Research Interests

My research interests concern pragmatic enrichment language interpretation. There are two classes of approaches of pragmatic enrichment. One is about competition between utterances, which is called implicature in the literature (Grice 1975; Sauerland 2004; Geurts 2010). If one particular thought can be conveyed by multiple utterances, then these utterances end up competing with each other, which gives rise to implicature. For example, "I will invite Alice or Bob" typically implies I won't invite both, even though strictly speaking, the sentence is compatible with me inviting both. This inference (implicature) arises because *or* competes with *and*: if I were going to invite both, I would have said "I will invite Alice and Bob", which is more informative. Thus, *or* is routinely enriched to mean *not both*. In other environments, however, namely downward entailing ones (e.g., "I won't invite Alice or Bob"), *or* does not get enriched, because the alternative with *and* is now less informative. The other class concerns enrichment of an utterance that is ambiguous between two or more interpretations, so that interlocutors go for the strongest one - the Strongest Meaning Hypothesis (Dalrymple et al. 1994) (henceforth SMH). Studies about SMH deal with ambiguities of reciprocal expressions. The basic paradigm is illustrated below.

(1) a. The girls know each other.
b. ...# but Mary doesn't know Sue
c. Every girl knows every other girl

(2) a. The girls are hugging each other
b. ... but Mary is not hugging Sue
c. # Every girl is hugging every other girl

A salient inference of (1a) is that one girl knows ALL the other three girls, namely the universal reciprocal interpretation. That is why (1c) is strongly preferred to (1b). But for *hug* in (2a), the preferred reading is the pairwise one (2b) but not universal (2c). How come in (1a) you have this set of universal relation, whereas 'hugging' in (2a) only has the pairwise interpretation? Dalrymple et al. 1994 argue that there is a principle in semantics and pragmatics interpretation: when an utterance has multiple meanings, the strongest meaning, relative to the context, will surface. For (1), the universal interpretation is both possible and natural, but for (2), the pairwise interpretation is more sensible than the universal (it's physically difficult to hug multiple people at the same time). If (1a) is negated - "The girls do not know each other", then the actual interpretation is not the negation of the universal. That follows naturally since if it is the universal reading that a language speaker picks to negate, the utterance would be very weak. What a language speaker is negating turns out to be the pairwise reading, i.e. there is no pair of girls knowing each other.

Both of these classes of phenomenon have been studied very well. Is there any interaction between the two? It turns out that Chinese degree constructions have the hallmark of both.

(3) *Kai gao.*
Kai tall
Kai is tall (POS)/ taller (COMP)

(4) *Kai hen gao.*
Kai HEN tall
Kai is tall (POS)

The empirical contribution of my research is that by considering truth value judgment relative to context, Cong & Buccola (2021) find the bare adjective phrases such as (3) show systematic ambiguity and it patterns like SMH, but the interpretations that surface seem to be sensitive to environments, which is reminiscent of implicatures. Specifically, the utterance (3) is construed in two ways: 'above average tall' (POS) and 'taller than contextually salient people' (COMP). The utterance (4) only has the POS interpretation. Relative to the utterance (3), in an upward entailing environment, the COMP interpretation surfaces; whereas in a downward entailing environment, the non-COMP interpretation surfaces. Relative to the thought 'above average tall' (POS), the utterance '*hen* adjective phrase' in (4) surfaces but not the bare adjective phrase as in (3). Overall the new data suggest a competition based account. But the SMH and the classic implicature cannot be readily applied to Chinese, due to the lack of an informativity relation between the two readings of *gao* 'tall'. When (3)'s COMP interpretation surfaces, we don't simultaneously get the negation of POS. And that is not how implicature patterns. In classic implicature studies that capture scalemates $\langle some, all\rangle$ and $\langle or, and\rangle$, *some* implies *not all* and 'p *or* q' implies 'not p *and* q'.

