This is not the case for other languages such as French and English, in which there is poor correspondence between graphemes and phonemes. For that reason, people with dyslexia will tend to struggle significantly more when learning to write in languages with an opaque writing system, such as French or English. As a result , it is more likely that reading difficulties go unnoticed in languages with a transparent writing system, as Italian, with the consequence that fewer Italian speakers are diagnosed with dyslexia as compared to English speakers. The second reason can be defined as socio-political. Offering adequate support and professional help to diagnose and manage the manifestations of dyslexia requires political drive and economic resources, which some countries have more than others. For that reason, it is estimated by the Italian Dyslexia Association (AID) that around 5% of the population in Italy is dyslexic, which might indicate that a significant portion of the population in Italy might be underdiagnosed.

2.2. Dyslexia and the brain

Neuroimaging studies have attempted to investigate the root differences in the brain anatomy of people with and without dyslexia.

No single area of the brain can be identified as responsible for reading, considering it is a rather recent ability of humans. Instead, neuroscience approaches the matter in terms of networks. In the case of reading, we are interested in which are the brain areas that form a network responsible for the complex cognitive function of reading. First, reading requires grapheme-phoneme mapping, that is the association of written letters (graphemes) and their correspondences to sounds (phonemes). Then, reading also requires to visually recognize a word and associate it with a meaning and a mental representation of that word. These functions are distinct since it is possible to

read a word (grapheme-phoneme association) without linking it to a meaning, such as in the case of non-word reading. Together, these two cognitive abilities allow us to read and understand what we are reading (IDA, 2024).

Neuroimaging studies have shown that reading, like other language abilities, is lateralized in the left hemisphere, including the occipito-temporal, temporo-parietal and inferior-frontal areas (Price, 2012). Precisely, the occipito-temporal cortex is responsible for the visual word form area, that is the visual recognition of a word and its association to a meaning. On the other hand, both the temporo-parietal and the inferior frontal cortices are involved in the phonological and semantic processing of words. Unsurprisingly, studies have shown that these areas are altered in people with dyslexia, specifically they show an underactivation in the left hemisphere (Richland et all, 2011).

Other studies (Finn et al, 2008) have used fMRI to compare how people with dyslexia read compared to neurotypical individuals. In their 2008 study, Finn et al. attempted to investigate the whole brain connectivity in both children and adults, which contrasts with other studies that have focused solely on the left hemisphere. Moreover, their study offers a novel perspective focusing on connectivity rather than activation. As mentioned above, neuroscience is moving away from trying to identify single brain areas responsible for each function, especially complex functions such as reading, and the term brain networks is preferred. In these terms, connectivity might be just as important as activation, or potentially more. Their research showed that differences in network connectivity were found in individuals with and without dyslexia. Specifically, visual areas seemed to be connected better in individuals without dyslexia. This follows previously found results which stated that individuals with dyslexia had weaker activation in the occipital and occipitoparietal regions. Another network was reported to show a weaker connection in dyslexics: the pathway between visual areas and the prefrontal cortex (PFC), said to be responsible for executive functions, such as focusing and shifting attention. This, along with a weaker connectivity in the visual network, suggests a difficulty in visual attention in the group with dyslexia, demonstrating a strong link between dyslexia and attention deficit.

Another valuable conclusion from their research is that individuals with dyslexia showed to be slower than neurotypical individuals to lateralize language to the left hemisphere. As previously mentioned, the left hemisphere is dominant for language, and lateralization to the left hemisphere increases until the age of 20. Contrary to neurotypical individuals, dyslexics relied on a bi-lateral system, rather than a lateralized one. Therefore, it was found that the right hemisphere was more active and more strongly connected in dyslexia (Finn et al, 2008). In other words, the impairment found in language networks in the left hemisphere may be compensated in individuals with dyslexia with increased connectivity with the right hemisphere. However, it seems that by 20 years of age, differences in lateralization have mostly been neutralized: thus, dyslexics are slower to lateralize language, but as they reach adulthood, language is normally lateralized to the left hemisphere.

2.3. What is the nature of the difficulties that adults with dyslexia face?

This section will investigate recent experimental research in psycholinguistics and cognitive science, highlighting just some of the difficulties faced by adults with dyslexia.

2.3.1. Reading

It is well-known that dyslexia is typically characterized by reading difficulties, yet, are these difficulties maintained in adulthood?

A systematic review of the literature by Vender and colleagues investigated 8 studies on different language-related abilities in adults with dyslexia. The criteria for research to be included in their review were the following: participants had to be 16 years old or older with a diagnosis of dyslexia or severe reading disabilities, and the focus of the study had to be on reading abilities (see Vender, Melloni, and Delfitto, 2022 for more detailed criteria). Crucially, all studies reported marked reading difficulties in dyslexic participants.

Additionally, a study conducted on the reading abilities of dyslexic students in higher education seems to indicate that the difficulties persist in adulthood, even for individuals in Higher Education, but not in all areas of reading (Simmons, 2000).

The goal of this study was to evaluate the literal understanding and the inferential abilities of students with dyslexia when compared with their neurotypical peers. To do so, they tested 10 dyslexic undergraduate students. Their reading comprehension test consisted of a 655-word passage of text and multiple-choice questions, half of which were classified as literal questions and the other half as inferential questions. The text was made relatively complex by the use of long sentences and difficult syntactic structures but was deemed suitable for college-level individuals.

For both groups, the inferential questions were more difficult, and no significant difference was found between the control and experimental groups for the literal questions. However, significantly lower scores were obtained by dyslexic individuals when answering the inferential questions.

For the current research, these findings are fascinating for two reasons: first, it seems that reading difficulties are still found in dyslexic individuals into adulthood. Second, the difficulties seem to be more marked in answering questions that require inferential skills. Making inferences requires two different skills: to integrate more than one piece of information or to resort to real-world knowledge, which might be affected in adults with dyslexia.

The conclusions from these findings seem to indicate the following: while it is true that dyslexic individuals in adulthood have an additional struggle when it comes to reading, that struggle seem to be more noticeable in inferential tasks and not less in word decoding.

Yet, some scholars would argue that decoding and general reading skills are connected, contrary to the predominant view (Daneman, 1987). Therefore, it is possible that inefficient decoding added a strain to the working memory of individuals with dyslexia which had the consequences of lowering the accuracy in the inferential

questions. In other words, the inferential impairment might be caused by an impaired working memory, and not necessarily by an impairment in making inferences. According to Daneman (1987), working memory as a system has a limited capacity due to a lack of processing efficiency in dyslexics, which has the effect of lowering reading comprehension abilities. Thus, inefficient decoders will have less working memory space for comprehension, since their working memory will be devoted to decoding rather than making inferences.

In terms of limitations, this study tested only 10 participants and would need to be reproduced to confirm the results.

2.3.2. Pragmatic abilities

This section will look over experimental data investigating the pragmatic abilities of adults with dyslexia.

Pragmatic abilities can be defined as the capacity to comprehend and produce language appropriately for the context (Domaneschi & Bambini, 2020; Levinson, 1983; Sperber & Wilson, 1995). Pragmatic abilities are key to communication, so impairments in these skills would create challenges in everyday activities which require to make inferences, integrating information, understanding metaphors, and interpreting context (Cappelli, 2022). Certain disorders have been associated with impaired pragmatic skills, such as Autistic Spectrum Disorder (Rosello, 2020), and some research has been conducted to understand if impairment in pragmatic abilities extends to developmental dyslexia.

The first study by Cappelli et al (2022) investigated the pragmatic skills of children and adults with dyslexia. In their study, Cappelli and colleagues wanted to present an overview of pragmatic skills and dyslexia by reviewing the few existing pieces of research. The main conclusion that can be reached from the growing body of research is that both children and adults with dyslexia experience some sort of pragmatic impairments.

