Language and Cognition **11** (2019), 582–620. doi:10.1017/langcog.2019.39
© UK Cognitive Linguistics Association, 2019

Searching for specific sentence meaning in context: the conceptual relation between participants*

YAO-YING LAI

Department of Linguistics, Yale University, New Haven, Connecticut, USA and Research Institute, National Rehabilitation Center for Persons with Disabilities, Tokorozawa, Saitama, Japan

AND

MARIA MERCEDES PIÑANGO

Department of Linguistics, Yale University, New Haven, Connecticut, USA

(*Received* 18 *February* 2019 – *Revised* 24 *September* 2019 – *Accepted* 24 *September* 2019 – *First published online* 11 *November* 2019)

ABSTRACT

We argue that the interpretation of transitive aspectual-verb sentences like "*Sue finishes the book*" results from an evaluation of the degree of asymmetry in control power between the participants in the sentence. *Control asymmetry* is proposed as one conceptual constraint on sentence meaning precisification. An evaluation of 'high control asymmetry' for the relation between "Sue" and "book" yields an agentive/actor-undergoer interpretation (Sue is doing something involving the book). An evaluation of 'low control asymmetry' yields a constitutive/part–whole interpretation (Sue's story is the last one in the book). Which reading emerges depends on the comprehender's control-asymmetry evaluation based on contextual cues or, in the absence of explicit context, based on conventionalized control asymmetry expectations given the participants' denotations. Results show that semantically under-specified aspectual-verb sentences such as "*Sue finishes/begins/continues the book*" (i) receive multiple readings in a control-asymmetry neutral context, (ii) are judged as less acceptable than their control asymmetry-biased counterparts, and (iii) clearly evidence the *constitutive* reading as part of

[*] This research was funded by NSF-BCS grant BCS-0643266 to Maria Mercedes Piñango, and NSF-INSPIRE Grant CCF-1248100 to Maria Mercedes Piñango, Ashwini Deo, Todd Constable, and Mokshay Madiman. We thank Ashwini Deo for useful discussions on this project and Michiru Makuuchi for comments on an earlier version of this manuscript. Declaration of interest: We have no conflict of interest regarding this study. Addresses for correspondence: Yao-Ying Lai: E-mail yaoyinglai@gmail.com; Maria Mercedes Piñango: E-mail maria.pinango@yale.edu.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

their core reading. These findings are consistent with a real-time linguistic meaning composition system that systematically draws from context guided by lexically driven semantic demands and that presents the structure of these demands as a cognitively viable metric of complexity.

KEYWORDS: semantic under-specification, semantic ambiguity, context, acceptability, sentence processing, complement coercion.

1. Introduction

Ambiguity is ubiquitous in language throughout all its subsystems (morphological, syntactic, semantic, or pragmatic). While it is generally agreed that ambiguity can be resolved by taking into account contextual constraints, the exact nature of the conceptual parameters along which these contextual constraints are organized is not well understood. We aim to address this question by investigating one specific case of semantic ambiguity, one for which contextually based disambiguation is required: the transitive aspectual-verb construction. This construction, containing aspectual verbs (AspVs) such as *start*, *finish*, *continue*, and animate or inanimate subject–complements pairs, is observed to support multiple semantic readings which result from the necessary specification of the under-specified lexical meaning of aspectual verbs (Lai, Lacadie, Constable, Deo, & Piñango 2017; Piñango & Deo, 2016).

For example, sentence (1) below gives rise to an **agentive reading** as in (2a), in which the individual denoted by the subject takes an agent role, performing some activity involving the complement denotation (e.g., Jackendoff, 1997; Katsika, Braze, Deo, & Piñango, 2012; McElree, Traxler, Pickering, Seely, & Jackendoff, 2001; Pustejovsky, 1995; Zarcone, McRae, Lenci, & Padó, 2017). The same sentence can also yield a **constitutive reading** as in (2b) below – a reading that has been left out in previous studies on the aspectual-verb transitive construction – whereby the subject denotation is interpreted as a subpart of the entity denoted by the complement.

(1) Adele started the CD of pop songs.

(2) a. *Agentive reading:* Adele started recording / listening to / etc. the CD of pop songs. (Figure 1, right)
b. *Constitutive reading:* Adele's song was the first song on the CD of pop songs. (Figure 1, left)

Notice that in (1) the complement "the CD of pop songs" can be interpreted as a physical entity (i.e., a set of tracks) or a body of informational content (i.e., a set of songs) (as in 2b), or serving as an undergoer participant in an event (as in 2a). Without further information of the *dimension* – the perspective

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

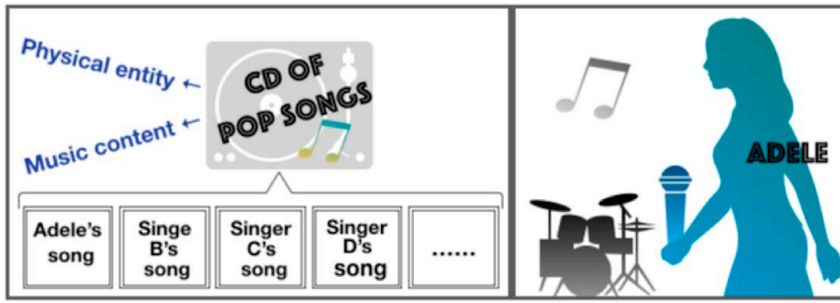


Fig. 1. Two kinds of readings of (1) "*Adele started the CD of pop songs*". Right: Agentive reading. Left: Constitutive reading.

from which the entity is construed (e.g., eventive, spatial, informational) – as intended by the speaker, the comprehender is left with more than one possible interpretation. That is, the interpretation for sentences like (1) demands the specification of a conceptual relation between the subject and complement participant (i.e., actor–undergoer or part–whole), as well as the specification of the *dimension* along which the complement denotation must be construed, i.e., spatial, informational, eventive, etc. (Krifka, 1998; Piñango & Deo, 2016). Sentences like (1) thus present a problem for the comprehension system; on the one hand the lexical meanings appear unambiguous regarding the references of the participants, and on the other hand the intended relation between these participants, other than the indication that their relation may be construed over some kind of mereological system, remains uncertain, leaving the sentence uninterpretable. Without a precise specification of this relation, a viable interpretation cannot be obtained. Therein lies the relevance of this construction for our understanding of the processes underlying the real-time linguistic meaning composition system.

In sum, the transitive aspectual-verb construction allows us to examine how comprehension is achieved in the face of meaning under-specification while factoring out morphosyntactic structure, structure that appears dissociable from the semantic compositional at hand. The specific **question** we ask is the following: What principles of context structure are available to the comprehension system such that it is able to derive a specific sentential interpretation that is based on lexically under-specified meaning variables?

We propose that for the transitive aspectual-verb construction meaning specification takes place through a lexically guided search carried out over a parameterized conceptual space. The "trigger" for the search is the lexical requirement by all aspectual verbs that their complement be construed as a structured individual along a specific dimension (Piñango & Deo, 2016). Meeting this requirement involves two components which are distinct yet not

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

disconnected: (a) the role that the entity denoted by the subject plays vis-à-vis the structured individual denoted by the complement, and (b) the dimension along which the structured individual is to be construed. Consider sentence (1) above; if the role that the entity denoted by the subject plays vis-à-vis the structured individual denoted by the complement is one of *actor*, the dimension along which the structured individual is to be construed is eventive and the reading is thus *agentive*. Alternatively, if the role that the entity denoted by the subject plays vis-à-vis the structured individual denoted by the complement is one of *subpart*, the reading is thus *constitutive*. Notice that, while the agentive reading is construed along the eventive dimension, the eventive dimension itself does not guarantee an agentive reading. This is demonstrated by "*A short announcement ended the conference*", which gives rise to a constitutive reading along the eventive dimension such that the announcement is a final subpart (subevent) of the (macro-)event denoted by the conference. As can be seen, whereas the choice of dimension has to do with the comprehender's familiarity with conceptualizations of the complement denotation, the determination of the role of the subject denotation – and consequently the specific sentence interpretation – involves an evaluation of the possible relations between the subject and complement denotations. We propose that this factor is key to sentence meaning specification and argue that such calculation results from an evaluation process of a specific conceptual relation between the two entities involved in the situation denoted by a sentence. We call this conceptual relation *control asymmetry*.

Control asymmetry refers to a parameter of context evaluation, at play during sentence comprehension, that allows the processor to assess the degree of relative control power between the participants in a situation. It is a generalization over our perception of causality, a fundamental property of human cognition (e.g., Carey, 2009; Piñango, 2019). In a two-participant situation, an evaluation of *high* control asymmetry means that one participant is construed as having control over the other participant (and not the other way around). An evaluation of *low* control asymmetry means that either participant can exert equal control over the other. Control asymmetry is thus an independently motivated parameter of conceptual organization, fundamental to the cognitive infrastructure within which linguistic meaning associated with sentence composition is construed.

The motivation for control asymmetry as a conceptual parameter emerges from a generalized observation that the relation between participants in terms of control power is essential for identifying their roles in events. On the force-dynamics approach, one key function of language is to mark a role difference between two entities exerting force in a causal chain (Talmy, 1988, 2000). This relation of force transmission underlies linguistic structure and is

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

argued by Croft (2012) to modulate thematic role assignment (e.g., agent, patient, theme) as well as argument realization (e.g., which participant is mapped onto which grammatical relation). The relation of force transmission is by nature an *asymmetry* relation (Croft, 2012, p. 198); in the context of causal events, Pinker (1989, p. 194) notes it as a relation (between the participants) that is "asymmetric in that the first argument is causally responsible for the relationship".

In this manner, control asymmetry subsumes the conceptual representation of *agency*. In line with previous work on thematic relations, we take an *agent* as an actor that is perceived as having self-control and potential power over another participant, the entity responsible for possible changes resulting from the action denoted by the predicate (Carey, 2009, p. 217; Croft, 1994; Jackendoff, 1983, p. 181; Pinker, 1989, p. 31; Talmy, 1988). The construal of agency is thus obtained from a conceptualized relation between participants (actor–undergoer). The more control power a participant is construed to possess over another in a situation, the more likely it will be taken as an *agent*. This said, causality is a necessary yet not sufficient component of agency (Carey, 2009, p. 217). This can be exemplified by the sentence "*The heavy rain ruined the man's shoes*". It involves an accidental causal relation between the two participants (heavy rain & the man's shoes) yet does not encode agency as normally understood. And that would be because agency requires a self-generated force in the causer, a self-generated force that control asymmetry entails. Control asymmetry is also implicated in sentential readings that are normally expected to depend on the animacy of the participants involved. Consider the aspectual-verb sentence "*The printer started my paper*". This sentence gives rise to an agentive reading yet it has an inanimate-denoting subject. By contrast, the sentence "*The little girl began the queue in front of the candy shop*" yields a constitutive reading even though its subject-denotation is animate. The agentive vs. constitutive reading thus appears orthogonal to animacy considerations yet it is naturally predicted by control asymmetry distinctions – high control asymmetry engenders an agentive reading whereas low control asymmetry engenders a constitutive reading.

