Obligatory implicatures and grammaticality

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Abstract. The paper explores some puzzling data on agreement with disjunctive noun phrases in Russian. I show that the data can be nicely explained by the theory of implicatures. The proposed analysis raises a more general question, namely whether scalar implicatures of a sentence can ever lead to ungrammaticality. In many theories of scalar implicatures it is predicted to be impossible. I argue that the answer is yes, but that happens in a limited number of cases, namely when a scalar implicature of a given sentence has to be calculated but potentially leads to a contradiction if conjoined with another scalar implicature of the sentence, importantly the one which cannot be disregarded due to relevance.

Keywords: Scalar Implicature Calculation, Formal Alternatives, Dependent Plurals, Number Agreement.

1 The puzzle

The core observation for this paper comes from Russian number agreement with disjunctive noun phrases. Typically, when the subject is a disjunction and both disjuncts are singular, plural agreement on the verb is out, as shown in (1):

(1) Bill ili Fred prišel-Ø /*-i**.**
Bill or Fred came-SG/*-PL
'Bill or Fred came.'

However, as first noted in [3], plural agreement with singular disjuncts is not always ungrammatical. Specifically, it becomes an option under modals and frequency adverbials, for example, an adverbial '*every day*', as in (2):

(2) Každyj vtornik Bill ili Fred prixodil-Ø/-i k Saše.
every Tuesday Bill or Fred came-SG/-PL to Sasha
'Every day Bill or Fred came to Sasha.'

Number agreement makes a semantic difference in (2). When the verbs agrees in singular, the disjunction can have either wide or narrow scope with respect to the quantificational adverbial, but when the agreement is plural, the wide scope interpretation of disjunction is ruled out. So, in a scenario where every day the same

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person was coming to Sasha, but the speaker is unsure which one, only singular agreement is possible, as demonstrated by (3):

(3) Každyj vtornik Bill ili Fred prixodil$_{SG}$/*-i$_{PL}$ k S. — ja ne pomnju kto imenno.
'Every Tuesday Bill or Fred came to S., but I don't remember who exactly.'

In the following sections, I am going to show that the ungrammaticality of plural agreement in (1) and (3) follows from independently motivated principles of scalar implicature calculation. To do so, I will first show that the plural agreement with disjunction is a special case of dependent plurality that has been analyzed as a scalar phenomenon in [11].

2 Zweig's dependent plurality

Dependent plurality is phenomenon observed in English when a bare plural appears in the scope of another plural leading to non-trivial semantic consequences. Although at first glance this description doesn't seem to extend straightforwardly to Russian agreement data, the semantic effects are quite on a par.

Here is an example of a dependent plural reading. The sentence in (4a) doesn't necessarily mean that any of my friends attends more than one school. It may be the case that each of my friends attends just one good school, but at the same time it is required that more than one school were referred to overall. If all of my friends attend the same school, (4b) must be used:

(4) a. My friends attend good schools.
b. My friends attend a good school. (examples from [11])

Zweig's proposal in [11] is that bare plurals do not have the 'more than one' component as part of their meaning, i.e. they are number neutral predicates truth-conditionally, but the 'more than one' component arises as a scalar implicature, based on the scale-mate relationship between the bare plural and its singular alternative.

An independent piece of evidence in favor of viewing 'more than one' as a scalar implicature comes from the fact that precisely this component disappears in environments where known scalar implicatures do too, for example, under negation:

(5) John doesn't own dogs. (see [10], [11] etc.)

According to [11], implicature calculation takes place at the level of an event predicate, namely before event closure is applied. The event predicate with a plural variable is weaker than its singular counterpart, giving rise to a scalar implicature. This assumption is crucial for the accounting for the multiplicity implicature, since after event closure applies, plural and singular alternatives become equivalent, so the multiplicity implicature cannot be generated any more.