The theoretical contribution I attempt to make is to develop a theory of disambiguation competition model, which can go back and forth for those two classes of enrichment analyses about interpretation and utterance, and hopefully unify the two classes. One promising model to built upon is Rational Speech Act (Frank and Goodman 2012; Bergen et al. 2016) (henceforth RSA). It's originally designed in the line

of implicature; but it always is intended to be more general of human cognition and reasoning. It thus appears promising that RSA can explain the Chinese data which interacts with both classes of enrichment. RSA is a class of probabilistic model that assumes language comprehension in context arises through a process of recursive reasoning about what speakers would have said, given a set of communicative goals. Essentially, the RSA model captures the idea that speakers are assumed to produce utterances to be helpful yet parsimonious, relative to some particular topic or goal. Listeners then understand utterances by inferring what such a helpful speaker must have meant, given what she said.

When the speaker uttered (3), they could have said (4), if they intend to indicate the COMP but not POS interpretation. Because otherwise the speaker can just choose to utter (4), which unambiguously mean 'above average tall' (POS). The RSA framework provides a direction of analysis regarding such kind of intuition, namely disambiguation by competition. This has been briefly proposed in Zhang 2019. However, the ambiguity here resolves itself in one way in upward entailing environment but in another way in downward entailing environment. RSA cannot help with that. That's another puzzle I attempt to address. Plus, RSA mostly copes with scalar implicature based lexical uncertainty, meaning it cannot be directly transferred to Chinese.

One direction of analysis is a markedness based RSA account. Relative to the thought POS, the utterance (4) surfaces, in contrast with the bare form without *hen* in (3). That appears to be a Manner implicature scenario, which is calculated relative to M-principle (Rett 2014a,2015). *hen gao* in (4) is as informative as *gao* in (3), and they are semantic equivalent to each other. Namely, they are markedness-based scalemates. The marked alternative *hen gao* is used (suppose the addition of *hen* indicates 'more marked'), when the unmarked alternative *gao* is available, which gives rise to Manner impilcature that the property is atypical in a relevant sense, according to the Marked Meaning Principle (Rett 2015). By treating markedness based Manner implicatures using cost, recent RSA-based accounts are great candidates in terms of unifying both and synthesizing both classes of enrichment phenomenon shown in Chinese (Bergen et al. 2016; Qing and Frank 2014; Lassiter and Goodman 2017; Franke and Jager 2016).

Computational simulations and behavioral experiments are the additional contributions this project intends to make. To theoretically confirm the predictions of the competition models, I'm currently working on a RSA-based computation modeling. Given that RSA is a rational theory about cognition, I'm also testing my hypothesis with behavioural experiments in order to get quantitative data and collect deeper empirical evidence. There is a lot of disagreement in the literature about the judgment of the *hen* data (Grano 2012; Li 2017; Zhang 2019). It's timely to set up context and carefully study the native speaker's response, so that a more fine grained and broader picture of the implicature could be provided.

Furthermore, an artificial language learning experiment is in progress, whose goal is to examine whether the mental mechanism regulating linguistic competition gets applied outside of languages. Buccola et al. 2018 propose an implicature competition principle, and testify that in an artificial language task. Findings show that people still apply this competition principle even though it's non-linguistic. The disambiguation competition principle I propose is being tested in a similar paradigm as in Buccola et al. 2018. The hypothesis is that, if it's applicable to the artificial language task, it indicates that disambiguation competition model is observed beyond language. The vast majority experimental studies of implicature is about scalar implicature. Data have shown that the Chinese puzzle cannot be explained as Quantity implicature, but Manner implicature is a great candidate. With the new proposal for Manner implicature based competition, I plan to do what Quantity implicature studies have done in artificial language learning experiments, which would open a completely new door about Manner implicature and whether it's cognitive and behavioral in general.

To sum up, I'm currently investigating interpretive enrichment in language, combined with novel observations of degree constructions in Chinese, with an attempt to address the puzzles that why one reading (or utterance) surface but not the other reading (or utterance), and how context interacts with interlocutors' reasoning. This research will advance the field of degree semantics by incorporating cognition reasoning insights and cross language generalizations.