Pragmatic skills are difficult to attest since pragmatics is at the intersection with all levels of language abilities, making it challenging to isolate it from other aspects of communication behavior. For that reason, very few standardized tests exist for pragmatics as a whole rather than specific abilities, for example, the understanding of idioms or simply attesting unregulated speech acts. Amongst the general pragmatic standardized tests, we find Bryan's (1995) Right Hemisphere Language Battery (RHLB), which includes lexical-semantic skills, written and picture metaphor comprehension, the understanding of humour, sensitivity to emotional and linguistic prosody, and discursive abilities. This battery was first aim towards brain-injured patients and might not be suitable for adults with dyslexia.

Another standardized test was more recently developed by Arcara and Bambini's (2016) and is called 'Assessment of Pragmatic Abilities and Cognitive Substrates' (APACS). This test includes a production section and a comprehension section. It attests abilities regarding figurative language and humour. It was designed to be used on a wide range of adult populations and some studies have been done on dyslexia with the APACS (Cappelli, 2018).

While most of the research currently done focused on children with dyslexia, this section will look into some of these key findings in adulthood. However, it is important to note that the existing research done on dyslexia in childhood indicates that children with dyslexia tend to demonstrate lower proficiency in pragmatic skills compared to their peers without dyslexia. This discrepancy is particularly evident in their comprehension of figurative language such as metaphors, idioms, and humor, as well as in their ability to infer implicit meanings like scalar implicatures and implicit information (Cappelli et al, 2022, Ferrara et al., 2020; Lam and Ho, 2014). Additionally, some may experience challenges related to Theory of Mind (ToM) and executive functions, while others may struggle with utilizing context, organizing narratives, and navigating social interactions, such as managing conversations within a peer group (Cardillo, 2018). That being said, let us now look at the research in adulthood.

A study by Kasirer and Mashal (2017) tested various age groups, and while they found that children with dyslexia performed significantly worse than their peers in metaphor comprehension, they did not find such results in adulthood, suggesting that with age, the gap closes or diminishes significantly.

On the other hand, studies done by Griffiths (2007) and Cappelli et al. (2018) found different results. They both wanted to test pragmatic skills in young adults with dyslexia by comparing the experimental group to comparable high-functioning adults enrolled in university. In this case, they found a significant difference between the two groups. Both found participants with dyslexia's pragmatic abilities to be reduced compared to peers without dyslexia. Let us look at both of their findings.

Griffiths (2007) compared the results of 20 English-speaking university students with dyslexia and of 20 controls on subtests from Fawcett and Nicolson's (1998) Dyslexia Adult Screening Test (DAST), which served at categorizing the participants as dyslexic or control, and on four adapted subtests from Bryan's (1995) Right Hemisphere Language Battery (RHLB) assessing pragmatics in comprehension. The choosen section of the RHLB aimed at testing Metaphor comprehension through picture and text, comprehension of inferred meaning and appeciation of humour. For the metaphor picture comprehension, participants were asked to listen to a pre-recorded phrase while looking at four pictures, each representing respectively one metaphorical, one literal and two control meanings (Bryan, 1995). Participants had 10 second to match the phrase with the picture. For the metaphor verbal comprehension, participants had to listen to a pre-recorded phrase and match it with 3 potential meanings, representing a metaphorical meaning, one catch, and one literal meaning (Bryan, 1995). As for the inference test, the task consisted of a short story followed by four questions which all required inferential abilities. Finally for the humour task, participants were asked to listen to a joke and finish with four possible punch-lines. According to Bryan, the punchlines were either the actual punchline, an ending with a neutral or emotional content, or an unrelated surprise ending. Results from this study evidenced marked difficulties in understanding humour and deriving inferential information from a storyline. Moreover, they found a correlation between the results

on the DAST and on the RHLB, which suggests, similarly to the inferential difficulties in reading, that cognitive overload in the working memory would result in inefficient and inaccurate non-literal language comprehension.

Similarly, a study done by Cappelli et al. (2018) assessed the pragmatic skills of well-compensated Italian-speaking young adults with dyslexia compared with controls. They used different assessment tasks: the APACS as well and an Italian adaptation of the RHLB called the "Batteria sul Linguaggio dell'Emisfero Destro SantaLucia" (BLED), with the aim of reproducing the study previously done by Griffiths in 2007. When tested with BLED, people with dyslexia performed significantly worse than controls in the Picture Metaphor task and in Humour, and a trend was also observed in the Written Metaphor and Inference tasks. Similarly to the study by Griffith cited above, the tasks comprised in the BLED included Picture Metaphors, Written Metaphors, Inference, Requests, and Humour. As for the APACS, the task which asked the participants to explain the meaning of figurative expressions (Figurative Language 2) proved the most challenging, being the one where 84% of the individuals with dyslexia performed below cut-off.

The Figurative Language 2 task required to infer meaning from non-explicit verbal explanations. The participants heard 15 items, 5 idiomatic expressions, 5 metaphors, and 5 proverbs. Participants had to explain the meaning of each. The score of 0 was given when the subject was not able to explain the meaning or got the explanation wrong. A half point was given if the answer was correct but incomplete, and the full point was given for a correct explanation of the item (APACS, 2017).

In the dyslexia group, seven out of 19 participants (36%) had a performance below cut-off in the APACS Total score. None of the participants in the control group had a performance below cut-off in APACS Total score. Among the different tasks, Figurative Language 2 was the one where most often individuals with dyslexia performed below cut-off (16 out of 19 participants; 84%).

The pragmatic profile of adults with dyslexia shows compromised competence across both expressive and receptive modalities, with the greatest challenges posed by

inferring meanings from figurative expressions and from texts. Furthermore, the manifestation of pragmatic inefficiencies was confirmed by performance disparities in the BLED, where notable distinctions between individuals with dyslexia and the control group emerged in tests assessing metaphor and humor comprehension.

In conclusion, the research clearly points- to the fact that the difficulties found in childhood persist to a varying degree into adulthood in terms of the relationship between dyslexia and pragmatic abilities. While some studies suggest a developmental trend towards improvement in certain areas of pragmatic skills (Kasirer and Mashal, 2017), others highlight persistent challenges faced by individuals with dyslexia, particularly in understanding figurative language and humor (Cappelli et al.,2018; Griffiths,2007)

2.3.3. Working Memory Deficit

Working Memory can be conceptualized using a variety of models. One of the most influential models by Baddeley and Hitch (1974) refers to WM as a multi-component system, responsible not only for the temporary storage of information but also for the manipulation of that information.

According to their model, Baddeley and Hitch have individuated 4 sub-components of the WM system: the central executive (responsible for focus and dividing attention and supervision of the other components), the phonological loop (responsible for language and phonological information), the visuo-spatial sketchpad (responsible for the storage of visual and spatial information), and the episodic buffer (stores and manipulates information from the other components to the long-term memory).
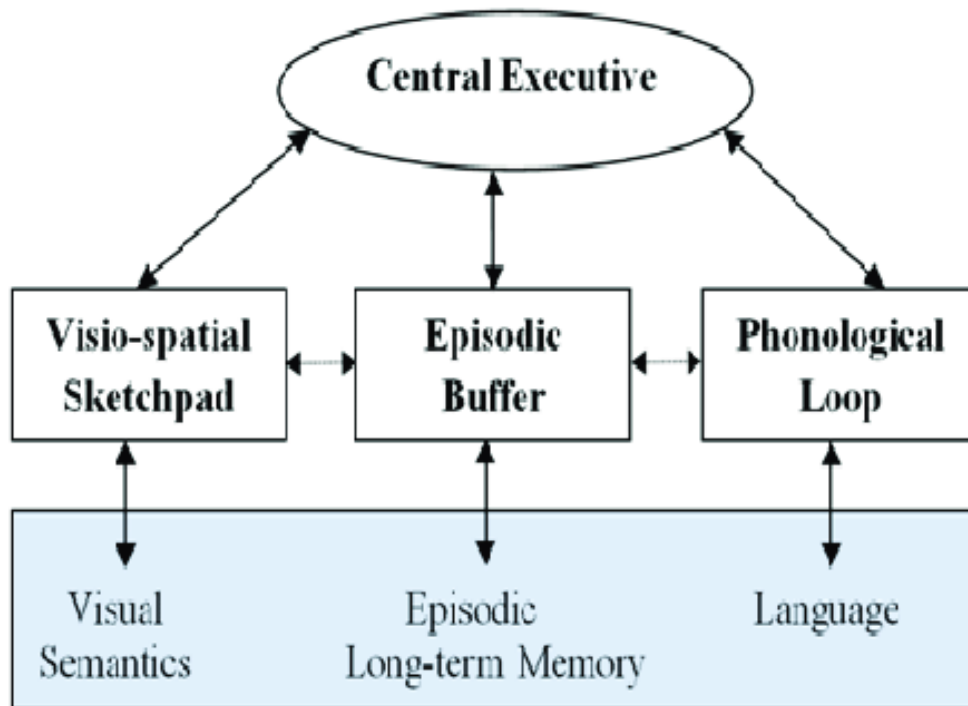
Figure 1. Baddeley's working memory model (Demir, 2021)

Different studies have pointed to the possibility of a link between Working Memory deficit and dyslexia, pointing out that children with dyslexia perform poorly on WM tasks, especially in the phonological loop and the central executive, but that the visuo-spatial sketchpad is mostly unaffected (Vender, 2017). For those reasons, it is hypothesized that deficiency in WM might be the underlying cause of dyslexia (Fiorin, 2010).