The conceptual parameter of control asymmetry and the evaluation process that it demands has also been claimed to underpin the meaning comprehension of other linguistic constructions. Piñango (2019) suggests that it supports the comprehension of circumstantial metonymy (i.e., reference transfer) such as "*a waiter said to another: 'The ham sandwich ordered another coffee.*'" Proper comprehension of this sentence arises from an evaluation of high control asymmetry between "ham sandwich" and "another coffee" determined by the semantic requirements of "ordered". This evaluation in turn enables the expansion in conceptual structure of the original sentential event whereby

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

the participant "ham sandwich" is construed not as an "controller" argument but as a "controllee" participant, "the person who ordered the *ham sandwich*". One virtue of this approach to circumstantial metonymy is that it allows for a unified treatment with other metonymic processes such as lexical/systematic metonymy: "*Every student reads Hemingway*." The interpretation of cases like this, the analysis goes, results from an evaluation of *high control asymmetry* between "every student" and "Hemingway", determined by the lexico-conceptual requirements of "reads", such that the latter participant is understood again not as a controller (as a proper name normally would) but as a controllee – a piece of work by Hemingway. So, in this way a control asymmetry-based approach serves as a unifying parameter for the computation of reference during adult sentence composition above and beyond lexical-level factors such as expected causal agency and animacy (see Piñango, Zhang, Foster-Hanson, Negishi, Lacadie, & Constable, 2017, for processing and neurological evidence supporting this unified approach).

Another source of evidence for the existence of control asymmetry as a fundamental conceptual parameter comes from research on early human development. Saxe, Tenenbaum, and Carey (2005) and Saxe, Tzelnic, and Carey (2007) show that preverbal infants as young as 7 months of age compute agency from patterns of interaction among entities and that they infer dispositional properties of the participants involved in a situation (Carey, 2009, pp. 232–233). Infants categorize entities that move themselves (e.g., human hands) as potential causal agents while conceiving inert entities (e.g., bean bags) as potential patients. For example, when the infants construe a moving object as an inert entity (which has no control over itself and others), they look for an external explanation for the motion. They do not do so when they take a moving object as self-regulating. This is precisely the behavior that a hypothetical control asymmetry evaluation would predict and supports our proposal that the evaluation of the control relation between participants is fundamental to the specification of sentence meaning.

In sum, research from linguistics and cognitive psychology is consistent with the proposal that humans appear to "parse" the world in terms of situational segments and evaluate the participants in a situation in terms of their relative control relations; one fundamental aspect of which is whether or not the participants are in a position to control each other equally (low control asymmetry) or not (higher control asymmetry). Crucially, the evaluation of control relation between participants, one on which a specific sentence reading depends, is context-dependent: the relation is expected to vary depending on the specific contextual setting. Context-dependence is clearly instantiated in the current case of aspectual-verb sentences, illustrated in Figure 2. When the control asymmetry between the participants denoted by the subject and the complement is perceived as high, such that the subject

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

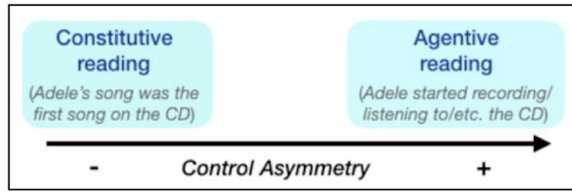


Fig. 2. Control asymmetry and the Agentive/Constitutive reading.

participant is interpreted as exerting control over the complement participant, an AspV sentence like (1) "*Adele started the CD*" receives an agentive reading as in (2a). By contrast, if the two participants are construed as having equal control power over each other i.e., low control asymmetry (≡ control symmetry), the sentence receives a constitutive reading as in (2b).

Once control asymmetry has been determined as high, leading to an agentive reading, no ambiguity remains, as this reading is only compatible with the construal of the complement along an eventive dimension, a dimension whereby the subject denotation takes the role of actor and the complement denotation takes the role of undergoer in an under-specified event (e.g., *Adele started doing something with the CD of pop songs*.). If control asymmetry is deemed low, leading to a constitutive reading, further ambiguity remains. This is because the complement denotation (e.g., "the CD") can be interpreted as a physical entity along the spatial dimension or as a body of musical content along the informational dimension; this further disambiguation will take place through further contextual search, this time in terms of the specific dimension (i.e., the perspective from which the complement denotation must be construed as a structured individual) intended by the speaker. If no information regarding the expected control asymmetry is available (through context or conventionalization), reading ambiguity remains. Unresolved ambiguity due to unavailability of disambiguating cues results in meaning indeterminacy, which crucially impacts the perceived acceptability of the sentence. The specifics of this connection between meaning ambiguity and acceptability are discussed below.

1.1. CONTEXTUAL INFORMATIVITY AND SENTENCE COMPREHENSIBILITY

Previous work has established a robust relationship between meaning ambiguity, context informativity and sentence acceptability. Specifically, availability of relevant contextual information has been shown to influence sentence acceptability for otherwise grammatical sentences. Acceptability increases,

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

the proposal goes, because a supporting context speeds up the determination of sentence meaning by making available information needed to resolve compositional and/or lexical ambiguity, thus decreasing the computational effort that a similar search through a non-supporting context would represent. Comprehenders are sensitive to this comparable decrease in effort which translates as an experience of greater acceptability (Ariel, 1991, 2001; Burmester, Spalek, & Wartenburger, 2014; Hofmeister, Jaeger, Arnon, Sag, & Snider, 2013). The possibility of a semantic ambiguity acceptability rating inverse relation is consistent with predictions from well-established theoretical proposals such as Ariel's Accessibility Theory (Ariel, 1991, 2001); Accessibility Theory states that the more informative, unambiguous, and unattenuated an expression is, the lower the accessibility it encodes. For the purposes of comprehension, lower accessibility of contextual cues reduces the effort of an otherwise necessary contextual search, and this, in turn, raises the perceived sentence acceptability.

Experimentally, the impact of contextual facilitation on acceptability ratings has been demonstrated independently in connection to *wh*-dependency processing. Hofmeister et al. (2013) and Sag et al. (2008) show that *which*-NPs, which carry richer semantic features that facilitate the identification of the dependent argument and the dependency linking in discourse, induce higher acceptability judgments as compared to bare *wh*-words. They also find that acceptability scores negatively correlate with processing difficulty measured by online reading times. Kluender and Kutas (1993), examining sentences with different complementizers (*that*/*if*) and different interrogative pronouns (*who*/*what*), show that offline sentence acceptability decreases when comprehenders need to hold a filler in working memory (*who*/*what* < *if* < *that*). Along similar lines, Burmester et al. (2014, Exp. 1) report that acceptability ratings appear modulated by the preceding context type (neutral context vs. context with a given aboutness topic). Converging with these findings, a direct relation between context informativity and offline judgments has also been manifested in referentiality processing, indicating a robust correlation between uninformative contexts and lower acceptability ratings (Davies & Katsos, 2013; Engelhardt, Bailey, & Ferreira, 2006). Davies and Arnold (2019) interpret these results as indicative of a system whereby supporting contextual information constrains sentence meaning construal such that it serves as a means of prediction for incoming meaning, thus facilitating the unfolding of comprehension. Just and Carpenter (1992) similarly contend that contextual information benefits processing by pre-activating relevant concepts or relations in comprehension. Altogether, these findings evidence that acceptability judgments are modulated by processing difficulty and mediated by the ease of contextualization (e.g., accessibility of discourse referent linking).

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Unlike previous studies, we tackle the influence of contextual informativity on semantic composition independent of morphosyntactic factors by probing the mechanisms underlying the resolution of lexical meaning under-specification. As such, this study contributes to establish how – in the face of lexico-semantic under-specification – a search for meaning is grounded in contextual cues, and how the related processing factors impact offline acceptability. Furthermore, whereas previous work has identified a tight relation between context informativity and acceptability (e.g., Beltrama & Xiang, 2016; Davies & Katsos, 2013; Engelhardt et al., 2006; Hofmeister & Sag, 2010), the conceptual parameters that guide the comprehension system in accessing such context are less clearly understood. With control asymmetry, this is a specific gap that the present study seeks to bridge.

Specifically, we **hypothesize** that the initially under-specified meaning is ultimately determined from a search through contextual content, and that this search is guided by the control-asymmetry assessment in a given context. If such contextual content is under-informative, it will increase the comprehender's effort in carrying out the search. This, in turn, decreases immediate comprehensibility of the sentence in question, lowering its acceptability as compared to a fully explicitly contextualized counterpart. We thus test the hypothesis that sentence acceptability is proportional to "context-sentence fit", where the metric for acceptability is gradient, stemming from the degree to which compositional demands in the sentence are satisfied. The greater the compositional demands that are satisfied for a given sentence, the greater the acceptability rating for that sentence. In cases where the lexical-semantics are under-specified and thus demand a supporting context, acceptability will be predictable from the properties of the context. The more supporting it is, the easier it is for the processor to achieve meaning composition, the greater the perceived acceptability of the sentence.

