Proceedings of SALT 33: 000–000, 2023

An approach to Hurford Conditionals*

Alexandros Kalomoiros
Heinrich Heine Universität

Abstract We propose a redundancy-based solution to the puzzle of Hurford conditionals. We argue that the puzzle goes away once we recognise that negated and unnegated Hurford disjunctions are not on par. We develop a theory, dubbed super-redundancy, that captures this contrast, and investigate how it can be paired with different approaches to conditionals. It turns out that under super-redundancy, the Hurford conditional paradigm follows under the material implication and strict semantics approaches to conditionals, but not under the variably strict semantics. Finally, we extend our theory to capture some puzzling cases of Hurford phenomena that have recently received attention in Marty & Romoli (2022).

Keywords: Hurford Conditionals, Hurford Disjunctions, Redundancy

1 Introduction

It has been known for almost fifty years that disjunctions where one disjunct entails the other are odd:

(1) a. #Either John studied in Athens or he studied in Greece.
b. ✓Either John studied in Athens or he studied somewhere else in Greece.

Descriptively this data suggests a constraint that bans disjunctions where one disjunct entails the other (such disjunctions are known as *Hurford disjunctions* and the constraint banning them as *Hurford's constraint*). Even though this constraint is easy to state at a descriptive level, getting it to follow from deeper principles in a way that can handle various edge-cases has been a subject of intense research, (Hurford 1974; Schlenker 2009; Chierchia, Fox & Spector 2012; Katzir & Singh 2013; Ciardelli & Roelofsen 2017; Westera 2019: a.o.), and the issue is not yet fully settled, (Marty & Romoli 2022). However, any theory that can derive the generalization that a disjunction is odd if one of the disjuncts entails the other makes a

* Thanks to Florian Schwarz, Julie Legate, Jacopo Romoli, Muffy Siegel, Andrea Beltrama, Chris Kennedy, Larry Horn and members of the Penn semantics lab for useful feedback. Thanks also to audiences at the LSA 2023 and SALT 33. Special thanks to Julie Legate, Muffy Siegel and Chris Kennedy for providing me with their judgments.

prediction: if p^+ and p are such that $p^+ \models p$, then their negations are also related by entailment (by contraposition): $\neg p \models p^+$. Therefore, Hurford's constraint predicts that both $p^+ \vee p$ and $\neg p \vee \neg p^+$ should be odd:

(2) a. #Either John studied in Athens or he studied in Greece.
b. (#) Either John didn't study in Greece or he didn't study in Athens.

Indeed, the literature on Hurford disjunctions has accepted this: for instance Mandelkern & Romoli (2018) explicitly give a judgment where (2-b) is odd.

However, Mandelkern & Romoli (2018) show that once this basic picture is in place, a simple yet quite fiendish puzzle arises. Suppose that we treat the conditional as material implication and consider the following paradigm:

(3) a. #If John didn't study in Athens, he studied in Greece.
b. ✓If John studied in Greece, he didn't study in Athens.

By the *or-to-if* tautology ($\neg p \vee q \equiv p \rightarrow q$) we can convert between a disjunction and a conditional. If we use this tautology to convert the conditionals in (3) to disjunctions we get the disjunctions in (2).

To the extent that a theory derives the oddness of Hurford disjunctions on the basis of their semantics, it will fail to differentiate between $p^+ \vee p$ and $\neg p \rightarrow p^+$. This is a good prediction since both (2-a) and (3-a) are odd. But such a theory makes a terrible prediction since it also predicts that both (2-b) and (3-b) should be odd; yet clearly, at least (3-b) is unobjectionable.

Furthermore, as Mandelkern & Romoli (2018) point out, in popular approaches to Hurford's constraint, problems persist even if the conditional is analyzed as a strict conditional (von Fintel 1999; Gillies 2009: a.o.), or a variably strict conditional, (Stalnaker 1958; Lewis 1973). Thus, we seem to find ourselves in a corner.

The aim of the current paper is to offer a solution to this predicament: we begin in section 2 with a more careful examination of why two popular appraoches to Hurford disjunctions fail when confronted with Hurford conditionals. In Section 3 we present the empirical core underlying our solution: we adduce novel data arguing that there exists a contrast between the classic Hurford case in (2-a) and its negated counterparts in (2-b): the former is indeed odd; but the latter is not, and this can be brought out clearly in the proper contexts. Once this piece of data has been clarified, the picture becomes much less confusing: disjunctive cases pattern like the conditional cases. What is needed then is a theory that can derive the oddness of (2-a) and (3-a), without also penalizing (2-b) and (2-b). Inspired from Redundancy-based approaches to Hurford phenomena, (Katzir & Singh 2013; Meyer 2013; Mayr & Romoli 2016), we offer in section 4 a novel theory of redundancy that accomplishes this, and is dubbed **super-redundancy**. We also examine what happens when we combine the super-redundancy theory with other approaches to the semantics of conditionals, specifically the strict and variably strict approaches: things continue to work out with the strict conditional, but not with the variably strict conditional. Section 5 extends the theory to the broader landscape of Hurford phenomena and ties some loose ends. Section 6 concludes.

2 Background

2.1 The Brevity constraint

The redundancy approach to Hurford phenomena is based on the following simple and appealing intuition: a Hurford disjunction is odd because it is (contextually) equivalent to one of its disjuncts. This essentially triggers a violation of a Gricean brevity constraint, (Grice 1975): one could have said something simpler by uttering only one of the disjuncts instead of the whole disjunction.

It is not difficult to see that (1-a) is equivalent to *John studied in Greece*. If (1-a) is true, then John studied either in Athens or in Greece. Either way, it's true that John studied in Greece. Conversely, if *John studied in Greece* is true, then clearly so is (1-a).

One way to characterize this state of affairs more precisely is the following brevity constraint:

(4) **Brevity:** (adapted from Mandelkern & Romoli (2018), see also Katzir & Singh (2013); Mayr & Romoli (2016))

a. A sentence p cannot be used in a context C if $[\![p]\!]$ is contextually equivalent to one of its simplifications.

b. q is a simplification of p iff it is derived from p by replacing nodes in p with their subconstituents.