While there is a growing body of research on the WM limitations of children with dyslexia, relatively few studies have been done with dyslexic adults. In 2007, a study used event-related fMRI to investigate the neuro correlates of WM in adolescents and young adults with dyslexia (Visac, 2007). Specifically, their research used a cognitive activation paradigm, in which participants saw 3 capital letters on a screen for 1500 ms, with one, two, or three of these letters highlighted during the last 500 ms. In the following 6000 ms, subjects were instructed to try to memorize the highlighted letters and think of the following letters in the alphabet. With more letters highlighted, the cognitive load increased. The subjects were then presented with a letter and had to

decide if that letter was one following the capitalized letters. This paradigm allows to test WM limitations by introducing both the storage of information and its manipulation for a short period.

They found that behaviorally, dyslexic participants showed reduced task-accuracy as well as a tendency to be slower only during the most demanding WM load level (three letters task). In terms of neural activation, differences were found only for the two conditions with high memory load (two or three letters), but no differences were found in the low memory load tasks (one letter). Specifically, at the level of highest cognitive demand (three letters task), dyslexics showed increased activation in left and right ventrolateral prefrontal regions (including Broca's area), as well as in the left superior frontal gyrus. On the other hand, the control group showed activation in the left precentral cortex and in the superior parietal cortex. In addition, the dyslexic participants showed increased activation in the right inferior frontal gyrus at high WM load levels, which indicates a possible compensation with the right hemisphere.

These results demonstrate that, similarly to children with dyslexia, adults also demonstrate limitations in their WM, with lower accuracy and slower reaction times, only in the increased WM tasks (three letters task). Furthermore, these results indicate different brain activation in dyslexic individuals compared with the control group, which might indicate to certain neural compensation strategies in the dyslexic brain.

While Visac's research was innovative in exploring the link between WM and dyslexia in adulthood, further confirmation would be needed with a greater number of participants (in Visac, 2007, n=13) and perhaps a different paradigm that isolates between the different components of WM.

2.4. Navigating Dyslexia in Adulthood: Challenges and Triumphs.

Receiving a diagnosis of dyslexia can be an empowering experience in some cases, but it can also be a quite troubling one for parents of dyslexic children and for the children themselves. While it is well known that dyslexic students typically struggle with reading, this often leads to believing that individuals with dyslexia are less

capable than their typically developing peers. This belief has led many parents to worry for their children's future, both in terms of their academic career, their professional development, and their social life. For that reason, a 2020 study was conducted by Shaywitz and colleagues to compare the performance of Yale students with and without dyslexia to investigate the success rate of dyslexics when compared to a similar group of non-dyslexic Yale students (Shaywitz, 2020)

The study tested two similar groups which had as only notable difference a diagnosis of dyslexia. The first one identified as dyslexic readers, and the second one was a control group of typical readers. All participants had graduated 5 years ago from Yale University. The large majority of the participants in both groups were employed full-time and their annual revenue did not differ significantly when comparing both groups. The study employed a survey completed by both groups which aimed at investigating their overall experience in academia as well as the quality of their overall adult life through self-assessments. Specifically, the survey explored different aspects of academic life, such as stress, study habits, extra-curricular activities, and accommodations needed for exams and assignments. The survey also delved into the participants' lives as recent graduates in aspects such as employment, life and relationship satisfaction, confidence in their goals, work habits, etc.

While it might be expected that students with dyslexia in higher education would struggle significantly more than their peers, the results from this study disprove this belief. Regarding their college experience, both groups did not differ except for one aspect: the dyslexic group reported needing more accommodation in their school work, mainly extra time for their exam and assignments.

Regarding their life as recent graduates, neither groups differed in any way. The study found no statistically significant differences in terms of income, relationship satisfaction, and overall life satisfaction.

The results from this study should come as reassurance to parents of dyslexic children. Individuals with dyslexia, given proper opportunities and support, can achieve anything their neurotypical peers can. One of the participants interviewed for the current work said that, in their opinion, having dyslexia forced them to work harder

from a very young age and perhaps compensate in other areas: "I struggle with reading, but I can paint, I am a natural leader, I am good at sports", demonstrating that children with dyslexia are fully capable of a bright future in any career. We have interviewed adults with dyslexia who have become successful lawyers, others were doctorate students, artists, and much more. While dyslexia is a condition that typically comes with challenges in reading, it does not entail a lack of intelligence and dedication, which certainly contribute significantly to one's academic success and life satisfaction.

However, it is also important to note that other studies have pointed to different result (Nalavany, Logan & Carawan 2018,). A 2018 study done by Nalavany and colleagues collected data from 143 adults with dyslexia (average age = 43.5 years, females = 56.6%) in an online survey. Their study revealed more negative or uncomfortable emotions emanating from living with dyslexia which predicted lower levels of total work self-efficacy, work attributes, work competency, and work anxiety.

The data from these two studies (Nalavany at al, 2018, Shaywitz, 2020) are not completely opposing. In the Yale Outcome study, participants were of a younger generation than the 2018 study, in which the participants's mean age was 43,5 years old. Hopefully, younger generations have access to better support both during their education and in their work life, which is key for a successful and happy work life.

2.4.1. Living with dyslexia: Lucrezia's story

Lucrezia, a 26 year-old doctorate student who has been diagnosed with dyslexia at the age of 8, has accepted to share her story. Receiving her diagnosis of dyslexia was a mixed experience for Lucrezia. On one hand, it felt scary. On the other hand, it felt like a relief to finally give a name to her hardships. Before this complicated label of "dyslexia", Lucrezia was perceived by everyone around her (teachers, peers, parents) as simply lazy, with a lack of discipline, and a lack of will to learn. However, Lucrezia reveals a completely different story. As a little girl, Lucrezia recalls what her afternoons and evenings after school were like. Living in a small village, she could hear the kids she knew so well playing outside. Sometimes, they would knock at her

door and ask if she would join. Her mom's answer was always the same: Lucrezia can't go out, she has to do her homework. While most children could do their homework quickly and then play, Lucrezia would stare at the page for hours, confused, sleepy, and mostly desperate to understand why she couldn't do as well as the others. The answer to that last question came to her pretty easily: I must be lazy, I must be stupid, I must be incapable; what else could explain my difficulties?

If little Lucrezia could see her adult self, she would certainly be very proud. But how did she manage to make this much progress in academia, to the point of reaching the highest level of education, given that at the age of 8, most of the adults in her life would have predicted that she could not have obtained her high school diploma.

Her story shows courage, resilience, and resourcefulness. Once she received her diagnosis, Lucrezia's teachers were able to better support her, and she made notable progress. Unfortunately, her struggles came back in high school. While her teachers were aware of her dyslexia, some of them "didn't believe her". As a consequence, they would refuse to treat her differently as she deserved, resulting in humiliation and despair. Lucrezia recalls being called to the board to solve math equations, a traumatic experience which she is certain still affects her to this day.

