

The search for universal primate gestural meanings¹

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Abstract. This paper pursues the idea that human and non-human great apes share a common set of directive (imperative) gestures and their meanings. We investigate gestures that are multifunctional, in that they have different effects in different contexts, focusing on non-human ape gestures that communicate “Stop that” in some contexts, and “Move away” in others. What may superficially appear to be lexical ambiguity can be derived from a single abstract lexical entry, “Not X!”, concluded to be a candidate for a universal building block of meaning, shared by human and non-human great apes, reflections of which may also be found in the pragmatic gestures in humans.

Keywords: gesture semantics; imperative gestures; ape gestures; directive gestures; Super Linguistics; semantic universals.

1. Introduction

1.1. Gestures as an object of linguistic inquiry

In linguistics, *gestures* are defined as communicative body movements (see, e.g., Abner et al. 2015). While modern gesture research has been pursued for roughly half a century, beginning with the work of Kendon (1972, 1980) and McNeill (1985, 1992), the last fifteen years have also seen the emergence of formal semantics work on gestures (e.g., Lascarides & Stone 2009a,b, Ebert & Ebert 2014, Schlenker 2018, Esipova 2019). This signifies what we may consider a new chapter in formal semantics that embraces multi-modality as an important aspect of human language.

Much of the above-mentioned formal semantics literature has focused on gestures that add descriptive content to the accompanying speech, such as a *LARGE* gesture while referring to a bottle of water (Ebert & Ebert 2014), or a *SLAP* gesture when discussing a *punish*-event (Schlenker 2018).² To illustrate, consider the example in (1), which is to be understood as follows: while pronouncing the word *this*, Alex performs the *LARGE* gesture, which involves holding one’s hands apart at a distance that indicates the size of Sam’s cat. The co-occurrence of *this* and *LARGE* is marked by the plus sign and underlining of *this*.

(1) Alex: Sam’s cat is this+*LARGE* big.


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² Henceforth, italicized words in all caps (e.g., *LARGE* and *SLAP*) will be used to refer directly to the gestures.

A different type of gesture are *pragmatic gestures* (also referred to as *interactive gestures*), which have a discourse-managing use (see, e.g., Bavelas et al. 1992, Kendon 2004, Abner et al. 2015, Müller 2004, 2017, Wehling 2017). Example (2) illustrates a concrete example of a pragmatic gesture, namely the *throwing away* gesture, *THROW* (see, e.g., Bressemer & Müller 2014, 2017).³ Francis et al. (2023) argue that Sam's use of *THROW* in (2) communicates that it is unimportant whether it is getting late or not. The pragmatic contribution of the gesture is congruent with the implicatures of Sam's spoken utterance: Sam's statement that the following day is Sunday implicates that Sam and Alex can sleep in on Sundays, thus supporting Sam's dismissal of Alex's utterance by virtue of *THROW*.

- (2) *Context: Alex and Sam are dancing at a club, it is 3am*
 a. Alex: It's getting late.
 b. Sam: Tomorrow is Sunday+*THROW* (Francis et al. 2023)

This paper focuses on a third type of gesture, which we may call *directive gestures*; we define directive gestures as attempts by the *signaler* (the person gesturing) to get the *recipient* (the intended addressee) to change their behavior.⁴ Directive gestures are often referred to as *imperative gestures* (e.g., by Tomasello & Camaioni 1997, Kersken et al. 2019), but this label potentially conflates the morpho-syntactic notion of *imperative* (a linguistic verb form or sentence type) with the semantic-pragmatic notion of *directive* (a type of speech act). I will thus use the term *directive* in this paper. Examples of directive gestures include the *STOP* gesture in (3).⁵ This gesture is often performed as a silent gesture (without accompanying speech). It is typically understood as an attempt to get the recipient to stop an activity, e.g., it can be a prompt (i) to stop moving towards the signaler, (ii) to stop speaking, or (iii) to simply hold still.

- (3)  *stop hand gesture* (cropped from original picture)
 Source: Pexels.com (Free to use license)⁶

In the absence of any linguistic material, it is not trivial to describe the meaning of the *STOP* gesture; it could be paraphrased as a negative imperative that expresses prohibition (*Don't come closer*) or as a regular imperative that expresses a command (e.g., *Stop* or *Stay away*). Moreover, paraphrases are not limited to imperative-like paraphrases; the gesture may just as well be rendered by declarative paraphrases such as *You cannot come closer* or *I want you to stay away* (among other possible paraphrases). This highlights the usefulness of a more abstract semantic analysis of the type developed in Sections 2 and 3 of this paper.

At this point, it is important to address a phenomenon that we encounter when dealing with silent gestures, which we may descriptively call *multifunctionality*, and for present purposes,

³ Here, the dotted underlining (e.g., tomorrow) marks the gesture's preparatory phase, lifting the hand up into a vertical position where its palm is facing away from the speaker's body; regular underlining (e.g., Sunday) marks the gestural stroke, where the hand is dropped forward in a motion as if throwing away an object.

⁴ We adopt the definition of *directive* from Searle (1975:355).

⁵ The *STOP* gesture is related to the *holding away* gesture, see Bressemer & Müller (2017:3) for discussion.

⁶ URL: <https://tinyurl.com/yckk6z8a> (Last accessed on 10th March 2023.)

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we define as follows: an expression is *multifunctional* if its use has different functions/effects depending on the context. Multifunctionality is illustrated by the *STOP* gesture in (3); in some contexts, the signaler will be satisfied by the recipient's response if the recipient stops moving toward the signaler. In other contexts, the signaler will be satisfied if the recipient stops speaking. These outcomes are not identical, since it is possible to stop moving toward the signaler while continuing to speak. This begs the question of how the observable uses of the gesture relate to its underlying core meaning.