Assuming the simplified syntax of a propositional language, it is easy to see that a disjunction of the form $(p \vee q)$ has q (as well as p) as a simplification: since q is a subconstituent of $(p \vee q)$, we can replaced the top node of $(p \vee q)$ with q and get q. In general this derives that a disjunction cannot be equivalent to one of its disjuncts; since this is exactly the situation that a Hurford disjunction puts as in, Hurford dijsunctions are banned under the Brevity constraint.

2.2 The problem of Hurford conditionals

When confronted with Hurford conditionals, we find ourselves in the predicament we noted in the introduction. On the material implication analysis of the conditional, a Hurford conditional is equivalent to its consequent:

(5) a. #If John didn't study in Athens, he studied in Greece ≡ John studied in Greece. $\rightsquigarrow (\neg p^+ \rightarrow p) \equiv p$

Since the consequent is a simplification of the conditional, the Brevity constraint penalizes Hurford conditionals, deriving the oddness of (5-a). However, the same kind of reasoning derives that (6-a) is equivalent to its consequent. As the consequent is also a simplification of the conditional, the prediction is that (6-a) should be infelicitous, contrary to intuition.

(6) a. ✓If John studied in Greece, he didn't study in Athens ≡ John didn't study in Athens. $\rightsquigarrow (p \rightarrow \neg p^+) \equiv \neg p^+$

2.3 Beyond the material implication

As noted by Mandelkern & Romoli (2018) this puzzling state of affairs does not change when we switch to strict implication, (von Fintel 1999; Gillies 2009): $\Box(\neg p^+ \rightarrow p)$ has $\Box p$ as simplification and is equivalent to it.[1] However, the same kind of reasoning derives that $\Box(p \rightarrow \neg p^+)$ has $\Box p$ as simplification and is equivalent to it. Again, (5-a) and (6-a) are both predicted to be odd, contrary to fact.

Finally, as Mandelkern & Romoli (2018) again observe, switching to the variably strict conditional, (Stalnaker 1958; Lewis 1973; Kratzer 1986) is of no help either. In fact, this approach loses the good prediction that (5-a) should be odd.

In the variably strict semantics $(\alpha \rightarrow_{vs} \beta)$ is true in a world w iff β is true in all worlds in $f(w, [\![\alpha]\!])$; f is a contextual parameter that takes a world w and a proposition $[\![\alpha]\!]$, and returns the set of worlds that are 'closest' to w and where α is true. With this in mind, suppose that p is true in a world w (in a context C), and suppose also that $\neg p^+$ is false in w. Then $(\neg p^+ \rightarrow_{vs} p)$ (cf. (5-a)) is true in w iff p is true in all the the closest $\neg p^+$ worlds to w. But just because p is true in w, this doesn't guarantee that p will be true in all the the closest $\neg p^+$ worlds to w.

Seen in the more intuitive context of (5-a) the reasoning above amounts to the following: just because John studied in Greece in a world w, this doesn't guarantee that in the closest worlds to w where John doesn't study in Athens, he studies in Greece (perhaps those closest worlds are worlds where he studies in Scotland). So, $(\neg p^+ \rightarrow_{vs} p)$ isn't equivalent to p (nor to any other simplification for that matter), and is hence predicted to be fine, contrary to fact.

1 This is simply a consequence of the preservation of equivalences under $\Box$. Suppose that in a context C, α and β are equivalent. Then so are $\Box\alpha$ and $\Box\beta$. For suppose that $\Box\alpha$ is true throughout C. Now, take an arbitrary world w in C. In in all R-accessible worlds w' from w, α is true in w'. Since α is equivalent to β, β is true in w'. Because w' was arbitrary, β is true in all R-accessible worlds from w. And since w was arbitrary, this holds across worlds in C, which means that $\Box\beta$ is true throughout C. Therefore, since $(\neg p^+ \rightarrow p)$ and p are equivalent, so are $\Box(\neg p^+ \rightarrow p)$ and $\Box p$.

2.4 The triviality approach

It is interesting to note, following again Mandelkern & Romoli (2018), that switching to the triviality approach to Hurford phenomena isn't of any help either. Since the intuitions behind the triviality approach will not be central for the rest of this paper, we only review it briefly here.

The triviality approach is based on the following constraint:

(7) **Triviality constraint:** a sentence p is felicitous in a context C just in case no sub-constituent q of p is entailed or contradicted by q's local context.

The notion of *local context* is that of Schlenker (2009) (which in turn has important antecedents in the presupposition literature, see Karttunen (1974); Heim (1983)), and will not be presented in detail here. For the present discussion it suffices to know that the symmetric local context of p^+ in a Hurford disjunction like $(p^+ \vee p)$ in a context C is $C \cap [\![\neg p]\!]$. Since $\neg p \models \neg p^+$, the first disjunct is contradicted by its local context, and the sentence is predicted to be infelicitous.

Similar reasoning derives the infelicity of a Hurford conditional: assuming a material implication analysis, the symmetric local context of $\neg p^+$ in $(\neg p^+ \rightarrow p)$ is $\neg p$. Since $\neg p \models \neg p^+$, the first disjunct is entailed by its local context, and the sentence is predicted to be infelicitous.

Once again, all this breaks down when applied to the case of $(p \rightarrow \neg p^+)$. The symmetric local context of p is $\neg\neg p^+ = p^+$. Since p^+ entails p, the antecedent of the conditional is entailed by its local context, and the sentence should be infelicitous. But it's not.[2]

Problems persist even if we switch from a material implication analysis to a strict or variably strict analysis of the conditional. However, given that the details of these cases are quite complicated, and do not matter for the purposes of our argumentation in the rest of this paper, we refer the reader to Mandelkern & Romoli (2017, 2018) for more details.