We test this hypothesis by examining the comprehension of aspectual-verb sentences, where a specific interpretation can only be obtained by searching through contextual information to precisify the otherwise multiply ambiguous semantic interpretations. To recapitulate, two factors play a role in this precisification process: (a) the *control relation* between the participants denoted by the subject and the complement as perceived by the comprehender, and (b) the exact *dimension* relevant in a given context. We take such disambiguating information as constraints that the processor needs to satisfy in pursuit of an adequate interpretation. The more accessible this information is in the explicit context, the less the comprehender needs to compute it by their own search (i.e., the more the constraints are satisfied in the context, the less they need to be satisfied by the comprehender's own computation); this means, in turn, that lesser processing effort is required, leading to higher acceptability of the sentence in question.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

To summarize, in this study we **aim** to (i) explore the interpretive differences, agentive vs. constitutive readings of transitive aspectual-verb sentences, caused by control asymmetry evaluation in context, and on this basis (ii) examine the impact of contextual informativity on sentence comprehensibility measured by acceptability. Our hypothesis **predicts** that comprehenders will obtain the agentive reading when the control asymmetry between the participants is perceived as high; in contrast, the constitutive reading will be obtained when the control asymmetry is perceived as low (or control symmetric) in context (Figure 2). In addition, we hypothesize that the availability or specificity of this conceptual relation between participants in context, which disambiguates the reading, will impact the comprehensibility and hence acceptability of the sentence accordingly. This **predicts** that a context that contains such disambiguating cues will be preferable to comprehenders, raising sentence acceptability by reducing the processing effort needed to resolve meaning ambiguity. We present the specifics of the study that tests these predictions directly below.

2. Methods

2.1. MATERIALS

Thirty sets of two-sentence passages were created. Each passage consisted of a context sentence followed by a target sentence that contained either an aspectual verb (**AspV**) or a control psychological verb (**Control**$_{PsychV}$). Each target AspV sentence was preceded by three types of context sentences. In the agentive-biasing context (**agentBiasing**), an action (e.g., *watch*) was mentioned and the control asymmetry was manipulated as high such that the subject of the target sentence could be easily perceived as an agent. In the constitutive-biasing context (**constBiasing**), a structured entity (e.g., *specials that feature individual characters*) was mentioned and the control asymmetry was manipulated as low to bias the subpart–whole/constitutive reading; also, the aspectual verb in the following target sentence appeared in the present tense form to further facilitate the constitutive (stative) reading (while the target sentences in other conditions appeared in the past tense form).[1]

[1] One may be concerned that the constitutive reading is remote even in present-tense sentences (e.g., "*Jennifer Aniston finishes this DVD* …"). This is likely due to a tendency that an animate subject referent (especially one that is alive) is more often, though not necessarily, associated with a participant with high control power, and therefore privileging the Agent role over the Theme role, consequently distancing the constitutive reading (in which the subject is conceived as a Theme). In situations where the subject participant carries a low control power and is thus more symmetric in control relation with respect to the object participant, the constitutive reading is in fact preferred in either present tense or past tense, as exemplified by the following attested sentences in Piñango and Deo (2016).

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

The tense shift in the target AspV sentences between the agentBiasing condition and the constBiasing condition only serves to maximize the availability of the two readings to comprehenders respectively. Verb tense itself, while privileging one reading over another, does not predict the agentive vs. constitutive reading, as the agentive reading can be obtained with the present tense (e.g., *The researcher begins a new project every year.*) while the constitutive reading can be obtained with the past tense (e.g., *A short announcement began the conference.*). The two biasing-context conditions were contrasted with a baseline in which AspV sentences were preceded by a neutral context (**Neutral**), which involved no information about control asymmetry and was compatible with both agentive and constitutive readings. On the other hand, each target sentence with the control psychological verbs was preceded by either an agentBiasing or Neutral context sentence; they were not paired with the constBiasing context because sentences with psychological verbs do not give rise to a constitutive reading. A set of conditions and sample sentences are provided in Table 1. In addition, fifty filler items were introduced, half of which were sensical and the other half were not.

The target sentences were normed through a cloze study (DiNardo, 2015) and a questionnaire study (Lai, Lacadie, Constable, Deo, & Piñango, 2017, acceptability). Those results show that AspV sentences are equally acceptable and equally expected to native speakers of American English as compared to psychological verb sentence counterparts (age range reported: 18~30). These tested target sentences were the basis for the three types of context sentences. The context-sentence pairs were subsequently presented to five native speakers of English who as consultants were instructed to judge whether the intended preference bias of the target sentences under different contexts had been achieved. To ensure that the AspV sentences in the neutral context give rise to both agentive and constitutive readings, the stimuli of the Neutral-AspV condition were presented to an additional nine native consultants to

---

(a) This is the famous perch that officially begins the Appalachian Trail. (p. 367)
(b) Chapter 1 begins the book with a brief overview. (p. 371)
(c) A thunderstorm began the morning. (p. 369)
(d) A plenary talk by a distinguished linguist finished the conference last week. (p. 392)

To be clear, it is not subject animacy per se but the control relation between the subject–object participant that determines the ultimate sentence reading. The following examples engender a constitutive reading preferably despite an animate-denoting subject, regardless of verb tense.

(e) The little girl with glasses began the queue. (p. 371)
(f) Defoe (1661–1731) begins the list of writers of the period of people's influence. (p. 371)
(g) The Grammy-winning singer ended the musical festival.

Although certain sentential configurations may make the constitutive reading less salient, such reading is not only obtained but favored in a supportive sentential/discourse context as long as the context supports a low control asymmetry between the participants.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

TABLE 1. *Conditions and sample sentences*

Condition	Context sentence	Target sentence
Neutral (AspV | $Control_{PsychV}$)	Most actors keep video clips that feature themselves as well as other well-known performers.	Jennifer Aniston {***finished*** (AspV) | ***enjoyed*** ($Control_{PsychV}$)} this DVD of "*Friends*" season 1 bloopers.
agentBiasing (AspV | $Control_{PsychV}$)	Well-known actresses often watch popular sit-coms in their free time.	
constBiasing (AspV)	Television sitcoms often produce specials that feature individual characters.	Jennifer Aniston **finishes** this DVD of "*Friends*" season 1 bloopers.

ascertain that both readings were perceived as equally available as intended. The stimuli pairs were further modified according to these consultants' comments to maximize the expected sentence readings.

Finally, to control for any unintended lexical level variation which could facilitate/hinder comprehension, we checked the frequencies of the critical verbs in both their lemma forms and the exact forms used in the target sentences via the Corpus of Contemporary American English (COCA). Results of the item-analysis using Analysis of Variance (ANOVA) showed that aspectual verbs were significantly more frequent than the control verbs in both the lemma forms ($Mean_{AspV}$ = 67283.13, $Mean_{Control}$ = 43238.53; $F_{(1,148)} = 8.23$, $p < .005$) and the exact forms appeared in the target sentences ($Mean_{AspV}$ = 71407.20, $Mean_{Control}$ = 8186.73; $F_{(1,148)} = 81.65$, $p < .001$). Assuming that the more frequent an item appears the less processing effort it induces, this difference in frequency would predict that AspV sentences will be easier to process than the controls. The effect of verb type in frequency, if anything, goes against our prediction that AspV sentences should be less acceptable than controls due to under-specified semantic ambiguity. With this consideration in mind, we proceeded with the resulting stimuli set.

2.2. PARTICIPANTS

We recruited 30 native speakers of American English (22 females), aged 18~30 with normal or corrected-to-normal vision; none of them reported to have reading disability. The participants were recruited via advertisements posted around the campus, and received monetary compensation for their participation. Written informed consent was obtained from each participant prior to the experimental session.

2.3. PROCEDURES

The questionnaire implemented by the Qualtrics Survey software (Qualtrics, Provo, UT <https://www.qualtrics.com/blog/citing-qualtrics>) was carried

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

out in a quiet room. The items were pseudo-randomized to avoid consecutive items with the same condition; each participant received a distinct order of the stimuli. The stimuli were visually presented on a computer screen. For each passage (i.e., a pair of context sentence and target sentence), the participants were asked to (i) rate its acceptability on a 1~5 scale (5 = fully understandable) in response to the question "*Is the above passage acceptable?*"[2] The mid-point 3 was defined and visually presented as "*I know what you mean, and maybe I could say it in that way*". Hence, an item receiving a score equal or above 3 is interpreted as comprehensible.

After the rating task, the participants received a multiple-choice question asking them to (ii) choose the plausible interpretation(s) for the target sentence given the context. The question template of this interpretation task was: "Given [the context sentence], what could [the target sentence] possibly mean?" For example: Given "*Most actors keep video clips that feature themselves as well as other well-known performers", what could "Jennifer Aniston finished this DVD of 'Friends' season 1 bloopers*" possibly mean? Four response types were provided to answer the question: (a) the agentive reading (e.g., *Jennifer Aniston finished watching this DVD …*), (b) the constitutive reading (e.g., *Jennifer Aniston was the last character featured on this DVD …*), (c) nonsensical (*The sentence does NOT make sense*), and (d) others, for which a blank text box ☐ was provided for the participants to fill in voluntarily. The order of the agentive and the constitutive option was randomized throughout the trials. Multiple answers were allowed.

2.4. DATA ANALYSES

The data from one participant were excluded due to problems in the protocol administration. Statistical analyses were run on the data from the remaining twenty-nine participants. Data from the acceptability task and the sentence interpretation task were analyzed separately to address different research questions (Lai & Piñango, 2019).[3]

Regarding acceptability judgments, the rating scores (1~5) were transformed to z-scores for each participant to account for potential individual scale bias (Schütze & Sprouse, 2014). A mixed-effect model analysis was performed in the R environment (R Core Team, 2017) using the *lme4* package (Baayen, Davidson, & Bates, 2008). Two sets of analyses on the rating scores

[2] The rating scale was defined as: 5 = *I fully understand what you mean and I would express it in that way*; 4 = *I understand what you mean and I may express it in that way*; 3 = *I know what you mean, and maybe I could say it in that way*; 2 = *I am not sure what you mean*; 1 = *I don't know what you are talking about*.

[3] Data of this reported study have been made public on the repository of Open Science Framework (OSF) and can be found at <https://osf.io/9uvz5/>.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

were carried out. First, we assessed the effect of semantic ambiguity and contextual informativity. To this end, we crossed Verb Type (AspV/ $Control_{PsychV}$) × Context Type (Neutral/agentBiasing), which were incorporated in the model as two fixed factors in a 2 × 2 design. We began with the maximal model structure, which incorporated random intercepts for subject and item as well as random slopes over verb type and context type along with their interaction. Since the maximal models failed to converge, we simplified the random effect structure by dropping the interaction term between the two fixed factors. The resulting models incorporated random intercepts for subject and item as well as random slopes for context type plus verb type over subject and item.[4] Significant effects were evaluated by model comparisons (Winter, 2013). An interaction effect was assessed by contrasting a model incorporating the interaction of verb type and context type as the fixed effect structure against the additive model that dropped their interaction. A verb type effect was assessed by contrasting the additive model against the model that dropped the fixed factor of verb type. Likewise, a context effect was evaluated by contrasting the additive model against the model that dropped the fixed factor of context type.