There is a striking similarity between the reading of (2) with plural agreement and the dependent plural reading of (4a). Namely, the sentence (2) with plural agreement

requires that each Tuesday at least one of the guys come to Sasha, while at the same time it is inappropriate if each Tuesday, it is the same person who is coming (in that case singular agreement must be used). One could say that plural agreement makes dependent plural reading obligatory.

3 The Proposal

As we just saw, Russian disjunctions behave similar to English indefinite NPs (either singular or plural). To capture this correlation, I will make the following assumptions:

- Disjunction is a GQ consisting of a covert existential quantifier and a predicate [A or B].
- Predicate [A or B] can be singular or plural, triggering singular or plural agreement on the verb respectively.
- The plural feature denotes the closure of the predicate under sum formation. The predicate [A or B] having a plural feature will have the following denotation:

(6) $[\![(\text{A or B})\text{-}PL\ ]\!] = *(\lambda x.\ x \text{ is A or X is B}) = \lambda x.\ x \text{ is A or x is B or x is A} \oplus \text{B}$

It seems reasonable to hypothesize that sentences like (1) or (2) have two implicatures: a multiplicity implicature (MI) generated by plural feature (following Zweig's logic) and an exclusivity implicature (EI) generated by a scalar item or.
In case of (1), repeated below as (7), the two implicatures look as shown in (8):

(7) *[Bill or Fred]$_{PL}$ came.

(8) a. Bill or Fred came and *it's not true that only one of them came* (MI) =
= Bill *and* Fred came.

b. Bill or Fred came and *it's not true that both Bill and Fred came* (EI)

It is obvious that these two implicatures contradict each other, and this is precisely where the plural agreement (which reflects the plural feature on disjunction) is ungrammatical.
In cases like (2)/(9) the situation is different:

(9) Every Tuesday [Bill or Fred]$_{PL}$ came.

The two implicatures we get in this case are given below:

(10) a. Every Tu. Bill or Fred came and *it's not true that every Tu. Bill came and it's not true that every Tuesday Fred came* (MI)

b. Every Tu. B. or F. came and *it's not true that every Tu. B. and F. came.* (EI)

In this case, the two implicatures are consistent with each other, giving rise exactly to the dependent plural reading: both boys have to come overall, but on no Tuesday, both boys have to come.
In order to formalize this intuition, I will explicitly lay out my assumptions on the implicature calculation process. First, I assume that scalar implicatures are brought about by a covert exhaustivity operator EXH akin to 'only' (see [7], for example):

(11) $[\![\text{EXH}_{ALT}]\!] = \lambda P_{<s,t>}.\lambda e.\, P(e) \,\&\, \forall Q \in \text{ALT} \,\&\, Q \subseteq P\text{: } [\neg Q(e)]$

Second, I assume, following [9], that the set of alternatives for a sentence with two occurrences of a scalar item φ(X, Y), where X is an element of the scale Q_X and Y an element of the scale Q_Y, is defined as follows:

(12) $\text{Alt}(\varphi(X, Y)) = \{\varphi(X', Y') | X' \text{an element of } Q_X, Y' \text{ an element of } Q_Y\}$

Third, I follow [11] in assuming that implicature calculation happens before the event closure.

Also, I adopt the idea that plural and singular are scalar alternatives with singular being the strongest element of the scale.

On top of these assumptions, I would like to add a new assumption, namely the predicative OR ([A or B]) has non-boolean conjunction [A⊕B] defined in (13) as its non-weaker alternative:

(13) $[A_{<e,t>} \oplus B_{<e,t>}] = \lambda x_e.\exists y_e, z_e\, [x = y \oplus z \,\&\, A(y) \,\&\, B(z)]$ (cf. [6])

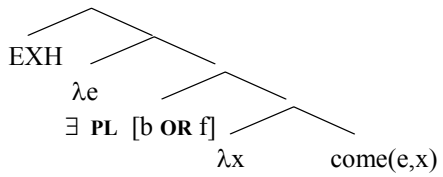
Below I give some examples from Krifka's [6] which serve as an evidence for the existence of non-boolean conjunction which applies to <e,t> predicates (for the details I refer the reader to Krifka's paper):

(14) John and Mary are husband and wife.