3 The impact of negation

The theories we have examined so far aim to derive that disjunctions where one disjunct entails the other are infelicitous; but as soon as we do that, we are unable

2 Note that switching to an asymmetric notion of local context is of no help. In the case of $(\neg p^+ \rightarrow p)$, the asymmetric local context of $\neg p^+$ is the global context C, and the asymmetric local context of p is $\neg p^+$. Assuming that C neither entails, nor contradicts the antecedent, the only way the triviality constraint can be violated is if $\neg p^+$ either entails or contradicts p. But in the Hurford conditionals examples, the antecedent neither contradicts nor entails the consequent. Thus, Hurford conditionals will be predicted to be felicitous.

to account for Hurford conditionals. In this section, we present new data suggesting that **it is not in fact true** that disjunctions where one disjunct entails the other are always infelicitous: this only holds for disjunctions whose disjuncts are **un**negated.

3.1 The data

Consider the following contrast between (8) and (9):[3]

(8) a. ***Context:*** We go into John's office and see a full pack of Marlboro cigarettes on his desk:
b. ✗John either smokes Marlboros or he smokes.

(9) a. ***Context:*** We go into John's office and see a full pack of Marlboro cigarettes in the dustbin. We are entertaining hypotheses about what's going on:
b. ✓John either doesn't smoke or he doesn't smoke Marlboros.

(8) is a classic instance of a Hurford disjunction, and its infelicity is fully expected. The judgment for the negated Hurford disjunction in (9) though is unexpected: *John doesn't smoke* entails that *John doesn't smoke Marlboros*, thus Hurford's constraint would predict (9) to be odd. But as has been confirmed by native speaker consultants, (9) sounds fine, especially when contrasted to the obviously infelicitous (8).

The reason this contrast is important is that if we apply the *or-to-if* tautology to these sentences, we get the Hurford conditional paradigm that was puzzling us before, with the judgments following the same pattern as the corresponding disjunctions. For conceptual symmetry, let's call sentences like (10) *Hurford Conditionals*, and sentences like (11), *Negated Hurford Conditionals*:

(10) a. ***Context:*** We go into John's office and see a full pack of Marlboro cigarettes on his desk:
b. ✗If John doesn't smoke Marlboros, he smokes.

(11) a. ***Context:*** We go into John's office and see a full pack of Marlboro cigarettes in the dustbin. We are entertaining hypotheses about what's going on:
b. ✓If John smokes, he doesn't smoke Marlboros.

The same paradigm can be replicated with other examples:

3 The judgments in this section come from three native speakers, and were also discussed with the SALT audience without objections. Naturally, it is important to also verify them through experiment.

(12) a. ***Context:*** We're searching the house for John. We've checked most of the house, and we are almost done checking his bedroom, but we haven't found him:

b. ✓John either isn't in the house or isn't in his bedroom.

(13) a. ***Context:*** We're searching the house for John. He often likes to hide in his bedroom.

b. ✗John either is in his bedroom or in the house.

(14) a. ***Context:*** We are searching for John in France. We've spent three days in Paris and haven't found him yet. At the same time, we know that he rarely visits any other French cities.

b. ✓John either isn't in France or isn't in Paris.

(15) a. ***Context:*** We are searching for John, and we believe that he's in France. He often likes visiting Paris:

b. ✗John is either in Paris or in France.

3.2 The landscape of generalisations

Let's review. Hurford's constraint predicts that all disjunction where one disjunct entails the other should be infelicitous. But this made the Hurford conditional paradigm puzzling under a material implication analysis[4] However, we have argued that the empirical picture is in fact the one represented in table 1:

	$p^+ \vee p$	$\neg p \vee \neg p^+$	$\neg p^+ \rightarrow p$	$p \rightarrow \neg p^+$
Prediction	✗	✗	✗	✗
Facts	✗	[✓]	✗	✓

Table 1 The current landscape of Hurford disjunction and conditionals

Now sentences that are equivalent under the *or-to-if* tautology pattern in the same way, and what needs to be explained isn't why Hurford disjunctions and Hurford conditionals pattern differently (they don't), but why negated vs unnegated Hurford disjunctions pattern differently. Once an explanation of that is in place, and assuming a material implication analysis for the conditional, then the same explanation should capture Hurford conditionals. The rest of the paper is devoted to precisely developing such an explanation and exploring its consequences.

4 And we saw considering other analyses of the conditional wasn't much help either.

4 A solution: super-redundancy

I would like to pursue a redundancy-based approach to the problem of Hurford disjunctions/conditionals. While my approach will share some common intuitions with the Katzir & Singh approach reviewed in section 2, the mechanics will be rather different. I will first introduce the intuition behind the approach, showing how it helps us break the symmetry between negated vs unnegated Hurford disjunctions. I will then formalize the intuition and derive the paradigm indicated in table 1, assuming a material implication analysis of the conditional. I then proceed to apply the approach to the strict and variably strict implication.

4.1 Intuitions

I want to start with the following notion of redundancy: something is redundant if you remove it and nothing changes. In the context of semantic redundancy, we can say informally that a constituent C is a sentence S is redundant iff we remove it from S and the truth conditions of S remain unchanged. In the case of a Hurford disjunction, we have $(p^{+} \vee p)$. We can imagine removing p^{+} (and deleting the $\vee$), being left with p. We have already seen that these two sentences are equivalent, so on the basis of our current terminology we can say that p^{+} *is redundant in* $S = (p^{+} \vee p)$.

Of course this doesn't help yet with the difference between negated vs unnegated disjunctions: in $S = \neg p \vee \neg p^{+}$ we can remove $\neg p$ and be left with $\neg p^{+}$. Since $(\neg p^{+} \vee \neg p) \equiv \neg p^{+}$, $\neg p$ is redundant in S. How then do we break the symmetry between negated vs unnegated disjunctions?

To do that, we will make use of the following property: in a classic Hurford disjunction like $S = p^{+} \vee p$, there is no way of strengthening p^{+} so that it becomes non-redundant in S. To keep the discussion for the moment informal, suppose we try to strengthen the redundant first disjunct in (16-a) below, by conjoining some sentence D to it:

(16) a. (John studied in Athens *and D*) or John studied in Greece.
b. John studied in Greece.