Until one day, she met a math teacher who saw the potential in Lucrezia. This teacher saw her for who she really was: a brave and hard-working little girl who needed support, and given the right tools and resources, could achieve great things. With the help of her math teacher, Lucrezia was able to finally progress and gain confidence. As a result, she was able to make friends and feel more confident in her future. A core memory in Lucrezia's high school experience was the first time she got a 10/10 in a math test, thanks to her dedicated teacher. The whole school heard about it. For the first time, Lucrezia saw that she could, indeed, be successful. Hard work and dedication were always present in her personality. What she needed was support and access to proper tools. This story, beautifully shared by Lucrezia, is not unique to her. Many individuals with dyslexia have similar experiences. Given the proper ingredients (access to a diagnosis and dedicated teachers) students with dyslexia can

achieve anything they set their mind to. In the case of Lucrezia, she went ahead and pursued a career as a researcher, now completing her doctoral degree in education.

2.5. Conclusion

This chapter discussed dyslexia with a specific focus on its manifestations in adulthood. A definition of dyslexia was provided along with key statistics. Some of the existing neuroscience research on adults with dyslexia was discussed, showing differences in neural activation between groups and network connectivity. This chapter then investigated the evolution of behavioral differences in adulthood, looking into reading and conversational difficulties, and working memory limitations. Finally, it was demonstrated that individuals with dyslexia have the potential to achieve a successful life, given the proper tools.

Chapter 3

Exploring the data

While different accounts have been suggested to the FC phenomenon, as discussed in Chapter 1, to our knowledge, no research has successfully provided empirical data which would explain FC. The current study aimed at investigating the computation of disjunction in different contexts, specifically the FC interpretation, in which the disjunction carries a conjunctive meaning, and the logical interpretation, in which the disjunction maintains a truly disjunctive interpretation. Following Delfitto and Vender's intuition (2024), our experimental design makes use of a pragmatically supportive context which pushes towards either the logical or the FC reading. With this experiment, we hope to deepen our understanding of how disjunction is processed by the human brain, both in dyslexic and neurotypical individuals.

Our research questions are as follows.

(1) Is the logical interpretation readily accessible, provided it is pragmatically supported? If it is, does the cognitive cost differ between the logical interpretation and the FC interpretation?

(2) Do adults with dyslexia experience processing difficulties that differ from those of non-dyslexic adults?

(3) Can we find further evidence that FC is not the result of implicature calculation, but rather a process of local pragmatic intrusion?

We decided to investigate these questions on adults with dyslexia for the following reasons. Thus far, most research has been conducted on children with dyslexia for the simple reason that dyslexia is a condition that has only been officially recognized in Italy since 2010 (Legge 170, 2010). Therefore, the first individuals to have received a diagnosis of dyslexia while in school have now recently entered adulthood. This is an exciting perspective considering that these young adults are the first cohort of diagnosed dyslexics to have gone through the whole education system and therefore for the first time, it is possible to investigate the development

of dyslexia in early adulthood. For that reason, we believe that it will be interesting to investigate their linguistic abilities through our FC task, which we hope will help to deepen our understanding of semantics and pragmatics abilities in dyslexia. The current study thus adds to the growing body of research on dyslexia in adulthood (Griffiths, 2007,Cappelli et al, 2018, 2022, Vasic, 2008, Simmons, 2000, Shawitz, 2020, Richland, 2011).

3.1. Participants

For the current research, we tested 40 participants divided into two groups: 21 neurotypical adults, which constituted the control group (age 18-35, Mean: 26, *SD:* 3.54) and 19 adults with dyslexia and poor readers (age 18-35, Mean: 22.7, SD: 3.7).

All participants in this study were recruited through social media, word of mouth, and flyer distribution. Most participants were recruited at the University of Verona (75,6%) and the rest were distributed among high school students and young workers. All data were acquired with the written consent of participants. No compensation was offered in exchange for the subjects' participation.

3.1.1 Control Group

The control group comprised of 21 native Italian speakers with no history of learning disabilities or other known neurological conditions. Most of the control group were university students. Many of the participants (47%) had previous knowledge of Linguistics, but none of them were familiar with the FC phenomenon. One participant had to be excluded because they were distracted throughout the experiment, which would have impacted their speed and accuracy. The control group had an average age of 26 years old.

3.1.2. Dyslexic/poor readers Group

For the experimental Group, none of the participants had any background in Linguistics, and their academic background was quite diverse. About half of them had

a university-level degree completed (41%), and some of them were completing their graduate degree at the moment of the study. While the education level was lower in the dyslexic/poor readers group, this difference could be explained by the average age of 22 years old, 4 years younger than the average of the control group.

The experimental group consisted of (1) native Italian speaking adults with dyslexia that received a diagnosis of dyslexia previously in their life (N=13) and (2) native Italian speaking adults with no official diagnosis of dyslexia (N=6) but had a strong intuition of being dyslexic and who performed below cut-off in a word and non-word reading test (which we classified as 'poor readers' for the purpose of our experiment). The poor readers participants had the intuition of being dyslexic based on family history of learning disabilities and perceived difficulties in writing and reading.

The word and non-word reading test and the Vinegrad Self-assessment for perceived difficulties (see Appendix for both test) were given to all participants. Both tests were part of the 'Nuova batteria per studenti universitari e adulti LSC-SUA' a battery to evaluate reading difficulties in university students and adults. For the word and non-word reading test, errors and speed were evaluated, both for the word and non-word task (with 4 scores in total). As previously mentioned, the 'poor readers' participants were classified as such by being under the cut-off for the reading group, which meant that the 'poor readers' had below 2 standard deviations (SD) in 2 or more of the 4 scores. Their score in the Vinegrad Self-assessment also had to be higher than 5, meaning that they had a significant perceived difficulty that could indicate towards dyslexia.

The following tables compare data from both groups in terms of age, their results on the word and non-word reading test, the Vinegrad Self-assessment Report, and gender (Table 1). Moreover, Table 2 reports data on the participants' level of education. All participants were asked to report their foreign language abilities and Table 3 reports these data.

	Dyslexia Group		Control Group	
	n =19		n= 21	
	Mean	SD	Mean	SD
Age	22,8	3,8	26	3,57
Word Speed	-2,6	1,93	0	0,83
Word Accuracy	0,37	0,71	0,69	0,26
Non word Speed	-2,1	1,6	-0,1	0,92
Non word Accuracy	-0,4	1,38	0,7	0,47
Vinegrad	12,8	4,65	3,1	2,56
Gender (%)				
M	0.15		0,4	
F	0.85		0,59	

Table 1. Participants summary table.

	Dyslexia Group		Control group	
Level of education	n.	%	n.	%
High School				
Diploma	9	47,36	1	4,76
Bachelor Degree	7	36,84	8	38,09
Master's degree	1	5,26	10	47,61
Doctorate Studies	0	0	2	9,5
None	2	10,52		0
Total	19	100	21	100

Table 2. Level of Education per group

	Dyslexia Group		Control Group	
	n= 19		*n=* 21	
N.of foreign languages known	**n.**	**%**	**n.**	**%**
None	3	15,78	0	0
1	9	47,36	7	33,33
2	6	31,57	6	28,57
3	1	5,26	8	38,09
Total	19	100	21	100

Table 3. Foreign languages by groups

3.2. Experimental procedure

3. 2. 1. The FC task

This task aimed at addressing the processing of disjunction in different conditions, where the given context supports either a FC reading (1), or a truly disjunctive (which we called 'logical') reading (2); we also added two filler conditions in which the disjunction occurred in a context requiring the computation of a scalar implicature or in a downward entailing context where the implicature is not computed. We called these fillers exclusive and inclusive respectively. Participants were presented with the relevant contexts and asked a multiple-choice question about the options permitted in each scenario. There were 10 sentences for each condition and 20 fillers, for a total of 40 items. The experiment included a short practice phase to help familiarize the participants with the task.

All trials were simultaneously shown to the participants while they heard a pre-recorded reading of the sentences, hoping to reduce the cognitive load associated with reading.