Two concepts from linguistics are relevant for the analysis of such gestural multifunctionality (see, e.g., Falkum & Vicente 2015 and Recanati 2017 for recent discussion). First, *homonymy* (or *lexical ambiguity*) is defined as a case where a single expression (e.g., a gestural form) is associated with two or more distinct lexical entries. If we were to analyze the different uses of *STOP* in (3) as a case of homonymy, we would assume at least two distinct lexical entries, amounting to *STOP*₁ and *STOP*₂. A well-established example of homonymy is the English word *bank*, which can denote a riverside or a financial institution. Second, *non-specification* is defined as a case where an expression has a single abstract lexical entry that is compatible with different contexts, giving rise to distinct contextual effects. Applied to the gesture in (3), a non-specification account would assume a single lexical entry for *STOP*, which would be more abstract than either of the lexical entries that a homonymy view would posit.⁷ The question of whether the case of multifunctional directive gestures involves homonymy or non-specification will be central to the discussion in Section 3.

1.2. The search for gestural universals – from non-human primates to humans

We now turn to the question whether there are universals in human gestures, an issue that dates back to the writings of Quintillian in 95 C.E. While it has since become uncontroversial that gestures are culture-dependent, recent research on the topic argues that there are *candidates* for gestural universals - though at a very general, abstract level. Cooperrider (2019:230) proposes that all human cultures may have (i) gestures for negation, (ii) pointing gestures, (iii) palm-up gestures, (iv) size gestures (such as the above-mentioned *LARGE* gesture), and (v) time gestures. While previous research on gestural universals builds on the cross-cultural comparison of human gestures, which is indeed an important line of inquiry, we build on work such as Byrne et al. (2017), Graham et al. (2018) and Kersken et al. (2019), and take the gestures of great apes as our point of departure, i.e., gestures that appear to be shared by bonobos, chimpanzees, gorillas, orangutans — and humans.

In recent primatology research, Kersken et al. (2019) observe that 1-to-2-year-old (pre-linguistic) human children have an 89% overlap with chimpanzees in their repertoire of communicative gestures. It is an open question whether this overlap is due to a shared innate gestural repertoire, or due to resemblance-based (iconic) properties of the gestures coupled with general cognitive abilities. Either way, the presence of gestures that are shared by human children and chimpanzees strongly suggests that the same gestural repertoire was

⁷ *Non-specification* is related to the notion of *polysemy*, where one expression is used in different related senses, as illustrated by the word *line* in *draw a line* vs. *read a line* (from Falkum & Vicente 2015:1). The terms differ in that *polysemy* is a broader concept, which also includes phenomena and analyses that do not map onto the notion of *non-specification* as defined in this paper.

present in our last common ancestor, ~6.6 million years ago (see, e.g., Pozzi et al. 2014). While published studies on the gestures of human children and chimpanzees focus on the form of the gestures,⁸ and not on their meanings, Graham et al. (2018) investigate gestural meanings across ape species; their findings unearth a meaning overlap between chimpanzees and bonobos, whose last common ancestor lived ~1.2 million years ago.

Taken together, the overlap in the form of gestures between human children and chimpanzees, and the plausible assumption that there is also an overlap in meaning (be it due to innateness or the iconicity of the gestures), give rise to an interesting line of inquiry: gestural form-meaning combinations that are shared between humans and non-human great apes may trace back to our last common ancestor ~6.6 million years ago, and thus be shared by *all* present-day humans, who plausibly share the same ancestor. As a direct consequence, we expect that gestural meanings shared by humans and non-human primates are part of the gestural universals and/or semantic universals in humans.⁹ Whether this hypothesis can be confirmed is an empirical question, since some shared meaning similarities may have arisen by chance or due to convergent evolution. The more modest aim of this paper is to address the question of what these universal building blocks of meaning may actually look like.

2. Laying out the toolbox

Semantic research that aims to establish building blocks of gestural meanings shared by humans and non-human primates needs to start by addressing two questions. First, given that potential meanings are more constrained in great apes than in humans, we need to establish which meanings are found in great apes. Second, it is useful to put a formalism in place that permits us to establish maximally precise renderings of gesture meanings in the form of lexical entries; this allows us, among other things, to decide whether multifunctional gestures involve homonymy or whether non-specification can explain the observed gesture uses. Section 2.1 reviews the approach from primatology, Section 2.2 sketches a first translation into a formal semantic approach. Subsequently, Section 3 proceeds to refine this approach.

2.1. Methodology from primatology for establishing ape gestural meanings

While linguistic research on human languages has (within limits) direct access to native speaker intuitions on the meaning of linguistic expressions, we cannot probe the intuitions of non-human primates in order to directly access meanings. This creates a need for a reliable method that allows us to establish the “meaning” of a given ape gesture in a given context. The established view on ape gestures holds that ape gestures are exclusively “imperative”, i.e., directive gestures as defined in Section 1.1 of the present paper; in other words: attempts by the signaler to elicit an action from the recipient (see, e.g., Gómez et al. 1993, Tomasello & Camaioni 1997 for discussion).

⁸ For example, the *BECKON* gesture is defined as “Hand moved in a sweep from elbow or wrist towards signaller” (Byrne et al. 2017:758).

⁹ On the topic of semantic universals, see, e.g., Wierzbicka (1996), von Stechow and Matthewson (2008).