It doesn't matter what D is: if (16-a) is true, then either the second disjunct is true, or the first disjunct is true. If the second disjunct is true, then (16-b) is true. And if the first disjunct is true, then it's true that John studied in Athens and hence in Greece; again (16-b) is true (the other direction from the truth of (16-b) to the truth of (16-a) should be obvious).

But consider now $S = (\neg p \vee \neg p^{+})$. $\neg p \models \neg p^{+}$, so $\neg p$ here is just like p^{+} above. Suppose we wanted to strengthen p, so that $\neg p$ would stop being redundant in S.

Note that if we are strengthening p, the strengthening will happen **under** the scope of the negation, i.e. we will end up with $\neg(p \wedge D)$ (for some sentence D). It is now very easy to find a D that will render $\neg(p \wedge D)$ non-redundant in S. Again, consider this in the context of an actual example:

(17) a. Either John didn't (study in Greece and Germany) or he didn't study in Athens.
b. John didn't study in Athens.

If (17-a) is true either the first or second disjunct is true. If the second disjunct is true, then (17-b) is clearly true. But if the first disjunct is true, all we know is that John either didn't study in Greece or didn't study in Germany. The truth of this is perfectly compatible with John not having studied in Athens; he could have studied instead in Berlin, in which case the first disjunct of (17-a) would be true, but (17-b) would be false.

Thus, unnegated Hurford disjunctions have a disjunct that can never be rendered non-redundant, no matter how one strengthens the atomic sentences underlying it, while negated Hurford disjunctions have a disjunct that can be strengthened under the negation, and thus rendered non-redundant.

We are going to call a constituent C in a sentence S **super-redundant** just in case one can never strengthen the atomic sentences in C in a way that renders C non-redundant in S. If we assume that what our judgments are sensitive to is not plain redundancy, but the stronger notion of super-redundancy, then we have a handle on the negated vs unnnegated Hurford disjunctions contrast: unnegated Hurford disjunction have a constituent that is super-redundant, while negated Hurford disjunctions have no such constituents. Assuming the material implication analysis of the conditional, the same kind of reasoning will be able to give us the difference we are after in that domain as well.

Now we turn to the formalization of the notion of super-redundancy.

4.2 Definitions

Mirroring the intuitive build-up to the notion of super-redundancy in the previous subsection, it is instructive to begin by first defining a very simple, but inadequate, notion of redundancy. To do this, we first define what it means to remove a constituent from a complex sentence S:

(18) **Definition 1** : $(\mathbf{S})^-_{\mathbf{C}}$ Given a complex sentence S that contains a sub-constituent $(C * \psi)$ or $(\psi * C)$, where $*$ is a binary connective, $(S)^-_C$ equals the version of S where $(C * \psi)/(\psi * C)$, has been replaced by ψ. If S is not a complex sentence, or contains no $(C * \psi)/(\psi * C)$ sub-constituent, then $(S)^-_C$ is

undefined.

(19) **Definition 2** : **Redundancy** A constituent C in a sentence S is **redundant** iff $(S)^-_C$ is defined and $(S)^-_C \equiv S$.

As already discussed in the previous subsection, this simple notion doesn't work because it fails to differentiate between unnegated vs negated Hurford disjunctions. To do that, we need to move to super-redundancy. Since super-redundancy involves reasoning about the redundancy of a constituent C under all possible strengthenings of the atomic formulas of C, we first give a definition of what it means to strengthen C in this way:

(20) **Definition 3** : $\mathbf{Str(C,D)}$ Given a sentence S, a sub-constituent C of S, and sentence D: the *strengthening of C with D*, $Str(C,D)$, is defined as follows:

- If C is atomic, then $Str(C,D) = C \wedge D$
- If $C := \neg\alpha$, then $Str(C,D) = \neg Str(\alpha,D)$
- If $*$ is a binary connective, and $C := \alpha * \beta$, then $Str(C,D) = Str(\alpha,D) * Str(\beta,D)$

Since what super-redundancy checks is the equivalence between the version of a sentence S where C has been strengthened and the version of S where C has been removed, we need to define the version of S with C strengthened. To do so, we build on Definition 3 in the following way:

(21) **Definition 4** : $\mathbf{S_{Str(C,D)}}$ Given a complex sentence S that contains a sub-constituent $(C * \psi)$ or $(\psi * C)$, where $*$ is a binary connective, and given a sentence D, $\mathbf{S_{Str(C,D)}}$ equals the version of S where C has been replaced by $Str(C,D)$ in S. If S is not a complex sentence, or contains no $(C * \psi)/(\psi * C)$ sub-constituent, then $\mathbf{S_{Str(C,D)}}$ is undefined.

Finally, we are in a position to define the notion of **super-redundancy**:

(22) **Definition 5** : **Super-redundancy** A constituent C is **super-redundant** in a sentence S iff $(S)^-_C$ is defined and for all D, $(S)^-_C \equiv S_{Str(C,D)}$.[5]

We have now formalized the intuition developed in the previous subsection that something is super-redundant iff no possible strengthening would make it non-redundant. Finally, we need a constraint that penalizes super-redundancy:

(23) **Definition 6** : **No Super-redundancy** Given a sentence S, it must hold that

5 Note that since $(S)^-_C$ and $S_{Str(C,D)}$ have the same definedness conditions, it suffices to explicitly require only one of them to be defined.

for every subsentence S' of S, S' contains no constituent C such that C is super-redundant in S'.

If a sentence S violates the *No super-redundancy* constraint, this leads to infelicity.

4.3 Some notes on the definitions

4.3.1 Projectivity of (in)felicity

Note that Definition 6 demands the absence of super-redundant constituents in **all** subsentences of S. The reason is that the presence/absence of Hurford-based infelicity appears unaffected by embedding; in this sense, infelicity 'projects':

(24) a. ***Context:*** We know that in general John has healthy habits. But we go into his office and see a full pack of Marlboro cigarettes on his desk. So, we think:
b. #John has in general healthy habits, **but** [either he smokes Marlboros or he smokes].

