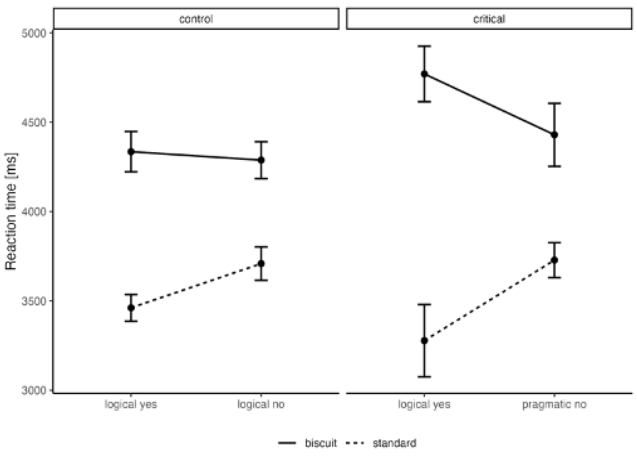
Already Perfect: Conditional Statements

Conditional statements often convey implied meanings beyond their literal content: The standard conditional 'If you mow the lawn, you'll receive $5' is logically true even when the lawn is not mowed and the person receives $5 anyway (e.g., for a different chore). However, listeners often judge this sentence as false in those situations, treating it exhaustively with an '*if and only if*' meaning, known as Conditional Perfection (CP).[1] However, in other cases, sometimes called 'biscuit conditionals', the pragmatic interpretation is infelicitous.[2] For example, in 'If you are hungry, there are biscuits in the cupboard', perfection is not possible, since the outcome (biscuits being in the cupboard) does not depend on the condition (being hungry), making a logical interpretation more fitting. Here we exploit this well-attested difference to investigate how people arrive at the pragmatic interpretation as opposed to the literal, logical one. In two sets of studies, we investigate if computing CP is linked to processing cost and whether the listener starts with the logical (not-perfected) meaning of the conditional and then enriches it via implicature (CP-later hypothesis)[10,12] or instead *begins* with the perfected meaning and retreats to the weaker meaning if supported by context (CP-first hypothesis).[13,14] These hypotheses are associated with different processing costs: an enrichment cost for the CP-later and a weakening cost for the CP-first.

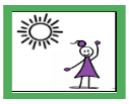
Exp 1: This experiment included 3 reaction time (RT) studies where participants read sentences in the form of (p → q) and then saw pictures in one of the three conditions [control: (p & q), (p & ¬q); critical: (¬p & q)] and evaluated whether the fictional character told the truth (Table 1). In **Exp. 1a** (N=151), both the experimental group reading standard "if" sentences and the control group reading "only if" sentences, where CP is obligatory, showed a clear preference for pragmatic responses. No significant differences in RTs were observed, indicating no additional processing cost for CP. In **Exp. 1b** (N=75), we tested biscuit conditionals and found that they generated longer overall, but there was no difference between the control and critical trials, suggesting no weakening cost either. Note that the RT measures were collected *after* the conditional statement had been read and interpreted, which could pose an issue if participants formed interpretations while reading sentences, leading to RT differences during reading but not in the response phase. Thus, in **Exp. 1c** (N=72), we recorded both the reading and reaction time for each trial, manipulating standard and biscuit conditionals within subjects. The results showed that it took longer to interpret biscuit conditionals, which required a logical interpretation, compared to standard conditionals, which were perfected (β=0.22, SE=0.04, t=5.45, p<0.001). Notably, the logical interpretation of biscuit conditionals was also slower than that of control trials (Conditional*Condition: β=-0.08, SE=0.03, t=-2.61, p<0.01), indicating that computing logical, non-perfected, meanings are costly whereas deriving CP comes without a processing cost (see the Figure on the right).



Exp 2: While data regarding processing costs are informative, they may not conclusively reveal the machinery behind CP. To provide converging evidence, in **Exp. 2a** (N=91), we asked participants to verify sentence-picture pairings (similar to Exp 1) while simultaneously memorizing visual dot patterns, varying in memory load from low to high. Drawing on existing research on scalar implicatures, [11, 14] we hypothesized that an increase in memory load would reduce their capacity to compute pragmatic inferences. Thus, if CP is an inference on top of the logical meaning, then it is less likely to arise under a high cognitive load. Manipulating conditional type (standard, biscuit) and cognitive load (low, high) within-subjects, we found that participants perfected standard conditionals (92%) while the logical responses for biscuits were below chance (41%), irrespective of the degree (high vs low) of the cognitive load. The degree of cognitive load did not influence interpretations of either type of conditionals. The complexity of conditional utterances, paired with our use of a picture-sentence verification task, might have been sufficient to exhaust participants' cognitive resources in *both* load conditions, unique to this study. Supporting this possibility, in Exp 1, we found that participants predominantly (60-80%) provided logical responses for biscuit conditionals when there was no load manipulation. This difference between our prior work and the subsequent study that added load suggests a potential effect, albeit not between the low and high load conditions. Considering these, we ran a No-Load version of the same experiment in **Exp 2b** (N=46) and compared these data to the Load (high & low load combined) conditions. Results revealed an effect of both Load (β=-0.19, SE=0.07, t=-2.58, p<0.01) and Conditional (β=0.47, SE=0.07, t=6.44, p<0.001), such that both types of conditionals were interpreted less *logically* when there was load, and standard conditionals were less logical than biscuit conditionals overall.

Discussion: Results indicated that standard conditionals are understood with a pragmatic meaning without extra effort. In fact, the pragmatic meaning remains even under cognitive load, leading to converging evidence for the CP-first hypothesis. In contrast, a richer pragmatic inference might be necessary to establish the logical interpretation for biscuit conditionals, requiring more resources. Each of these results contrasts with findings regarding other forms of implicature, suggesting that conditional statements - and conditional perfection - may require a unique analysis.

Table 1: Sample stimuli used in **Exp 1** & **Exp 2**

conditional	**sample stimuli**	**[p&q]**	**[p & ¬q]**	**[¬p & q]**	
standard	Ms. Blicket: If the weather is sunny, I will wear purple.				Did she tell the truth? **Yes/No**
biscuit	Ms. Blicket: If your phone is dead, there is a charger in the drawer.				

References: [1] Geis & Zwicky, 1971; [2] Austin, 1961; [3] Cornulier, 1983; [4]Horn, 2000; [5] von Fintel, 2001; [6] van der Auwera 1997; [7]Marcus & Rips, 1979; [8] van Tiel & Schaeken, 2016; [9] Barrouillet et al., 2000; [10] Bott & Noveck 2004; [11] De Neys & Schaneken, 2007; [12] Noveck et al., 2011; [13] Huang & Snedeker, 2009; [14] Chemla & Bott, 2011; [15] Marty & Chemla, 2013