Prosody of Positive and Negative Conjunction in English and Bangla

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Abstract

In addition to merely joining multiple constituents, conjunction can serve as an explicit indicator of how those constituents are related – viz., if they are in a positive or negative semantic relation. Positive conjunction conveys a positive relation and is facilitated with markers such as *and, so, or because*. Conversely, negative conjunction conveys a negative relation and is facilitated with markers such as *but, yet, or though*. Because conjunction reliably conveys positive and negative semantic relations, previous literature has used prosodic closeness of positively/negatively related conjuncts as a proxy for underlying semantic closeness, examining prosodic correlates of conjunction to infer “closeness” of positive/negative relations. Factors used to operationalize prosodic closeness have included inter-conjunct pitch reset and pause duration, for which a decrease in either is associated with increased closeness. Beyond possible insight into inherent closeness of semantic relations, investigation of these prosodic correlates is also useful in that if they are found to reliably deviate between positive and negative conjunction, then conjunction can be used to better inform efforts to simulate natural speech, as in text-to-speech. Previous studies have found pitch reset and pause duration to be less between positive conjuncts than between negative conjuncts in English, but have observed the opposite effect in Japanese. Tokizaki and Kuwana (2009) propose that negative relations are underlingly closer, but that this effect is obscured in English.

The current study analyzed inter-conjunct pitch reset, pause duration, as well as phrase-final lengthening, in various positive and negative conjunction structures in English and Bangla in an effort to address this account, as well as primarily to determine whether conjunction is a reliable correlate of certain prosodic features. The current study replicated the apparent positivity-closeness effect in English, but could not draw conclusions from the Bangla results (beyond observation of pronounced phrase-final lengthening in negative conjunction), primarily due to methodological issues.

*Keywords*: positive conjunction, negative conjunction, semantic closeness, prosodic closeness, English, Bangla, pitch reset, pause duration
Prosody of Positive and Negative Conjunction in English and Bangla

Introduction

Prosody, the suprasegmental acoustic features of speech, seems to be one of the least understood and oft-neglected components of speech in linguistic study, perhaps due to collection and analysis of satisfactory, relevant data being necessarily resource-intensive, as well as its relatively minimal impact on particular focal phenomena such as propositional truth conditions (Tonhauser, 2017). It serves a tremendous purpose, however, facilitating communication beyond what can be conveyed in the bare syntactic and semantic content of an utterance. Prosody can serve to convey emotion, the focus of discourse, the separation of constituents, and the type of sentence (e.g., declarative vs. interrogative), among other information, so it is very important in allowing a listener to interpret what the speaker intends to be taken away from their utterance. This import lends merit to the investigation of factors that may reliably interplay with or contribute to surface prosody. Factors that are evidenced to correlate with prosodic features in English include syntactic phrasal structure (Conwell & Barta, 2018; Brennan & Kraljic, 2005), syntactic functions (Köhn et al., 2018), lexical category (Heldner & Megyesi, 2003; Conwell, 2009), and linguistic focus (Kabagema-Bilan, 2011), among myriad others.

Furthermore, semantics are also believed to influence or correlate with prosody. A particularly interesting case is that of positive and negative semantic relations, which are readily testable using conjunctions, but whose analysis has been rather deficient in the extant literature. This paper adopts a conceptualization of positive and negative relations akin to that set forth by Louwerse (2001: 295), who indicates, “in positive relations the situation presented first is continued in the conjoined situation. On the other hand, in negative relations the expected related situation is discontinued”.


In general, there is a sense of contrast between negatively related elements, while the second element in a positive relation feels like an extension of the first element (see Halliday & Hasan, 1976, for a comparable account of positive vs. negative taxonomies).

In this thesis, I intend to replicate prosodic effects of positive and negative relations found in previous research. Additionally, I intend to test a pre-existing account (by Tokizaki and Kuwana (2009) based on Japanese data) of the relationship between positive/negative association and prosody by examining English and Bangla.

In English, the effect of positive vs. negative semantic association on prosody has been tested somewhat using positive-association conjunctions (i.e., “positive” conjunctions), such as *and*, as well as negative-association conjunctions (i.e., “negative” conjunctions), such as *but*, *yet*, and *though*. Conjunction markers seem to reliably constrain semantic orientation and thus are a good means of gleaning underlying positive and negative semantic relations. In an analysis of orientation of conjoined modifiers in a corpus, Hatzivassiloglou and McKeown (1997) found modifiers joined by *and* to typically have the same orientation (i.e., be positively related) and modifiers joined by *but* to have distinct orientation (i.e., be negatively related). Such reflects the general observation that particular conjunction markers highly correspond with manifestation of particular semantic relations.

To my knowledge, prosodic analyses of positive and negative conjunction have only ever been performed with modifiers as the conjuncts as in (1a) and (1b), with the semantic association occurring across two sentences as in (2a) and (2b), or with the association occurring intrasententially across multiple clauses as in (3a) and (3b) (Nespor & Vogel, 1986; Tokizaki & Kuwana, 2009; Ladd, 1986, 1988).
(1) a. The strong and compassionate boy

   b. The strong yet compassionate boy

(2) a. The temperature was high. I drank water.

   b. The temperature was high. I drank no water, though.

(3) a. The dog hurt Steve, and I laughed.

   b. The dog hurt Steve, but I laughed.

Previous studies have often only analyzed one prosodic factor (e.g., pause duration, post-boundary pitch, or pitch reset) in their investigations of conjunction, however. Additionally, some studies (i.e., Nespor and Vogel, 1986; Ladd, 1986, 1988) were descriptive in reporting effects, meaning that no standards for statistical significance were necessarily obtained. Taken in conjunction with the fact that many of these effects were observed incidentally when pursuing some other focal inquiry (Ladd, 1986, 1988), the effects reported are somewhat insufficiently grounded. Thus, additional replication efforts are necessary. If effects are replicated for prosody of conjunctions with deviant semantic associations, even in such contexts where there are normally more defined prosodic boundaries (i.e., between clauses), they would provide strong evidence for a tangible correlate between a semantic relation and prosody. Indeed, further evaluating prosodic features of positive and negative conjunction could advance our understanding of contexts in which semantic relations inform prosody, facilitating a richer appreciation of factors that interplay with prosody.

**Practical Applications of Analyzing Conjunction Prosody**

Examining and contrasting prosodic correlates of positive and negative conjunction is not merely important for our understanding of language, however. It could also have valuable
mainstream applications. One such application could be to TTS (text-to-speech), or speech synthesis. Because of prosody’s major role in facilitating intelligibility of speech and its fundamental ubiquity in spoken language, it is a phenomenon that the field of speech synthesis seeks to better replicate. As it stands now, however, despite the great and continual improvement speech synthesis has shown, it still struggles with the minutiae of prosody (Tseng, Pin, & Lee, 2019), precluding it from wholly realizing human naturalness, and thus resulting in somewhat deficient intelligibility. In the enterprise of producing systems that can more accurately generate prosody, many researchers analyze actual speech data, looking for features that can be interpreted in a text that can predict appropriate prosody.

In this way, discovering and documenting prosodic correlates of positive and negative conjunction structures could offer insight into additional identifiable features that could be used to inform generated prosody. In fact, finding dependable correlates between the positive/negative nature of conjunction and prosody is particularly useful because conjunctions that would manifest in such contexts are part of a closed class and are thus readily identifiable. In this way, conjunctions also provide a means for TTS systems to convey broader semantic information, which is normally difficult (if not impossible) to infer from parsable surface structure of speech. Thus, investigation of the acoustics of positive and negative conjunction could prove beneficial to speech synthesis. While comprehensively identifying specific correlates for such a purpose is not the primary aim of this paper, this effort may nonetheless serve as a preliminary indicator of such extant properties of conjunction, which can be expanded upon in more robust studies with further analyses. Given that TTS is not merely a tool of convenience – mute or speech-impaired individuals can use TTS to drastically improve quality of life – there is at least some practical merit to the pursuit of acoustic correlates for such factors. Although the current study does not
set out to exhaustively examine dependable correlates, it does represent a small step in a research direction that could be beneficial in the ways delineated.

What the Literature suggests about the Acoustics of Positive and Negative Conjunctions

Research examining positive and negative conjunction often seeks to assess the closeness of the prosodic domains characterizing conjuncts (such “closeness” can ostensibly be used to infer whether positive or negative relations constitute closer associations). This closeness is generally evaluated based on a number of acoustic properties, namely pause duration and pitch reset, among others. Greater pause duration between constituents is thought to indicate greater separation between those constituents. Pitch reset is the increase in pitch that occurs across major syntactic/prosodic boundaries. A terminal fall in pitch pre-boundary often signals finality, while higher pitches generally accompany the beginnings of utterances. A terminal lack of a marked fall in pitch pre-boundary, however, can convey non-finality (Wells, 2006). As such, one would expect a lack of a decline in pitch before the boundary between closely joined constituents, but would expect relatively low pitch before the boundary between less closely-joined constituents; furthermore, one might expect relatively higher pitch after the boundary between two closely-joined constituents, but less of a marked increase in pitch across a boundary between less closely-joined constituents. Pitch reset encapsulates these dynamics well, in that a greater pitch reset suggests marked pre-boundary decline and/or post-boundary rise in pitch. Thus, greater pitch reset is thought to indicate less closely-joined domains, while lesser pitch reset is thought to indicate closely-joined domains. The literature herein reviewed primarily use measures of pitch reset and pause duration to assert closeness of relation.
Our review begins with Tokizaki (2008) who, invoking previous work by Nespor and Vogel (1986), affirms that in the context of English modifier conjunction (wherein the conjuncts are modifiers, specifically adjectives) – it is more likely that pausing will occur immediately before a negative conjunction (yet, but), as in (1b), than before a positive conjunction (and), as in (1a). It remains to be seen whether such an effect would be observed in propositional conjunction, however, but this lends itself to a potential hypothesis that greater pause duration will be observed between the first clause X and the conjunction in the construction X but Y than in X and Y. One would thus also expect greater pitch reset between negative modifier conjuncts than between positive modifier conjuncts, as well. The present study expects to replicate this positivity-closeness effect in English modifier conjunction.

Nespor and Vogel (1986) themselves also observed that phonological rules may apply across two sentences with a positive semantic relation, such as in (4), below, in which late may undergo flapping, appearing as la[ɾ] (Nespor and Vogel, 1986). Flapping can only occur in this context if there is a marked lack of pause duration, suggesting a particular “closeness” between the positively related sentences.

(4) It’s late. I’m leaving.

It is important to note, however, that the “positive” data analyzed by Nespor and Vogel, like (4), lack explicit conjunction markers, meaning that the data do not directly evidence that explicit positive conjunction structures behave similarly. Nonetheless, the implicit positive association between the clauses and the observed prosody still suggest that such positive relations constitute more closely-joined prosodic domains. Because explicit positive conjunction constructions would also necessarily signify positive relations, however, this hypothesis can reasonably be extended to positive conjunction constituting more closely-joined prosodic
domains. This contributes to the expectation that there be less of a pitch reset and shorter pause duration between positively related conjuncts in di-sentential conjunction constructions.