(15) The flag is green and white.

Now let's see how these assumptions taken together allow us to explain for the data in (1)/(7) and (2)/(9). First, let's examine a "non-quantificational" case repeated below:

(16) *$[\text{Bill or Fred}]_{PL}$ came.



Before existential closure applies, our sentence denotes the following:

(17) λe.∃x [x=b or x=f or x=b⊕f &*came(e, x)] [PL, OR]

As shown in the LF, we are dealing with two scalar items: predicative OR and PL associated with two scales <OR, AND> and <PL, SG> respectively.

Based on the assumption in (12), the set of scalar alternatives for (17) consists of (18) and (19) (the [SG, AND] alternative is contradictory):

(18) λe.∃x [x=b or x=f &*came(e, x)] [SG, OR]

(19) λe.∃x [x=b⊕f &*came (e, x)] [PL, AND]

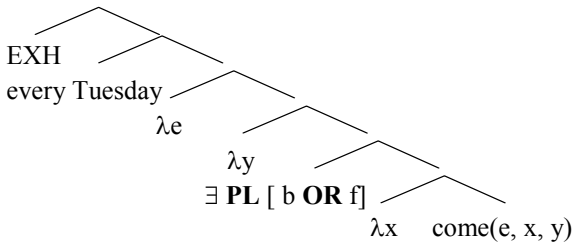
The result of exhaustification of (17) with respect to the alternatives given above is shown in (20):

(20) λe.∃x [x=b or x=f or x=b⊕f &*came(e, x)] &
&¬∃x[x=b or x=f &*came(e, x)] &
&¬∃x [x=b⊕f &*came(e, x)]

(20) is contradictory, which I take to be the reason of the ungrammaticality of (1)/(7).

Now let's turn to the "quantificational" case repeated below:

(21) Every Tuesday [Bill or Fred]$_{PL}$ come.



In order to make the analysis work, we will need to adopt the following denotation for the adverbial universal quantifier (based on [5]):

(22) [[every Tuesday]] =
= λP.λe.∃Y [*Tu(Y)&*P(e)(Y)&∀y [Tu(y)→∃e': e'⊂e &P(e')(y)]]

It's important to point out that the denotation we will adopt consists of two parts – namely, besides universal quantification over events, it also introduces a big event which is the sum of smaller events we quantify over. This will be very crucial for accounting for (2)/(21).

Before existential closure the sentence will denote the following:

(23) λe.∃Y[*Tu.(Y)&∃x [x=b or x=f or x=b⊕f &*come(e, x, Y)]&
& ∀y [Tu.(y) → ∃e'[e'⊂e &∃x [x=b or x=f or x= b⊕f &*come (e', x, y)]]]]

The alternatives of (24) are given below:

(24) a. *SG*-alternative:
λe.∃Y[**Tu.*(Y)&∃x [x=b or x=f &*come (e, x, Y)]&
& ∀y [*Tu.*(y) → ∃e'[e'⊂e &∃x [x=b or x=f &*come(e', x, y)]]]]

b. *AND*-alternative:
λe.∃Y[**Tu.*(Y)&∃x [x=b⊕f &*come (e, x, Y)] &
& ∀y [*Tu.*(y) → ∃e'[e'⊂e &∃x [x=b⊕f &*come(e', x, y)]]]]

The result of exhaustification of (23) with respect to these alternatives is in (25):

(25) λe.∃Y [**Tu.*(Y)&∃x [x=b or x=f or x=b⊕f &*come(e, x, Y)] &
& ∀y [*Tu.(*y) → ∃e'[e'⊂e &∃x [x=b or x=f or x= b⊕f &*come (e', x, y)]]]] &

& ¬[∃Y[**Tu.*(Y)&∃x [x=b or x=f &*come (e, x, Y)] &
& ∀y [*Tu.(*y) → ∃e'[e'⊂e &∃x [x=f or x=b &come(e', x, y)]]]]] &