(25) a. ***Context:*** We know that in general John has unhealthy habits. But we go into his office and and see a full pack of Marlboro cigarettes in the dustbin. We are entertaining hypotheses about what's going on:
b. ✓John has in general unhealthy habits, **but** [either he he doesn't smoke or he doesn't smoke Marlboros].

In (24), a Hurford disjunction is embedded the second conjunct of a conjunction and the whole conjunction sounds infelicitous. Similarly, in (25) a negated Hurford disjunction is embedded in a conjunction, with the whole conjunction appearing felicitous. Having the *No Super-redundancy* constraint apply to all subsentences of a sentence S is a simple way of imposing this 'projective' behavior.

4.3.2 Atomic sentences and negations of atomic sentences do not contribute to super-redundancy

Finally, note that one need not ever check whether in a sentence S, atomic subsentences or negations of atomic subsentences contain constituents that are super-redundant in them.

Suppose that a sentence S has either $S' = p$ or $S'' = \neg p$ as subsentneces. Definition 6 demands that we check whether either S' or S'' contain constituents C that are super-redundant. For S', the only constituent is p. $(S')^-_p$ is undefined, since S' is not a complex sentence. Thus, by Definition 5, p is never super-redundant in S'.

Similarly, in $S'' = \neg p$, the only constituents are $\neg p$ and p. Since neither of these are adjacent to a binary connective in S'', S'' contains no sub-constituent of the form $(C*\psi)$ or $(\psi*C)$, thus rendering $(S'')^-_{\neg p}$ and $(S'')^-_p$ undefined. Thus, by Definition 5, neither $\neg p$ nor p is ever super-redundant in S''.[6]

4.4 Deriving the basic generalisations

With these ingredients and notes in place, we're finally in the position to apply the theory to our data. We do so initially under the assumption that conditionals denote material implications.

4.4.1 Hurford disjunctions

Consider a simple HD of the form $S = p^+ \vee p$. We argue that p^+ is super-redundant in S. $(S)^-_{p^+} = p$, $S_{Str(p^+,D)} = ((p^+ \wedge D) \vee p)$. We need to check whether for all D, $p \equiv ((p^+ \wedge D) \vee p)$. Take some arbitrary D, and suppose that p is true; then clearly, $((p^+ \wedge D) \vee p)$ is true. Now suppose that $((p^+ \wedge D) \vee p)$ is true. If it's true because p is true, then the result follows immediately. If it's true because $(p^+ \wedge D)$, then p^+ must be true (because $(p^+ \wedge D)$ is a conjunction). Since $p^+ \models p$, then p is true, so again the result follows.

4.4.2 Negated Hurford disjunction

Consider a negated HD of the form $S = \neg p \vee \neg p^+$. We argue that S shows no kind of super-redundancy, i.e. it super-redundant for neither $\neg p$ nor $\neg p^+$. Note that $\neg p$ and $\neg p^+$ are the only licit candidates for super-redundancy, since by the definitions in (18) and (21), C must be immediately adjacent to a binary connective. The only other sub-constituents here are p and p^+, which are immediately adjacent to a negation, and not to the disjunction.

We start with $\neg p$. $(S)^-_{\neg p} = \neg p^+$, $S_{Str(\neg p,D)} = (\neg(p \wedge D)) \vee \neg p^+)$. We show that there is D such that $\neg p^+ \not\equiv (\neg(p \wedge D) \vee p^+)$. Take D to be a contradiction $\bot$. Then, $S_{Str(\neg p,\bot)} = (\neg(p \wedge \bot)) \vee p^+) = \neg p \vee \neg\bot \vee p^+ = \neg p \vee \top \vee p^+$, where $\top$ is a tautology. The last formula is equivalent to just $\top$. Clearly, $(S)^-_{\neg p} = \neg p^+$ is not equivalent to $S_{Str(\neg p,\bot)} = \top$.

6 Actually this reasoning can be generalized somewhat: any sentence of the form $S = \neg\alpha$, where α does not contain a binary connective, will never contain a constituent C such that C is super-redundant in S. This follows simply from the fact that for any C in S to be super-redundant, $(S)^-_C$ needs to be defined, and for $(S)^-_C$ to be defined, S needs to contain a subconstituent of the form $(C*\psi)$ or $(\psi*C)$, for some ψ. But then S contains a binary connective. The only subsentence in S that can contain a binary connective is α, and this is ruled out by hypothesis.

Now consider $\neg p^+$. $(S)^-_{\neg p^+} = \neg p$, $S_{Str(\neg p^+,D)} = (\neg p \vee \neg(p^+ \wedge D))$. We show that there is D such that $\neg p \not\equiv (\neg p \vee \neg(p^+ \wedge D))$. Take D to be some tautology $\top$. Then, $S_{Str(\neg p^+,D)} = (\neg p \vee \neg(p^+ \wedge \top)) = (\neg p \vee \neg p^+)$. It's perfectly possible for $S_{Str(\neg p^+,D)}$ to be true, while $(S)^-_{\neg p^+}$ is false, e.g. in a case where $p = 1$ and $p^+ = 0$.

Thus, neither $\neg p$ nor $\neg p^+$ are super-redundant in S, and no infelicity arises.

4.4.3 Hurford conditionals

Consider a HC or the form $S = (\neg p^+ \rightarrow p)$. We argue that $\neg p^+$ is super-redundant in S. $(S)^-_{\neg p^+} = p$, $S_{Str(\neg p^+,D)} = (\neg(p^+ \wedge D) \rightarrow p) = (\neg p^+ \vee \neg D) \rightarrow p$. We need to show that p and $(\neg p^+ \vee \neg D) \rightarrow p)$ are equivalent. Take some arbitrary D and assume that p is true; this automatically makes $(\neg p^+ \vee \neg D) \rightarrow p$ true. Now take $(\neg p^+ \vee \neg D) \rightarrow p$ to be true; in this case, either $p = 1$ (and the equivalence follows) or $(\neg p^+ \vee \neg D) = 0$. In the latter case, $p^+ = 1$ (since both disjuncts in $(\neg p^+ \vee \neg D)$ are false), and since $p^+ \models p$, then $p = 1$; so again the equivalence follows. Thus, $\neg p^+$ is super-redundant in S, and infelicity ensues.