In analyses of similar conjunction constructions in English and Japanese, Tokizaki and Kuwana (2009) replicate this positivity-closeness effect in English --observing greater pitch reset and pause duration between negatively-conjoined clauses (such as (5a)) than positively-conjoined clauses (such as (5b). However, they find the exact opposite effect in comparable Japanese constructions (such as in (6), where (a) is a negative construction and (b) is a positive construction), wherein negative semantic relations corresponded to less of a pitch reset and less of a pause duration. Notably, Tokizaki and Kuwana find higher (first) clause-final pitch in the negative constructions, explaining the lesser pitch reset. Because rising intonation generally denotes dependence relations (Wells, 2006), Tokizaki and Kuwana argue that negative conjuncts must be more dependent than positive conjuncts.

(5) a. The temperature was low. I drank beer, though.
   b. The temperature was high. I drank beer. (Datum 5 – E1 in Tokizaki & Kuwana)

(6) a. *Samukatta-*noni nama-o nonda.
   Cold-was-though draft-ACC drank
   ‘Though it was cold, I drank draft beer.’

   b. *Atsukatta-*node nama-o nonda.
   Hot-was-because drank-ACC drank
   ‘As it was hot, I drank draft beer.’ (Datum 4-J1 in Tokizaki & Kuwana)

In this way, Tokizaki and Kuwana claim that negative semantic relations facilitate closer joining in prosody and that this effect is simply obscured in English. Tokizaki and Kuwana argue that this obfuscation is rooted in an increase in syntactic “brackets” in negative conjunction constructions in English at the juncture between clauses. They attribute this increase in brackets at the clausal juncture to the morphology of conjunction in English. In the English data, negative
conjunction is marked via a word, *though*, as in (5a); Tokizaki and Kuwana argue that the presence of this word indicates an additional phrasal level (and thus an additional bracket at the inter-sentence boundary) in utterances such as (5a) that is not present in “positive” utterances such as (5b). According to a “mapping rule” which they invoke, claiming that number of syntactic brackets at a juncture correlates with the magnitude of the prosodic boundary (Tokizaki, 2007), this increase in syntactic brackets results in greater separation in negative conjunction that overrides the semantic effect that should be present. Conversely, Tokizaki and Kuwana posit that this overriding effect is absent in Japanese because conjunction is conveyed via a verb-attached morpheme, which does not constitute an additional syntactic phrasal level or bracket at the clausal juncture.

Thus, Tokizaki and Kuwana essentially propose that negatively-related conjuncts are closer than positively-related ones, but that this effect is simply obfuscated by morphologically-owed syntax-induced separation in English. While this account is compelling, it fails to explain the previously discussed positivity-closeness effect found for English modifier conjunction. In such constructions (e.g., *X and Y* vs. *X but Y*, wherein *X* and *Y* are modifiers), the greater apparent separation between negatively-related conjuncts cannot be explained by such an account because the bracketing between modifier conjuncts is the same for positive and negative constructions. To reconcile this discord, one could entertain the notion that closeness of conjuncts varies as a function of the nature of the conjuncts being joined (i.e., modifier vs. clausal conjunction). By this account, one might hypothesize that the positivity-closeness effect will manifest for English modifier conjunction like in (1) and disentential conjunction like in (2) (by virtue of the bracketing account), but that negatively-related conjuncts will be closer than positively-related conjuncts in intrasentential clausal conjunction constructions such as (3), under
the premise that the syntactic type of the conjunct can predict closeness differences (i.e., clausal conjunction predicts a negativity-closeness effect obscured in disentential constructions and modifier conjunction predicts a positivity-closeness effect). This hypothesis is discordant with the limited extant literature on the closeness of conjuncts in intrasentential clausal conjunction, however.

Specifically, D. Robert Ladd (1986, 1988) analyzed initial post-boundary accent peaks in complex conjunction structures such as those in (7) below. He found that those peaks following a boundary with *but* were markedly higher than those following a boundary with *and*.

(7) a. Ryan is a stronger campaigner, **and** Warren has more popular policies, **but** Allen has a lot more money.

   b. Ryan is a stronger campaigner, **but** Warren has more popular policies, **and** Allen has a lot more money. (Datum 24 in Ladd, 1986: 327)

In other words, the pitch of the clause following a boundary between negatively-joined conjuncts starts off with a higher pitch (fundamental frequency) than that of a comparable clause in positive conjunction. This suggests that Ladd observed greater pitch reset in negative intrasentential clausal conjunction than in positive variants. Such indicates that positively-related conjuncts are closer than negatively-related conjuncts in intrasentential clausal conjunction structures, which would refute the hypothesis conjectured above based on Tokizaki.

Of course, Ladd only reported the pitch differences in the post-boundary context, not offering insight into the relative pitch declination pre-boundary, which would also help inform inferences about closeness. Additionally, Ladd did not offer insight into acoustic features other than pitch that could indicate boundary strength (and thus conjunct closeness), nor did he indicate whether effects were statistically significant. As such, although it is likely that his
observations are accurate, it is worthwhile to not only attempt to replicate his finding, but to
approach it much more robustly, investigating overall pitch reset, as well as boundary “pause”
duration in testing the apparent positivity-closeness effect. Given Ladd’s observation, of course,
the most reasonable expectation for prosodic effects in intrasentential clausal conjunction is that
there is greater pitch reset and boundary (“pause”) duration between negatively-joined conjuncts
than between positively-joined conjuncts.

**Hypotheses regarding English**

The current study expects to replicate the effects suggested by the previous literature,
expanding upon analysis, however, by assessing both pitch reset and pause duration. Thus, the
study adopts the following hypotheses:

**H1:**  
- **a.** In English modifier conjunction, there is greater pitch reset between negatively-related conjuncts than between positively-related conjuncts.  
- **b.** In English modifier conjunction, there is greater pause duration between negatively-related conjuncts than between positively-related conjuncts.

**H2:**  
- **a.** In English disentential clausal conjunction, there is greater pitch reset between negatively-related conjuncts than between positively-related conjuncts.  
- **b.** In English disentential clausal conjunction, there is greater pause duration between negatively-related conjuncts than between positively-related conjuncts.

**H3:**  
- **a.** In English intrasentential clausal conjunction, there is greater pitch reset between negatively-related conjuncts than between positively-related conjuncts.  
- **b.** In English intrasentential clausal conjunction, there is greater “pause” duration between negatively-related conjuncts than between positively-related conjuncts.
The study also hopes to analyze an additional acoustic property – pre-boundary lengthening - in order to attain a more holistic view of reliable prosodic correlates for conjunction. Analysis of this measure will not inform inferences about closeness of positive and negative relations, however.

Pre-boundary lengthening is the temporal expansion of domain-final segments before a prosodic boundary (i.e., elements before a major boundary tend to be lengthened relative to their production elsewhere) (Cho, 2016). This phenomenon is prevalent cross-lingually as a signal of phrasal boundaries (Hayes, 1997; Cho, 2016) and appears to be a prominent marker of junctures between major syntactic constituents (Chow, 2005). While it tends to co-occur with postboundary strengthening, I will only focus on pre-boundary lengthening. Specifically, for many data, I will compare the duration of a phrase-final nucleus when the segment appears in a positive conjunct (as /i/ does in 8a), when it appears in a negative conjunct (as /i/ does in 8b), and when it appears in a corresponding non-conjunct (as /i/ does in 8c).

(8) a. The dog licked me. I like the dog.
   b. The dog licked me. I don’t like the dog though.
   c. The dog licked me.

Because pre-boundary lengthening is expected to be more pronounced before a major boundary, I would expect segments to be “longest” in non-conjunct constructions, constituting the following hypothesis:

**H4:** A phrase-final nucleus is longer in non-conjunct constructions (i.e., proposition-final position) than in the first conjunct of a conjunction structure (regardless of positive or negative relationship).
Additionally, however, because lengthening corresponds to pronounced junctures, I predict greater lengthening in the salient position in negative conjunction than in positive conjunction because negative relations seemingly constitute greater boundaries between the related elements in English. As such, I adopt the following hypothesis regarding relevant length of the phrase-final segment in matching positive and negative conjunction constructions:

**H5:** A phrase-final nucleus is longer in the first conjunct of a negative conjunction structure than in the first conjunct of a comparable positive conjunction structure.

While analysis of segment length in this way will not necessarily contribute to our question of closeness of positive and negative relations, it will hopefully provide preliminary insight into how conjunction markers can potentially be used as signals to modulate the temporal aspect of a pre-marker segment, perhaps informing TTS to do so.

**Testing Tokizaki’s Account: Analysis of Bangla**

Returning to Tokizaki and Kuwana, to test Tokizaki’s claim that the volume of bracketing can predict the observed differences between English and Japanese for disentential clausal conjunction, I will compare conjunction constructions in Bangla and English. Because Bangla is left-branching like Japanese (Sultana, 2016), if Bangla-like Japanese differs from English, I can look to structural factors endemic to being left-branching to guide my account for the deviation, rather than the morphologically-owed syntactic bracketing explanation given by Tokizaki.

I collect data from Bangla-English bilinguals for disentential clausal conjunction (i.e., *X. Y. vs. X. Y though/jodio.*) in both Bangla and English. Note that *jodio* can appear clause-initially or clause-finally in the second conjunct of Bangla disentential clausal conjunction, but the current study positions it clause-finally to mirror English’ positioning. Because, like in English,
negative constructions in Bangla only differ superficially from positive constructions in that a conjunction-marking word is present at the end of the second clause in negative but not positive constructions, I expect Bangla to behave like English such that negatively-related conjuncts are not closer than positively-related conjuncts by virtue of the additional “bracket” and corresponding separation. Thus, the current study predicts to find an apparent “positivity”-closeness effect in the Bangla disentential clausal constructions, which is in-line with Tokizaki’s account. This constitutes the following hypothesis:

**H6: a.** In Bangla disentential clausal conjunction, there is greater pitch reset between negatively-related conjuncts than between positively-related conjuncts.

**b.** In Bangla disentential clausal conjunction, there is greater pause duration between negatively-related conjuncts than between positively-related conjuncts.

To allow for possible insight into whether the differences encountered between Japanese and English are due to closeness effects being language-dependent, I also collected English data from the balanced Bangla-English bilingual participants. If Bangla were to behave differently than English (and thus differently than predicted) and this held even within individual speakers of both languages, it may be preliminary encouragement to consider language-dependence of closeness effects as a possibility. Analysis of the Bangla-speakers’ English data was unfortunately abandoned due to time constraints, but I nonetheless chose to include original motivation for English-stimuli-elicitation here.