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Given that ape gestures are directive, Hobaiter & Byrne (2014:1596) infer the presumably intended “meanings” for such gestures on the basis of *apparently satisfactory outcomes* (ASOs), which is the intended action to be elicited from the recipient. Ape gestures are typically performed towards an intended recipient, and they are repeated more than once. The ASO of a gesture is defined as the recipient’s reaction that makes the signaler stop gesturing. For instance, if a signaler performs a *BECKON* gesture, we observe that the signaler repeats the gesture, and stops repeating it when the recipient moves towards the signaler. This *moving-closer-action* constitutes the ASO, and Hobaiter & Byrne thus conclude that *BECKON* has the meaning “Move closer”. In Hobaiter & Byrne’s (2014) Table S1,¹⁰ “Move closer” is defined more technically as “recipient moves closer to signaler”.¹¹

2.2. Comparing the ASOs in primatology to utterance denotations in formal semantics

Zooming out from the ASO “Move closer”, we observe that 17 of 19 ASOs defined in Hobaiter & Byrne (2014) follow the template “recipient [VERB]-s [...]”, and the two remaining ASOs follow the template “[...] [VERB]-ing between the signaler and recipient”. ASOs thus differ from the type of meanings generally assumed in formal semantic theory in that they are oriented exclusively towards a recipient and an outcome. In a linguistic analysis, this would be equivalent to rendering the meaning of the human-language imperative *Move closer!* by virtue of the paraphrase “addressee moves closer to speaker”.

Comparing ASOs to the sentence/utterance denotations in human language semantics, the human-language imperative *Move closer!* would be analyzed as sketched in (4) for three different approaches to imperatives (modeled after Rudin 2018:106-109). The approach of Portner (2007), (4a), treats imperatives as property descriptions, which are proposed by the speaker as an addition to the recipient’s *To-Do List*, a virtual set of properties that recipients aim to realize of themselves. Kaufmann (2012, 2016) treats imperatives as statements that contain a covert necessity modal (*must*), coupled with a performative presupposition (\approx *I hereby decree*), (4b). Condoravdi & Lauer (2012, 2017), by contrast, argue that imperatives encode a preference of the speaker, (4c), which the imperatives make public.

- (4) *Informal renderings of different approaches to human language imperatives*
- [[*Move closer*]] $\approx_{(\text{Portner})}$ [$\lambda x : x$ is the recipient . x moves closer to the speaker]
 - [[*Move closer*]] $\approx_{(\text{Kaufmann})}$ [[I hereby decree that you must move closer to me]]
 - [[*Move closer*]] $\approx_{(\text{Condoravdi \& Lauer})}$ [[I want you to move closer to me]]

Out of the approaches in (4), Portner’s in (4a) is the most comparable to an ASO-based approach in that the semantics only encodes the desirable actions of the recipient in the form of a property description, and leaves it to the pragmatics to communicate the desirability of these actions, rather than semantically encoding it. The alternative approaches also entail semantically represented modality (e.g., *must* or *want*), and there is no reason to assume that the meanings of ape gestures contain such modality. As a point of departure, we can thus use Portner’s approach to model the semantics of directive gestures, both in non-human apes and

¹⁰ Table S1 and S3 of Hobaiter & Byrne (2014) are found in the *Supplemental Information* document.

¹¹ As a helpful convention, the names of ASOs and their descriptions will be set between double quotation marks (e.g., “Move closer”) whereas English language expressions will be italicized (e.g., *Move closer*).

in humans. As an informal notation, we can use (5), where Hobaiter & Byrne’s (2014) “Move closer” ASO is mapped onto a Portnerian denotation by virtue of a wave arrow.

(5) ASO:Move-closer \rightsquigarrow $[\lambda x : x \text{ is the recipient} . x \text{ moves closer to the signaler}]$

For the 17 ASOs in Hobaiter & Byrne (2014) with a “recipient [VERB]-s [...]” template, a Portner-style analysis can be rendered via a direct mapping, substituting x for *recipient*. Similarly, an ASO that follows the “[...] [VERB]-ing between the signaler and recipient” template is illustrated in (6) for Hobaiter & Byrne’s (2014) “Initiate grooming” ASO.

(6) ASO:Initiate-grooming \rightsquigarrow $[\lambda x : x \text{ is the recipient} . \text{grooming between the signaler and } x]$

Note that the lambda notation in (5)-(6), which treats gesture meanings as expressions of type $\langle e, t \rangle$ may suggest a compositionality of gesture meanings that is not found. Crucially, the presupposition of these expressions requires the argument slot x to be contextually saturated by the recipient, which in fact precludes further compositionality. We will maintain this notation for present purposes as a means of highlighting similarities to human language imperatives.

We have thus put into place an initial formalization of the gestural meanings proposed in the primatology literature. Section 3 problematizes and further refines this formalization.

3. *Core Meanings: towards the meaning atoms of ape gestures*

3.1. Lack of one-to-one matching between gestures and ASOs

One well-established feature of non-human ape gestures is that there are virtually no one-to-one matchings of gesture to ASO. Some ASOs are only associated with one or two gestures, but other ASOs are associated with an entire range. To give an example for each scenario, Graham et al. (2018:9) cross 11 ASOs with 21 gestures. In their selection, the ASO “Travel with me” in chimpanzees is only associated with the *LOUD-SCRATCH* gesture, whereas, the ASO “Move closer” is associated with 9 distinct chimpanzee gestures. (Note also that this selection is not exhaustive in that, e.g., Hobaiter & Byrne 2014:1596 document 19 ASOs and 66 gestures.)

Making matters even more complex, a given ape gesture generally occurs with more than one ASO; for the 9 chimpanzee gestures that are associated with the ASO “Move closer” in Graham et al.’s (2018:9) selection, the authors list only one gesture (*BECKON*) that is only associated with “Move closer” in chimpanzees, whereas the other 8 gestures are associated with anywhere between three and seven ASOs (*OBJECT-SHAKE* being associated with seven ASOs). This overview may still be incomplete, since *BECKON* has elsewhere been established to occur with two different ASOs, “Move closer” and “Reposition body” (Hobaiter & Byrne 2014). The one-to-many matching of non-human primate gestures and ASOs will be the focus of the remainder of this paper.