4.4.4 Negated Hurford Conditionals

Consider a negated HC of the form $S = (p \rightarrow \neg p^+)$. Neither p nor $\neg p^+$ are super-redundant in S. Consider p first. $(S)^-_p = \neg p^+$, $S_{Str(p,D)} = (p \wedge D) \rightarrow \neg p^+$. Take $D = \perp$. Then, $S_{Str(p,D)} = \perp \rightarrow \neg p^+$, while $(S)^-_p = \neg p^+$. These are not equivalent, as no matter the truth value of $\neg p^+$, $\perp \rightarrow \neg p^+$ will be true. Hence p is not super-redundant in S.

Now consider $\neg p^+$. $(S)^-_{p^+} = p$, $S_{Str(\neg p^+,D)} = p \rightarrow \neg(p^+ \wedge D))$. Take $D = \top$. Then $S_{Str(\neg p^+,\top)} = p \rightarrow \neg p^+$. p and $(p \rightarrow \neg p^+)$ are not equivalent: $(p \rightarrow \neg p^+)$ can be true because p is false. Therefore, no sub-constituent of S is super-redundant, and no infelicity arises.

4.5 Beyond the material implication

We now check the results of the theory under two different approaches to the conditional: the strict and variably strict implication.

4.5.1 The strict conditional

Under a strict implication analysis, Hurford conditionals will continue to be infelicitous, whereas negated Hurford conditionals will continue to be felicitous.

4.5.2 Hurford conditionals

The strict Hurford conditional has the form $S = \Box(\neg p^+ \rightarrow p)$. By the reasoning in section 4.5.2, we know that $\neg p^+$ is super-redundant in in $S' = \neg p^+ \rightarrow p$. Given that the *No super-redundancy* constraint applies to every subsentence in S, and S' is a subsentence of S that violates it, this already establishes that S also violates it.

It's interesting to note that $\neg p^+$ can be shown to be super-redundant in the full $S = \Box(\neg p^+ \rightarrow p)$ as well, i.e. the following holds:

(26) For all D, $\Box(\neg(p^+ \wedge D) \rightarrow p) \equiv \Box p$

The reasoning follows the basic pattern that we have been utilizing throughout the paper and is left as an exercise for the reader.

4.5.3 Negated Hurford conditionals

A negated Hurford strict conditional has the form $S = \Box(p \rightarrow \neg p^+)$. We know already that neither p nor $\neg p^+$ are super-redundant in the subsentence $S' = (p \rightarrow \neg p^+)$. The same can be shown for these two constituents in S. We go through the case of $\neg p^+$, leaving p to the reader.

We need to show that there is a D such that:

(27) $\Box(p \rightarrow \neg(p^+ \wedge D)) \not\equiv \Box p$

Take $D = \bot$. Then, $\Box(p \rightarrow \neg(p^+ \wedge \bot)) = \Box(p \rightarrow \top)$. Clearly, $\Box(p \rightarrow \top)$ is true in all worlds w (since in all w' accessible from w, $p \rightarrow \top$ is true, given that the consequent is a tautology). Since it is easy to imagine a context where there are accessible worlds from w where p is false, $\Box p$ need not be true. Hence, for $D = \top$, $\Box(p \rightarrow \neg(p^+ \wedge D))$ is not equivalent to $\Box p$.

4.5.4 The variably strict conditional

Things work differently when we switch to the variably strict implication. Just like Katzir & Singh (2013), we stop being able to account for the infelicity of Hurford conditionals.

Consider a variably strict implication of the form $S = (\neg p^+ \rightarrow_{vs} p)$. Neither $\neg p^+$ nor p are super-redundant in S. For $\neg p^+$ to be super-redundant, the following would need to hold:

(28) For all D, $((\neg(p^+ \wedge D) \rightarrow_{vs} p) \equiv p$

Take $D = \top$. We already know from the discussion in section 2 that $(\neg p^+ \rightarrow_{vs} p)$

is not equivalent to p. Therefore, (28) doesn't hold.

For p to be super-redundant, the following would need to hold:

(29) For all D, $(\neg p^+ \rightarrow_{vs} (p \wedge D)) \equiv \neg p^+$

Take again $D = \top$. Suppose that $(\neg p^+ \rightarrow_{vs} p)$ is true in w. Does this mean that $\neg p^+$ is also true in w? No, as w could be a world where $\neg p^+$ is false, but all the closest worlds to w where $\neg p^+$ is true are worlds where p is true. Therefore, (29) doesn't hold.

Thus, assuming the variably strict conditional analysis fails to capture the infelicity of Hurford conditionals under our super-redundancy approach.

5 The broader landscape of Hurford phenomena

In this section we examine how our theory can address the recent challenge issued by Marty & Romoli (2022) to theories of Hurford phenomena. While so-called *Long distance Quasi Hurford Disjunctions* are problematic for our theory, a simple amendment solves the issue, without jeopardizing any of our good results.

5.1 The challenge

Marty & Romoli (2022) present the following paradigm, arguing that no extant theory of Hurford phenomena can successfully capture it:

(30) a. #John studied in Athens or in Greece. $\rightsquigarrow p^+ \vee p$ (Hurford Disjunction)

b. ✓John studied in Athens or somewhere else in Greece. $\rightsquigarrow p^+ \vee q$, $q \models \neg p^+ \wedge p$ (Quasi Hurford Disjunction)

c. #John studied in Greece or in London or in Athens. $\rightsquigarrow p \vee (r \vee p^+)$ (Long Distance Hurford Disjunction)

d. ✓John studied in Athens or he didn't study in Athens but studied in Greece. $\rightsquigarrow p^+ \vee (\neg p^+ \wedge p)$ (Long Distance Quasi Hurford Disjunction)

For reasons of space, I am not going to repeat the Marty & Romoli (2022) arguments showing why this paradigm is problematic for other theories of Hurford phenomena. For our purposes, it suffices to note that our super-redundancy approach captures (30-a)-(30-c), but struggles with (30-d).