In addition to inter-conjunct pitch reset and pause duration, phrase-final duration was also measured for Bangla data. Because phrase-final lengthening is observed in Bangla and appears to be more pronounced at the boundary of more major prosodic phrase levels (Khan, 2014), I maintain hypotheses H4 and H5 for Bangla.
Thus, the primary goals of this study are replication and confirmation of the prosodic effects found in previous research in di-sentential conjunction (e.g., \( X. Y, \text{ though} \), wherein \( X \) and \( Y \) are clauses), modifier conjunction (example (1)), and intrasentential clausal conjunction (e.g., \( X \text{ and } Y. \)) in English. Additionally, comparative analyses of di-sentential conjunction in Bangla and English will be conducted in order to test Tokizaki and Kuwana (2009)’s explanation of conjunction prosodic differences observed between English and Japanese. If their explanation is not supported, other potential reasons will be explored, including particular phenomena relating to left vs. right-branching in languages. The current study will also examine pre-boundary lengthening (specifically, the duration of phrase-final pre-boundary nuclei) between corresponding non-conjunct constructions and conjunct constructions, so as to gain preliminary insight into reliable acoustic correlates of conjunction in general, which is primarily useful under the purview of TTS implementation.

**Methodology**

**Language Consultant**

My peer, Ahmed Ishtiaque, a native speaker of colloquial Bangla, born in Dhaka, acted as my language consultant for Bangla. He produced grammatical Bangla constructions to elicit from subjects comparable to English constructions used. Additionally, he proofed the written materials I produced to make sure they are natural for a native speaker to engage with. Ahmed also graciously helped identify Bangla speakers in the Tri-Co to recruit.

**Participants**

I elicited speech from two main samples of speakers – balanced Bangla-English bilinguals from Dhaka, Bangladesh, and native English speakers from the Delaware Valley region of the United States. All speakers were college students in the Tri-College consortium,
which includes the colleges of Haverford, Bryn Mawr, and Swarthmore. The two samples have the same gender proportions. For the English sample, I elicited speech from six female subjects and two male subjects, and for the Bangla-speaking sample, I elicited speech from three female subjects and one male subject. Each English and Bangla speaker, except for one, orated 32 constructions. The exception was a Bangla speaker who did not read relevant English stimuli due to time concerns and the abandonment of intention to analyze said item type. Speakers completed an informed consent form (see Appendix A) and were compensated 5 dollars for their participation.

Design

Each participant was elicited using the researcher’s personal laptop in a low-noise room, which was held constant across all sessions, so as to obviate environmental differences. Each construction to be orated was written on a white index card. All index cards were shuffled via a riffle shuffle technique prior to a recording session so that the order in which the stimuli were presented was pseudo-randomized. For each construction to be orated, the speaker was given the opportunity to read it repeatedly. Once they signified that they were comfortable with the sentence(s), the researcher began recording them and they verbalized the construction as naturally as possible. This was repeated for each construction. While having individuals read isolated constructions is far from naturalistic and has its obvious deficiencies, the greater focus (and convenience in subsequent analyses) that it affords necessitated its implementation.

Apparatus/Materials

Stimuli. English natives produced only English data. These data include eight disentential clausal constructions (EDCs) with six corresponding non-conjuncts, eight intrasentential clausal constructions (EICs), and four modifier conjunction constructions (EMs)
with four corresponding non-conjunct modifier constructions. Each of these types of constructions (i.e., EDCs, EICs, EMs) are further comprised of pairs of positive and negative constructions with comparable meanings (so, in reality, for example, there are four EIC pairings showing contrast between a positive and a negative). English speakers were also asked to produce *and* and *but* multiple times in isolation to facilitate EIC analyses. The items that English-speakers produced can be found in Appendix B.

Similarly, Bangla natives produced 12 disentential clausal constructions in Bangla (BDCs) with six corresponding non-conjunct constructions and eight disentential clausal constructions in English with six corresponding non-conjuncts (the same EDCs that English speakers produced). None of the English items produced by Bangla-speakers were analyzed, however, because the research question motivating their inclusion was abandoned before data collection was completed, but far enough into collection that most participants still had to produce them.

The items that Bangla-speakers produced can be found in Appendix C. It is worth noting that *যদিও*, /dʒodio/, the negative conjunction marker in the negative Bangla data (roughly corresponding to English *though*), can appear clause-initially or clause-finally, but was placed clause-finally so as to better approximate the English constructions.

All items were made with the welfare of the participants in mind and thus constructions which could cause emotional distress were avoided.

Commas were excluded from constructions so as to avoid potential prompting to pause. Stimuli were not balanced for word frequency. Additionally, the intrinsic length of preboundary nuclei was not controlled for in producing the constructions. Given that the intrinsic vocalic length in phrase-final words corresponds inversely to the duration of subsequent pause duration
(Ferreira, 1993), this represents a potential confound that while also not considered in previous studies, optimally should have been addressed. It should also be noted that rate of speech was not manipulated. Despite faster rate of speech being associated with boundary deletion, this seems unlikely to be an impactful confound.

**Apparatus.** The computer used for the recordings was an HP ENVY m6 Notebook laptop. The head-mounted recording device worn by participants was a Sennheiser PC8 USB headset. Audacity v.2.3.2 was used to record participant speech.

**Measures**

Relevant acoustic measures include pause duration and pitch reset, both of which correlate with the magnitude of a boundary and thus with extent of relatedness, as well. Measures were obtained using Praat v.6.1.03.

Pause duration was measured in milliseconds from the end of the first conjunct to the beginning of the second conjunct. In the intrasentential constructions (in which a conjunction word *and* or *but* appears between the clausal conjuncts), pause duration is expressed as a ratio of this duration to the duration of the conjunction word when produced in isolation (this is to preclude the intrinsic acoustic deviation between the conjunction words from being explanatory confounds). The duration of the conjunction word is the mean of the several isolated utterances of the word elicited from the speakers.

Pitch reset was operationalized similarly to its representation in Xie et al. (2007), which normalizes it with regards to variable pitch range. Thus, pitch reset is defined as follows:

\[ \text{Pitch reset} = F_{O2} - F_{O1} \]

wherein 2 indicates properties of the first syllable of the second conjunct and 1 indicates properties of the last syllable of the first conjunct, and:
\[ F_0 = \frac{(f_0 - \mu)}{\sigma} \]

\( f_0 \) is the average F0 frequency of the nucleus of the relevant syllable. \( \mu \) is the mean of all such averages across constructions produced by the speaker, and \( \sigma \) is the standard deviation of that distribution of focal means.

Another measure of interest is pre-boundary lengthening, which is relevant in the comparison of conjunct constructions with non-conjunct constructions. Pre-boundary lengthening was inferred by examining the duration (ms) of the phrase-final nucleus in a particular construction and the duration of that same nucleus in another construction and expressing any discrepancy as a proportion of the shorter span. Specifically, the duration of the phrase-final nucleus is compared between positive and negative conjunction constructions, as well as the corresponding isolated presentation of the first conjunct in those constructions (this establishes a non-conjunct construction as a baseline).

**Analyses**

For our purposes, the items analyzed can be grouped in the following way. In the proceeding itemization, most superordinate groupings represent pairs of positive (a) and negative (b) constructions (Note: \( a \) does not indicate a positive construction when a subordinate of an NC item). Some are non-conjunct counterparts for which some segments will be relevant to analyses. EDP denotes English disentential clausal conjunction pairs (of the forms \( X. Y. \) and \( X. Y \text{ though} \)).

wherein \( X \) and \( Y \) are clauses), EIP denotes English intrasentential clausal conjunction pairs (of the forms \( X \text{ and } Y. \) and \( X \text{ but } Y. \) wherein \( X \) and \( Y \) are clauses), and EMP denotes English modifier conjunction pairs (of the forms \( X \text{ and } Y \) and \( X \text{ but } Y \) wherein \( X \) and \( Y \) are modifiers). BDP denotes Bangla disentential clausal conjunction pairs (of the form \( X. Y. \) and \( X. Y \text{ jodio} \) (“though”) wherein \( X \) and \( Y \) are clauses). Additionally (B/E)NC denotes non-conjuncts for Bangla/English.
Note that for English, six non-conjunct items (EDC 1a and 1b, EM 1a and 1b, and EM 2a and 2b in Appendix B) were elicited but completely excluded from analyses due to time-constraints.

Compartmentalization of English items analyzed:

[EDP 1]  a. The temperature was high. I drank cold water.  
  b. The temperature was low. I drank cold water, though.

[EDP 2]  a. The dog licked me. I like the dog.  
  b. The dog licked me. I don’t like the dog, though.

  b. What a relaxing day. I’m tired, though.

[EDP 4]  a. The cookies were bad. I ate none of them.  
  b. The cookies were bad. I ate many of them, though.

[EIP 1]  a. The tiger was walking away and Joe fled.  
  b. The tiger was walking away but Joe fled.

[EIP 2]  a. The difficulty of the task was moderate and I failed miserably.  
  b. The difficulty of the task was moderate but I failed miserably.

[EIP 3]  a. The temperature was high and I drank cold water.  
  b. The temperature was high but I drank hot coffee.

[EIP 4]  a. He’s ill and I’m worried about him.  
  b. He’s ill but I’m unworried about him.

[EMP 1]  a. The large and tender boy  
  b. The large but tender boy

Note: Several participants indicated that they consider this item to be “awkward”.
[EMP 2] a. The small and imposing dog
   b. The small but imposing dog

[ENC 1] a. The dog licked me
[ENC 2] a. I drank cold water
[ENC 3] a. I like the dog
[ENC 4] a. I don’t like the dog

Compartmentalization of Bangla items analyzed:

[BDP 1] a. আজকের তাপমাত্রা বেশি ছিল। আমি ঠান্ডা পানি খেয়েছিলাম।
   ‘Today’s temperature was high. I drank cold water.’
   ▪ See item “BDC 1-Positive-a” in Appendix C for a full gloss

b. আজকের তাপমাত্রা কম ছিল। আমি ঠান্ডা পানি খেয়েছিলাম যদিও।
   ‘Today’s temperature was low. I drank cold water, though.’
   ▪ See item “BDC 1-Negative-a” in Appendix C for a full gloss

[BDP 2] a. কুকুরটি আমাকে চেটেছিলো। আমি কুকুরটিকে পছন্দ করি।
   ‘The dog licked me. I like the dog.’
   ▪ See item “BDC 2-Positive-a” in Appendix C for a full gloss

b. কুকুরটি আমাকে চেটেছিলো। আমি কুকুরটিকে পছন্দ করি না যদিও।
   ‘The dog licked me. I don’t like the dog, though.’
   ▪ See item “BDC 2-Negative-a” in Appendix C for a full gloss

[BDP 3] a. আমি শুকন। আমি ঘুমাতে চাই।
   ‘I am tired. I am going to sleep.’
   ▪ See item “BDC 3-Positive-a” in Appendix C for a full gloss
b. আমি রান্ন। আমি জেগে থাকবো যদিও।

‘I am tired. I will stay awake, though.’

- See item “BDC 3-Negative-a” in Appendix C for a full gloss

[BDP 4] a. কুকিগুলো খারাপ ছিল। আমি একটিও খাইনি।

‘The cookies were bad. I ate none of them.’