Second, we evaluated whether or not the availability of contextual constraints impacts the acceptability of semantically under-specified sentences. To this end, we examined the effect of Context Type (3 levels: Neutral/agentBiasing/ constBiasing) on AspV sentences. Context effects were assessed by contrasting a model with this fixed factor against a base model without it. All models included random intercepts for subject and item as well as random slopes for context type over subject and item.[5] Pairwise comparisons between conditions were corrected by Tukey tests.

With respect to the sentence interpretation task, we examined the effect of different contextual cues on the ultimate sentence reading(s). This allowed us to ascertain whether or not comprehenders arrived at the reported interpretation guided by control asymmetry specifications available from context (high control asymmetry in agentBiasing, low control asymmetry in constBiasing, null in Neutral). To this end, we first calculated the proportions of the agentive vs. constitutive reading chosen by the participants for the target AspV sentences under different contexts. Additionally, the responses of the participants were coded dichotomously for each reading type (agentive/

[4] The model specification encoding the interaction of the two fixed factors on rating scores was as follows: *lmer*(scores ~ ContextType*VerbType + (1+ContextType+VerbType | Subject)+(1+ContextType+VerbType | Item), data=data, REML=F)

[5] The model specification encoding the effect of context type on the rating scores of AspV sentences was as follows: *lmer(* scores~ContextType+(1+ContextType | Subject)+(1+ ContextType | Item), data, REML=F)

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

constitutive) per condition: 1 if a reading type in question was chosen and 0 otherwise. Hence, if all participants select the agentive reading for the stimuli of the agentBiasing-AspV condition, that condition would receive a value of 1 (i.e., 100 in percentage) on the agentive reading. For each AspV condition of different context types, we evaluated if there was a difference in reading type by performing a logistic mixed-effect model analysis for binominal dependent variables (0/1) on the readings. A difference in reading type was assessed by contrasting a model with a fixed factor of reading type against a base model without it. All models in this analysis incorporated random intercepts for subject and item as well as random slopes for reading type over subject and item.[6]

3. Results

3.1. ACCEPTABILITY RATING RESULTS

Results of the acceptability rating task are summarized in Table 2 and visualized in Figure 3. On average, all critical sentences were within the comprehensible range (> 3.5). The first analysis on acceptability rating that crossed Verb Type (AspV/Control$_{PsychV}$) and Context Type (Neutral/agentBiasing) revealed a main effect of verb type ($\chi^2(1) = 10.26$, $p = .001$): AspV sentences were rated significantly lower than the Control$_{PsychV}$ sentences. We also found a main effect of context type, such that the Neutral context conditions were rated significantly lower than the agentBiasing context conditions ($\chi^2(1) = 24.52$, $p < .001$). No interaction was found ($\chi^2(1) = 0.60$, $p < .44$).

Second, the analysis evaluating the three context types of AspV sentences showed a significant effect of context in acceptability rating ($\chi^2(2) = 17.06$, $p < .001$), in the direction of Neutral < constBiasing < agent-Biasing. Pairwise comparisons (corrected) revealed that the Neutral-AspV condition was rated significantly lower than the agentBiasing-AspV condition ($z = -4.73$, $p < .001$). The comparisons between Neutral-AspV vs. constBiasing-AspV and between agentBiasing-AspV vs. constBiasing-AspV did not reach significance.

3.2. SENTENCE INTERPRETATION RESULTS

The percentages of the reading types chosen by the participants per condition are shown in Table 3. Results on the three AspV conditions indicated that

[6] The model specification assessing the effect of reading type obtained in different context was as follows: *glmer*(response ~ ReadingType + (1 + ReadingType|Subject) + (1+ReadingType|Item), data, family=binomial(link = logit))

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

TABLE 2. *Results of acceptability rating (n = 29)*

Condition	Mean	se	median
agentBiasing-AspV	3.84	0.03	4
Neutral-AspV	3.59	0.04	4
constBiasing-AspV	3.69	0.03	4
agentBiasing-Control$_{PsychV}$	4.06	0.03	4
Neutral-Control$_{PsychV}$	3.84	0.04	4

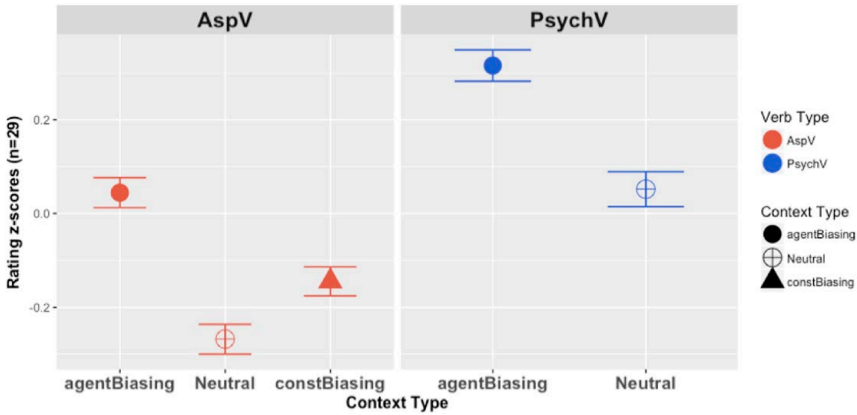


Fig. 3. Results of the acceptability rating task (5 = fully understandable).

TABLE 3. *Results of the interpretation task: the percentage of each reading type obtained per condition*

Condition	Agentive	Constitutive	Nonsensical	Others
Neutral-AspV	70.92 %	59.77 %	3.91 %	6.67 %
agentBiasing-AspV	86.32 %	35.98 %	2.76 %	4.48 %
constBiasing-AspV	41.26 %	78.85 %	2.41 %	5.52 %
Neutral-Control$_{PsychV}$	81.26 %	5.52 %	6.32 %	21.15 %
agentBiasing-Control$_{PsychV}$	87.01 %	3.33 %	2.99 %	18.39 %

sentence interpretation is modulated by contextual information. The Neutral context engendered both the agentive and constitutive readings with roughly equal percentages, showing no significant difference between the two readings ($\chi^2(1) = 1.84$, $p = .175$). In comparison, the agentBiasing context elicited the agentive reading significantly more often than the constitutive reading ($\chi^2(1) = 28.67$, $p < .001$). In contrast, the constBiasing context engendered the constitutive reading significantly more often than the agentive reading ($\chi^2(1) = 13.29$, $p < .001$). These are illustrated in Figure 4.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

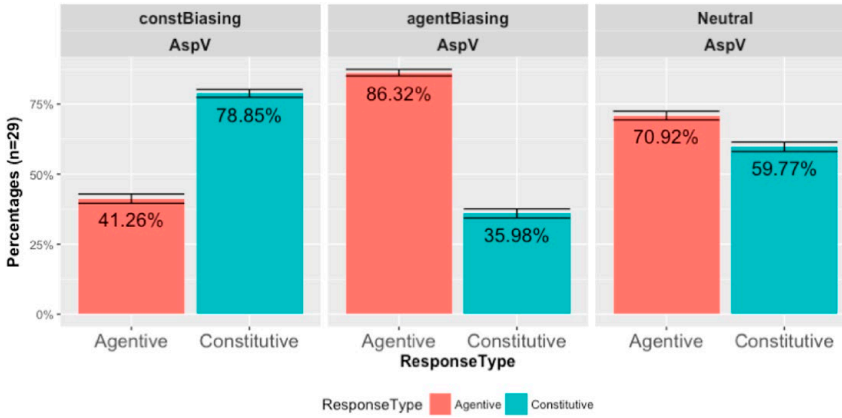


Fig. 4. Results of sentence interpretation showing contextual modulation for the three AspV conditions.

On the other hand, the control conditions, i.e., Neutral-Control$_{PsychV}$ and agentBiasing-Control$_{PsychV}$, did not show a context effect. Both received mostly the agentive reading (> 80%). We observed that around 1/5 of the Control$_{PsychV}$ sentences received the [Others] response, and accordingly we examined the participants' comments in the text box provided (see Section 2.3). As it turns out, many of the responses referred to what we call "the content reading" for the psychological-verb sentences. As indicated by the participants, these sentences could simply refer to the content denoted by the complement itself (e.g., *Jennifer Aniston enjoyed the content of the DVD.*) without being associated with any event or subpart relation.

4. Discussion

In this section, we first discuss the findings as captured by our hypothesis. We then elaborate further on how the conceptual parameter of control asymmetry connects more generally to sentential meaning construal relative to other sentential constructions.

First, results of the acceptability questionnaire show that aspectual-verb sentences as well as the control counterparts were deemed acceptable by comprehenders, evidencing their grammatical well-formedness. Moreover, and as predicted, we observe that when comparing aspectual-verb sentences with the control counterparts, the former received lower acceptability rating scores. We attribute this difference to the effect of comprehension uncertainty resulting from the semantic ambiguity inherent in aspectual-verb sentences among multiple readings. This pattern not only resonates with previous findings on the impact of linguistic ambiguity on acceptability (see Section 1.1), but

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

is also consistent with reported comprehension patterns of decontextualized AspV sentences exhibiting longer reading times and additional brain activity during real-time processing (DiNardo, 2015; Katsika et al., 2012; Lai et al., 2017). This interpretation is further supported by the acceptability results from the comparison between Neutral vs. Biasing context whereby sentences in the Neutral context received lower scores than those in the Biasing context.

Altogether, this pattern suggests that while sentences with under-specified meaning are above the "acceptable" threshold, they differ in the degree of acceptability as a function of contextual informativity (the availability of relevant information in the utterance context as dictated by the lexical requirements in the utterance). This, we argue, reflects the degree of comprehender's certainty about the specific interpretation of the sentence in question. In this way, and in line with previous work, aspectual-verb sentence acceptability appears modulated by context informativity (Burmester et al., 2014; Davies & Arnold, 2019; Davies & Katsos, 2013; Engelhardt et al., 2006; Hofmeister & Sag, 2010). If context contains information that directs comprehenders towards a specific interpretation, hence resolving ambiguity and thus increasing the certainty of the interpretation, the target sentence's referentiality increases, resulting in increased acceptability to comprehenders. By contrast, if supporting cues are absent in the context (e.g., for AspV sentences this would be in the form of an indication of the degree of control asymmetry and/or the intended dimension for the structured individual), the exact meaning of the target sentence remains uncertain, resulting in decreased ability of comprehenders to refer and hence lower acceptability.