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Before we proceed to a more in-depth discussion of gestural multifunctionality, it is worth mentioning a distinction that was introduced by Cartmill & Byrne (2007), between “tight”, “loose”, and “ambiguous” gestures in great apes. Gestures are classified as “tight” when their use corresponds to a select ASO in 70% or more of the observations. By contrast, gestures that map onto a single ASO in 50% to 70% of observations are classified as “loose”, and the remaining gestures as “ambiguous”. This scalar distinction models the observed degree of multifunctionality of these gestures, i.e., it is not the case that “tight” gestures necessarily occur with only one ASO. Hobaiter & Byrne (2014) classify 13 of 36 gestures as “tight”, but only 4 of those “tight” gestures occur with only one ASO in their observations, whereas the remaining 9 “tight” gestures still occur with more than one ASO.

For the purposes of this paper, the “tight” vs. “loose/ambiguous” distinction is inconsequential, as we will focus on the ASOs themselves. To give a concrete example, *PUSH* in chimpanzees is a “tight” gesture that has “Move away” as a non-primary ASO. *PUSH* is used for “Stop that” in 78% of the observations of Hobaiter & Byrne (2014), and for “Move away” in 22% of the observations. Much in line with Graham et al. (2018:9), I will nevertheless assume that *PUSH* does in fact occur with the ASO “Move away” and thus needs to have a meaning compatible with this ASO. Using these two ASOs as a case study, an approach is outlined in Sections 4.1–5 that assumes non-specification rather than lexical ambiguity, as defined in Section 1.1, suggesting that abstract semantic analyses of this type are possible for many multifunctional gestures.

3.2. Stating the challenge and outlining a solution

For a linguist studying the gestures of non-human great apes, their high level of multifunctionality may suggest that these gestures are fundamentally distinct from human modes of communication. For example, the chimpanzee *ARM-RAISE* gesture maps onto five ASOs, given as “Acquire object” (48% of observations), “Move away” (19%), “Move closer” (15%), “Stop that” (11%),¹² and “Climb on you” (7%) (Graham et al. 2018:5). It may initially seem hopeless to posit a *core meaning*, i.e., a uniform lexical entry, for such a gesture, possibly even suggesting that such a gesture *lacks* meaning altogether. Much to the contrary, Sections 4.1–5 show that a formal semantics toolkit provides a useful technology to handle the observed variation in how such a gesture is used. As a first step towards a linguistic analysis, it is worth highlighting the ways in which standard linguistic expressions are no less multifunctional than great ape gestures.

In human language, many elements have a highly abstract meaning that is compatible with a range of different contexts. A classic example of such abstraction concerns German discourse particles; while a lexical entry for German *ja* may be posited along the lines of (7) (see Lindner 1991, Jacobs 1991, Grosz 2021), the variation in the actual uses of *ja* is reflected by its translation equivalents. When translating a sentence that contains *ja* into English, suitable translation equivalents include *as you know*, *after all*, *of course*, *in fact*, and *indeed*, but none of them are perfect counterparts for *ja* (see Gast 2022 for recent discussion and analysis).

¹² Graham et al. (2018) use the label “Stop behaviour”, while Hobaiter & Byrne (2014) use “Stop that”.

- (7) *ja(p)* conveys: the possibility of $\neg p$ is not currently under consideration.
(quoted from Grosz 2021)

Even closer to the example of directive ape gestures, we observe that human language imperatives may easily involve non-specification, as illustrated by the English imperative *Stop!*, which is as multifunctional as the corresponding gesture in (3). (Compare also imperatives such as *Keep going!*, *Continue!* or *Go ahead!*) If we were to use ASOs to describe the meaning of the spoken language imperative *Stop!* in English, we would plausibly posit a range of distinct ASOs, including, but not limited to, “recipient keeps physical distance to signaler” and “recipient is silent”.

This suggests that the real task for a semanticist (and an arena in which linguistics and primatology research can inform one another) is to aim to establish an underspecified core meaning for a given gesture such as *ARM-RAISE*, which is compatible with each of its attested uses. In other words, rather than positing five utterance denotations for *ARM-RAISE*, as sketched in (8),¹³ we aim to find one single abstract denotation that can give rise to the five different communicative effects in a suitable context. (The denotations in (8) are adapted from the ASOs of Hobaiter & Byrne’s (2014) Table S1, see Section 2.2.)

- (8) *Sketch of a homonymy-based analysis (to be rejected) of the meanings of ARM-RAISE*
- a. $[[ARM-RAISE_{Acquire\ object}]] \approx [\lambda x : x \text{ is the recipient} . x \text{ gives the signaler a salient object}]$
 - b. $[[ARM-RAISE_{Move\ away}]] \approx [\lambda x : x \text{ is the recipient} . x \text{ moves away from the signaler}]$
 - c. $[[ARM-RAISE_{Move\ closer}]] \approx [\lambda x : x \text{ is the recipient} . x \text{ moves closer to the signaler}]$
 - d. $[[ARM-RAISE_{Stop\ that}]] \approx [\lambda x : x \text{ is the recipient} . x \text{ either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual}]$
 - e. $[[ARM-RAISE_{Climb\ on\ you}]] \approx [\lambda x : x \text{ is the recipient} . x \text{ permits signaler to climb on them}]$

For a researcher pursuing a non-specification account of the various uses of *ARM-RAISE*, different outcomes are conceivable. As with the expressions of human language, the observed multifunctionality may owe to homonymy, non-specification, or a combination thereof. In other words, it is conceivable that the five readings in (8) derive from one single abstract lexical entry, which would eliminate homonymy from the analysis of *ARM-RAISE* in favor of non-specification, but it is equally conceivable that they derive from two abstract lexical entries, allowing for residual homonymy in combination with non-specification. The worst-case scenario would be one in which five distinct lexical entries are needed, as this would not contribute to our understanding of why individual gestures typically map onto more than one ASO, and why select ASOs are typically expressed by more than one gesture. In what follows, we outline a descriptive strategy for grouping together ASOs that share semantic properties, Section 3.3, and then outline an attempt at an abstract lexical entry that may underlie both the “Stop that” ASO and the “Move away” ASO, Section 4.