- See item “BDC 4-Positive-a” in Appendix C for a full gloss

b. কুকিগুলো খারাপ ছিল। আমি অনেকগুলো খেয়েছি যদিও।

‘The cookies were bad. I ate many though.’

- See item “BDC 4-Negative-a” in Appendix C for a full gloss

[BDP 5] a. এটা সস্তা ছিল। আমি এটা কিনেছি।

‘It was cheap. I bought it.’

- See item “BDC 5-Positive-a” in Appendix C for a full gloss

b. এটা দামি ছিল। আমি এটা কিনেছি যদিও।

‘It was expensive. I bought it, though.’

- See item “BDC 5-Negative-a” in Appendix C for a full gloss

[BDP 6] a. রাস্তাটি অনেক দীর্ঘ ছিল। আমি পুরোটা হাঁটিনি।

‘The road was long. I did not walk all of it.’

- See item “BDC 6-Positive-a” in Appendix C for a full gloss

b. রাস্তাটি অনেক দীর্ঘ ছিল। আমি পুরোটা হেঁটেছি যদিও।

‘The road was long. I walked all of it, though.’

- See item “BDC 6-Negative-a” in Appendix C for a full gloss

[BNC 1] a. আজকের তাপমাত্রা বেশি ছিল।

‘Today’s temperature was high’

- See item “BDC 1-Non-conjuncts-a” in Appendix C for a full gloss
Average pitch reset and pause duration (raw or as a ratio) were calculated for each non-[NC] item for each participant. Comparisons were drawn between the positive and negative counterparts in a pair. Paired sample t-tests were performed for distributions for items from [EDP1] to [EMP2] in order to test hypotheses H1, H2, and H3.

Paired sample t-tests were also performed on the measures for phrase-final nuclear duration for [EDP 1] through [EMP 2] to test hypothesis H5. Additionally, a one-factor repeated measures ANOVA was carried out for the aforementioned for ([EDP 1] a), ([EDP 1] b), and
([ENC 1]) to test if there is a significant difference between the means. For instances in which there is a significant difference, Fisher’s LSD post-hoc test was performed to test hypothesis H4.

Additionally, a one-factor repeated measures analysis of variance (ANOVA) was carried out for the values of the fundamental frequency of the conjunct-initial nuclei (that appear post-boundary in conjunction structures or clause-initially in non-conjunct constructions) in the groupings [EDP1] and [ENC 2], ([EDP 2] a) and [ENC 3], and ([EDP 2] b) and [ENC 4]. This was done in order to determine if any observed difference in pitch reset is at least in part due to deviate post-boundary pitch. For these analyses, fundamental frequency was normalized as follows:

\[ \text{Fundamental frequency} = \frac{(C_2 - \mu)}{\sigma} \]

wherein \( C_2 \) is the observed F0 measurement for the first nucleus in the relevant (non-)conjunct, \( \mu \) is the mean of all F0 measures for the relevant language, and \( \sigma \) is the standard deviation of all such F0 measures.

Comparable analyses to the aforementioned were carried out for the Bangla stimuli in order to test hypothesis H6, as well as assess pre-boundary lengthening and post-boundary pitch as was delineated for English, maintaining the core of hypotheses H4 and H5 for the Bangla data. All statistical analyses were carried out using the software SPSS (IBM Corp., 2012).

Results

Because of the limited data and speakers used in this study, analyses performed and patterns asserted are descriptive and preliminary in nature. Because the data are largely insufficient for claiming significance in effects, observations made can at best be used to inform future hypotheses and research directions. Although necessarily inconclusive, this can still provide beneficial insight to properly orient future research.
English

Due to experimenter error, [EDP3] was not elicited from three participants, resulting in all analyses involving [EDP 3] having a sample size of 5, three fewer than that of all other analyses.

Pitch reset (see Table 1) was greater between negative conjuncts than between positive conjuncts for all items, except for [EDP2]. This general direction of effect supports the pitch reset components of hypotheses H1, H2, and H3. For EDP2, the second conjunct of the positive construction began with I like, while that of the negative construction began with I don’t like. Exploratory comparison of the average fundamental frequency of the initial “I” in each construction as an isolated non-conjunct (ENC3 and ENC4, respectively) via a paired samples t-test found that the initial nucleus had a higher fundamental frequency in the construction with like immediately following it (M=1.119, SD=0.952), than in the construction with don’t immediately following it (M=0.895, SD=0.526). While this difference was far from significant (t(7)=0.921, p=0.388), it still might help account for why [EDP2] was the only item with the opposite direction of effect (following the reasoning that because the positive conjunction structure is expected to have a higher pitch in the second conjunct by default, it is likely to skew toward higher pitch reset). Of the pitch reset effects observed, those for [EDP1] and [EIP3] obtained significance, and that for [EDP3] obtained marginal significance, but all others were non-significant. Despite this general lack of significant results, the overall direction of effect across items and at least disparate significance tentatively supports the hypothesis that pitch reset is greater between negative conjuncts than between positive conjuncts in each of the three construction types elicited.
Table 1. Paired sample t-test Results comparing Pitch Reset in Positive & Negative Constructions

<table>
<thead>
<tr>
<th>Item</th>
<th>Positive M</th>
<th>SD</th>
<th>Negative M</th>
<th>SD</th>
<th>t-test</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDP1</td>
<td>0.824**</td>
<td>1.201</td>
<td>2.119</td>
<td>0.903</td>
<td>-4.478</td>
<td>.003</td>
</tr>
<tr>
<td>EDP2</td>
<td>1.817</td>
<td>2.271</td>
<td>1.022</td>
<td>1.221</td>
<td>1.036</td>
<td>.335</td>
</tr>
<tr>
<td>EDP3</td>
<td>1.067*</td>
<td>0.200</td>
<td>1.568</td>
<td>0.376</td>
<td>-2.506</td>
<td>.066</td>
</tr>
<tr>
<td>EDP4</td>
<td>1.479</td>
<td>1.045</td>
<td>1.673</td>
<td>0.741</td>
<td>-0.391</td>
<td>.708</td>
</tr>
<tr>
<td>EIP1</td>
<td>-0.334</td>
<td>1.253</td>
<td>0.654</td>
<td>0.958</td>
<td>-1.726</td>
<td>.128</td>
</tr>
<tr>
<td>EIP2</td>
<td>0.609</td>
<td>1.166</td>
<td>1.303</td>
<td>1.653</td>
<td>-1.042</td>
<td>.332</td>
</tr>
<tr>
<td>EIP3</td>
<td>-0.323**</td>
<td>0.893</td>
<td>0.591</td>
<td>0.993</td>
<td>-2.883</td>
<td>.024</td>
</tr>
<tr>
<td>EIP4</td>
<td>-0.714</td>
<td>0.348</td>
<td>-0.264</td>
<td>1.320</td>
<td>-1.186</td>
<td>.274</td>
</tr>
<tr>
<td>EMP1</td>
<td>-0.266</td>
<td>0.411</td>
<td>0.121</td>
<td>0.866</td>
<td>-1.688</td>
<td>.135</td>
</tr>
<tr>
<td>EMP2</td>
<td>-0.566</td>
<td>0.668</td>
<td>-0.284</td>
<td>0.911</td>
<td>-1.269</td>
<td>.245</td>
</tr>
</tbody>
</table>

* p<.05. ** p<.01. *** p<.001. ; **Bold**=would conventionally indicate greater closeness

It should be noted that many of the items exhibited negative pitch reset values, indicative of a pitch decline across the boundary between conjuncts. This phenomenon was most commonly observed among the positive intrasentential items (EIP and EMP), of which all but one demonstrated negative pitch reset. Additionally, the negative constructions of EIP4 and EMP2 also exhibited negative pitch reset. The presence of pitch decline in intrasentential and modifier conjunction, but not in disentential conjunction, suggests that conjuncts are more closely joined within a sentence than when they constitute separate sentences, which is hardly a surprising sentiment given than stronger boundaries are expected between sentences. Additionally, the much greater prevalence of pitch decline in positive conjunction items than in negative conjunction items further supports the notion that positively related conjuncts are more closely joined than negatively related conjuncts. However, among EIP items with negative pitch reset, fundamental frequency was often observed to increase substantially in non-initial nuclei of
the second conjunct (typically in the second word), suggesting that pitch reset was merely delayed for these items. This observation was informal, however, and not subject to analysis, thus conclusions should not be drawn from it.

In general, difference in pitch reset seemed least substantial in EMP items, which is congruent with the expectation that pitch reset occur across major junctures, of which the boundary between conjoined modifiers is not.

To examine whether greater pitch reset measures are at least in part attributable to greater pitch post-boundary, the mean fundamental frequencies of post-boundary initial-nuclei (as characterized in the analyses section) of certain corresponding positive, negative, and non-conjunct constructions were compared via repeated measures ANOVA (see Table 2).

<table>
<thead>
<tr>
<th>Type</th>
<th>Mean</th>
<th>SD</th>
<th>df&lt;sub&gt;type&lt;/sub&gt;</th>
<th>df&lt;sub&gt;error&lt;/sub&gt;</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDP1 a (Positive)</td>
<td>0.190</td>
<td>1.245</td>
<td>2</td>
<td>14</td>
<td>1.496</td>
<td>.258</td>
</tr>
<tr>
<td>EDP1 b (Negative)</td>
<td>0.755</td>
<td>0.500</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENC2 a (Non-conjunct)</td>
<td>0.738</td>
<td>0.266</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDP2 a (Positive)</td>
<td>1.264</td>
<td>1.194</td>
<td>1</td>
<td>7</td>
<td>0.072</td>
<td>.796</td>
</tr>
<tr>
<td>ENC3 a (Non-conjunct)</td>
<td>1.119</td>
<td>0.952</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDP2 b (Negative)</td>
<td>0.422</td>
<td>0.600</td>
<td>1</td>
<td>7</td>
<td>2.831</td>
<td>.136</td>
</tr>
<tr>
<td>ENC4 a (Non-conjunct)</td>
<td>0.895</td>
<td>0.526</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The p-value for the two-condition ANOVAs are equivalent to those that would be obtained in a t-test

†: C2 refers to items that appear as the second conjunct of conjunction structures, but that were also elicited in isolation (ex: I like the dog in The dog licked me. I like the dog.)

No significant differences were found between groups. However, examination of Comparison 1 in Table 2 shows that the initial nucleus of the second conjunct of negative conjunction item
EDP1b (M=0.755) is almost equivalent in fundamental frequency to that of non-conjunct item ENC2 (M=0.738), while that of the positive conjunction item EDP1a is much lower (M=0.190). This basic observation, while non-significant, supports the notion that our pitch reset measure reflects an actual reset to a higher pitch in that pitch reset was observed to be less between the positive conjuncts of [EDP1] than between the negative conjuncts of [EDP1] (recall Table 1) – thus the higher post-boundary pitch and the greatest pitch reset was observed for the same item – negative conjunction – as one would expect of pitch reset as defined. Comparisons 2 and 3 also similarly support our operationalization of pitch reset (recall that [EDP2] was the only item in which negative conjuncts had lesser pitch reset than positive conjuncts).