Writing Sample

Overview Utterances compete with each other. Rational speakers choose an utterance that is true, informative, and relevant, and listeners reason about that choice. As a consequence, pragmatic listeners make inferences about other possible utterances (so-called *alternatives*). In the well-studied case of Scalar Implicature (henceforth SI), pragmatic enrichment yields the inference that more informative alternatives are false, or at least that the speaker doesn't believe them (Chierchia, Fox, and Spector 2012; Fox 2007; Geurts 2010; Grice 1975; Horn 1972; Papafragou and Skordos 2016; Sauerland 2004; Schwarz and Zehr 2020). A central question in the SI literature is what counts as an alternative of a given utterance, due to what is known as the *symmetry problem*: without constraints on alternatives, every potential alternative ψ has a symmetric partner (roughly, *not* ψ), whose existence preempts any SI about ψ. Consequently, theories of formal alternatives have been proposed (Katzir 2007). However, relatively few studies concern Non-Scalar Implicature (henceforth NSI) (Rett 2015). I argue that the interpretation of adjectival constructions in Mandarin Chinese involves non-scalar competition, that a kind of symmetry problem arises even for NSIs, and that standard (e.g., Katzirian) theories of formal alternatives do not solve the problem. I propose to associate gradient costs with structural alternatives to break symmetry (cf. Bergen, Levy, and Goodman 2016; Buccola, Križ, and Chemla 2020; Gleitman and Papafragou 2016).

Data A bare adjective sentence like (1) has been argued to have only a comparative reading (Grano 2012; Sybesma 1999): "Kai is taller (than someone else in the context)." I claim instead that: **(i)** (1) is ambiguous between a positive (POS) and a comparative (COMP) reading (cf. Zhang 2019); **(ii)** the reading that surfaces is sensitive to linguistic contexts; and **(iii)** its COMP reading is typically the more *salient* one. To verify **(i–ii)**, I recruited 18 self-declared Chinese speakers on Prolific to judge whether utterances like (1), as well as versions with negation, can truly describe a given picture. Pictures involved an explicitly mentioned degree standard (e.g., "Anna thinks 6 ft. is tall"), along with people or objects who instantiate the given property to different degrees. Most importantly, in the target scenarios, 78% chose *can* given a picture where the POS reading is true (e.g., Kai is taller than 6 ft.) and the COMP reading is false (e.g., Kai is shorter than everyone else in the picture), indicating that the POS reading is available. I interpret the results as evidence that *gao* is ambiguous between POS and COMP, and that its COMP reading is merely *preferred*, and I ask why this should be the case.

(1) *Kai gao.*
Kai tall
"Kai is tall/ taller"

(2) *Kai hen gao.*
Kai HEN tall
"Kai is tall"

(3) *Kai bi Anna gao.*
Kai than Anna tall
"K is taller than Anna"

Note that the above properties **(i–iii)** are not attested for adjectives such as *lv* "green" and *bing* "sick", which have no comparative semantics that is inherent (Liu 2018).

Proposal in a nutshell I argue that NSI differs from SI in that NSI concerns the *intentions* of the speaker, not (just) the speaker's *beliefs*. A speaker who utters (1) uses an ambiguous expression not because they intended to convey an ambiguity, nor that they meant one reading is true and the other false, nor that they are uncertain about which reading is true. Instead, they have a particular lexical intention in mind, and they trust the listener to arrive at the target interpretation. In the case of uttering (1), the target interpretation is COMP. To derive the inference "speaker intended COMP" for (1), one can try to adapt the Standard (neo-Gricean) Recipe for Quantity implicature (Geurts 2010), but for Manner implicature: Speaker *S* uttered (1), which is ambiguous between POS and COMP. On the surface, this speech act violates the Maxim of Manner. Nevertheless, I can still assume that *S* is cooperative and rational, and that *S* is following Manner. I can assume, then, that either *S* intends to convey POS, or *S* intends to convey COMP (*Intention-based* Competence Assumption). If *S*'s intended meaning were POS, then *S* could have used the unambiguous alternative (2). But *S* did not. Why not? The most likely explanation is that POS is not what *S* intended. Therefore, *S* intended COMP, and (1) is disambiguated to its usual interpretation.

The symmetry problem The reasoning algorithm above relies crucially on the presence of (2) as an alternative of (1), and on the *absence* of (3). Both points raise questions. First, from a structural perspective,

(2) is strictly more complex than (1) (at least, prima facie), hence should not be a formal alternative, on a strict Katzirian view. Second, if (3) but not (2) were the alternative considered, then (1) would disambiguate to POS, not COMP. And if both were considered, there would be no disambiguation at all, which is reminiscent of the symmetry problem that arises for SIs. To see this, note that I would derive "*S* intended POS or *S* intended COMP, but *S* did not intend POS (because *S* could have uttered (2)), and *S* did not intend COMP (because *S* could have uttered (3))"—a contradiction. While one could propose that COMP is somehow irrelevant (hence, not considered, despite (3) being an alternative), such a proposal lacks independent motivation. Absent such an account, a theory of alternatives is needed that allows (2) but not (3) to be an alternative of (1).