¹³ Notationally, (8) models ape gesture meanings the way imperatives are modeled in (4a), while sketching an approach based on lexical ambiguity, i.e., homonymy, which subscripts the ASOs onto 5 distinct lexical entries.

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3.3. Probing for common denominators

Looking at the findings of Hobaiter & Byrne (2014) and Graham et al. (2018), in particular, one noticeable ASO overlap concerns the ASOs “Move away”, “Stop that” and “Follow me”, as defined in (9). Cumulatively, the two texts discuss a total of 11 gestures that are attested with two of these three ASOs, plus 3 gestures that are attested with all three ASOs.

- (9) *Hobaiter & Byrne’s (2014) definitions for three connected ASOs*
- a. “Stop that” ... the recipient either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual
 - b. “Move away” ... recipient moves away from signaler
 - c. “Follow me” ... mature recipient follows mature signaler, usually in consortship

For a concrete example of a gesture that is attested with all three ASOs in (9), consider the *OBJECT-SHAKE* gesture (defined as “repeated back and forth movement of an object” in Byrne et al. 2017:759); in the observations of Graham et al. (2018:7), *OBJECT-SHAKE* is most frequently associated with “Follow me” (73%) and counts as a “tight” gesture in the sense in which this label has been discussed in Section 3.1 (= one ASO more than 70% of the time). In addition, *OBJECT-SHAKE* occurs with “Move away” in 8% of the observations and with “Stop that” in 3% of the observations. (For now, we set aside further ASOs associated with this gesture, which are “Initiate copulation”, “Acquire object”, “Move closer” and “Initiate grooming”.) In the same data set, a gesture that is attested with two of the ASOs in (9) is *ARM-RAISE*, which occurs in the “Move away” meaning 19% of the time and in the “Stop that” meaning 11% of the time.¹⁴ *ARM-RAISE* is most frequently associated with “Acquire object” (48%) and counts as an “ambiguous” gesture in the sense of our Section 3.1 discussion (= no ASO more than 50% of the time).

What stands out about the set of meanings in (9) is that their connection is not arbitrary; two of the meanings share a negative component (“Stop that” and “Move away”), whereas two of them share a locational component (“Move away” and “Follow me”). In a very first informal attempt, we could capture this by means of assuming a negative component that is crossed with a locational component, (10); the three gestures could then be described in terms of semantic feature matrixes. In the feature matrix, [\pm negative] denotes whether we are dealing with an encouraging [$-$ negative] or discouraging [$+$ negative] gesture; [\pm locational] denotes whether movement is involved; [\pm signaler] denotes whether the signaler intends to perform the same activity or not. The common denominator of these three gestures would then be the presence of the feature [$+$ negative], bold typed in (10). Feature matrices of the type in (10) are a notational convenience in order to allow us to descriptively capture commonalities among different ASOs.

- (10) *first informal rendering of negative meaning overlap*
- a. [**+negative**, $-$ locational, $-$ signaler] “Stop that” \rightsquigarrow “not *this activity!*”
 - b. [**+negative**, $+$ locational, $-$ signaler] “Move away” \rightsquigarrow “(you) not *here!*”
 - c. [**+negative**, $+$ locational, $+$ signaler] “Follow me” \rightsquigarrow “(you and me) not *here!*”

¹⁴ These two ASOs correspond to (8b) and (8d). A noteworthy observation is that the remaining three ASOs of *ARM-RAISE*, (8a), (8c) and (8e), all involve movement *towards* the signaler.

Moving beyond the ASOs in (10), there is a range of gestures that overlap not only in the ASOs “Move away” and “Follow me”, but also in the ASO “Move closer”, e.g., *ARM-SWING*, *OBJECT-SHAKE* and *OBJECT-MOVE* in Graham et al. (2018:9). These could similarly be modeled by assuming that “Move closer” shares the [+locational, –signaler] composition of “Move away” but differs in that it is [–negative], i.e., an encouraging (non-negative) gesture. The corresponding feature overlap can then be illustrated as given in (11).

(11) *first informal rendering of locational meaning overlap*

- a. [–negative, +**locational**, –signaler] “Move closer” \rightsquigarrow “(you) *here!*”
- b. [+negative, +**locational**, –signaler] “Move away” \rightsquigarrow “(you) not *here!*”
- c. [+negative, +**locational**, +signaler] “Follow me” \rightsquigarrow “(you and me) not *here!*”

In words, the essential building block of meaning in (10) seems to be “*not*” or “*no*”, whereas the corresponding building block in (11) would be “*here*”.

The idea that [\pm negative] may be a central feature with regards to ape gesture classification is corroborated by the following observation with regards to the range of attested ASOs. Hobaiter & Byrne (2014) list the ASOs for 36 non-play gestures in their Table S3; out of those 36 non-play gestures, 8 gestures had “Stop that” as the most frequently attested ASO, and 6 gestures had “Move away” as the most frequently attested ASO, in addition to which these two ASOs were associated with a further 7 gestures, i.e., 21 in total. Since “Stop that” and “Move away” are transparently negative and discouraging (which we return to in Section 4), this indicates a division of gestures into discouraging/negative gestures (the meaning of which relates to “Stop that” and/or “Move away”) and encouraging/positive gestures. ASOs that are clearly encouraging/positive are “Contact” and “Move closer”, which Hobaiter & Byrne (2014) define as “physical contact of an apparently affiliative nature, such as hugging, touching etc. between the signaler and recipient” and “recipient moves closer to signaler”, respectively.