Pause duration was found to be greater between negative conjuncts than between positive conjuncts in all items (see Table 3). This effect was significant in all EIP and EMP items, but non-significant for all EDP items.

<p>| Table 3. Paired sample t-test Results comparing Inter-conjunct Pause duration in Positive &amp; Negative Constructions |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|</p>
<table>
<thead>
<tr>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>t-test</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDP1</td>
<td>239.356</td>
<td>159.631</td>
<td>297.276</td>
<td>115.447</td>
<td>-1.855</td>
<td>.106</td>
</tr>
<tr>
<td>EDP2</td>
<td>273.569</td>
<td>147.610</td>
<td>345.938</td>
<td>272.651</td>
<td>-1.202</td>
<td>.269</td>
</tr>
<tr>
<td>EDP3</td>
<td>288.031</td>
<td>158.432</td>
<td>469.731</td>
<td>267.518</td>
<td>-1.718</td>
<td>.161</td>
</tr>
<tr>
<td>EDP4</td>
<td>229.612</td>
<td>136.135</td>
<td>274.684</td>
<td>184.674</td>
<td>-1.123</td>
<td>.299</td>
</tr>
<tr>
<td>EIP1</td>
<td>0.339**</td>
<td>0.065</td>
<td>0.637</td>
<td>0.170</td>
<td>-3.955</td>
<td>.005</td>
</tr>
<tr>
<td>EIP2</td>
<td>0.325**</td>
<td>0.110</td>
<td>0.719</td>
<td>0.338</td>
<td>-4.761</td>
<td>.002</td>
</tr>
<tr>
<td>EIP3</td>
<td>0.249*</td>
<td>0.094</td>
<td>0.407</td>
<td>0.104</td>
<td>-3.393</td>
<td>.012</td>
</tr>
<tr>
<td>EIP4</td>
<td>0.232*</td>
<td>0.090</td>
<td>0.573</td>
<td>0.303</td>
<td>-2.995</td>
<td>.020</td>
</tr>
<tr>
<td>EMP1</td>
<td>0.292**</td>
<td>0.115</td>
<td>0.586</td>
<td>0.214</td>
<td>-3.562</td>
<td>.009</td>
</tr>
<tr>
<td>EMP2</td>
<td>0.204**</td>
<td>0.078</td>
<td>0.429</td>
<td>0.164</td>
<td>-4.044</td>
<td>.005</td>
</tr>
</tbody>
</table>

*p<0.1.  **p<0.05.  ***p<0.01.  *Bold=*would conventionally indicate greater closeness
Recall that pause duration was calculated as the ratio between observed duration and duration of an isolated conjunction marker (and/but) for intrasentential items (EIP and EMP), but was reported as raw observed duration for EDP items. Given the disparity in significance between intrasentential items (EIP and EMP) and EDP items, it seemed plausible that the apparent positivity-closeness effect may be magnified in intrasentential items due to greater duration of and relative to but. Thus, a paired sample t-test was performed comparing the mean duration of and and but produced by subjects. And (M=566.678, SD=97.801) was found to be significantly longer than but (M=420.119, SD=134.699) (t(7)=2.744, \( p=0.029 \)) when produced in isolation. Thus, even if raw pause duration was constant between positive and negative constructions, the pause duration ratio would be less for the positive constructions by virtue of a greater quotient. This, of course, is not problematic, assuming the measures for and and but in isolation are good indicators of their relative durations across all contexts (which admittedly may be a dubious assumption). Raw pause duration was also qualitatively less for nearly all positive EIP and EMP constructions than for their negative counterparts (no formal analyses were performed), but reporting such would be even more egregious in that it neglects to account for the confound of baseline difference in duration between and and but. Therefore, the analyses of the ratio measures are maintained with the caveat that the measures for and/but duration be assumed strong indicators of their relative duration across contexts.

In all, the direction of effect and predominant significance support the pause duration components of hypotheses H1, H2, and H3 in that pause duration seems to be reliably greater between negative conjuncts than between positive conjuncts in all three elicited conjunction types.
Difference in phrase final nuclear length was observed between positive and negative constructions, but the direction of this difference was inconsistent across items (see Table 4).

<table>
<thead>
<tr>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>t-test</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDP1</td>
<td>281.422*</td>
<td>49.708</td>
<td>258.517</td>
<td>50.872</td>
<td>2.073</td>
<td>.077</td>
</tr>
<tr>
<td>EDP2</td>
<td>171.408</td>
<td>49.270</td>
<td>183.278</td>
<td>55.883</td>
<td>-0.735</td>
<td>.486</td>
</tr>
<tr>
<td>EDP3</td>
<td>269.151</td>
<td>41.536</td>
<td>265.065</td>
<td>59.795</td>
<td>0.267</td>
<td>.803</td>
</tr>
<tr>
<td>EDP4</td>
<td>247.919*</td>
<td>45.902</td>
<td>229.451</td>
<td>25.979</td>
<td>1.949</td>
<td>.092</td>
</tr>
<tr>
<td>EIP1</td>
<td>204.746</td>
<td>57.728</td>
<td>213.936</td>
<td>49.835</td>
<td>-0.497</td>
<td>.634</td>
</tr>
<tr>
<td>EIP2</td>
<td>106.837</td>
<td>39.916</td>
<td>134.833*</td>
<td>46.717</td>
<td>-3.318</td>
<td>.013</td>
</tr>
<tr>
<td>EIP3</td>
<td>225.359</td>
<td>67.287</td>
<td>254.462*</td>
<td>62.591</td>
<td>-2.227</td>
<td>.061</td>
</tr>
<tr>
<td>EIP4</td>
<td>185.809</td>
<td>82.424</td>
<td>199.939</td>
<td>84.249</td>
<td>-0.605</td>
<td>.564</td>
</tr>
<tr>
<td>EMP1</td>
<td>160.148</td>
<td>63.220</td>
<td>164.629</td>
<td>65.801</td>
<td>-0.985</td>
<td>.358</td>
</tr>
<tr>
<td>EMP2</td>
<td>189.128</td>
<td>55.945</td>
<td>180.327</td>
<td>68.849</td>
<td>0.566</td>
<td>.589</td>
</tr>
</tbody>
</table>

* p<0.1. * p<0.05. ** p<0.01. ***p<.001. ; Bold = Longer

In all EDP items, except [EDP2], duration was greatest in positive constructions, but in all intrasentential (EIP and EMP) items, except [EMP2], duration was greatest in negative constructions. The differences observed in [EDP1], [EDP4], and [EIP3] were marginally significant, while the difference observed in [EIP2] was significant (all other results were non-significant). This tentatively supports hypothesis H5 for EIP constructions, such that the phrase-final nucleus of the first conjunct is longer in negative intrasentential clausal conjunction than in positive intrasentential clausal conjunction, but does not support this hypothesis for EDP and EMP constructions, which have mixed to opposite effects.
Comparison of phrase-final nuclear length for [EDP1] and its corresponding non-conjunct construction [ENC1] via repeated measures ANOVA indicates that there is significant difference among the positive construction EDP1a, the negative construction EDP1b, and the non-conjunct construction ENC1a ($F(2,14)=30.652, p=0.000$). Fisher’s LSD post-hoc test reveals that the phrase-final nucleus of EDP1a (M=281.422) and of EDP1b (M=258.517) are (highly) significantly longer than that of ENC1a (M=182.931). Thus, phrase-final length is apparently greater within a conjunction structure than in an isolated non-conjunct, which directly opposes hypothesis H4, which expects phrase-final nuclear duration to be greatest in non-conjunct items. This observation, of course, is based on only one comparison, making it vulnerable to item idiosyncrasies, and so conclusions drawn might be somewhat more tenuous.

<table>
<thead>
<tr>
<th>Type</th>
<th>Mean</th>
<th>SD</th>
<th>df_type</th>
<th>df_error</th>
<th>$F$</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDP1 a (Positive)</td>
<td>281.422***</td>
<td>49.708</td>
<td>2</td>
<td>14</td>
<td>30.652</td>
<td>0.000</td>
</tr>
<tr>
<td>EDP1 b (Negative)</td>
<td>258.517**</td>
<td>50.872</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENC1 a (Non-conjunct)</td>
<td>182.931</td>
<td>48.529</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p<0.1$. * $p<.05$. ** $p<.01$. *** $p<.001$. ;

Underlined = Significantly different than the non-conjunct’s mean according to Fisher’s unadjusted LSD test.

Note: The $p$-value for the two-condition ANOVA is equivalent to that which would be obtained in a $t$-test.

**Bangla**

No significant differences in inter-conjunct pitch reset or pause duration were found between positive and negative conjunction for any item analyzed in Bangla. Calculated means, standard deviations, $t$-test statistics and significance levels for pitch reset and pause duration can be found in Tables 6 and 7, respectively.
Beyond lack of significance, the direction of deviation between positive and negative construction means varies between items, such that negative constructions exhibit less inter-conjunct pitch reset in BDP 1, BDP 4, and BDP 6, while positive constructions demonstrate less pitch reset in BDP 2, BDP 3, and BDP 5 (see Table 6).

<table>
<thead>
<tr>
<th>Item</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>BDP1</td>
<td>0.076</td>
<td>1.769</td>
</tr>
<tr>
<td>BDP2</td>
<td>0.403</td>
<td>1.730</td>
</tr>
<tr>
<td>BDP3</td>
<td>-0.323</td>
<td>1.754</td>
</tr>
<tr>
<td>BDP4</td>
<td>0.504</td>
<td>1.435</td>
</tr>
<tr>
<td>BDP5</td>
<td>-0.506**</td>
<td>1.448</td>
</tr>
<tr>
<td>BDP6</td>
<td>0.799</td>
<td>1.501</td>
</tr>
</tbody>
</table>

Table 6. Paired sample t-test Results comparing Pitch Reset in Positive & Negative Constructions (Bangla)

Additionally, there is less pause duration between negative conjuncts in BDP1, BDP2, and BDP 6, but less pause duration between positive conjuncts in BDP 3, BDP 4, and BDP 5 (see Table 7).

<table>
<thead>
<tr>
<th>Item</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>BDP1</td>
<td>165.684</td>
<td>128.229</td>
</tr>
<tr>
<td>BDP2</td>
<td>209.231</td>
<td>196.560</td>
</tr>
<tr>
<td>BDP3</td>
<td>197.742</td>
<td>252.404</td>
</tr>
<tr>
<td>BDP4</td>
<td>133.917</td>
<td>48.387</td>
</tr>
<tr>
<td>BDP5</td>
<td>99.803</td>
<td>103.881</td>
</tr>
<tr>
<td>BDP6</td>
<td>228.364</td>
<td>168.209</td>
</tr>
</tbody>
</table>

Table 7. Paired sample t-test Results comparing Inter-conjunct Pause duration in Positive & Negative Constructions (Bangla)
Unfortunately, time constraints do not permit exploratory analysis of why these inconsistencies might occur between items. Variation in these measures across participants also appears to be quite extensive, as indicated by the substantial standard deviation in values across all items. In all, the results do not allow rejection of the null hypothesis regarding difference in pitch reset and pause duration and thus do not support hypothesis H6.