The pattern that emerges is consistent with a constraint-satisfaction approach to sentence processing, according to which the amount of available constraining information negatively correlates with processing load (e.g., during inference generation, bridging or presupposition accommodation in the case of definite noun phrase interpretation), thus impacting comprehenders' acceptability judgments (e.g., Altmann & Steedman, 1988; Crain & Steedman, 1985; Davies & Katsos, 2013).

Second, sentence interpretation results support the above conclusion that the comprehension of AspV sentences appears guided by the presence of specific contextual cues, and the sentences remained ambiguous otherwise. Here we have tested the hypothesis that an important constraint that determines the agentive vs. constitutive readings of AspV sentences is the parameter of control asymmetry between the subject and complement participants, and consequently that contextual cues in the direction of establishing the presence of control asymmetry is relevant to sentence meaning disambiguation. As observed, a high control asymmetry as cued in the agentBiasing context elicited mostly the agentive reading, whereas a lower control asymmetry (≦ control symmetry) as cued in the constBiasing context

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

led to a constitutive reading. When the control relation between the participants denoted by the arguments of an aspectual predicate was left unclear, as in the Neutral context, both readings appeared available to comprehenders. This indicates that comprehenders make reference to this conceptual parameter in a given context to obtain a specific sentence reading.

One concern is that the difference in acceptability and interpretation between the AspV conditions might be due to the difference in verb tense (present tense in the constBiasing-AspV condition; past tense in others) rather than the proposed control asymmetry. We think this is unlikely for the following reasons: (i) as indicated in Section 2.1, both agentive and constitutive readings can be obtained with either past or present tense, suggesting a dissociation between verb tense and sentence reading; (ii) the target sentences in both the Neutral-AspV and agentBiasing-AspV condition appeared in their past tense forms, with identical target sentences, yet the two differed in both acceptability and sentence interpretation. Results of pairwise comparisons on acceptability ratings showed that the constBiasing-AspV condition did not differ from either agentBiasing-AspV or Neutral-AspV despite the tense difference. At the same time, the latter two past tense conditions with the identical target sentences differed significantly ($z = -4.725$, $p < .001$). If the present tense in the constBiasing-AspV condition had contributed to any differentiation, we would have observed that it is rated either the lowest or the highest among the three conditions, contrary to the findings which showed Neutral < constBiasing < agentBiasing. Finally, (iii) the agentBiasing-AspV and the Neutral-AspV condition received different interpretations – mostly agentive reading for the former; comparable agentive and constitutive readings for the latter – though their target sentences were identical, both in past tense, within each item-set. These observations combined indicate that the differences in ratings and interpretations between conditions could not result from tense alternation. Instead, and as argued, they appear to result from the difference in prior sentence context (because Neutral-AspV and agentBiasing-AspV differed only in the prior context sentence). An additional piece of evidence comes from our lab. A recent eye-tracking study (Lai, Braze, & Piñango, 2017) shows, using the same context-target sentences, that the target sentences of the constBiasing-AspV condition (present tense), agentBiasing-AspV (past tense), and Neutral-AspV (past tense) do not differ in reading times during real-time comprehension. Relatedly, Desai, Conant, Waldron, and Binder (2006) report no difference in reading times or accuracy when comprehenders read verbs in the present tense vs. past tense forms. Taken together, it is unlikely that the effect reported here is driven by verb tense alternation in the target sentences. Rather, the differential results of AspV sentences in different contexts are modulated by control asymmetry considerations between the participants as

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

cued by the prior context, irrespective of tense. The fact that the Neutral-AspV condition was rated the lowest and received comparable agentive and constitutive reading suggests that context informativity regarding control relation is the modulating factor in the sentence acceptability pattern observed.

The conceptualized control relation between participants not only accounts for the meaning of aspectual-verb sentences but applies to other cases as well. As Piñango (2019) notes, it marks a semantico-conceptual difference in the English genitive *'s*. For example, "*John's spot*", "*John's school*", and "*John's house*" exhibit a low-to-high degree of control asymmetry between two entities, corresponding to a shift in interpretation from incidental location, non-incidental location, to possession, respectively (Figure 5). In "*John's spot*", the two entities (John & his spot) are in an incidental locative relation such that John happens to be in the space denoted by the spot, with no strong control over that specific space (low control asymmetry). On the other hand, in "*John's house*", it is clear that John has control over his house and the expression encodes a possessive relation (higher control asymmetry).

Connectedly, control asymmetry also factors into models of the locative and possessive meaning space associated with English *have* (Zhang, Piñango, & Deo, 2018). As they show, the meaning of the sentence "*the maple tree has a car*" is perceived as marginally acceptable, at best, in large part because it involves low control asymmetry between the participants, leading to the uninformative locative interpretation (this locative interpretation is even more salient when following a context sentence like "*The motorcycle is under the pine tree while …*"). By contrast, the meaning of the sentence "*the maple tree has a big branch*" exhibits a relatively higher control asymmetry, leading to a possessive interpretation. The English *have* collocations manifest specific points in a low-to-high control asymmetry continuum, a distribution which crucially appears independent of animacy of the denoted participants.

The above two cases demonstrate that like the case of the transitive aspectual-verb construction the exact sentential meaning can be modulated by control asymmetry between two entities involved in the situation denoted by an expression. Positing control asymmetry between sentence participants as perceived in a situation thus allows us to predict possible gradability effects across semantico-conceptual representations within meaning domains, ranging from semantic under-specification (e.g., AspV sentences), metonymy (see Section 1 for details), and the specific meaning of the genitive *'s* and *have*-constructions.

As mentioned in Section 1, the ability to evaluate control asymmetry between participants is likely a conceptual bias in children; previous studies on cognitive development have shown that children make reference to the control relation between event participants in situations before one year of

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

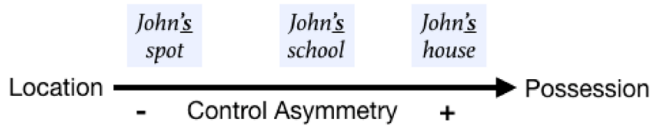


Fig. 5. Manifestation of control asymmetry in the English genitive *'s* construction.

age (Carey, 2009; Saxe et al., 2005, 2007). Such conceptualization of control asymmetry may allow the multiple related word senses to be under-specified under a common construction (such as various dimensional meaning of AspV sentences), reducing arbitrariness in language as Srinivasan and Rabagliati (2015) suggest for polysemy. Children would learn various senses or what we call *dimensions* of words like "the book", such that such a lexical item can refer to a physical entity or a body of informational content, depending on context. The aspectual-verb construction "*began the book*" for example, would then allow the encoding of various dimension interpretations that are all associated with the conceptual representation of "the book", resulting in meaning under-specification: the lexical meaning establishes that a structured individual along a dimension be construed, but more than one dimension may satisfy that requirement. This means in turn that for a given utterance the intended meaning of a word like "book" awaits to be precisified in context, in the case of the aspectual-verb construction, by evaluating the conceptual parameter of control asymmetry associated with it and the subject of the sentence. If true, this interpretive mechanism suggests an organizing principle underlying the language–cognition interface: the outsourcing of lexical-meaning encoding to cognitive evaluation spaces (e.g., semantic memory) which are constrained by parameters such as control asymmetry and which allow precisification of linguistic compositional meaning by taking into account the lexical meanings of the utterance together with the context of the utterance.

In sum, our findings show (1) that the presence of semantic ambiguity and contextual informativity affect sentence acceptability, and (2) that the precise sentence interpretation is the result of a search through context as situation participants are evaluated under control asymmetry. In the absence of disambiguating contextual cues, the meaning search will be unfruitful and the sentence is allowed to remain uncertain (ambiguous). This meaning uncertainty decreases sentence comprehensibility (referentiality), lowering its acceptability. In comparison, availability of disambiguating information in the context supports ambiguity resolution. This guides sentence meaning precisification which raises sentence acceptability. The findings support previous observations in the literature that sentence acceptability, a traditional proxy measure for sentence grammaticality, is impacted by processing factors

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

such as how productive the effort of meaning search through context is to resolve semantic under-specification (cf. Davies & Katsos, 2013; Engelhardt et al., 2006; Fanselow & Frisch, 2006; Hofmeister et al., 2013; Kleiman, 1980).

5. Conclusion

In this study, we show that context informativity, conditioned by the control relation between participants as perceived in a given context, influences the ultimate interpretation of sentences that involve under-specified meaning ambiguity and its corresponding degree of acceptability. When meaning-constraining information is unavailable, sentences that are otherwise grammatical remain semantically under-specified at the expense of lower comprehensibility manifested as lower acceptability. We find support for this conclusion in the results of a close examination of the comprehension of aspectual-verb sentences in the transitive construction, which involve semantic ambiguity between an agentive and a constitutive reading, argued to be modulated by the control asymmetry between the participants denoted by the subject and the complement of the predicate. As it turns out, control asymmetry between participants as perceived in context not only determines the ultimate interpretation of aspectual-verb sentences but also captures the conceptual-semantic dynamics in other English constructions. Capitalizing on this body of evidence, we argue that control asymmetry is a fundamental conceptual relation that structures linguistic meaning and guides contextual search during comprehension. This in turn suggests that context has organizing principles that are directly tied to the semantic requirements of the lexical items in the utterance, above and beyond morphosyntactic ones.

REFERENCES

Altmann, G. & Steedman, M. (1988). Interaction with context during human sentence processing. *Cognition* **30**(3), 191–238.

Ariel, M. (1991). The function of accessibility in a theory of grammar. *Journal of Pragmatics* **16**(5), 443–463.

Ariel, M. (2001). Accessibility theory: an overview. In T. Sander, J. Schilperoord & W. Spooren (Eds.), *Text representation: linguistic and psycholinguistic aspects* (pp. 29–87). Amsterdam/Philadelphia: John Benjamins.

Baayen, R. H., Davidson, D. J. & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language* **59**(4), 390–412.

Beltrama, A. & Xiang, M. (2016). Unacceptable but comprehensible: the facilitation effect of resumptive pronouns. *Glossa* **1**(1), 1–24.

Burmester, J., Spalek, K. & Wartenburger, I. (2014). Context updating during sentence comprehension: the effect of aboutness topic. *Brain and Language* **137**, 62–76.