Notably, a formalization of the hypothesized core meaning components of “Stop that” and “Move away”, which would amount to “*not*” and “*no*”, is not a trivial undertaking. The next section outlines first steps of doing so, and maps out the hypothesis space.

4. Towards a lexical entry for “Stop that” and “Move away”

We proceed to explore two possible approaches to the lexical entries of “Stop that” and “Move away”: one analysis that is relatively complex and builds on the meaning commonly assumed for the English word *stop*, in Section 4.1. This is contrasted with a more minimal analysis in Section 4.2. As shown in Section 4.3, support for the more complex analysis stems from its potential for unifying “Stop that” and “Move away” at an abstract level.

4.1. Spelling out “Stop that” and “Move away”

Focusing on the ASOs “Stop that” and “Move away”, a central commonality, (10a-b), is the fact that both are negative at an abstract level. The imperative command *Stop that* in spoken English could also be expressed by virtue of the prohibitive utterance *Don’t continue doing*

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that. Similarly, a command *Move away* could be expressed by virtue of the prohibitives *Don't be so close to me* or *Don't stay here*. In human language, the negativity of *Stop that* (or rather *Stop doing that*) is not expressed at the clausal level, but contained in the predicate *stop*. Similarly, the negativity of *Move away* (or *Move away from me*) as a spoken language expression is not expressed at the clausal level, but contained in the locative adverb *away*.

Crucially, a fundamental property of gestures is that they are non-linguistic and do not contain words, i.e., we cannot know whether the “Stop that” ASO (= “the recipient either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual”, as cited in (9a) from Hobaiter & Byrne 2014) is best modeled in parallel with the English-language imperative *Stop doing that* or in parallel with the English-language prohibitive *Don't continue doing that*. In fact, it is unclear whether such a distinction even makes sense in the realm of gesture analysis, given that there appear to be no formal theories of imperatives that draw a distinction between imperatives and prohibitives at the level of the denotation, once rendered in a formal metalanguage.¹⁵ In other words, a more precise rendering of a “Stop that” ASO would have to collapse the denotation of “Stop doing that” and “Don't continue doing that” into a single formalization, as sketched very roughly in (12), which models it as the denotation of an English-language utterance for ease of exposition; (12) incorporates the meaning of the word *stop* from Zehr & Schwarz (2018:465).

In (12), the italicized *doing-that_c* is short hand for a contextually salient activity of the recipient. The idea behind this lexical entry is that *Stop doing that* presupposes that the recipient is currently (at t_c) engaging in a *doing-that_c* activity; if that presupposition is met, then the signaler attempts to add a property to the recipient's To Do List such that there is a point in time t in the immediate future, at which the recipient no longer engages in the same activity. Adapting notation from Rapp & von Stechow (1999) (among many others), “ $t_c \gg t$ ” means ‘ t_c abuts t from the left side’, i.e., t immediately follows t_c . Further refinements of (12) are, of course, possible; however, as of now, (12) suffices to illustrate how we may approach a formal rendering of a “Stop that” ASO, and we can now turn to the challenges it may face.

- (12) $\llbracket \textit{Stop doing that} \rrbracket^c \approx \llbracket \textit{Don't continue doing that} \rrbracket^c \approx$
 $\llbracket \lambda x : x \text{ is the recipient}_c \ \& \ x \text{ is } \textit{doing-that}_c \text{ at } t_c \text{ in } w .$
 $\exists t [t_c \gg t \ \& \ \neg[x \text{ is } \textit{doing-that}_c \text{ at } t \text{ in } w]]$

One central problem raised by (12) is the fact that a lexical entry along these lines would be far from minimal in a meaningful sense, i.e., much less minimal than what was implied in Section 3.3 by suggesting that “*not*” or “*no*” is a building block of meaning found in great ape gestures. In addition to containing logical negation, (12) assumes temporal reference, i.e., a notion of how the present point in time t_c differs from a future point in time t , and presuppositional meaning, i.e., an awareness of ongoing events or activities that are presupposed by a signaler when performing such a gesture. In a first step, we should ask whether such meanings — temporal reference and presuppositions — have cognitive reality in non-human great apes.

¹⁵ I am grateful to Paul Portner (p.c.) for consultation on this matter.

As far as temporal reference is concerned, there is clear evidence that non-human great apes can plan for the near future, e.g., the next morning (see Janmaat et al. 2014). As a consequence, the temporal reference in (12) is conceptually unproblematic. (For discussions of whether chimpanzees remember have a concept of past events, see Janmaat et al. 2013.)

A reader may find it more questionable whether the lexical entries associated with chimpanzee gestures should contain presuppositional meaning of the type in (12). To see that this too, is unproblematic, consider the consequences of such an assumption. In humans, the presuppositions of the imperative *Stop doing that* would map onto the felicity conditions (or use conditions) of the imperative: if a speaker utters *Stop doing that* when the recipient is in fact not doing anything, then the imperative would clearly be infelicitous, prompting the recipient to respond by saying *I'm not doing anything*. This would plausibly be accompanied by a gesture / body movement of the type that signals presupposition denial, as described by Francis (2021) with the acronym *WAYTA*, i.e., *What Are You Talking About?!* For chimpanzee meanings, what we would predict is a similar reaction, i.e., bewilderment on part of the recipient if the signaler were to, in fact, communicate (12) in a situation in which the recipient is not engaging in any activity. For reasons that are self-evident, it is difficult to test experimentally if such bewilderment would arise, also since ASOs are defined in terms of recipient responses, which entails that a “Stop that” ASO would never be observed if the recipient wasn't engaging in an activity to begin with. However, for present purposes, there is no evident reason for *not* including assumptions on the recipient's current or prior behavior in the lexical entry of a gesture, as in (12), and presuppositions are one way of modeling this. An alternative would be to assume that gestures with a “Stop that” ASO have it as part of their at-issue entailment that the addressee was engaging in the activity to be stopped; this would eliminate the need to assume presuppositional meaning in non-human great apes. The empirical question remains, in either case, of whether presuppositional meaning is in fact found in non-human primates.