3.2.1.1. Experimental sentences

Two lists were created, with the same scenarios in either the FC or the logical condition; participants were randomly and homogeneously assigned to one of two lists. Examples of the FC and the logical reading follow in (1) and (2) (see the appendix for all sentences):

1. La squadra di calcio si allena tutto l'anno per diverse ore a settimana. Per prepararsi alla prossima partita, gli atleti professionisti potranno allenarsi al mattino o alla sera. ('The soccer team practices year-round for several hours a week. To prepare for the next game, professional athletes may practice in the morning or in the evening'.)

2. La squadra di calcio si allena tutto l'anno per diverse ore a settimana. In base alla decisione del loro allenatore, gli atleti professionisti potranno allenarsi al mattino o alla sera ('The soccer team trains year-round for several hours a week. Depending on their coach's decision, professional athletes may practice in the morning or in the evening')

The multiple-choice question was the same for both conditions (see 3); option (a) was expected to be chosen for (1) and option (b) for (2).

3. Quando potranno allenarsi gli atleti? ('When will the athletes be allowed to practice?')
   a. Saranno liberi di scegliere fra la mattina e la sera ('They will be free to choose between morning and evening')
   b. Sarà permessa solo una delle opzioni ('Only one of the two options will be allowed')
   c. Nessuna delle opzioni sarà permessa ('None of the options will be allowed').

Option a. was expected to be chosen for the FC condition as shown in (1) as it represents the agent of the sentence (i.e. the athletes) to be allowed to freely choose

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between one option and another. The conjunction ('and') is used to reflect the conjunctive reading of FC.

Option b. represents the truly disjunctive reading of the disjunction and was expected to be chosen for the logical condition, as shown in (2). In this option, the ignorance is maintained in which option will be permitted. It is known only that one of the options will be permitted, but we ignore which (ignorance presupposition is maintained). Crucially, choosing b. over a. indicates not having the ability to choose freely. Instead, choosing option c., which was defined as a catch option, showed that the participants did not understand the sentence properly.

3.2.1.2. Fillers

The filler sentences were half of the trials. Our goal was to find sentences that were seemingly similar to the experimental sentences (presence of a disjunction, future tense always used, the options and questions were of the same type) to distract participants from the goal of our experiment. To do so, we used sentences where the disjunction occurred in a context requiring the computation of a scalar implicature or in a downward-entailing context where the implicature is not computed. While the main goal of these trials was to distract the participants from the experimental goal, we were also interested in their responses to compare the computation of the inclusive disjunction (no implicatures) and the exclusive disjunction (presence of implicatures) in adults with dyslexia.

Examples of the filler sentences follow in (3) and (4):

> (3) Martina vuole sviluppare la sua carriera nel settore della moda. Se decide di fare un tirocinio o di seguire un corso, avrà la possibilità di migliorare il suo curriculum. ("Martina wants to grow her career in the fashion industry. If she decides to do an internship or to follow a course, she will have the opportunity to better her resume.")
>
> Question: Cosa potrà -fare Martina per sviluppare la sua carriera? ("What will Martina be permitted to do in order to grow her career?")

(4) Domani Gianni deve fare una trasferta di lavoro. Andrà a Milano o a Pavia per gestire un affare importante.("Tomorrow Gianni has to go on a work trip. He will go to Milano or Pavia for important business.")

Question: Dove andrà domani Gianni? ("Where will Gianni go tomorrow?")

The options were the same as for the experimental sentences.

For the inclusive sentence, we expected the same response as the FC sentence (option a.), representing that both options were possible, potentially both.

For the exclusive sentence, we expected the participants to choose option b. representing that only one option was permitted.
However, one limitation for our research was for the exclusive sentence, option a. was often chosen, which could mean that the participants interpreted a. as "can choose freely, but only one of them", resulting in lower-than-expected accuracy results (35%) for the calculation of implicature involved in the exclusive disjunction.

3.2.2. Procedure

The experiment was conducted using the facilities of the Language, Text, and Cognition Lab (LaTeC) at the University of Verona, offering a controlled environment. All subjects gave their written consent to participate in the study.

Subsequently, the experiment was divided into 4 parts:

1. Vinegrad Self-Assessment, which was completed by participants on their own.
2. A quick interview in which they answered questions regarding their age, level of education, personal experience with dyslexia and history with a learning disability (for the experimental group), and their foreign language competence.
3. Word and Non-Word reading test (see appendix) taken from the battery 'Nuova batteria per studenti universitari e adulti LSC-SUA', aiming to evaluate reading difficulties in university students and adults.
4. The FC task, that we originally developed with the aim of testing the processing cost of the FC and logical reading of the disjunction (measuring

behavioural measures like RTs and accuracy). This test was done on a computer with a mouse and speaker and lasted about 10-15 minutes.

In total, the experiment lasted around 30 to 40 minutes. All participants were informed initially that they could take a break or leave at any point.

3.2.3. Predictions

As discussed in Chapter 2, adults with dyslexia have language difficulties that extend to reading and writing and conversational skills (Cappelli et al, 2022). Thus, we expect adults with dyslexia to display processing difficulties in their pragmatic competence and in implicature computation (Cappelli et al, 2022; Vender, 2017).

The current study investigated the comprehension of disjunction in different contexts, where the given context supports either a FC reading or a truly disjunctive (logical) reading.

If FC was the result of complex processing involving implicature calculation, as proposed by Chembla and Bott (2013), we would expect higher reaction times and lower accuracy in the FC condition.

If FC was instead, as suggested by Delfitto and Vender (2024), derived through a local process of pragmatic intrusion strictly tied to the semantic mechanism of relative scope assignment, we would expect the FC and logical reading to have similar computation costs within groups. This hypothesis suggests that, even though the FC interpretation is most common, the 'purely disjunctive' reading can also be found in natural language, provided this reading is pragmatically supported. Therefore the FC reading should not have any additional cost compared to the purely disjunctive one. The reason is that, though the FC crucially depends on pragmatic intrusion, it is NOT a consequence of any process of implicature calculation (it is not based on the cognitively costly process of negating a complex set of alternatives). Rather, the

relevant computations are strictly local and thus, do not extend beyond the lexical resources provided by a single sentence.

As suggested by previous literature (Cappelli et al, 2022; Vender, 2017), we expected the dyslexic group to highlight any difficulties found in the control group, especially in their pragmatic abilities.

3.4 Results

3.4.1. Vinegrad and Reading test Results

The following table reports the results of the Word and Non-word test results and Vinegrad Self-Assessment for perceived difficulties for each group.

Group	Task	Mean	SD
Dyslexics	Word Speed	-2,6	1,93
	Word Accuracy	0,37	0,71
	Non-word Speed	-2,1	1,6
	Non-word Accuracy	-0,4	1,38
	Vinegrad	12,8	4,65
Control	Word Speed	0	0,83
	Word Accuracy	0,69	0,26

Non-word Speed	-0,1	0,92	
Non-word Accuracy	0,7	0,47	
Vinegrad	3,1	2,56	

3.4.2. FC task results

3.4.1 Response Times

Group	Condition	Mean	SD
Controls	FC	4469.69	1974.49
	Logical	4730.61	2180.73
Dyslexic	FC	6721.87	4479,90
	Logical	6910.64	4332,76

To analyze the presence of significant differences in RTs, we fitted a series of linear mixed models to predict RTs with Group (Dys vs Typical) and Condition (FC vs. logical) with full interaction; Participants and Item were added as random effects. A stepwise removal method was adopted starting from a fully specified model to identify

the best-fitting models. The interaction between Group and Version was not included as it did not contribute to the models' fit.

The best-fitting model showed a significant effect of Group ($\beta = 2267.83$, SE = 949.94, $t(794) = 2.39$, $p = <.05$), indicating that dyslexics were generally slower than controls. There was instead no effect of Condition ($\beta = 91.27$, SE = 91.78, $t(794) = 0.99$, $p = 0.320$.


