1. How can we verify that we are being understood? We can check to see if the interlocutor responds in a manner consistent with understanding.
2. How can we verify that an interlocutor has the same understanding of a word as us? We can check to see if the interlocutor responds in a manner consistent with understanding across the spectrum of uses of this word.
3. How can we use these checks to generalize about cases that we have not explicitly checked? We can infer their generalization through a variety of independent checks as well as inference based on their similarity to us and therefore the likely similarity of their inductive generalizations to ours.

1.

To explore this verification process in 1, we can work through examples of coordinated action through language and examine the inferences made by the interlocutors about their mutual understanding. These coordinated action games are especially useful in that they are highly amenable to experiment.

This verification can be generally captured through a framework of contingency observations. A contingency observation is the observation of the consequence Y, of a state or an input X. They can be formally expressed as antecedent-consequence pairs or tuples (X, Y) where the nature and representation of X and Y is left unspecified and might vary from that of a discrete random variable to a complex specification of a structured context. This unspecification is a particular power of the model in that it enables this analysis scheme to operate at a level of abstraction independent of the details of the events and actions, to capture only the observation of a relation. We will see the power of this representation later as we explore examples, and we will also see how such a representation enables a variety of interesting analyses and models including but not limited to hierarchical Bayesian inference.

Describe in more detail what I mean by contingency checking, what I hope to capture with contingency checking, and what it looks like in an abstract case.

Our first example of contingency checking will be two agents playing a board game such as chess. These agents are new at chess and therefore the simplicity and ignorance of their moves can be forgiven. In chess, the expectation is that players take turns moving pieces on the board in manners that are deemed legal by a set of rules that is implicitly mutually agreed upon when both participants begin playing. Chess is a simple example because the thing that is being checked is not a consistency with a highly complex and hard to capture scenario-dependent set of expectations and consistent behavior, but in chess these things are comparatively simple. The set of rules is explicitly defined, and the set of expectations is relatively simple. Here we will analyze how a chess player judges whether his opponent understands the scenario and is cooperating with the gameplay.

If the player A makes a move, there are many things that player B might do. It is useful to sort these behaviors into a typology of three categories, those that A expects, those that A does not expect, but are consistent with A’s understanding of what is cooperative, and those that are understood by A to be uncooperative.

As a simplified scenario, let us consider the case where player A has a king and a rook and where player B has only a king.

If player A moves her rook adjacent to player B’s king to put player B in check[[1]](#footnote-1) (and A’s king is on the other side of the board), player B has a variety of possible actions. If player B responds by capturing player A’s rook, then this is a move that is consistent with player A’s expectations and player A has no reason to believe that player B is not playing cooperatively within the framework of the game, nor that player B misunderstands the rules of the game.

Player B might also move his king to get out of check without capturing the rook. Though player A may not expect this because it is a highly suboptimal move in this case, it is within the rules and player A has no reason to believe that player B is being uncooperative, but perhaps simply that player B is not particularly proficient at achieving his goal of eventually capturing A’s king.

Player B might also move his king across the board to capture player A’s king. Player A would both not expect this move and would reason that this move is inconsistent with respect to the scenario. Player A might then infer that player B either does not understand the rules of the game, or that he is being uncooperative. The nature of this inference is dependent on context and prior observations. If player B had been moving his king within the rules for the entire game, then it would be a suspicious coincidence if he happened to not know the rules for king movement, especially if it would have benefitted him to move outside of the rules previously. A might infer of course that B had a complex understanding of the rules such that this kind of king movement is legal only under the present conditions, but the prior probability of this hypothesis is relatively low, and so the alternative that B is playing uncooperatively becomes the dominant hypothesis by A. Additionally, if player B had been flouting other rules all game, A would reasonably infer that B is not familiar with the game rules.

* Introduce three types of contingencies
* Discuss examples of behavior of the opponent B, given a move by the player A and how the player A interprets these behaviors with respect to intention to cooperate/understanding of the rules of the game.
* Show how this is formalized in the contingency notation

(three types of contingency responses: the expected, the unexpected but consistent, the inconsistent)

Expected: plays a move after you play a move

Unexpected, but consistent: goes to the bathroom after you play a move

Inconsistent: plays two moves after you play a move.

1. Chess game
   1. Introductory for the notation and for the three types of contingency interpretations
   2. Not particularly good evidence for why contingencies are the quantity of interest
2. Ordering at Chipotle
   1. Demonstrates contingencies based on the station. i.e. given “black or pinto beans?” the interpretations are different from given “chicken, steak, or veggie?”
   2. Still retains a relatively simple space and representation
3. …
   1. Demonstrates how we can use contingencies alongside similarity assumptions to explicitly infer others’ mental states
4. Turing test

Then try to argue that this is general for discourse.

Then try to argue that this is a general model of communication and that it captures essential features such as inference about interlocutor interpretation that are not captured in an information-theoretic communication signaling communication model.

**There are two reasons why cues are not sufficient:**

1. It is possible that people think that they understand and they do not and therefore they do not send a cue of misunderstanding. (Also a misunderstanding cue is sent only when a misunderstanding is inferred, which leaves open the question of how misunderstanding is inferred in the first place
2. This can be done via textual media without these multimodal cues. To explain this, we either need to appeal to subtle embedded cues or to other mechanisms.

**Need to explain the role of individual subcomponents of language**

So far we have treated linguistic utterances as units without decomposing them into the constitutive components that comprise them. This has helped us to understand language at a macro level and how utterances are understood in terms of the changes they cause in the state of the discourse system. This approach yields an important high-level feedback mechanism for macro-scale linguistic units and enables us to explain how the meaning of an expression may productively differ from a rule-derived compositional meaning formed from subcomponents. However, individual words and grammatical relations have meaning, and this meaning plays an important role, both in how these utterances are generated and in how language is learned. We do not learn language by memorizing the effects of utterances and using these utterances, but by extracting meanings and meaning components that tie to morphemes, constructions, relations with context, &c. This is what enables us to generate novel expressions and to use language to express novel thoughts and ideas. In this section we will explore the nature of these compositional mechanisms and how they relate to the picture we have drawn of language as a set of contingency relations between sound, text, and mind.

1. We will ignore the fact that this is probably a silly move on A’s part. [↑](#footnote-ref-1)