To again examine whether greater pitch reset measures are at least in part attributable to greater pitch post-boundary in the Bangla data, the mean fundamental frequencies of post-boundary initial-nuclei of certain corresponding positive, negative, and non-conjunct constructions were compared via repeated measures ANOVA (see Table 8).

<table>
<thead>
<tr>
<th>Type</th>
<th>Mean</th>
<th>SD</th>
<th>df\text{type}</th>
<th>df\text{error}</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDP1 a (Positive)</td>
<td>0.234</td>
<td>0.761</td>
<td>2</td>
<td>6</td>
<td>6.857</td>
<td>0.028</td>
</tr>
<tr>
<td>BDP1 b (Negative)</td>
<td>-0.205</td>
<td>1.060</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BNC3 a (Non-conjunct)</td>
<td>1.152</td>
<td>0.304</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDP2 a (Positive)</td>
<td>-0.335</td>
<td>1.030</td>
<td>1</td>
<td>3</td>
<td>6.697</td>
<td>0.081</td>
</tr>
<tr>
<td>BNC5 a (Non-conjunct)</td>
<td>1.186</td>
<td>0.367</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDP2 b (Negative)</td>
<td>0.094</td>
<td>1.135</td>
<td>1</td>
<td>3</td>
<td>3.475</td>
<td>0.159</td>
</tr>
<tr>
<td>BNC6 a (Non-conjunct)</td>
<td>1.233</td>
<td>0.548</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Underlined* = Significantly different from each other according to Fisher’s LSD test.

A significant group difference was obtained for a comparison between BDP1a, BDP1b, and BNC3a ($F(2,6)=6.857, p=0.028$); subsequent post-hoc analysis in the form of Fisher’s LSD test found that the significant difference lied in the mean pitch of BDP1b (a negative conjunct),
which was significantly lesser than that of the non-conjunct BNC3. This is congruent with the previous observation that the negative conjunct had non-significantly lesser pitch reset than the positive conjunct in BDP1. Given also that BDP2a (an element of a positive conjunct) demonstrated lesser post-boundary initial-nuclear pitch than the corresponding negative conjunct element BDP2b and pitch reset was observed to be lesser in the positive construction of BDP2, differences in pitch reset measures seem to at least in part be explained by differences in post-boundary pitch, which supports the idea that our operationalization actually measures a reset to a higher pitch.

While paired sample $t$-tests reveal no significant differences between the means of phrase-final length of positive initial conjuncts and negative initial conjuncts, negative initial conjuncts are longer in duration than their positive counterparts for all items, demonstrating consistency in the direction of effect (see Table 9 for relevant results).

<table>
<thead>
<tr>
<th>Item</th>
<th>Positive</th>
<th>Negative</th>
<th>$t$-test</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDP1</td>
<td>140.946</td>
<td>173.664</td>
<td>-1.274</td>
<td>.293</td>
</tr>
<tr>
<td>BDP2</td>
<td>144.769</td>
<td>156.027</td>
<td>-0.651</td>
<td>.561</td>
</tr>
<tr>
<td>BDP3</td>
<td>148.087</td>
<td>181.721</td>
<td>-1.343</td>
<td>.272</td>
</tr>
<tr>
<td>BDP4</td>
<td>159.967</td>
<td>197.561*</td>
<td>-2.806</td>
<td>.068</td>
</tr>
<tr>
<td>BDP5</td>
<td>177.658</td>
<td>188.299</td>
<td>-0.373</td>
<td>.734</td>
</tr>
<tr>
<td>BDP6</td>
<td>143.236</td>
<td>175.923</td>
<td>-1.661</td>
<td>.195</td>
</tr>
</tbody>
</table>

$^*$ $p<.1$, ** $p<.05$, *** $p<.01$. **Bold** = Longer
While the null hypothesis obtains, the consistency in negative-conjuncts’ demonstration of greater duration provides preliminary support for hypothesis H5 in Bangla in that phrase-final nuclear length seems to be greater in negative conjuncts than in positive conjuncts. Comparisons of mean duration of select corresponding positive conjuncts, negative conjuncts, and non-conjuncts via repeated measures ANOVA also do not indicate significant differences (see Table 10), but mean duration for both positive and negative conjuncts is greater than the duration of corresponding non-conjuncts. Although this finding is non-significant, it qualitatively opposes our expectation in H4 in that phrase-final nuclei of non-conjuncts are descriptively shortest, not longest.

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Type</th>
<th>Mean</th>
<th>SD</th>
<th>df&lt;sub&gt;type&lt;/sub&gt;</th>
<th>df&lt;sub&gt;error&lt;/sub&gt;</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BDP2 a (Positive)</td>
<td>144.769</td>
<td>24.262</td>
<td>2</td>
<td>6</td>
<td>0.232</td>
<td>.799</td>
</tr>
<tr>
<td></td>
<td>BDP2 b (Negative)</td>
<td>156.027</td>
<td>29.464</td>
<td>1</td>
<td>3</td>
<td>5.462</td>
<td>.101</td>
</tr>
<tr>
<td></td>
<td>BNC4 a (Non-conjunct)</td>
<td>137.094</td>
<td>44.299</td>
<td>1</td>
<td>3</td>
<td>0.293</td>
<td>.626</td>
</tr>
<tr>
<td>2</td>
<td>BDP1 a (Positive)</td>
<td>140.946</td>
<td>34.921</td>
<td>1</td>
<td>3</td>
<td>0.293</td>
<td>.626</td>
</tr>
<tr>
<td></td>
<td>BNC1 a (Non-conjunct)</td>
<td>128.479</td>
<td>29.453</td>
<td>1</td>
<td>3</td>
<td>5.462</td>
<td>.101</td>
</tr>
<tr>
<td>3</td>
<td>BDP1 b (Negative)</td>
<td>173.664</td>
<td>38.478</td>
<td>1</td>
<td>3</td>
<td>5.462</td>
<td>.101</td>
</tr>
<tr>
<td></td>
<td>BNC2 a (Non-conjunct)</td>
<td>124.931</td>
<td>30.754</td>
<td>1</td>
<td>3</td>
<td>5.462</td>
<td>.101</td>
</tr>
</tbody>
</table>

Note: The p-value for the two-condition ANOVAs are equivalent to those that would be obtained in a t-test.

**Discussion**

**English**

There was substantial evidence of greater pitch reset and pause duration between negatively related conjuncts than between positively related conjuncts, replicating the positivity-
closeness effect found in English in the previous literature. This effect appears to hold in

disentential clausal, intrasentential clausal, and modifier conjunction, supporting hypotheses H1,
H2, and H3. Given the limited and preliminary nature of the results, however, it would be wise to
refine and expand examination of these phenomena in future analyses. In particular, it would be
beneficial to investigate whether pitch reset is less robust (or perhaps absent) in modifier
conjunction, relative to clausal conjunction. Additionally, to test how generalizable this apparent
positivity-closeness effect is, future research should consider analyzing conjunction in which the
constituent conjuncts are types other than modifier or clausal, as well as conjunction with varied
markers (i.e., other than and, but, or though). Furthermore, of course, it is essential to evaluate
different dialects moving forward, as well, as doing so can indicate generalizability or –if
differences arise- offer insight into factors that may moderate acoustic closeness of conjuncts.

If such additional information is attained in the future, it would provide a base that could
more reasonably inform English speech synthesis - in particular, TTS. With the lack of such
prospective insight, however, the current study can still offer preliminary guidance as to how
TTS can produce more natural speech by biasing output towards correlates of conjunction
present in the input. While TTS systems decide F0 at different points of a sentence based on a
variety of factors focused on in training, as well as basic guiding constraints such as a tendency
toward pitch declination, simulation of natural F0 contour could be enhanced by biasing F0 in
the presence of certain conjunction markers in order to model pitch reset differences correlated
with positive/negative relations.

For example, when a positive conjunction structure is present, as indicated by the
presence of an explicit marker, such as and, as well as additional contextual information (e.g.,
lexical category of surrounding segments, sentence/clausal boundaries, etc.), the change in F0
that would typically be implemented should be altered such that the F0 at the beginning of the second conjunct is relatively low. Conversely, in the presence of apparent negative conjunction, F0 should be modified such that the fundamental frequency at the beginning of the second conjunct is higher than would have otherwise been implemented (to simulate the relatively greater pitch reset expected). Obviously, this is a simplistic description and does not illustrate the totality of information that would need to be considered in order for such an operation to be performed (e.g., discerning and characterizing conjuncts could be somewhat complicated). Regardless, at the very least, the observed effects suggest that it would be beneficial to label positive and negative conjunction markers/structures in TTS training data and recognize them in user inputs so that pitch determination can in part be informed by the presence of conjunction, which very much appears to correlate reliably with pitch effects.

The current study also suggests that TTS output should be biased in comparable ways regarding inter-conjunct pause duration. It indicates that –in cases wherein *though* is present clause-finally (as in the disentential clausal constructions examined), the pause between the preceding clause and the beginning of that clause should be expanded in duration – it is unclear whether such can be implemented with regards to markers other than *though*, however, further illustrating the need to examine other conjunction markers in future study. Additionally, the present study suggests that some sort of temporal manipulation should be implemented between conjuncts within the same sentence. In those cases, an expansion of pause duration for negative conjunction constructions is less straightforward given that conjunction markers appear within the area of interest between conjuncts (e.g., *but* factors into the duration between *strong* and *pliable* in *The strong but pliable man*). Thus, based on current insight, it is unclear whether true pause (lack of speech) duration, conjunction marker duration, or both should be manipulated.
While no formal analysis was conducted, across various items analyzed, I observed a trend of *and* blending with the preceding segment with a true pause then following *and*, and *but* blending with the following segment with a true pause preceding *but* (this makes sense given that the /æ/ of *and* and end of *but* -for which participants often dropped the word-final glottal stop- are vocalic). This suggests that if true pause duration were to be manipulated, the location of the pause might have to differ depending on the relevant marker. If one does not consider that nuance, however, the manipulation of “pause” duration can be more simply addressed. In the inter-conjunct boundary of interest, *and*/but (and perhaps similar markers, depending on future findings) should be temporally compressed (shortened in duration) relative to more standard durations, given that “pause” duration was found to be a fraction of the duration of *and*/but in isolation; this compression should be mitigated in negative conjunction, however, given that “pause” duration is observed to be greater between negative conjuncts than between positive conjuncts. If the notion of compression is unappealing or seems unjustified given the current study’s questionable appraisal of *and*/but’s baseline duration, then such can be dismissed, but regardless it should more basically be held that negative markers such as *but* be expanded relative to *and* in these contexts. Therefore, overall, disregarding the relevant minutiae and mechanisms for doing so, this study’s results suggest that “pause” duration should be expanded between negative conjuncts in TTS.