Figure 1. Average Response Times Across Conditions
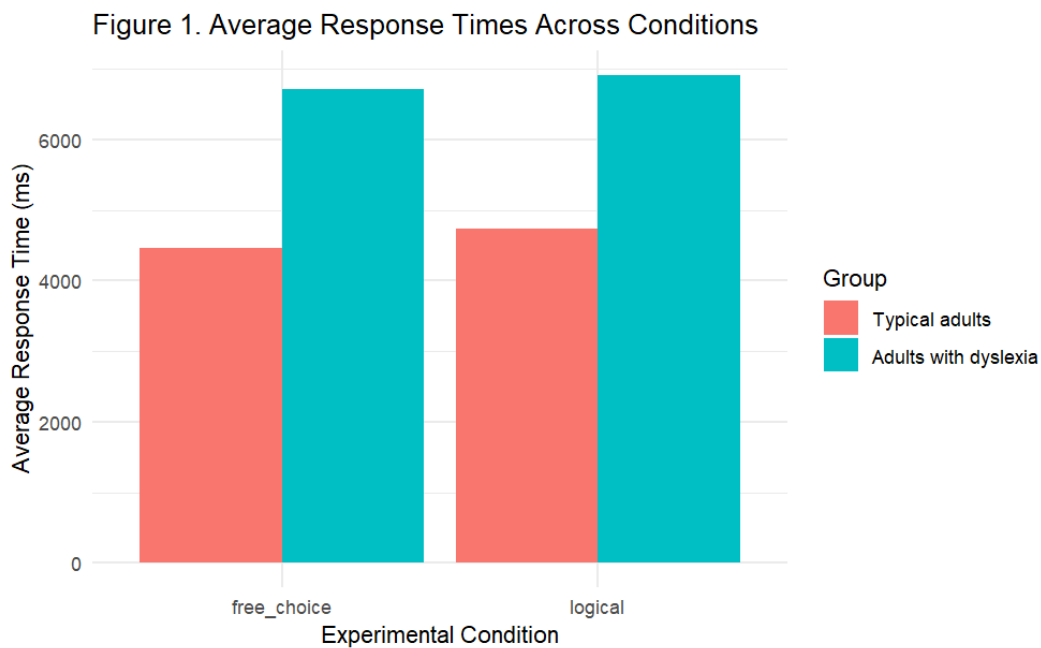
3.4.2. Accuracy

Group	Condition	Mean	SD
Controls	FC	0.82	0.39
	Logical	0.70	0.46
Dyslexics	FC	0.68	0.46

	Logical	0.52	0.50

As for accuracy, we fitted a logistic mixed model (estimated using ML and Nelder-Mead optimizer) to predict Accuracy with Group and Condition, with Participant and Item as random effects. Also in this case, the interaction between Group and Version was not included as it did not contribute to the models' fit. The best fitting model showed that Group was significant (β = -0.80, SE = -0.80, z = -3.361, p <.001), indicating that dyslexics were less accurate than typical readers; we also found a significant effect of Condition (β = -0.73, SE = 0.16, z = - 4.47, p < .001), indicating that for both groups the free-choice condition was processed more accurately than the logical condition.

Figure 2. Average Accuracy Across Conditions
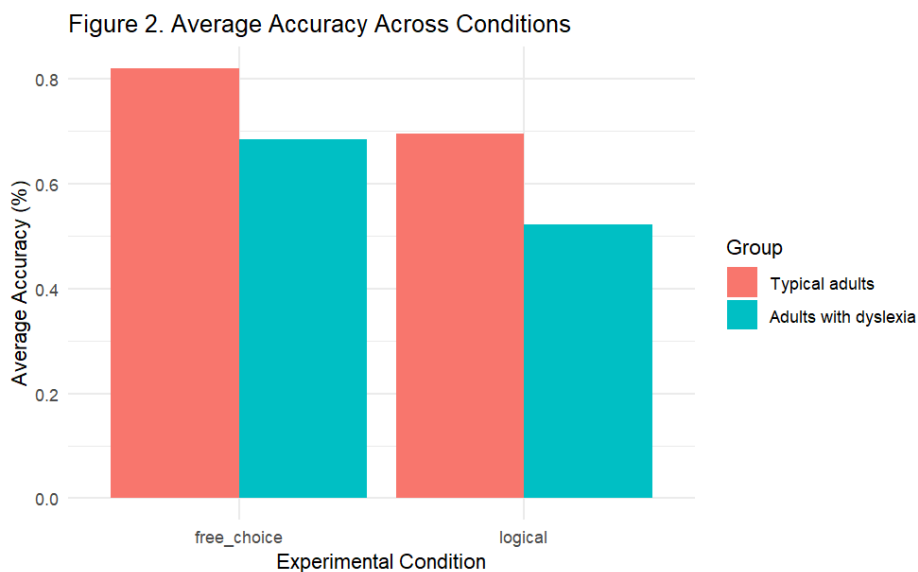
3.4.3. Summary of results for the FC task

One key finding is that dyslexic adults are generally slower in all conditions. In accuracy, there is also a significant Group * Condition interaction, indicating that conditions are processed differently by the two groups.

Comparing the two conditions, we found no statistically significant difference between the FC and the logical reading in RTs, as expected by our hypothesis.

As for the accuracy, instead, FC is processed more accurately than the logical condition. While dyslexic participants were overall slower, we found no significant difference in RTs between the two conditions.

3.5 Discussion

The hypothesis put forward by Delfitto and Vender (2024) was tested in the present experiment. According to their account, the FC interpretation results from a non-Gricean process of pragmatic intrusion, which slightly modifies the interpretation of propositional operators to ensure that different scope assignments yield distinct truth conditions. In this framework, the key to FC computation lies in local compositional semantics and, more specifically, the presence of two competing interpretations of relative scope assignment within the same sentence. Consequently a 'purely disjunctive' reading can also occur in natural language if it is pragmatically supported. Therefore, if both the FC and 'standard disjunction' readings are contextually supported, the FC reading should not incur any additional cognitive cost compared to the purely disjunctive one. This is because, although the FC interpretation relies on pragmatic intrusion, it is NOT the result of implicature calculation (which involves the cognitively demanding process of negating a complex set of alternatives). Instead, the necessary computations are strictly local, confined to the lexical resources within a single sentence.

Our research questions can be summarized as follows.

1. Is the logical interpretation readily accessible, when provided with a pragmatically-supportive context? If it is, does the cognitive cost differ between the logical interpretation and the FC interpretation?
2. Can we find further evidence that FC is not the result of implicature calculation, but rather a process of local pragmatic intrusion?
3. Do adults with dyslexia experience processing difficulties that differ from those of non-dyslexic adults?

To answer these research questions, we developed and administered a task assessing to processing of the disjunction in different contexts, namely the FC and logical reading. The task was administered to 40 adults divided in two groups: 19 adults with dyslexia and poor readers, and 21 controls non-dyslexic similarly-aged adults with no history of learning disabilities. During the task, participants were presented with 40 sentences divided in 4 conditions: 10 logical trials, 10 FC trials, and 20 fillers. They were asked a multiple-choice question about the options permitted in each scenario.

We found that for RTs, both conditions are processes similarly with no significant difference. For accuracy, we saw a higher accuracy rate for the FC condition.

For both conditions, the groups of dyslexic adults and poor readers were slower and less accurate than the controls.

These results provide an important contribution at different levels. Besides confirming the presence of processing difficulties in adults with dyslexia, our findings indicate that if provided with the appropriate context, participants can accurately compute the FC reading, which is in fact significantly easier than the logical reading in terms of accuracy. This disconfirms that FC is derived through a global process of scalar implicature computation, supporting the idea that it is derived, instead, through a local process of pragmatic intrusion strictly tied to the semantic mechanism of relative scope assignment. Contrary to calculation of implicature, which follows a cognitive cost, Chembla and Bott (2013) demonstrated that NOT deriving FC seems to be costly. In fact, our results support Delfitto and Vender's hypothesis. Their account states that the FC reading arises from a process of pragmatic intrusion that subtly alters the interpretation of propositional operators to ensure that distinct scope assignments yield different truth conditions. In this context, the key to FC computation lies in local compositional semantics, and NOT in the negation of alternatives. Consequently, FC relies on pragmatic intrusion but is not the result of implicature calculation. Instead, the relevant computations are strictly local and confined to the lexical resources of a single sentence.