Carey, S. (2009). *The origin of concepts*. Oxford: Oxford University Press.

Crain, S. & Steedman, M. (1985). On not being led up the garden path: the use of context by the psychological syntax processor. In D. R. Dowty, L. Karttunen & A. M. Zwicky

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

(eds), *Natural language parsing: psychological, computational, and theoretical perspectives* (pp. 320–358). Cambridge: Cambridge University Press.
Croft, W. (1994). Voice: beyond control and affectedness. In B. Fox & P. J. Hooper (Eds.), *Voice: form and function, 27* (pp. 89–117). Amsterdam: John Benjamins.
Croft, W. (2012). *Verbs: aspect and causal structure*. Oxford: Oxford University Press.
Davies, C. & Arnold, J. (2019). Reference and informativeness: how context shapes referential choice. In C. Cummins & N. Katsos (eds), *The Oxford handbook of experimental semantics and pragmatics* (pp. 474–493). Oxford: Oxford University Press.
Davies, C. & Katsos, N. (2013). Are speakers and listeners 'only moderately Gricean'? An empirical response to Engelhardt et al. (2006). *Journal of Pragmatics* **49**(1), 78–106.
Desai, R., Conant, L. L., Waldron, E. & Binder, J. R. (2006). fMRI of past tense processing: the effects of phonological complexity and task difficulty. *Journal of Cognitive Neuroscience* **18**(2), 278–297.
DiNardo, L. (2015). *Competing analyses of complement coercion: new evidence from behavioral and electropsychophysiological methods*. Unpublished thesis, Yale University.
Engelhardt, P. E., Bailey, K. G. & Ferreira, F. (2006). Do speakers and listeners observe the Gricean maxim of quantity? *Journal of Memory and Language* **54**(4), 554–573.
Fanselow, G. & Frisch, S. (2006). Effects of processing difficulty on judgments of acceptability. In G. Fanselow, C. Féry, R. Vogel & M. Schlesewsky (Eds.), *Gradience in grammar: generative perspectives* (pp. 291–316). Oxford: Oxford University Press.
Hofmeister, P., Jaeger, T. F., Arnon, I., Sag, I. A. & Snider, N. (2013). The source ambiguity problem: distinguishing the effects of grammar and processing on acceptability judgments. *Language and Cognitive Processes* **28**(1/2), 48–87.
Hofmeister, P. & Sag, I. A. (2010). Cognitive constraints and island effects. *Language* **86**(2), 366–415.
Jackendoff, R. (1983). *Semantics and cognition* (Vol. 8). Cambridge, MA: MIT press.
Jackendoff, R. (1997). *The architecture of the language faculty* (No. 28). MIT Press.
Just, M. A. & Carpenter, P. A. (1992). A capacity theory of comprehension: individual differences in working memory. *Psychological Review* **99**(1), 122–149.
Katsika, A., Braze, D., Deo, A. & Piñango, M. M. (2012). Complement coercion: distinguishing between type-shifting and pragmatic inferencing. *Mental Lexicon* **7**(1), 58–76.
Kleiman, G. M. (1980). Sentence frame contexts and lexical decisions: sentence-acceptability and word-relatedness effects. *Memory & Cognition* **8**(4), 336–344.
Kluender, R. & Kutas, M. (1993). Subjacency as a processing phenomenon. *Language and Cognitive Processes* **8**(4), 573–633.
Krifka, M. (1998). The origins of telicity. In S. Rothstein (ed), *Events and grammar* (pp. 197–235). Dordrecht: Kluwer.
Lai, Y.-Y., Braze, D. & Piñango, M. M. (2017). Context and semantic composition of multiple dimension representations in real-time. In *Language and Thought, IEICE technical report 117*(149) (pp. 7–11). Japan: The Institute of Electronics, Information and Communication Engineers.
Lai, Y.-Y., Lacadie, C., Constable, T., Deo, A. & Piñango, M. M. (2017). Complement coercion as the processing of aspectual verbs: evidence from self-paced reading and fMRI. In J. Hampton & Y. Winter (eds), *Compositionality and concepts in linguistics and psychology* (Language, Cognition, and Mind, 3). Cham: Springer.
Lai, Y.-Y. & Piñango, M. M. (2019). Searching for specific sentence meaning in context: the conceptual relation between participants. Retrieved from <osf.io/9uvz5>.
McElree, B., Traxler, M. J., Pickering, M. J., Seely, R. E. & Jackendoff, R. (2001). Reading time evidence for enriched composition. *Cognition* **78**(1), B17–B25.
Piñango, M. M. (2019). Concept composition during language processing: a model and two case studies. In C.-R. Huang, Z. Jing-Schmidt & B. Meisterernst (eds), *The Routledge handbook of applied Chinese linguistics* (pp. 624–644). Abingdon: Routledge.
Piñango, M. M. & Deo, A. (2016). Reanalyzing the complement coercion effect through a generalized lexical semantics for aspectual verbs. *Journal of Semantics* **33**(2), 359–408.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Piñango, M. M., Zhang, M., Foster-Hanson, E., Negishi, M., Lacadie, C. & Constable, R. T. (2017). Metonymy as referential dependency: psycholinguistic and neurolinguistic arguments for a unified linguistic treatment. *Cognitive Science*, **41**, 351–378.

Pinker, S. (1989). *Learnability and cognition: the acquisition of argument structure*. Cambridge, MA: MIT press.

Pustejovsky, J. (1995). *The generative lexicon*. Cambridge, MA: MIT Press.

R Core Team. (2017). R: a language and environment for statistical computing [Computer software manual]. Vienna, Austria. Retrieved from <https://www.R-project.org>.

Sag, I. A., Arnon, I., Estigarribia, B., Hofmeister, P., Jaeger, T. F., Pettibone, J. & Snider, N. (2008). Processing accounts for superiority effects. *Linguistic Inquiry*. Online <http://lingo.stanford.edu/sag/L222B/papers/squib.pdf>.

Saxe, R., Tenenbaum, J. & Carey, S. (2005). Secret agents: inferences about hidden causes by 10-and 12-month-old infants. *Psychological Science* **16**(12), 995–1001.

Saxe, R., Tzelnic, T. & Carey, S. (2007). Knowing who dunnit: infants identify the causal agent in an unseen causal interaction. *Developmental Psychology* **43**(1), 149–158.

Schütze, C. T. & Sprouse, J. (2014). Judgment data. In D. Sharma & R. Podesva (eds), *Research methods in linguistics* (pp. 27–50). Cambridge: Cambridge University Press.

Srinivasan, M. & Rabagliati, H. (2015). How concepts and conventions structure the lexicon: cross-linguistic evidence from polysemy. *Lingua* **157**, 124–152.

Talmy, L. (1988). Force dynamics in language and cognition. *Cognitive Science* **12**(1), 49–100.

Talmy, L. (2000). *Toward a cognitive semantics* (Vol. 2). Cambridge, MA: MIT press.

Winter, B. (2013). Linear models and linear mixed effects models in R with linguistic applications. https://arxiv.org/abs/1308.5499

Zarcone, A., McRae, K., Lenci, A. & Padó, S. (2017). Complement coercion: the joint effects of type and typicality. *Frontiers in Psychology*, **8**. https://www.frontiersin.org/article/10.3389/fpsyg.2017.01987

Zhang, M., Piñango, M. M. & Deo, A. (2018). Real-time roots of meaning change: electrophysiology reveals the contextual-modulation processing basis of synchronic variation in the location-possession domain. In *Cogsci:2019*.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix: Stimuli