Refined proposal Katzir (2007) proposes that the alternatives for a structure are those that are at most as complex, structurally, as the original one. *Complexity* is binary in this view. Inspired by Buccola, Križ, and Chemla 2020, I adopt a gradient version of Katzir 2007, where alternatives are associated with costs. I propose that (3) is *substantially* more costly than (2), relative to (1), because the former is both longer and requires an internal argument which is a content word, and this cost difference breaks the symmetry. Moreover, Zhang and Ling (2020) argue that the English comparative morpheme *more* actually marks the discourse salience of the comparison standard, rather doing the comparison itself. Chinese is among the group of languages in which comparative constructions never have a true comparative morpheme like *more* to mark the comparison standard; instead the morpheme *bi* as in (3) introduces the standard. One likely explanation for why it is hard to access the comparative alternative (3) is that marking the comparison standard is costly. Accessing words that are (distantly) available in the discourse but are beyond the propositional level can be computationally expensive. The moment speakers consider the costs of (1)'s alternatives, they are likely to favor the COMP reading over the POS one.

I may use probabilistic pragmatic tools (Bergen, Levy, and Goodman 2016; Frank and Goodman 2012) to implement this proposal, in which U stands for utility, P stands for Bayesian probability, and the pragmatic speaker is represented by subscript S. Speakers maximize a utility that is increasing with the informativity of an utterance but is decreasing with its cost. Consider sentences (2–3) as alternatives of the utterance (1): **(I)** In scenario (a) where the speaker intends to communicate COMP, (3) is more informative than (1), but cost(3) > cost(1). In scenario (b), speaker intends POS, (2) is more informative than (1) and cost(2) > cost(1), but the cost difference is small, compared to that in scenario (a). **(II)** With flat priors, $P_S((1)|\text{COMP}) > P_S((1)|\text{POS})$. Speaker *S* has a particular lexical intention in mind. Because *S* was more likely to use (1) in the COMP-situation than in the POS-situation, the listener increases the probability of interpreting (1) as COMP. **(III)** With flat priors, $U((1)|\text{COMP}) > U((1)|\text{POS})$. Thus, the listener infers, from hearing (1), that the speaker most likely intends COMP. In the next iteration, the efficiency of using (1) to communicate COMP has increased, so the effect gets amplified.

Implications I replicate the same problems and solutions in the domain of NSI as in the domain of SI. While this may not be particularly unexpected, up to now it has, to my knowledge, never been shown. Importantly, the solution argued for here crucially involves a structurally more complex alternative, which requires (even apart from the symmetry problem uncovered for NSI) a move to a gradient, cost-based theory of alternatives.

References Bergen et al. 2016 Pragmatic reasoning through semantic inference ⋆ Buccola et al. 2020 Conceptual alternatives ⋆ Chierchia et al. 2012 Scalar implicature as a grammatical phenomenon ⋆ Schwarz & Zehr. 2020 Pragmatics and the Lexicon ⋆ Fox 2007 Free choice and scalar implicature ⋆ Frank & Goodman 2012 Predicting pragmatic reasoning in language games ⋆ Geurts 2010 *Quantity Implicatures* ⋆ Gleitman & Papafragou 2016 New perspectives on language and thought ⋆ Grano 2012 Mandarin *hen* and universal markedness ⋆ Grice 1975 Logic and conversation ⋆ Horn 1972 PhD thesis ⋆ Katzir 2007 Structurally-defined alternatives ⋆ Liu 2018 Projecting adjectives in Chinese ⋆ Papafragou and Skordos 2016 Scalar Implicature ⋆ Rett 2015 *The Semantics of Evaluativity* ⋆ Sauerland 2004 Scalar implicatures in complex sentences ⋆ Zhang & Ling 2020 The semantics of comparatives: A difference-based approach