Specifically, to achieve the FC meaning, two pragmatically-triggered steps are necessary. First is the mechanism of relative scope assignment, where narrow scope is assigned. For example, in the sentence "John is permitted to have an apple or a pear," the narrow scope interpretation is "it is permitted that John has a pear OR it is permitted that John has an apple."

The second step involves adding a constraint that the antecedents cannot be false, which transforms ($\Diamond p \vee \Diamond q$) into ($\Diamond p \wedge \Diamond q$), thereby assigning a conjunctive value to the disjunction and giving rise to the FC inference. Essentially, for a disjunction to hold true, it must exist in a world where both disjuncts are accessible. This approach is intuitive; when we say "you may have ice cream or cake," it seems reasonable that both options (ice cream and cake) are available in the world where the sentence is uttered.

Crucially, the relative scope assignment triggers the FC reading without requiring to negate alternative statements, contrary to implicature calculation.

Differently from other similar accounts such as Aloni (2022), Delfitto and Vender's explanation also accounts for a truly disjunctive reading of the disjunction which is said to be equally accessible as the FC reading. Since we found no statistical difference in RTs between the conditions, the data further indicates that the logical reading is not only present but well accessible both to neurotypical participants and to adults with dyslexia, if provided with a pragmatically-supportive context.

3.5.2. Reliance on Theory of Mind

Theory of Mind is a foundational cognitive skill described as the ability to differentiate one own's mind to the mind of others (Cardillo, 2018). ToM is relevant to our experiment since it possibly could add a cognitive toll to the task. Specifically, the design of our experiment relied not only on simply the comprehension of the sentences but also on Theory of Mind abilities. In fact, to test the comprehension of the sentences, we had to ask the participants to imagine the possible choices of the actors at play which were a third party. As shown by literature, ToM might be

impaired in children with dyslexia (Cardillo, 2018). To the best of my knowledge, there is no evidence of the impairment being maintained in adulthood. However, it is important to note that while ToM might be intact in adults with dyslexia, it could add a cognitive toll which might contribute to group differences in behavioural response. Ideally, the design of the experiment could be improved by reducing the necessity to resort to ToM. For example, creating a context based on a story in which the participant is the agent instead on having to make decisions for a third party.

Conclusion

In this work, we aimed at investigating the puzzling phenomenon of FC by testing the processing of the disjunctions in different contexts. We tested 40 participants, 19 of which were adults with dyslexia. We tested for Response Times and Accuracy.

The two experimental conditions, which we called the logical reading and the FC reading, were compared by providing a pragmatically strengthening context to each sentence which would support one interpretation over the other. The same sentences were used, which a different context (logical or FC) and the participants were randomly presented with one list or another, resulting in seeing an equal number of logical trials and FC trials. After each trials, participants had to answer a multiple-choice question about the options that were permitted.

Comparing groups, we found a significant difference in Response Times, the dyslexic group being slower than the controls. These data confirm that difficulties found in children with dyslexia are at least partly maintained in adulthood.

Comparing conditions, both in terms of Response Times and Accuracy, we did not find significant difference. These results demonstrate that (1) FC inferences are most likely to not derived through calculations of implicature and (2) the logical interpretation, while less common in natural language, is still easily accessible, if provided with a context.

Furthermore, this research is an important contribution both to the field of logic and semantics, and also to psycholinguistics by studying adults with dyslexia, for which the growing body of existing research is still very limited.

In conclusion, this study enhances our understanding of disjunction processing, providing evidence to believe that FC might not be the result of scalar implicature, but rather through a local process of pragmatic intrusion strictly tied to the semantic mechanism of relative scope assignment. Furthermore, this experiment underscores the importance of context in interpreting natural language. It also opens new avenues

for research into the cognitive mechanisms underlying language processing in diverse populations.

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Appendices

Vinegrad Self- Assesment.

QUESTIONARIO VINEGRAD+

Caro studente, *ti preghiamo di leggere attentamente e rispondere indicando Sì o No. Non tralasciare nessuna risposta, se sei incerto, scegli la risposta che più si avvicina al vero.*

	SÌ	NO
1) Ho difficoltà a distinguere la destra dalla sinistra.		
2) Ho difficoltà nel consultare le mappe o nel trovare la strada in un luogo non familiare.		
3) Mi piace leggere ad alta voce.		
4) Impiego più tempo del previsto per leggere una pagina di un libro.		
5) Ho difficoltà nel ricordare il significato di ciò che ho letto.		
6) Mi piace leggere libri lunghi.		
7) Quando scrivo commetto errori di ortografia.		
8) La mia grafia è difficile da decifrare.		
9) Vado in confusione quando devo parlare in pubblico.		
10) Ho difficoltà nel prendere nota, in una conversazione telefonica, di un messaggio e nel riportarlo correttamente.		
11) Quando devo dire una parola lunga mi capita di trovare difficoltà nel mettere tutti i suoni nell'ordine giusto.		
12) Ho difficoltà nel fare dei calcoli mentali senza utilizzare le dita o un foglio di carta.		
13) Mi capita di invertire la posizione delle cifre dei numeri quando devo comporre un numero telefonico.		
14) Ho difficoltà a elencare fluentemente i mesi dell'anno in avanti.		
15) Ho difficoltà a ripetere i mesi dell'anno all'indietro.		
16) Mi capita di confondere date, orari e di perdere qualche appuntamento.		
17) Quando compilo degli assegni o delle note importanti mi capita spesso di fare degli errori.		
18) Ho difficoltà quando devo compilare un modello o un bollettino (postale, ecc.)		
19) Mi capita spesso di confondere numeri, come per esempio il 95 e il 59, il 6 con il 9, ecc., di autobus, numeri civici, numeri telefonici, ecc.		
20) Mi è stato difficile apprendere le tabelline quando andavo a scuola.		
21) Sono lento e resto spesso indietro quando scrivo.		
22) Ho difficoltà nel prendere appunti.		
23) Mi capita di commettere molti errori nella lettura.		
24) Ho difficoltà nell'apprendimento delle lingue straniere.		
25) Ho difficoltà nel controllare il resto dopo un acquisto.		
26) Incontro grosse difficoltà nel fare i calcoli scritti.		

LETTURA – NON PAROLE

Corte	**Lunghe**
bagle	cadilipi
ecali	figratica
dagia	calististi
idafa	ombarada
areco	ciaranlame
gameo	gliatanemo
gaspi	piragliapa
iaova	nucorpiaco
liaba	tostolasca
viaca	curerope
maspu	lagongorzo
nabri	danagiami
sagui	dralampana
tacre	fiasolifo
mapri	carlinato
rasuo	instatervi
taquo	cedenzapre
lebia	legerane
semea	nefuconsio
reodo	remecarie
tepre	ciacalreto
vegra	denacase
netro	riolencada
posco	corilope
tofia	lamanopo
topra	soriostemi
stogu	todicanda
rusvi	mendantofo

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LETTURA – LISTA PAROLE

a.f.c	b.f.c	a.f.l.	b.f.l.
prima	gleba	felicità	tragicità
ombra	braca	necessità	frugalità
suora	elica	efficacia	lipidica
sposa	giada	filosofia	gratifica
pausa	ridda	cartolina	anarchica
quota	faida	sfumatura	biochimica
erede	randa	intervista	stilistica
abile	corea	precedenza	baraonda
esame	omega	leggerezza	stenografa
carne	spiga	generale	melarancia
padre	vanga	confusione	carolingia
odore	ovaia	scaricare	monetaglia
prete	balia	riguardare	parapiglia
monte	celia	cameriere	monogamia
grave	cavia	ingegnere	salamoia
grido	asola	calciatore	cornucopia
animo	spuma	canadese	drogheria
treno	frana	comandante	sacrestia
pugno	gogna	paesaggio	sottoscala
scopo	brina	calendario	manopola
amaro	prora	pericolo	tarantola
magro	stura	recupero	gorgonzola
fiato	guisa	centimetro	calendula
prato	nassa	misterioso	pantomima
esito	agata	candidato	damigiana
gusto	creta	tormentato	palandrana
aiuto	garza	fondamento	rottamare
virus	ovale	intervento	rincorrere

Consenso informato

CONSENSO ALLA PARTECIPAZIONE AL PROGETTO DI RICERCA
Ricerca tesi magistrale di Linguistics

Io sottoscritto/a *(nome e cognome del partecipante)* ………………………….
nato/a a…......................... il…......................................

dichiaro:
- di aver preso visione del foglio informativo concernente lo studio;
- che i contenuti dello studio mi sono stati illustrati in maniera chiara e dettagliata da Sarina Motta
- che ho avuto modo di esporre le mie considerazioni e di chiedere ulteriori precisazioni, nonché di avere il tempo necessario per prendere una decisione spontanea, ponderata e non sollecitata.