& ¬[∃Y [**Tu.*(Y)&∃x [x=b⊕f &*come (e, x, Y)] &
& ∀y [*Tu.(*y) → ∃e'[e'⊂e &∃x [x=b⊕f &*come(e', x, y)]]]]] =

λe.∃Y [**Tu.*(Y)& ∃x[x=b or x=f or x=b⊕f &*come(e, x, Y)] &
& ∀y [*Tu.(*y) → ∃e'[e'⊂e &∃x [x=b or x=f or x= b⊕f &*come (e', x, y)]]]]&

a. **¬∃Y[*Tu.(Y)&∃x[x=b or x=f &*come (e, x, Y)]]** ∨
∨ ¬[∀y [*Tu.(*y) → ∃e'[e'⊂e &∃x [x=f or x=b &*come(e', x, y)]]]] *MI*

b. ¬∃Y[**Tu.*(Y)&∃x[x=b⊕f &*come (e, x, Y)]] ∨
∨ **¬[∀y[*Tu.(*y) → ∃e'[e'⊂e &∃x [x=b⊕f &*come(e', x, y)]]]]** *EI*

The conjunction of the assertion with the first disjunct in (25b) and the second disjunct in (25c) gives the meaning we are after. To be clear, let's give informal paraphrases of what we got in (25).

The first disjunct in (25b) can be paraphrased as below:

"It's not true that there is x such that x is atomic and it is either Bill or Fred which is the agent of the big coming event – that guarantees that the agent of the big event will be the sum of Bill and Fred, which excludes the situation in which it is the same person who is coming every Tuesday."

The paraphrase of the second disjunct in (25c) is:

"It's not the case that for every Tuesday there is an event the agent of which is the sum of Bill and Fred – that guarantees that there must be days on which only one of them comes."

Now assume that the first disjunct in (25c) is true. The truth of the first disjunct in (25c) is incompatible with neither disjunct in (25b). So as we just showed, the LF in (25) doesn't predict any other possible meanings for the sentence in (2)/(21).

4 Implications for the theory of scalar implicatures

The analysis we proposed in the previous section raises a question: can the scalar implicatures of a sentence be a reason for its ungrammaticality?

It is well-known that in general scalar implicatures are not obligatory, they can be cancelled, as illustrated below:

(26) Peter or John came. In fact, both Peter and John came.

If the implicature generated by disjunction (It's not the case that both Peter and John came) was obligatory, we would get a contradictory sequence of sentences, but the common intuition is that it is not.

One possible way of thinking about that is the following. Following [8], I will assume that the exhaustification operator is obligatory. But certain alternatives are subject to relevance. If they are not relevant, we are allowed to prune them and thus whether we get a certain implicature or not is a matter of whether we prune alternatives or not.

So cases of implicature cancellation like the one in (26) can be analyzed as follows: the *AND*-alternative ('Bill and Fred came') is not relevant, thus no implicature is generated and no contradiction arises.

It is also known that certain implicatures are obligatory, i.e. noncancellable. For example, as was shown in [2], the implicature associated with plural is obligatory, cf. oddness of the sequence in (27):

(27) I saw boys. # In fact, I saw only one boy.

The way of stating that could be that certain alternatives are not subject to relevance and they cannot get pruned. In our case, we will have to say that alternatives to plural cannot get pruned, thus obligatorily leading to a multiplicity implicature.

Now let's come back to the explanation of the ungrammaticality of (28):

(28) *[Bill or Fred]$_{PL}$ came.

In the previous section, I argued that the ungrammaticality is due to the conflict between implicatures which are generated by two scalar items: PL and OR.

(29) $\lambda e.\exists x$ [x=b or x=f &*came(e, x)] [**SG**, OR]

(30) $\lambda e.\exists x$ [x=b$\oplus$f &*came (e, x)] [PL, **AND**]

But as I said above, the status of these implicatures must be different: the one generated by the plural cannot get pruned, whereas the one generated by or is in fact prunable.