Set	condition	Context sentence	Target sentence
1	Neutral-AspV	Many musicians have music libraries that contain tons of albums.	Dave Brubeck started this CD of classic Jazz hits.
	agentBiasing-AspV	Musicians often record their pieces for compilation or memorial albums.	Dave Brubeck started this CD of classic Jazz hits.
	constBiasing-AspV	Kevin owns numerous CDs by different Jazz musicians.	Dave Brubeck starts this CD of classic Jazz hits.
	Neutral-PsychV	Many musicians have music libraries that contain tons of albums.	Dave Brubeck loved this CD of classic Jazz hits.
	agentBiasing-PsychV	Musicians often record their pieces for compilation or memorial albums.	Dave Brubeck loved this CD of classic Jazz hits.
2	Neutral-AspV	Media and literature can reveal a lot about history.	The Mongolian emperor ended the book about 13th century dictatorial regimes.
	agentBiasing-AspV	Some politicians read books to know more about autocracy.	The Mongolian emperor ended the book about 13th century dictatorial regimes.
	constBiasing-AspV	Some activists write satirical pieces to criticize dictators of different countries and ages.	The Mongolian emperor ends the book about 13th century dictatorial regimes.
	Neutral-PsychV	Media and literature can reveal a lot about history.	The Mongolian emperor detested the book about 13th century dictatorial regimes.
	agentBiasing-PsychV	Some politicians read books to know more about autocracy.	The Mongolian emperor detested the book about 13th century dictatorial regimes.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
3	Neutral-AspV	Famous composers are often involved in music albums commemorating international events.	John Cage finished the music recorded for the 1984 Olympics.
	agentBiasing-AspV	Famous composers are often asked to produce songs for special occasions, but sometimes they are not satisfied with their work.	John Cage finished the music recorded for the 1984 Olympics.
	constBiasing-AspV	Albums of music from the Olympic Games usually contain pieces by a variety of musicians.	John Cage finishes the music recorded for the 1984 Olympics.
	Neutral-PsychV	Famous composers are often involved in music albums commemorating international events.	John Cage tolerated the music recorded for the 1984 Olympics.
	agentBiasing-PsychV	Famous composers are often asked to produce songs for special occasions, but sometimes they are not satisfied with their work.	John Cage tolerated the music recorded for the 1984 Olympics.
4	Neutral-AspV	Without the freedom to choose their own husbands, female aristocrats were often the audience or main characters of romantic literature.	The noblewoman ended the romantic poem about the lovers from Verona.
	agentBiasing-AspV	In the past, female aristocrats did not have freedom to choose their own spouses and could only read novels or poems for comfort.	The noblewoman ended the romantic poem about the lovers from Verona.
	constBiasing-AspV	Female aristocrats are archetypal characters of love stories and can often be found in European literature.	The noblewoman ends the romantic poem about the lovers from Verona.
	Neutral-PsychV	Without the freedom to choose their own husbands, female aristocrats were often the audience or main characters of romantic literature.	The noblewoman detested the romantic poem about the lovers from Verona.
	agentBiasing-PsychV	In the past, female aristocrats did not have freedom to choose their own spouses and could only read novels or poems for comfort.	The noblewoman detested the romantic poem about the lovers from Verona.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
5	Neutral-AspV	In the Supreme Court, previous opinions are useful for informing future decisions.	Justice Sotomayor started the opinion about the recent embezzlement case.
	agentBiasing-AspV	The Supreme Court Justices often review previous opinions to inform their future decisions.	Justice Sotomayor started the opinion about the recent embezzlement case.
	constBiasing-AspV	The Supreme Court summarizes each justice's opinions on important cases of the year.	Justice Sotomayor starts the opinion about the recent embezzlement case.
	Neutral-PsychV	In the Supreme Court, previous opinions are useful for informing future decisions.	Justice Sotomayor respected the opinion about the recent embezzlement case.
	agentBiasing-PsychV	The Supreme Court Justices often review previous opinions to inform their future decisions.	Justice Sotomayor respected the opinion about the recent embezzlement case.
6	Neutral-AspV	In response to concerns from relatives about their move to Spain, Mona's family wrote letters with updates about each family member.	Mona's sick brother started the letter addressed to John.
	agentBiasing-AspV	Mona wrote letters on behalf of her brother, who had a stroke, but he would look over the letters before sending them out.	Mona's sick brother started the letter addressed to John.
	constBiasing-AspV	After Mona died, her family members found a pile of unsent letters addressed to her friends.	Mona's sick brother starts the letter addressed to John.
	Neutral-PsychV	In response to concerns from relatives about their move to Spain, Mona's family wrote letters with updates about each family member.	Mona's older brother liked the letter addressed to John.
	agentBiasing-PsychV	Mona wrote letters on behalf of her brother, who had a stroke, but he would look over the letters before sending them out.	Mona's older brother liked the letter addressed to John.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
7	Neutral-AspV	Professional painters usually kept an eye on collections of other artists.	Edgar Degas finished this set of impressionist paintings.
	agentBiasing-AspV	Professional painters liked to polish their work as much as they could.	Edgar Degas finished this set of impressionist paintings.
	constBiasing-AspV	This art library has many collections of famous painters.	Edgar Degas finishes this set of impressionist paintings.
	Neutral-PsychV	Professional painters usually kept an eye on collections of other artists.	Edgar Degas enjoyed this set of impressionist paintings.
	agentBiasing-PsychV	Professional painters liked to polish their work as much as they could.	Edgar Degas enjoyed this set of impressionist paintings.
8	Neutral-AspV	The exhibition in honor of Martha Graham included several documentaries featuring her interactions with students of different ages.	Martha Graham's senior students ended the documentary that depicted her as a dedicated teacher.
	agentBiasing-AspV	After Martha Graham's death, her colleagues and students worked on commemorative films about her life story.	Martha Graham's senior students ended the documentary that depicted her as a dedicated teacher.
	constBiasing-AspV	In honor of Martha Graham, the art museum is hosting a special screening of a documentary featuring her interactions with students of different ages.	Martha Graham's senior students end the documentary that depicts her as a dedicated teacher.
	Neutral-PsychV	The exhibition in honor of Martha Graham included several documentaries featuring her interactions with students of different ages.	Martha Graham's senior students detested the documentary that depicted her as a dedicated teacher.
	agentBiasing-PsychV	After Martha Graham's death, her colleagues and students worked on commemorative films about her life story.	Martha Graham's senior students detested the documentary that depicted her as a dedicated teacher.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
9	Neutral-AspV	Professional singers often had a variety of compilation CDs of other singers at their disposal.	Rihanna started the CD containing 2011's best-known pop songs.
	agentBiasing-AspV	Professional singers often listen to contemporary music to understand current trends.	Rihanna started the CD containing 2011's best-known pop songs.
	constBiasing-AspV	As a fan of pop music, Meredith owns numerous CDs by famous pop singers.	Rihanna starts the CD containing 2011's best-known pop songs.
	Neutral-PsychV	Professional singers often had a variety of compilation CDs of other singers at their disposal.	Rihanna preferred the CD containing her least-known pop songs.
	agentBiasing-PsychV	Professional singers often listen to contemporary music to understand current trends.	Rihanna preferred the CD containing her least-known pop songs.
10	Neutral-AspV	After they moved to Seattle, Emma's family sent e-mails reporting each family member's health condition to their old doctor in Ohio.	Emma's sick sister started the e-mail addressed to Vincent.
	agentBiasing-AspV	During her sister's hospitalization, Emma encouraged her to write e-mails to her friends.	Emma's sick sister started the e-mail addressed to Vincent.
	constBiasing-AspV	Emma is extremely family-oriented and often mentions her family in the e-mails she writes to her friends.	Emma's sick sister starts the e-mail addressed to Vincent.
	Neutral-PsychV	After they moved to Seattle, Emma's family sent e-mails reporting each family member's health condition to their old doctor in Ohio.	Emma's older sister liked the e-mail addressed to Vincent.
	agentBiasing-PsychV	During her sister's hospitalization, Emma encouraged her to write e-mails to her friends.	Emma's older sister liked the e-mail addressed to Vincent.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
11	Neutral-AspV	People pay attention to opinion columns that discuss non-politicians involved in public issues.	Stephen Hawking began the long list of academics protesting against the Iraq war.
	agentBiasing-AspV	A few scientists provided a list of the people that they knew to support peace agreements across countries.	Stephen Hawking began the long list of academics protesting against the Iraq war.
	constBiasing-AspV	The UN published several lists of famous intellectuals from various disciplines who oppose war efforts.	Stephen Hawking begins the long list of academics protesting against the Iraq war.
	Neutral-PsychV	People pay attention to opinion columns that discuss non-politicians involved in public issues.	Stephen Hawking preferred the long list of academics protesting against the Iraq war.
	agentBiasing-PsychV	A few scientists provided a list of the people that they knew to support peace agreements across countries.	Stephen Hawking preferred the long list of academics protesting against the Iraq war.
12	Neutral-AspV	The US Department of State collects opinions on character traits of officials from all countries.	The Lebanese official began the report about government officials.
	agentBiasing-AspV	The staff in the Department of State often reads papers on governmental issues.	The Lebanese official began the report about government officials.
	constBiasing-AspV	A series of recent papers discuss character traits of officials from all countries.	The Lebanese official begins the report about government officials.
	Neutral-PsychV	The US Department of State collects opinions on character traits of officials from all countries.	The Lebanese official disliked the report about government officials.
	agentBiasing-PsychV	The staff in the Department of State often reads papers on governmental issues.	The Lebanese official disliked the report about government officials.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
13	Neutral-AspV	The Psychology department is hiring a new researcher, and the department members have been discussing the applicants on the list.	The postdoc began the list of finalists recommended by the Department Chair.
	agentBiasing-AspV	In order to find a qualified research assistant, the faculty and postdocs in the searching committee examined the applicants carefully.	The postdoc began the list of finalists recommended by the Department Chair.
	constBiasing-AspV	As part of the hiring process, all the faculty members in the department are given lists of applicants recommended by various individuals.	The postdoc begins the list of finalists recommended by the Department Chair.
	Neutral-PsychV	The Psychology department is hiring a new researcher, and the department members have been discussing the applicants on the list.	The postdoc favored the list of finalists recommended by the Department Chair.
	agentBiasing-PsychV	In order to find a qualified research assistant, the faculty and postdocs in the searching committee examined the applicants carefully.	The postdoc favored the list of finalists recommended by the Department Chair.
14	Neutral-AspV	The NIH launched a series of research projects for various populations.	The senior group began the project about Alzheimer's disease.
	agentBiasing-AspV	The NIH recruited elderly participants to partake in research projects that aimed to improve quality of life, though some projects were quite demanding.	The senior group began the project about Alzheimer's disease.
	constBiasing-AspV	A series of NIH research projects targets subject populations of different age ranges.	The senior group begins the project about Alzheimer's disease.
	Neutral-PsychV	The NIH launched a series of research projects for various populations.	The elderly subjects tolerated the project about Alzheimer's disease.
	agentBiasing-PsychV	The NIH recruited elderly participants to partake in research projects that aimed to improve quality of life, though some projects were quite demanding.	The elderly subjects tolerated the project about Alzheimer's disease.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
15	Neutral-AspV	Many writers collect anthologies and other compilations edited by fellow writers.	F. Scott Fitzgerald continued the anthology of 20th century American literature.
	agentBiasing-AspV	Publishing companies sometimes ask famous writers to comment on anthologies or collections.	F. Scott Fitzgerald continued the anthology of 20th century American literature.
	constBiasing-AspV	The Norton Anthology collects literary work of different regions and different periods, each contains work by famous writers.	F. Scott Fitzgerald continues the anthology of 20th century American literature.
	Neutral-PsychV	Many writers collect anthologies and other compilations edited by fellow writers.	F. Scott Fitzgerald preferred only anthologies of 19th century American literature.
	agentBiasing-PsychV	Publishing companies sometimes ask famous writers to comment on anthologies or collections.	F. Scott Fitzgerald preferred only anthologies of 19th century American literature.
16	Neutral-AspV	The conservation magazine published a report highlighting the differing perspectives of various organizations.	The Rainforest Foundation completed that report in the magazine.
	agentBiasing-AspV	Environmental groups always read new documents about global climate issues.	The Rainforest Foundation completed that report in the magazine.
	constBiasing-AspV	The EU publications reveal the differing perspectives on climate change of various environmental groups.	The Rainforest Foundation completes the report about the negative impacts of global warming.
	Neutral-PsychV	The conservation magazine published a report highlighting the differing perspectives of various organizations.	The Rainforest Foundation endured that report in the magazine.
	agentBiasing-PsychV	Environmental groups always read new documents about global climate issues.	The Rainforest Foundation endured that report in the magazine.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
17	Neutral-AspV	UN newsletters often collect opinions on international issues from various UN departments.	The Security Council ended this month's newsletter about the recent nuclear crisis.
	agentBiasing-AspV	The UN departments are all required to read and comment on newsletters about different international issues.	The Security Council ended this month's newsletter about the recent nuclear crisis.
	constBiasing-AspV	The International Atomic Energy Association releases newsletters reporting concerns from different organizations on nuclear weapons.	The Security Council ends this month's newsletter about the recent nuclear crisis.
	Neutral-PsychV	UN newsletters often collect opinions on international issues from various UN departments.	The Security Council liked this month's newsletter about the recent nuclear crisis.
	agentBiasing-PsychV	The UN departments are all required to read and comment on newsletters about different international issues.	The Security Council liked this month's newsletter about the recent nuclear crisis.
18	Neutral-AspV	The US military owns documentaries of wars in which its branches were involved.	The US Army started the grim documentary about the Vietnam War.
	agentBiasing-AspV	All branches of the US Military watch war documentaries as part of their training programs.	The US Army started the grim documentary about the Vietnam War.
	constBiasing-AspV	Military forces are core elements in war films; for example, different branches of the US Military are omnipresent in many war movies.	The US Army starts the grim documentary about the Vietnam War.
	Neutral-PsychV	The US military owns documentaries of wars in which its branches were involved.	The US Army detested the grim documentary about the Vietnam War.
	agentBiasing-PsychV	All branches of the US Military watch war documentaries as part of their training programs.	The US Army detested the grim documentary about the Vietnam War.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
19	Neutral-AspV	The NBA records video of every game of every season.	Jeremy Lin began the NBA documentary released last week.
	agentBiasing-AspV	NBA players often watch video records of previous games to examine their turnovers.	Jeremy Lin began the NBA documentary released last week.
	constBiasing-AspV	Sports documentaries often quote comments made by famous players in their introductions.	Jeremy Lin begins the NBA documentary released last week.
	Neutral-PsychV	The NBA records video of every game of every season.	Jeremy Lin detested the NBA documentary released last week.
	agentBiasing-PsychV	NBA players often watch video records of previous games to examine their turnovers.	Jeremy Lin detested the NBA documentary released last week.
20	Neutral-AspV	The EU documented and distributed the environmental strategies of every automobile manufacturer to all members of the industry.	The Volvo Car Corporation finished the accusatory report on air pollution.
	agentBiasing-AspV	Most car companies read the reports on environmental protection published by the European Automobile Manufacturers Association.	The Volvo Car Corporation finished the accusatory report on air pollution.
	constBiasing-AspV	The EU environmental protection reports usually list the harmful actions of every car company.	The Volvo Car Corporation finishes the accusatory report on air pollution.
	Neutral-PsychV	The EU documented and distributed the environmental strategies of every automobile manufacturer to all members of the industry.	The Volvo Car Corporation hated the accusatory report on air pollution.
	agentBiasing-PsychV	Most car companies read the reports on environmental protection published by the European Automobile Manufacturers Association.	The Volvo Car Corporation hated the accusatory report on air pollution.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
21	Neutral-AspV	Professional singers often have a variety of CDs for parties.	Adele started the CD containing 2011's best-known pop songs.
	agentBiasing-AspV	Many singers listen to pop music in their free time.	Adele started the CD containing 2011's best-known pop songs.
	constBiasing-AspV	These albums contain the most popular songs of recent years.	Adele starts the CD containing 2011's best-known pop songs.
	Neutral-PsychV	Professional singers often have a variety of CDs for parties.	Adele preferred the CD containing her least-known pop songs.
	agentBiasing-PsychV	Many singers listen to pop music in their free time.	Adele preferred the CD containing her least-known pop songs.
22	Neutral-AspV	Marathons with runners from all over the world have become major tourist attractions.	The Zimbabwean athlete finished the list of participants in last year's NYC Marathon.
	agentBiasing-AspV	Before running a marathon, many people like to take a look at the list of all runners.	The Zimbabwean athlete finished the list of participants in last year's NYC Marathon.
	constBiasing-AspV	In most marathons, registered participants are listed for people's reference.	The Zimbabwean athlete finishes the list of participants in last year's NYC Marathon.
	Neutral-PsychV	Marathons with runners from all over the world have become major tourist attractions.	The Zimbabwean athlete enjoyed the list of participants in last year's NYC Marathon.
	agentBiasing-PsychV	Before running a marathon, many people like to take a look at the list of all runners.	The Zimbabwean athlete enjoyed the list of participants in last year's NYC Marathon.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
23	Neutral-AspV	Well-known writers usually owned collections of literary work to look at for reference.	William Shakespeare began the volume containing works of classic Renaissance comedies.
	agentBiasing-AspV	In the past, writers often looked at collections of literary work for inspiration.	William Shakespeare began the volume containing works of classic Renaissance comedies.
	constBiasing-AspV	Larry owns many collections of Renaissance literature.	William Shakespeare begins the volume containing works of classic Renaissance comedies.
	Neutral-PsychV	Well-known writers usually owned collections of literary work to look at for reference.	William Shakespeare enjoyed the volume containing works of classic Greek comedies.
	agentBiasing-PsychV	In the past, writers often looked at collections of literary work for inspiration.	William Shakespeare enjoyed the volume containing works of classic Greek comedies.
24	Neutral-AspV	Most actors keep video clips that feature themselves as well as other well-known performers.	Jennifer Aniston finished this DVD of "*Friends*" season 1 bloopers.
	agentBiasing-AspV	Well-known actresses often watch popular sitcoms in their free time.	Jennifer Aniston finished this DVD of "*Friends*" season 1 bloopers.
	constBiasing-AspV	Television sitcoms often produce specials that feature individual characters.	Jennifer Aniston finishes this DVD of "*Friends*" season 1 bloopers.
	Neutral-PsychV	Most actors keep video clips that feature themselves as well as other well-known performers.	Jennifer Aniston enjoyed this DVD of "*Friends*" season 1 bloopers.
	agentBiasing-PsychV	Well-known actresses often watch popular sitcoms in their free time.	Jennifer Aniston enjoyed this DVD of "*Friends*" season 1 bloopers.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
25	Neutral-AspV	Politicians often keep an eye on documents regarding global issues, which frequently involve American senators.	Hillary Clinton began the UN document about the situation in Syria.
	agentBiasing-AspV	Politicians are used to reading documents on global issues.	Hillary Clinton began the UN document about the situation in Syria.
	constBiasing-AspV	Important American politicians are often mentioned in documents about global issues.	Hillary Clinton begins the UN document about the situation in Syria.
	Neutral-PsychV	Politicians often keep an eye on documents regarding global issues, which frequently involve American senators.	Hillary Clinton favored the UN document about the situation in Syria.
	agentBiasing-PsychV	Politicians are used to reading documents on global issues.	Hillary Clinton favored the UN document about the situation in Syria.
26	Neutral-AspV	Local cooks often read blogs commenting on the chefs that work in New Haven restaurants.	The nervous chef started the review of the new restaurant on Chapel Street.
	agentBiasing-AspV	Almost every chef reads the comments about the restaurants that they work at.	The nervous chef started the review of the new restaurant on Chapel Street.
	constBiasing-AspV	The local gourmet blog writes comments about each big restaurant chef in New Haven.	The nervous chef starts the review of the new restaurant on Chapel Street.
	Neutral-PsychV	Local cooks often read blogs commenting on the chefs that work in New Haven restaurants.	The nervous chef tolerated the review of the new restaurant on Chapel Street.
	agentBiasing-PsychV	Almost every chef reads the comments about the restaurants that they work at.	The nervous chef tolerated the review of the new restaurant on Chapel Street.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
27	Neutral-AspV	The EU newsletters often reveal comments made by each department.	The European Commission completed the newsletter about the financial crisis.
	agentBiasing-AspV	The different EU departments comment on various issues in their monthly newsletters.	The European Commission completed the newsletter about the financial crisis.
	constBiasing-AspV	The EU newsletters usually consist of a series of opinions made by each department.	The European Commission completes the newsletter about the financial crisis.
	Neutral-PsychV	The EU newsletters often reveal comments made by each department.	The European Commission liked the newsletter about the financial crisis.
	agentBiasing-PsychV	The different EU departments comment on various issues in their monthly newsletters.	The European Commission liked the newsletter about the financial crisis.
28	Neutral-AspV	Some politicians read anthologies of important public speeches, especially those given by American presidents.	Jimmy Carter continued the anthology of 20th-century inaugural speeches.
	agentBiasing-AspV	Some politicians read anthologies of important public speeches.	Jimmy Carter continued the anthology of 20th-century inaugural speeches.
	constBiasing-AspV	Anthologies of American political speeches often contain addresses made by each previous president.	Jimmy Carter continues the anthology of 20th-century inaugural speeches.
	Neutral-PsychV	Some politicians read anthologies of important public speeches, especially those given by American presidents.	Jimmy Carter endured the anthology of 20th-century inaugural speeches.
	agentBiasing-PsychV	Some politicians read anthologies of important public speeches.	Jimmy Carter endured the anthology of 20th-century inaugural speeches.