Pertanto, sono consapevole:
- delle attività previste e delle modalità di adesione;
- che la partecipazione alla ricerca è volontaria e che ho la facoltà di ritirare il consenso in qualsiasi momento;
- che, secondo il rispetto della normativa vigente, i dati raccolti saranno utilizzati soltanto per gli scopi della ricerca scientifica.

Ciò premesso do il mio consenso alla partecipazione allo studio proposto.

Data, ……………………

Firma ………………………………………………………………………………

List of sentences

Logical

- In questa zona delle Alpi, ci sono molte passeggiate, tutte con vista panoramica. Domani, a seconda delle condizioni meteorologiche, gli escursionisti potranno prendere il sentiero principale o il percorso alternativo.

- La settimana prossima, la città di Verona organizza una gara ciclistica. A seconda del regolamento, i ciclisti potranno pedalare su strada o sulla pista ciclabile.

- Luca soffre di problemi allo stomaco e dovrà prendere una medicina. A seconda della prescrizione del medico, Luca potrà assumere il farmaco prima o dopo i pasti.

- Vienna è una città conosciuta per i suoi musei. A seconda degli orari di apertura, i turisti potranno visitare un museo di storia o una galleria d'arte.

- Durante il weekend, le famiglie hanno più tempo per stare insieme. Domani, a seconda del prezzo del biglietto, i genitori potranno portare i bambini allo zoo o al parco divertimenti.

- La fine dell'anno accademico sta arrivando. Domani, a seconda del carico di lavoro che verrà assegnato, gli studenti potranno studiare per il prossimo esame o rilassarsi.

- Prima della fine della scuola, gli studenti dovranno fare ancora alcune interrogazioni. A seconda della disponibilità del professore, gli studenti potranno sostenere l'interrogazione il lunedì o il venerdì.

- Gli italiani preferiscono andare in vacanza nei mesi d'estate. A seconda delle scadenze dell'azienda Rossi, i dipendenti potranno prendere le ferie nel mese di luglio o nel mese di agosto.

- La squadra di calcio si allena tutto l'anno per diverse ore a settimana. In base alla decisione del loro allenatore, gli atleti professionisti potranno allenarsi al mattino o alla sera.

- Tanti studenti decidono di continuare il loro percorso academico dopo il liceo. A seconda del programma che li accetterà, gli studenti del quinto anno potranno frequentare un'università in Italia o all'estero.

Free-Choice

- Il Black Friday è un giorno importante per i negozi di elettronica. Per comprare un nuovo computer, i clienti potranno pagare in contanti o con la propria carta di credito.
- Vivere in città in rispetto alla periferia ha i suoi vantaggi e svantaggi. Quando cercheranno casa, gli acquirenti potranno prendere casa in periferia o in città.
- Gli sport e le attività artistiche sono una parte importante dello sviluppo dei bambini. Per le loro attività extrascolastiche, i bambini potranno seguire il corso di karate o di pittura.
- L'estate è un periodo ottimale per organizzare matrimoni. Per il loro matrimonio, le coppie potranno celebrare le nozze all'interno o all'esterno.
- Tante sono le famiglie che decidono di adottare un'animale tramite un canile. Come nuovo membro della famiglia, le famiglie potranno prendere un cane o un gatto.
- Il periodo natalizio è un periodo ottimo per viaggiare in Europa. Per le loro vacanze di natale, i turisti potranno andare a Praga in treno o in aereo.
- A contrario delle scuole italiane, le scuole americane hanno l'obbligo di uniforme. Quando si vestono la mattina, gli studenti potranno indossare pantaloni o gonne dell'uniforme scolastica.
- Le case di riposo propongono molte attività per i loro ospiti. Come attività del venerdì sera, gli anziani potranno partecipare al torneo di bingo o giocare a carte.
- I corsi magistrali in Italia durano due anni e si concludono con una laurea. Alla fine del loro percorso universitario, gli studenti potranno laurearsi a luglio o a novembre.

- I club di lettura sono molto frequentati. Per l'incontro mensile, i lettori potranno leggere un giallo o un romanzo storico.

Inclusive fillers

- Martina vuole sviluppare la sua carriera nel settore della moda. Se decide di fare un tirocinio o di seguire un corso, avrà la possibilità di migliorare il suo curriculum.
- L'esame di psicologia si terrà la settimana prossima. Se gli studenti studiano il libro o le slide, saranno preparati.
- Marta andrà a Barcellona domani. Se porta con sé il passaporto o la carta d'identità, potrà passare alla dogana.
- Laura vuole diventare una brava fotografa. Se segue un corso professionale o se pratica da sola, migliorerà le sue capacità.
- Il concerto di musica classica si terrà venerdì sera. Se gli spettatori acquistano i biglietti in anticipo o arrivano in tempo per il check-in, potranno godersi il concerto senza intoppi.
- Giulia partirà per un viaggio in Thailandia. Se si informa sulle tradizioni locali o impara alcune frasi di base in thailandese, potrà arricchire la sua esperienza.
- Questo weekend, Lucia deve occuparsi di alcuni lavori casalinghi. Se taglia l'erba del giardino o pulisce la cucina, sarà pronta per cominciare al meglio la settimana.
- Gli studenti del secondo anno seguono un corso di letteratura inglese. Per rispondere ai loro dubbi, manderanno una email al professore o si presenteranno ai ricevimenti.
- Andare in palestra è un hobby per molti italiani. Se seguono un corso di gruppo o si allenano da soli, i clienti della palestra si sentiranno più in forma.
- Per la sua festa di compleanno, Davide deve scegliere tra diverse attività. Se decide di andare al ristorante o andare in discoteca, i suoi amici saranno contenti.

Exclusive fillers

- Domani Gianni deve fare una trasferta di lavoro. Andrà a Milano o a Pavia per gestire un affare importante.

- Domani iniziano le vacanze invernali a Oslo. Le famiglie potranno andare a sciare o a fare pattinaggio.

- Massimiliano e Anna-Maria hanno invitato i loro amici a cena sabato prossimo. Come piatto principale, prepareranno il pesce o la carne.

- Il centro Italia è spesso sottovalutato dai turisti stranieri. Nonostante ciò, i viaggiatori visiteranno l'Abruzzo o le Marche per le loro vacanze estive.

- Alla fine della giornata, i bambini e i genitori possono finalmente stare insieme. Prima di andare a dormire, i bambini scelgono di ascoltare una favola o una canzone.

- Venerdì sera, Maria vorrebbe uscire con degli amici. Per questo, proporrà loro di andare al cinema o al teatro.

- Mario vuole organizzare una festa di compleanno per la sua ragazza. Prenoterà un ristorante al lago o in un ristorante in montagna.

- La settimana prossima, gli studenti si occuperanno dell'organizzazione dei campionati studenteschi della scuola. Alla fine della settimana, gli studenti organizzeranno una partita di calcio o di pallavolo con i loro insegnanti.

- Il ristorante di pesce Bellavista a Roma propone un menu di degustazione. Sabato sera lo chef cucinerà il menu di pesce crudo o pesce cotto.

- La compagnia AirFrance offre ai suoi clienti dei voli economici e confortevoli. Durante il viaggio, i clienti avranno la possibilità di bere un caffè o un succo di frutta.