An entirely separate concern with the lexical entry in (12) is whether an imperative with such a meaning wouldn't in fact be vacuous in that every imperative command is an instruction to the recipient to stop doing one thing and do something else instead. For example, if an English speaker were to say *Close the window*, it would generally be the case that the intended recipient is in fact doing something else at the time, which is decidedly *not* a *closing-the-window* activity; this corresponds to the presupposition in (12). Subsequently, the recipient would stop engaging in that *not-closing-the-window* activity in order to close the window; this includes the main contribution suggested by (12). In other words, (12) may be a part of *any* imperative, rather than the specific meaning of “Stop that”.¹⁶ To see that this is intuitive, consider how most imperatives that prompt an immediate action of the recipient could easily be rephrased in *Do something else than what you are doing now, namely ...* Crucially, what sets *Stop doing that* apart from *Close the window* (in humans) is in fact the presuppositional nature of *Stop doing that*. While it is quite natural for a recipient to counter *Stop doing that* with the presupposition-denying response *I'm not doing anything*, as spelled out in (13a), it seems rather deviant to do so in response to a regular ‘garden-variety’ imperative, as shown in (13b). This means that the presuppositionality of (12) is, in fact, not a bug, but a feature of the analysis.

¹⁶ I am grateful to Mats Rooth (p.c.) and Uli Sauerland (p.c.) for highlighting this concern.

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(13) *Difference between “stop that” imperatives and garden-variety imperatives*

- a. A: Stop doing that. – B: I’m not doing anything!
- b. A: Close the window. – B: #I’m not doing anything!

To conclude this section, we can slightly modify the semantics of *Stop that* in (12) in order to model the semantics of *Move away*, as sketched in (14). We return to the similarity between the two denotations in Section 4.3.

(14) $\llbracket \text{Move away (from here)} \rrbracket^c \approx \llbracket \text{Don't be so close to me} \rrbracket^c \approx$

- $[\lambda x : x \text{ is the recipient}_c \ \& \ x \text{ is close to the location of the signaler}_c \text{ at } t_c \text{ in } w .$
 $\exists t [t_c \gg t \ \& \ \neg[x \text{ is close to the location of the signaler}_c \text{ at } t \text{ in } w]]]$

Again, the presuppositional nature of “Move away” can be brought out by a mini dialogue, (15), where B denies A’s presupposition (see Francis 2019 on *even* in presupposition denial.)

(15) A: Move away. – B: I’m not even close to you!

4.2. Exploring the hypothesis space

To conclude our discussion, let us start by revisiting central observations from the previous sections. First, we observed that a total of 14 non-play gestures (from a set of 36 gestures) in Hobaiter & Byrne’s (2014) Table S3 have a most frequent meaning that amounts to “Stop that” ($n=8$) or “Move away” ($n=6$), both of which are negative in their nature. This suggests a partition of gestures into those that are negative/discouraging (including “Stop that” and “Move away”) vs. those that are positive/encouraging (including “Contact” and “Move closer”). Second, we focused on the negative gestures and observed that their semantics may be complex in that they presuppose, in the case study of “Stop that”, that the recipient is currently engaging in an activity, while prompting the recipient to change that activity. We can consider this our Hypothesis 1:

(16) *Hypothesis 1: semantically negative gestures*

- $\llbracket \text{“Stop doing that”} \rrbracket^c \approx [\lambda x : x \text{ is the recipient}_c \ \& \ x \text{ is } \textit{doing-that}_c \text{ at } t_c \text{ in } w .$
 $\exists t [t_c \gg t \ \& \ \neg[x \text{ is } \textit{doing-that}_c \text{ at } t \text{ in } w]]]$

An alternative worth considering is to assume that the core meaning of such gestures is semantically much more minimal, leaving their actual use conditions entirely to the pragmatics. The complexities from (16) may be eliminated by simplifying it to something along the lines of “be still” when it amounts to the cessation of an activity, (17), or “interact with a (contextually salient) other individual” when it amounts to redirecting the recipient’s behavior.

(17) *Hypothesis 2: minimal semantics of negative gestures + pragmatic enrichment*

- ASO:Stop-that $\rightsquigarrow \llbracket \text{“Be still”} \rrbracket^c \approx [\lambda x : x \text{ is the recipient}_c . x \text{ is still}]$

A minimal semantics of this type would require a more heavy (but not implausible) reliance on pragmatics, e.g., by assuming that great apes (much like humans) only command an recipient to *be still* when the recipient is not still to begin with, but rather engaging in

undesirable activity. Similarly, a semantics of “Move away” may not include an “away” component, but simply amount to “move in direction y ”, with a pragmatics that makes the directive infelicitous if the recipient isn’t close to the signaler to begin with.

Issues of this sort, which concern the division of labor between semantics and pragmatics, are not unique to the study of great ape gestures. Similar questions arise with regards to the human *STOP* hand gesture illustrated in (3) and analyzed in (18). Does this gesture *mean* ‘Stay away’ or ‘Don’t come closer’? This may both involve negation and a presupposition that the recipient is moving towards the signaler at the utterance time t_c , as illustrated in (18).

(18) *Hypothesis 1: semantically negative gestures*

$$\llbracket \text{[img alt="A hand gesture with the palm facing forward, fingers spread, and the thumb pointing up." data-bbox="181 311 228 358]} \rrbracket^c \approx [\lambda x : x \text{ is the recipient}_c \ \& \ x \text{ is moving towards the signaler}_c \text{ at } t_c \text{ in } w . \\ \exists t [t_c \gg t \ \& \ \neg[x \text{ is moving towards the signaler}_c \text{ at } t \text{ in } w]]]$$

Or should the meaning of *STOP* be rendered in terms of ‘Be still’, as sketched in (19)? Such questions need to be addressed in future research on the topic; the contribution of the present paper is to raise the question, which I consider to be fundamental for our understanding of directive (‘imperative’) gestures in general, and great ape gestures in particular.