It should be reaffirmed, however, that the conclusions drawn about inter-conjunct pause duration from this study are tenuous, in part due to a number of methodological flaws that should be corrected in future study. Firstly, in the present study, intrinsic relative duration of *and* and *but* was estimated based on a handful of productions of them in isolation – if one intends to factor their “baseline” durations into measurement of pause duration in the future, one should
measure *and* / *but* (or other examined markers) across various contexts (perhaps with several instances of them in a single text to be read by participants) and calculate a mean duration based on this that would serve as a better indicator of the relative durations of *and* and *but*. Secondly, the present study did not normalize pause duration measures based on speaker – this is problematic because it allows idiosyncratic tendencies of speakers to pause much longer or shorter than others to skew the overall analysis, biasing it towards whatever effects were observed in the outlier speakers. Finally, it should be noted that, in the current study, participants may have paused more markedly to delineate separate constituents due to the unnatural quality of the elicitation (reading an isolated item aloud). This seemingly exaggerated pausing tended to decrease as the speaker progressed through the recording session, however, perhaps due to increased comfort. As such, if future research also applies the same elicitation methodology (eliciting isolated utterances), it would perhaps benefit from disregarding early data or expressly counterbalancing the order of appearance of items so that all items appear early on for the same number of participants. If future studies rectify these three flaws, they would be even better suited to offer insight into pause duration differences between negative and positive conjunction.

Finally, while the current study offers preliminary insight into pitch reset and pause duration differences between positive and negative conjunction structures, it offers little in informing expectations regarding phrase-final nuclear length. No reliable difference in phrase-final nuclear duration was observed between positive and negative disentential conjunction. The study did, however, observe that phrase-final length may be enhanced in the first conjunct of a conjunction structure relative to an isolated non-conjunct utterance in that phrase-final nuclear duration was significantly greater in the first conjunct of a positive or negative conjunction structure than in a non-conjunct. While this was only examined for one item, this observation
tentatively suggests that phrase-final nuclei are temporally expanded in clauses that are followed by another semantically-related clause. While I had expected phrase-final length to be relatively greater in negative conjunction due to lengthening being a mechanism to convey contrast one would expect in such an utterance, I did not expect positive conjunction to result in similar phrase-final lengthening. As such, it would be rewarding in the future to investigate whether this apparently enhanced phrase-final lengthening holds for positively and negatively related sentences and whether this effect is greater than what is observed in semantically “non-related” successive sentences. Investigating this can further illuminate whether conjunction (a proxy for underlying semantic relations) should be taken into account when determining phrase-final duration in TTS. If this focus is pursued in the future, additional conjunction structures should be examined (beyond the utterance-final though that is examined in the current study) in order to discern if effects hold for different markers (e.g., however, so, thus) and for different positions of said markers (e.g., clause-initially, rather than clause-finally).

Returning to discussion of the apparent positivity-closeness effect in English, the observation of this effect in all three constructions investigated (i.e., EDC, EIC, and EM), including intrasentential clausal constructions, suggests that negatively related conjuncts are not underlyingly more closely related in English, as Tokizaki and Kuwana (2009) might argue. Should one recall their syntactic bracketing argument – that the presence of a word as the negative conjunction marker in English obscures a negativity-closeness effect – one might see that it does not hold when considering intrasentential clausal conjunction (i.e., X and Y. vs. X but Y. wherein X and Y are clauses) in English. Between these positive and negative constructions, the syntactic structures are equivalent and both employ a word – and or but – in the same position to mark conjunction. If Tokizaki and Kuwana’s proposed underlying negativity-
closeness were assumed, one would expect the negative conjunction construction to exhibit less inter-conjunct pitch reset and pause duration, but the opposite was observed in the present study. Thus, it seems that deviation in conjunct closeness observed between languages likely is not attributable to difference in syntactic bracketing owing to conjunction morphology. While one could argue that it is unreasonable to use evidence from one structure (EIC) to inform conjecture about another (EDC), given that Tokizaki and Kuwana are looking for universal relations between semantic closeness and prosodic closeness, I feel it is fair to do so. The question, of course, still persists as to whether it is reasonable to expect a reliable correlate between prosodic closeness and semantic closeness cross-lingually. That is not necessarily a question that the current study can answer, but rather is an inquiry that is left to individual consideration. If such a correlate is considered to be plausible, then the current study certainly might suggest that positive semantic relations are closer, but it is of course tenuous to assert that such is a universal. Additionally, such an explicit association cannot definitively be asserted even just for English, given that it is possible other unaddressed confounding properties of English completely account for the apparent positivity-closeness effect or perhaps obscure a dissimilar underlying closeness effect. This, however, does not mean that prosodic closeness cannot be a legitimate proxy for semantic closeness, but rather that its legitimacy as a proxy is fair to question. How one views this legitimacy may largely shape the implications drawn from the current study’s results and frame one’s outlook for future research.

Returning to Tokizaki and Kuwana’s account, if one believes that there is merit in considering different types of conjunction independently, then one can still entertain their account solely for disentential conjunction in English. I propose their account can serve as an explanation for why non-conjunction-marked constructions are closer than negatively-conjoined
constructions. Specifically, in such disentential clausal constructions, I propose that the stimuli we have been using is inadequate in that the positive constructions do not have an explicit conjunction marker, but the negative constructions do. As such, I make a distinction between positively-related *marked* conjuncts (we’ll call them PMs), negatively-related *marked* conjuncts (like 2b) (we’ll call them NMs), and positively-related *unmarked* constituents (like 2a) (we’ll call them PUs). If one maintains Tokizaki and Kuwana’s account, then one can hypothesize the following hierarchy of closeness: PMs are more closely joined than NMs which are more closely joined than PUs. This incites the question of why PUs manifest as closer than NMs in the delineated studies; such could be explained by Tokizaki’s account – the presence of the word *though* obscures the underlyingly greater closeness of the NMs, making the PUs seems closer. Even if such an account is dismissed, it would be beneficial to study PM conjunction structures in the future in order to verify whether effects do differ between PUs and PMs. If differences do arise, then it could bring into question the current and past studies’ assertions about disentential conjunction.

To conclude discussion of the English results, steps that should be taken to improve and expand upon the literature in the future will be delineated. Firstly, if future research examines similar phenomena, it should improve upon the paradigm employed for data elicitation. In the current study, participants read individual stimuli in isolation. This results in particularly unnatural speech, however. To improve upon the naturalness of speech elicited, it would be beneficial to adopt an alternative method, perhaps by embedding focal stimuli (items of interest) logically in an extended passage of text that the participants read. While the resulting speech would not be wholly indicative of natural speech, it would likely be a closer approximation than that which was elicited in the current study. Additionally, future research should control for word
frequency, overall item/stimulus length, and intrinsic vowel quality of nuclei of interest, measures that the current study neglected to wholly realize. Furthermore, of course, future study would greatly benefit from larger sample sizes. Beyond strictly improving upon the current study’s methodology, future research should meaningfully extend beyond it. As asserted previously, future study should look to examine more conjunction markers and structures, as well as investigate different dialects, in order to assess generalizability of previously documented effects.

**Bangla**

Unlike in English, it is hard to justify conclusions based on the available Bangla data. The only tentative preliminary conclusion may be drawn from the consistent deviation in phrase-final nuclear duration observed between negative and positive conjuncts (recall Table 9). If regarded as illustrative of a legitimate effect, this observation suggests that phrase-final lengthening in Bangla may be more pronounced in constructions in which a negative semantic relation is conveyed than in those in which a positive relation is conveyed. Such a conclusion tentatively supports H5 with regards to Bangla and may suggest that Bangla reliably uses lengthening as a mechanism to signify contrast. If such holds consistently in future research, this may make negative conjunction markers useful indicators that particular segments should be temporally expanded, thus offering value to TTS modeling of Bangla. This apparent finding is, of course, highly tenuous given the lack of statistical significance and considerable variance, which is perhaps endemic to the grossly minute sample size.

In addition to lack of statistical significance, observed effects (besides phrase-final duration) were often inconsistent in their direction. Additionally, there was great variance between speakers in almost all measures. While this in part reflects the severely underpowered
nature of the current study, it may also be reflective of deficient stimulus design, particularly when it comes to controlling for tone.

While tone is not lexically contrastive in Bangla, the language nonetheless has a rich tonal system which lends itself to prominently different pitch contours between utterances. Bangla demonstrates three basic pitch accents (low, high, and rising) as well as interactions between extant accentual phrase, intermediate phrase, and intonational phrase boundary tones (Khan, 2014). Although the current study controlled for tones immediately adjacent to focal boundaries between constructions, it failed to account for pitch contour elsewhere in the utterances. Given that non-final accents and tones at non-prominent boundaries inevitably influence pitch at the nuclei measured, this is a problematic oversight. Additionally, because shorter words and function words reliably reach lower pitch than longer words and content words, particularly with downtrend of “Ha”, an accentual phrase boundary tone (Khan, 2008), lack of control over word length throughout stimuli is especially problematic. Furthermore, as length of a focused phrase increases, rate of F0 change can shift (Khan, 2014), suggesting that speaker rate of speech might be important. Future studies would benefit from controlling for word length and tonal distribution and perhaps considering speech rate differences.

Ultimately, however, if there are no robust differences apparent between positive and negative conjunction structures without controlling for such factors, then presence of conjunction might be minimally useful for informing TTS modeling of Bangla. This cannot be concluded based on the current study given its limited size, however. Thus, future research with better stimuli and more subjects is still worthwhile because it could more definitively illuminate whether conjunction markers are a useful indicator for certain prosodic correlates in Bangla. Additionally, if the question of whether semantic closeness manifests phonetically is of interest,
then future study is motivated with particular effort being made to parse out the potential effects of overall tonal distribution among other factors, such as syntactic bracketing. Furthermore, future research might benefit from considering the question of whether syllable- vs. stress-timing constitute factors that can reliably shape differences in inter-conjunct pitch reset and pause duration.

Regardless of the particular inquiries of future related work, it would incontrovertibly be rewarding to systematically discern observed pitch contour in analyses, using models such as B-TOBI (Khan, 2008). This would better enable inferences to be drawn about how differential contour may moderate manifestation of effects of interest.