Note that if we were able to prune the *AND*-alternative, we wouldn't get a contradiction and the sentence would be grammatical, meaning 'Bill and Fred came'. Note that this is exactly the and-alternative to our sentence.

The fact that the sentence is ungrammatical suggests that the and-alternative cannot be pruned, which may be a reflex of the principle in (31), cf. similar ideas in [4]:

(31) It is impossible to prune a certain alternative of a sentence if the result of its exhaustification with respect to the remaining subset of alternatives gives the meaning which is equivalent to that alternative.

This generalization can be related to relevance and its properties. It has been argued in [4] that relevance is closed under negation and conjunction. It is also assumed that the prejacent of the EXH operator is always relevant.

So when we exhaustify $[p \vee q]_{PL}$ with respect to the singular alternative $(p \vee q)_{SG}$, what we get looks schematically as follows: $(p \vee q)_{PL} \& \neg (p \vee q)_{SG}$. As relevance is closed under negation and conjunction, the result we got is relevant, but that's equivalent to [p&q](which in turn is equivalent to the and-alternative), so the and-alternative cannot be not relevant and hence cannot be pruned.

The following generalization describes how grammaticality is related to implicature calculation:

(32) Ungrammaticality arises in those cases when implicatures of a sentence lead to a contradiction and there is no possibility of obviating the contradiction by pruning alternatives which give rise to those implicatures (either due to the requirements of certain scalar items or to the principle in (31)).

The difference between cases of implicature cancellation like those in (26) and our cases falls out: in cases like (26), the contradiction can be obviated by pruning "malicious" alternatives, as nothing blocks pruning them in those cases. In our cases the contradiction created by implicatures cannot be saved by pruning of alternatives due to the requirements of plural (alternatives to plural cannot be pruned) and the constraint on pruning (impossibility of pruning singular alternative leads to the meaning equivalent to the and-alternative, thus it cannot be pruned).

One more phenomenon which is covered by that generalization is the distribution of free choice items like any, namely the fact that free choice items are bad in episodic sentences as shown in (33) as opposed to modal environments (34):

(33) *John read any book.

(34) You are allowed to read any book.

In [1], Chierchia accounts for the ungrammaticality of sentences like (33) in the following way: on the one hand, FC items (we can schematically represent them as

disjunctions: a∨b) obligatorily activate domain alternatives (a, b); on the other hand, they also have a scalar implicature (a&b). In episodic sentences these two implicatures clash, thus leading to ungrammaticality. Modals are able to resolve this conflict, making the implicatures consistent.

However, Chierchia doesn't explain why the scalar implicature is obligatorily calculated in this case – he uses a stipulation saying that if D-alternatives are active, scalar alternatives cannot be not active.

We can give it more of a principled explanation now.

Domain alternatives (similar to alternatives to plural) cannot be pruned. But the scalar one is in principle prunable. But notice if we pruned it, the result of second-level exhaustification[1] of a∨b with respect to the domain alternatives would give us the meaning which is equivalent to the *AND*-alternative (as shown in (35)), thus the constraint in (31) would apply, blocking the *AND*-alternative from being pruned.

(35) $EXH_{ALT}(p \vee q) = p \vee q \ \& \ \neg EXH(p) \& \ \neg EXH(q) = p \vee q \ \& \ \neg(p \& \neg q) \& \neg(q \& \neg p) = p \& q$

5 Conclusions

In this paper, I raised the question of whether scalar implicatures can ever lead to ungrammaticality. Based on the puzzling data on agreement with disjunctions, I argued that this happens in those cases when implicatures of a sentence lead to contradiction which cannot be obviated by pruning alternatives which give rise to those implicatures (either due to the requirements of certain scalar items or to constraint on pruning stated in (31)).

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[1] Note that the first-level exhaustification would lead to contradiction in this case. But according to Chierchia, recursive exhaustification is an option which is always available. So what we do is we exhaustify the prejacent with respect to pre-exhaustified set of alternatives {EXH(p) = p&¬q, EXH(q)= q&¬p}. For details, I refer the reader to [1].

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