https://doi.org/10.1017/langcog.2019.39 Published online by Cambridge University Press

Appendix (*Cont.*)

Set	condition	Context sentence	Target sentence
29	Neutral-AspV	Many people like Shakespearean poems that feature solitary female protagonists.	The young widow began the audiobook of traditional Elizabethan sonnets.
	agentBiasing-AspV	Many single women like to listen to recordings of Shakespearean poems.	The young widow began the audiobook of traditional Elizabethan sonnets.
	constBiasing-AspV	Many Shakespearean poems feature contemporary female protagonists.	The young widow begins the audiobook of traditional Elizabethan sonnets.
	Neutral-PsychV	Many people like Shakespearean poems that feature solitary female protagonists.	The young widow loved the audiobook of traditional Elizabethan sonnets.
	agentBiasing-PsychV	Many single women like to listen to recordings of Shakespearean poems.	The young widow loved the audiobook of traditional Elizabethan sonnets.
30	Neutral-AspV	Staff members in the Department of State sometimes see papers criticizing officials in the Middle East.	The Palestinian official began the paper about international peace-keeping strategies.
	agentBiasing-AspV	Staff members in the Department of State need to review papers on global issues frequently.	The Palestinian official began the paper about international peace-keeping strategies.
	constBiasing-AspV	In some international affairs documents, government officials of various countries are named and criticized.	The Palestinian official begins the paper about international peace-keeping strategies.
	Neutral-PsychV	Staff members in the Department of State sometimes see papers criticizing officials in the Middle East.	The Palestinian official disliked the paper about international peace-keeping strategies.
	agentBiasing-PsychV	Staff members in the Department of State need to review papers on global issues frequently.	The Palestinian official disliked the paper about international peace-keeping strategies.