(30-a) is the classic Hurford disjunction which we have already argued comes out infelicitous in our system. (30-b) is a so-called 'Quasi Hurford Disjunction' (QHD). It is straightforward to show that neither p^+ nor q are super-redundant in this case. If p^+ were super-redundant the following would be true:

(31) For all D, $((p^+ \wedge D) \vee q) \equiv q$

Take $D = \top$, hence $(p^+ \wedge D) = p^+$. Since $q \models \neg p^+ \wedge p$, the truth of p^+ directly contradicts the truth of q. So, the desired equivalence doesn't hold. Similarly, q is not super-redundant. If it were, the following would hold:

(32) For all D, $(p^+ \vee (q \wedge D)) \equiv p^+$

Take again $D = \top$, hence $(q \wedge D) = q$. Since the truth of q directly contradicts the truth of p^+, again the desired equivalence doesn't hold.

On the other hand, in (30-c), p^+ is super-redundant, since (33) holds (as the reader can verify):

(33) For all D, $(p \vee (r \vee (p^+ \wedge D)) \equiv (p \vee r)$.

The problematic case is (30-d), as $\neg p^+$ is super-redundant:

(34) For all D, $(p^+ \vee (\neg(p^+ \wedge D) \wedge p)) \equiv (p^+ \vee p)$

Take an arbitrary D. Suppose that $(p^+ \vee (\neg(p^+ \wedge D) \wedge p))$ is true. If p^+ is true, then so is $(p^+ \vee p)$. If $(\neg(p^+ \wedge D) \wedge p)$ is true, then p is true, and hence $(p^+ \vee p)$ is true. For the other direction, suppose that $(p^+ \vee p)$ is true. If p^+ is true, then we are done. If p is true, then there are two cases to consider: either p^+ is true, in which case again we are done, or $\neg p^+$ is true. In the latter case, $\neg(p^+ \wedge D)$ is true; since p is true as well, then $(\neg(p^+ \wedge D) \wedge p)$ is true, making $(p^+ \vee (\neg(p^+ \wedge D) \wedge p))$ true.

5.2 The amendment

We propose the resolve the problem that LDQHDs pose for our theory by constraining which constituents can be tested for super-redundancy. Note that given a sentence $S = (\alpha \vee \beta)$, we cannot simply ban constituents embedded in α or β from being tested for super-redundancy. This would rule out the offending LDQHD case, but it would also create problems with LDHDs. Recall that in (30-c), it was the p^+ constituent that was super-redundant, and that was a constituent embedded in the second disjunct in (30-c). Thus, we require a subtler criterion.

We propose the following:[7]

(35) a. A constituent C in a sentence $S = (\alpha * \beta)$ is a *candidate for super-redundancy* iff there exists $S' \in Perm(S)$ of the form $(C * \gamma)$ or $(\delta * C)$

7 The presentation of the ideas here is by necessity somewhat compressed. Hopefully, a deeper exploration will be published in the future.

b. Given a sentence $S = (\alpha * \beta)$, $Perm(S)$ is the set of sentences that result from S by a finite number of applications of the associative and/or commutative laws for the connective $*$. If no associative or commutative laws are valid for $*$, then $Perm(S) = \{S\}$.

Here's the proposal intuitively: if a constituent C in S can be made an argument of the top-level binary connective in S by manipulating S through commutativity and associativity, then C can be tested for super-redundancy. Now consider again the case of LDQHD:

(36) $S = (p^+ \vee (\neg p^+ \wedge p))$

There is no way that $\neg p^+$ can end up a first or second argument of the top-level $\vee$ by applying the commutative and associative laws for conjunction and disjunction. If that were possible we would end up with a disjunction S' where $\neg p^+$ being true would make the entire disjunction true. But applying the commutative or associative laws for conjunction/disjunction to a sentence S produces an S' that is equivalent to S. Since clearly (36) is not necessarily true in a case where $\neg p^+$ is true, this is enough to show that it is not possible to make $\neg p^+$ an argument of the top-level $\vee$ by applying the commutative and associative laws for conjunction and disjunction. Therefore, $\neg p^+$ is not a candidate to be tested for super-redundancy. The only such candidates under our criterion are p^+ and $(\neg p^+ \wedge p)$, and as the reader can verify, neither comes out as super-redundant.

Conversely, in the case of a LDHD like $(p \vee (r \vee p^+))$, it is easy to see that there is a proof showing that it is equivalent to $((p \vee r) \vee p^+)$ by simply applying the associative law for disjunction. Hence p^+ is a candidate to be tested for super-redundancy, just like we want.

Finally, note that the amendment proposed in this section has no bearing on our results in section 4: the only candidates for super-redundancy that were considered there were already the argument of the top-level binary connectives.

5.3 (On the way towards) tying some loose ends

Consider the following example, suggested by an anonymous SALT reviewer:

(37) #John didn't study in Athens or John didn't study in Athens. $(\neg p \vee \neg p)$

Note that neither instance of $\neg p$ here is super-redundant; yet, (37) is infelicitous.

A solution is to require all sub-sentences S' of S that are true every time S is true, to be non-redundant in the sense of Definition 2 (in addition to being non-super-redundant). Since every time (37) is true, its sub-sentence $S' =$ *John didn't* *study in Athens* is true, S' must be non-redundant; but clearly, this is isn't the case.[8]

A welcome consequence of adding this principle to the theory is that it gives us a handle on redundancy in conjunctions:

(38) #John smokes Marlboros and he is a smoker.