(19) *Hypothesis 2: minimal semantics + pragmatic enrichment*

$$\llbracket \text{[img alt="A hand gesture with the palm facing forward, fingers spread, and the thumb pointing up." data-bbox="181 498 228 545]} \rrbracket^c \approx [\lambda x : x \text{ is the recipient}_c . x \text{ is still}]$$

One evident drawback of the analyses in (17) and (19) is that they do not capture the negative discouraging nature of such gestures in the semantics proper, but rely heavily on the pragmatics to yield discouragement. It is an open question whether this is a desirable result or a concern to be remedied.

4.3. Unifying “Stop that” and “Move away”

Having explored a more minimal analysis of gestures such as “Stop that”, we can return to the observation that great ape gestures are often systematically associated with certain sets of ASOs that do not seem accidental. For example Hobaiter & Byrne’s (2014) Table S3 lists six gestures as occurring with both the “Move away” ASO and the “Stop that” ASO, with the observed frequencies of the ASOs cited in (20).

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(20) *Gestures with ASO “Move away” and “Stop that”, with percentages of observations, from Hobaiter & Byrne (2014), including their tight/loose/ambiguous terminology*

gesture type	ASO	classification
a. HAND-FLING	“Move away” (73%), “Stop that” (27%)	tight
b. SLAP-OBJECT	“Move away” (60%), “Stop that” (13%)	loose
c. PUNCH-OTHER	“Move away” (57%), “Stop that” (29%)	loose
d. TAP-OTHER	“Stop that” (42%), “Move away” (25%)	ambiguous
e. SLAP-OTHER	“Stop that” (64%), “Move away” (32%)	loose
f. PUSH	“Stop that” (78%), “Move away” (22%)	tight

The abstract building blocks of meaning that we are looking for when we explore the possibility of gestural meanings that non-human great apes share with humans would plausibly amount to the common denominators of “Stop that” and “Move away”. Such a “no/not” meaning atom is relatively easy to spell out in the more complex analysis of Section 4.1, as given in (21a). Here, P_c would be a contextually provided property, for which the specifications for “Stop that” and “Move away” are given in (21b-c). An attentive reader might notice that (21a) roughly amounts to the general meaning of “Stop!”.

(21) *Common denominator of “Stop that” and “Move away”*

- $\llbracket \text{Not X!} \rrbracket^c \approx [\lambda x : x \text{ is the recipient}_c \ \& \ P_c(x, t_c, w) . \exists t [t_c \succ t \ \& \ \neg [P_c(x, t, w)]]]$
- “Stop that”: $P_c(x, t, w) = x$ is *doing-that*_c at t in w
- “Move away”: $P_c(x, t, w) = x$ is close to the location of the signaler_c at t in w

We can thus conclude that (21a) may be a building block of meaning present in great apes; this building block is plausibly shared by humans and non-human great apes (compare Patel-Grosz et al. 2023), indicating that it may be a semantic universal. The larger project involves the determination of a more extensive set of such building blocks by carefully looking at systematic ASO overlaps of the type found in (20).

5. Conclusion: revisiting building blocks of meaning and the consequences

This paper outlined a larger project with the premise that we can learn something about human gestural universals (and thus, possibly, human semantic universals) by looking at the gestures that humans share with non-human primates, and their meanings. The main contribution of this paper is to outline a methodology for determining the actual building blocks of meaning that may play a role in such an exploration. In doing so, we proceeded from the ASOs proposed in primatology, e.g., Hobaiter & Byrne’s (2014) “Stop that” in (22a) and “Move away” in (22b). We then outlined a potential mapping onto an abstract lexical entry, sketched in (21a), building on established analyses of imperatives in human language.

(22) *from the ASOs of primatology to the lexical entries of formal semantics*

- ASO:Stop-that ... the recipient either ceases behavior previously directed towards the signaler or changes their behavior to direct it towards another individual
- ASO:Move away ... recipient moves away from signaler

Importantly, the idea that (21a) may be a universal building block of meaning has consequences not only for our understanding of human and non-human great apes, and for our understanding of directive (‘imperative’) gestures, but also for our understanding of semantic universals in pragmatic gestures. A wide-spread view (see, e.g., Abner et al. 2015:439) maintains that the management of discourse objects (i.e., information or topics in a discourse) can be metaphorically modelled as the management of virtual objects (McNeill’s 1992 *conduit metaphor*). Particularly for the case of the gestures in (20), such metaphoric transfer can now be modeled quite directly. *HAND-FLING*, (20a), has been argued to fulfil the pragmatic function of rejecting a proposition ϕ that has been proposed (by the recipient) as an addition to the common ground (Patel-Grosz et al. 2023). Maintaining the core meaning in (21a), in (23a), we can transparently derive the meaning of *HAND-FLING* in (23a-b).

(23) *Revisiting pragmatic uses of HAND-FLING*

- a. $[[\text{Not } X!]]^c \approx [\lambda x : x \text{ is the recipient}_c \ \& \ P_c(x, t_c, w) . \exists t [t_c \succ t \ \& \ \neg[P_c(x, t, w)]]]$
- b. *pragmatic use*: $P_c(x, t, w) = x$ proposes at t_c in w that the proposition ϕ be added to the common-ground_c of x and the signaler_c

This additional step from the shared directive gestures of primates to the pragmatic gestures of humans allows us to connect these findings to the question of universals in human pragmatic gestures, as in the findings of Bressemer & Müller’s (2014, 2017) family of *Away gestures*.

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