**Conclusion**

The present study examined inter-conjunct pitch reset, inter-conjunct pause duration, and phrase-final nuclear length in disparate positive and negative conjunction structures in English and Bangla. Its results tentatively support the positivity-closeness effect in English reported in previous literature, such that pitch reset and pause duration were less pronounced between positively related conjuncts than between negatively related conjuncts in disentential clausal, intrasentential clausal, and modifier conjunction. No reliable differences were observed in phrase-final length between positive and negative conjunction structures; the current study did find preliminary evidence that phrase-final lengthening is more pronounced in the first conjunct of positive or negative conjunction structures than in non-conjunct structures, however. These results tentatively suggest that conjunction is a meaningful correlate to consider when simulating natural F0, pausing, and phrase-final lengthening and thus can perhaps be used to inform TTS. Conversely, in Bangla, the current study found no reliable pitch reset and pause duration effects, but did find preliminary evidence that phrase-final length is more pronounced in the first
conjunct of a negative conjunction structure than in that of a positive conjunction structure. The lack of reliable effects in Bangla, however, may be more indicative of gross fundamental flaws in the methodology employed in eliciting Bangla and thus future study should improve upon stimuli and methods used in investigation of Bangla. Future study for both English and Bangla should investigate additional conjunction structures and dialects, and should look to further evaluate what other factors might influence closeness effects, especially focusing on syntactic bracketing, and the distinctions endemic to stress-timing vs. syllable/mora-timing. Given the limited nature of the current study’s results, no firm conclusions could reasonably be drawn to try to explain closeness effect differences observed between English and Japanese in the previous literature.
References


http://www.speech.kth.se/~heldner/papers/PS021248.pdf


Appendices

Appendix A:
Informed Consent Form
Haverford College

Title of Project: Prosody of Positive and Negative Conjunction in English and Bengali

You are being asked to take part in a research study conducted as part of a senior thesis project at Haverford College that will occur from July to December, 2019. Please read this form and ask the researcher any questions you might have prior to consenting to participate in the study.

Purpose of the study: The study aims to collect spoken data for conjunction structures in English and Bangla/Bengali. This data will be analyzed in an effort to identify acoustic properties that correlate with these conjunction structures. Such information is desired in that it could be used to bias text-to-speech technology in ways that make the output more natural and intelligible in contexts with conjunction. Additionally, this information offers insight into the prosody of positive and negative semantic relations across languages.

What you will be asked to do: Following informed consent, you will wear a head-mounted recording device, and will read aloud about 32 words/phrases/sentences. The study should take no longer than 15 minutes.

Risks: There is minimal risk involved in participation in this study as participation will not expose you to any risk greater than everyday actions. You will be asked to wear a headset recording device, but this device is similar to headphones with a small microphone attached.

Compensation: You will receive a $5.00 compensation for your participation in this study.

Confidentiality: The data and results of this study are anonymous and confidential and will not be connected to any personal information of the participants. Each recording will be labeled and saved only in terms of the construction being studied, the language being spoken, and a participant code. Though recordings will be identified by a code in place of your name, your identity could possibly be deduced from the audio of your voice. Thus, recordings will be stored in the student researcher’s college-provided server and on a flash drive provided only to the principal investigator. Recordings will be deleted from the server by June 2020, and copies on the flash drive will neither be distributed nor used for other research.

Rights as a research participant: Participation in this study is voluntary. You need not continue if the device cannot be fitted comfortably, an item you are asked to read is disturbing you, or you need to leave before the procedure is completed. You may withdraw at any time and for any reason without penalty. At any point, if you have a question, you may ask the researcher.

Contact: If you have any questions about this research project or your rights as a research participant, please contact the student researcher, Travis Herringshaw (therringsh@haverford.edu; 518-844-2585), or principal investigator, Jane Chandlee (jchandlee@haverford.edu; 610-795-3371). You may also address any concerns to the chairperson of Haverford College's IRB (a committee with oversight over human subject research) via hc-irb@haverford.edu.
Appendix B:

Stimuli read by English-speaking Subjects

Note: The lettered entries are what were read by participants.

English Disentential Clausal (EDC):

1. Non-conjuncts:
   a. The temperature was high.
   b. The temperature was low.
   c. I drank cold water.

   Positive:
   a. The temperature was high. I drank cold water.

   Negative:
   a. The temperature was low. I drank cold water though.

2. Non-conjuncts:
   a. The dog licked me.
   b. I like the dog.
   c. I don’t like the dog.

   Positive:
   a. The dog licked me. I like the dog.

   Negative:
   a. The dog licked me. I don’t like the dog though.

3. Positive:
   a. What an exhausting day. I’m tired.
Negative:

a. What a relaxing day. I’m tired though

4. Positive:

a. The cookies were bad. I ate none of them.

Negative:

b. The cookies were bad. I ate many of them, though.

English Intrasentential Clausal (EIC):

1. Positive:

a. The tiger was walking away and Joe fled.

Negative:

a. The tiger was walking away but Joe fled.

2. Positive:

a. The difficulty of the task was moderate and I failed miserably.

Negative:

a. The difficulty of the task was moderate but I failed miserably.

3. Positive:

a. The temperature was high and I drank cold water.

Negative:

a. The temperature was high but I drank hot coffee.

4. Positive:

a. He’s ill and I’m worried about him.

Negative:

a. He’s ill but I’m unworried about him.
Isolated conjunction markers:

a. and (x4)
b. but (x4)

**English Modifier (EM):**

1. Non-conjunct:
   a. The large boy
   b. The tender boy

   **Positive:**
   a. The large and tender boy

   **Negative:**
   a. The large but tender boy

2. Non-conjunct:
   a. The small dog
   b. The imposing dog

   **Positive:**
   a. The small and imposing dog

   **Negative:**
   a. The small but imposing dog
Appendix C:

Stimuli to be read by Bangla-speaking Subjects

Note: The first lines of the lettered entries are what were presented to participants (the spacing, however, was changed here to accommodate the glossing).

Bangla Disentential Clausal (BDC): (employing the conjunction যদিও /dʒodio/, ‘though’)

1. Non-conjuncts:
   a. আজকের তাপমাত্রা বেশি ছিল|
      ajker tapmatra beshi cchilo.
      of.today temperature much was
      ‘Today’s temperature was high’
   b. আজকের তাপমাত্রা কম ছিল|
      ajker tapmatra kom cchilo.
      of.today temperature few was
      ‘Today’s temperature was low’
   c. আমি ঠাণ্ডা পানি খেয়েছিলাম|
      ami thanda pani kheecchilam.
      I cold water drank.1s
      ‘I drank cold water’
Positive:

a. আজকের তাপমাত্রা বেশি ছিল। আমি ঠান্ডা পানি খেয়েছিলাম।

Ajker tapmatra beshi cchilo. Ami thanda pani kheecchilam.

Today’s temperature was high. I drank cold water.

Negative:

a. আজকের তাপমাত্রা কম ছিল। আমি ঠান্ডা পানি খেয়েছিলাম যদিও।

Ajker tapmatra kom cchilo. Ami thanda pani kheecchilam jodio.

Today’s temperature was low. I drank cold water, though.

2. Non-conjuncts:

a. কুকুরটি আমাকে চেটেছিল।

kukurti amake chetecchilo.

dog.the me licked

‘The dog licked me.’

b. আমি কুকুরটিকে পছন্দ করি।

ami kukurtike pocchondo kori.

I dog.the which like do.1sg

‘I like the dog.’
c. আমি কুকুরটিকে পছন্দ করি না।

ami kukurtike pocchondo kori na.

I dog.the.which like do.1sg not

‘I do not like the dog.’

Positive:

a. কুকুরটি আমাকে চেটেছিল। আমি কুকুরটিকে পছন্দ করি।

Kukurti amake chetecchilo. Ami kukurtike pocchondo kori.

dog.the.me licked I dog.the.which like do.1sg

‘The dog licked me. I like the dog.’

Negative:

a. কুকুরটি আমাকে চেটেছিল। আমি কুকুরটিকে পছন্দ করি না যদিও।

Kukurti amake chetecchilo. Ami kukurtike pocchondo kori na jodio.

dog.the.me licked I dog.the.which like do.1sg not though

‘The dog licked me. I don’t like the dog, though.’

3. Positive:

a. আমি ক্লান্ত। আমি ঘুমাতে গেলাম।

Ami klanto. Ami ghumate gelam.

I tired I to.sleep went

‘I am tired. I am going to sleep.’
Negative:

a. আমি ক্লান্ত | আমি জেগে থাকবো যদিও।

Ami klanto. Ami jege thakbo jodio.

I tired I wake will.stay though

‘I am tired. I will stay awake, though.’

4. Positive:

a. কুকিগুলো খারাপ ছিল | আমি একটিও খাইনি।

Kukigulo kharap cchilo. Ami ektio khaini.

cookies.these bad was I even.one eat.did.not

‘The cookies were bad. I ate none of them.’

Negative:

a. কুকিগুলো খারাপ ছিল | আমি অনেকগুলো খেয়েছি যদিও।

Kukigulo kharap cchilo. Ami onekgulo kheecchi jodio.

cookies.these bad was I many ate though

‘The cookies were bad. I ate many though.’

5. Positive:

a. এটা সস্তা ছিল | আমি এটা কিনেছি।

Eta shosta cchilo. Ami eta kinecchi.

It cheap was I it bought

‘It was cheap. I bought it.’
Negative:

a. এটা দামি ছিল। আমি এটা কিনেছি যদিও।

Eta dami cchilo. Ami eta kinecchi jodio.

It expensive was I it bought though

‘It was expensive. I bought it, though.’

6. Positive:

a. রাস্তাটি অনেক দীর্ঘ ছিল। আমি পুরোটা হাটিনি।

Rastati onek dirgho cchilo. Ami purota hatini.

road.the much long was I all.of.it walk.did.not

‘The road was long. I did not walk all of it.’

Negative:

a. রাস্তাটি অনেক দীর্ঘ ছিল। আমি পুরোটা হেটেছি যদিও।

Rastati onek dirgho cchilo. Ami purota hetecchi jodio.

road.the much long was I all.of.it walked though

‘The road was long. I walked all of it, though.’

English Disentential Clausal (EDC):

1. Non-conjuncts:

a. The temperature was high.

b. The temperature was low.

c. I drank cold water.
Positive:
   a. The temperature was high. I drank cold water.

Negative:
   a. The temperature was low. I drank cold water though.

2. Non-conjuncts:
   a. The dog licked me.
   b. I like the dog.
   c. I don’t like the dog.

Positive:
   a. The dog licked me. I like the dog.

Negative:
   a. The dog licked me. I don’t like the dog though.

3. Positive:
   a. I’m tired. I’m going to sleep.

Negative:
   a. I’m tired. I’ll stay awake though.

4. Positive:
   a. The cookies were bad. I ate none of them.

Negative:
   a. The cookies were bad. I ate many of them though.
Appendix D:

Correspondence confirming Exempted IRB Status

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Sep 3, 2019, 7:25 PM

Hi Travis,

Your project titled “Prosody of Positive and Negative Conjunction in English and Bengali” is exempt according to 45 CFR §46.104 Exempt research. See paragraph (d), category (3) at www.ecfr.gov/cgi-bin/text-idx?node=se45.1.46_1104.

This determination was made from the information you submitted:

The research involves benign behavioral interventions and collection of information from adult subjects;

and

the subject prospectively agrees to the intervention and information collection through audio recording;

and

there is no deception involved in the research design;

and

disclosure of the human subjects’ responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, educational advancement, or reputation.

Wishing success for your research,

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