Every time (38) is true, S' = *John is a smoker* is true, and hence S' must be non-redundant.[9] That is clearly not the case in (38), so its infelicity is predicted. What is currently not predicted is the felicity of (39):

(39) ✓John is a smoker and he smokes Marlboros.

S' = *John is a smoker* is true every time (39) is true, so the current version of our theory would require it to be non-redundant (and it's clearly not). This pattern is an instance of the so-called *asymmetry of conjunction*, where a constituent is redundant when it appears in the left conjunct but not on right conjunct; analogues to it exist also with presupposition projection,. How to handle such asymmetries is not a straightforward issue (see Schlenker (2009), Fox (2008), Katzir & Singh (2013), Mayr & Romoli (2016), Kalomoiros & Schwarz (Forth) for more discussion). In the context of the current approach, a natural move is to somehow ban left conjuncts from being candidates for redundancy, e.g. by preventing a sub-sentence S' from being a candidate for redundancy in a sentence of the form $S = (S' * \phi)$ if every time S is true, then S' is true. While I believe that this kind of constraint has promise, reasons of space prevent a fuller investigation at this point.

6 Conclusion

To sum up: starting from the observation that unnegated and negated Hurford disjunctions are not on par, we have developed a redundancy-based approach (the first one as far as we know) that can successfully handle Hurford conditionals, as well as other edge-cases of Hurford phenomena that have been problematic for other theories. While some issues (e.g. the way to properly handle redundancy in conjunctions) have been deferred for the future, the current theory already captures a large part of the data in a unified and predictive way.

8 This addition doesn't mess with our previous results: while every time $S = p^+ \vee p$ is true, p is true, p is not redundant in S (while p^+ is super-redundant), and while every time $S = \neg p \vee \neg p^+$ is true, $\neg p^+$ is true, $\neg p^+$ is not redundant in S. The same holds for p in $\neg p^+ \rightarrow p$, and for $\neg p^+$ in $p \rightarrow \neg p^+$.

9 Note that in a conjunction $(p \wedge q)$, neither p nor q can be super-redundant. Suppose p were super-redundant. Then, it would hold that for all D, $((p \wedge D) \wedge q) \equiv q$. This obviously isn't true (just take $D = \bot$). Similar reasoning shows that q cannot be super-redundant.

References

Chierchia, Gennaro, Danny Fox & Benjamin Spector. 2012. The grammatical view of scalar implicatures and the relationship between semantics and pragmatics. In Claudia Maienborn, Klaus von Heusinger & Paul Portner (eds.), *Semantics: An international handbook of natural language meaning*, vol. 3, Berlin: Mouton de Guyter.

Ciardelli, Ivano & Floris Roelofsen. 2017. Hurfords constraint, the semantics of disjunction, and the nature of alternatives. *Natural Language Semantics* 25. 199–222.

von Fintel, Kai. 1999. Counterfactuals in dynamic contexts. In *The Interpretative Tract*, 1–15. MIT Working Papers in Linguistics.

Fox, Danny. 2008. Two short notes on Schlenker's theory of presupposition projection. *Theoretical Linguistics* 237–252.

Gillies, Anthony S. 2009. On truth-conditions for if (but not quite only if). *Philosophical Review* 118(3). 325–349.

Grice, Herbert Paul. 1975. Logic and conversation. In Peter Cole & Jerry L. Morgan (eds.), *Syntax and Semantics, Volume 3*, 41–58. Academic Press.

Heim, Irene. 1983. On the projection problem for presuppositions. In M. Barlow, D. Flickinger & N. Wiegand (eds.), *Proceedings of WCCFL 2*, 114–125.

Hurford, James R. 1974. Exclusive or inclusive disjunction. *Foundations of language* 11(3). 409–411.

Kalomoiros, Alexandros & Florian Schwarz. Forth. Presupposition projection from 'and' vs 'or': Experimental data and theoretical implications. *Journal of Semantics* .

Karttunen, Lauri. 1974. Presupposition and linguistic context. *Theoretical Linguistics* 1(1-3). 181–194.

Katzir, Roni & Raj Singh. 2013. Hurford disjunctions: embedded exhaustification and structural economy. In *Proceedings of Sinn und Bedeutung*, vol. 18, 201–216.

Kratzer, Angelika. 1986. Conditionals. In *Chicago Linguistics Society 22*, 1–15.

Lewis, David. 1973. *Counterfactuals*. Cambridge MA: Harvard University Press.

Mandelkern, Matt & Jacopo Romoli. 2017. Parsing and presuppositions in the calculation of local contexts. *Semantics and Pragmatics* 10.

Mandelkern, Matthew & Jacopo Romoli. 2018. Hurford Conditionals. *Journal of Semantics* 35(2). 357–367. doi:10.1093/jos/ffx022. https://doi.org/10.1093/jos/ffx022. _eprint: https://academic.oup.com/jos/article-pdf/35/2/357/24786773/ffx022.pdf.

Marty, Paul & Jacopo Romoli. 2022. Varieties of Hurford disjunctions. *Semantics and Pragmatics* 15(3). 1–25. doi:10.3765/sp.15.3.

Mayr, Clemens & Jacopo Romoli. 2016. A puzzle for theories of redundancy: Exhaustification, incrementality, and the notion of local context. *Semantics and Pragmatics* 9. 1–48.

Meyer, Marie-Christine. 2013. *Ignorance and Grammar*: MIT PhD dissertation.

Schlenker, Philippe. 2009. Local Contexts. *Semantics and Pragmatics* 2. 1–78.

Stalnaker, Robert. 1958. A theory of conditionals. In Nicholas Rescher (ed.), *Studies in logical theory*, 98–112. Blackwell.

Westera, Mathijs. 2019. Hurford disjunctions: an in-depth comparison of the grammatical and the pragmatic appraoch. Unpublished Ms. Leiden University.

Alexandros Kalomoiros
Institute for Linguistics
Heinrich Heine Universität
Düsseldorf, Germany
akalomoiros@gmail.com