

The primate gestural meaning continuum¹

Pritty Patel-Grosz

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Abstract

Research in formal theoretical semantics has recently expanded its scope to include gestural communication, focusing in particular on gestures that contribute to the content of an accompanying utterance, e.g., size gestures (*LARGE*, *WIDE*), pointing gestures, and gestures that depict objects (*TELESCOPE*) or actions (*SLAP*). At the same time, fruitful inquiries at the intersection of primatology and linguistics have given rise to the hypothesis that human and non-human great apes share a common set of directive (=imperative) gestures. Directive gestures such as *STOP* or *COME-CLOSER*, pose non-trivial issues for a semantic analysis: we inherit the challenges that pertain to the analysis of imperative utterances (*Come closer!*), while adding a further challenge that stems from the underspecified mapping between a directive body movement and its potential counterparts in human language. We begin by outlining the problem and surveying the nascent state-of-the-art with regards to a formal semantics of directive gestures. Particular attention is given to the multifunctionality of directive gestures, which typically have different effects in different contexts; for example, a non-human ape gesture may communicate “Stop that” in some contexts and “Move away” in others, with similar patterns found in humans. We show that this multifunctionality can be derived from a single, rich abstract lexical entry, “Not...!”, a candidate for a universal building block of meaning, shared by human and non-human great apes. “Not...!”, which incorporates negation/rejection, temporal reference and presuppositionality is more explanatory in comparison to a minimal alternative. This chapter lays out the hypothesis space, addressing the foundational question of how to explain attested gestural overlap between human and non-human great apes. We conclude the chapter by reviewing potential expansions of the analysis to the pragmatic gestures of humans, which are thus placed on the primate gestural meaning continuum and connected to the directive gestures we share with our non-human relatives in the great ape family.

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

1. Introduction

The ubiquity of directive (=imperative) gestures is best illustrated with a concrete example. We can imagine a situation where our office is on the ground floor, the window is open, and there is a busy footpath outside, leading past the window. A colleague enters the office; as we

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greet them, they raise an index finger in front of their lips and use a head tilt to nod towards the window. Quite naturally, we will understand their two body movements to communicate two separate imperatives: *Don't speak!* and *Close the window!* Presumably, they have entered the office in order to discuss the planning of a surprise birthday celebration...or something more sinister. What is important for the purpose of this article is that we have encountered two body movements that map onto an imperative meaning. It is this type of body movement that we set forth to explore in this article.

2. Current perspectives on gestures

2.1 Gestures as an object of inquiry in theoretical semantics

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 seen the emergence of formal semantics work on gestures (e.g., Lascarides & Stone 2009a,b, Ebert & Ebert 2014, Schlenker 2018, Esipova 2019, Ebert 2024). This signifies a new chapter in formal semantics that embraces multimodality as an important aspect of human language.

Much of the abovementioned formal semantics literature has focused on gestures that add descriptive content to the accompanying speech; such gestures are called **representational gestures** in Abner et al. (2015:438), a term that traces back to Freedman (1972) (see Kendon 1986). Examples of representational gestures include 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 (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.

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). A concrete example of a pragmatic gesture is given in (2), namely the *throwing away* gesture *THROW* (see, e.g., Bresse & 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 concerns by virtue of *THROW*.

(2) Context: Alex and Sam are dancing at a club, it is 3am
a. Alex: It's getting late.

² Italicized words in all caps (e.g., *LARGE* and *SLAP*) are used to refer directly to the gestures.

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.

- b. Sam: Tomorrow is Sunday+*THROW* (Francis et al. 2023:3, slightly adapted)

2.2 Directive gestures: a new frontier


2.2.1 Definitions and illustrations

In this handbook chapter we focus on a third type of gesture, which we call **directive gestures**, defined 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 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). Bullinger et al. (2011) circumvent this issue by using the term *imperative/directive gesture*, but this disjunctive term is too unwieldy for practical purposes. I will thus use the term *directive* in this article.

Examples of directive gestures include the *STOP* gesture in (3). 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)⁵

The *STOP* gesture is plausibly one of the cross-culturally most recognizable directive gestures.⁶ A depiction of this gesture has been included in road signs, as illustrated by the historical Finnish stop sign in (4) and the existing Norwegian road sign in (5).

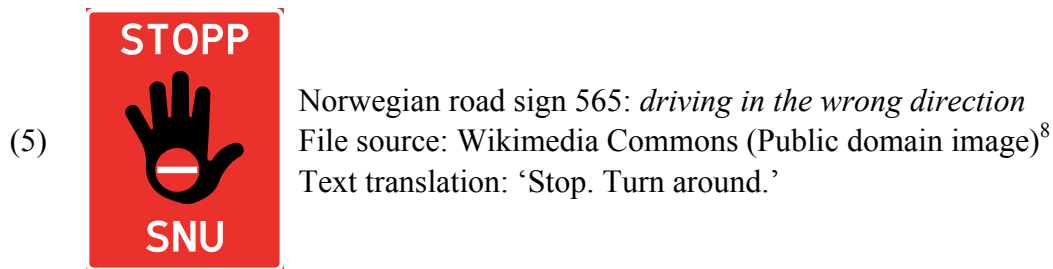
- (4)  Historical stop sign for Finland (1957-1971)
File source: Wikimedia Commons (Public domain image)⁷

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

⁵ URL: <https://www.pexels.com/photo/a-woman-doing-a-stop-hand-gesture-10545012/> (Last accessed on 21st June 2024.)

⁶ The *STOP* gesture is also related to the *holding away* gesture, see Bressem & Müller (2017:3) for discussion.

⁷ URL: [https://commons.wikimedia.org/wiki/File:Finland_road_sign_232_\(1957%E2%80%931971\).svg](https://commons.wikimedia.org/wiki/File:Finland_road_sign_232_(1957%E2%80%931971).svg) (Last accessed on 21st June 2024.)



In the absence of any linguistic material, it is not trivial to describe the meaning of the *STOP* gesture in (3); 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 possibilities). It is a central challenge in the analysis of directive gestures to determine how much semantic content is in fact encoded by the gestures, and what is left to the pragmatics; in other words: do the meaning of directive gestures contain the semantics of modal operators such as *want*, *must* or *cannot*? This challenge highlights the usefulness of a richer, more abstract semantic analysis, as outlined in Section 5.

2.2.2 The multifunctionality problem

A central phenomenon that we encounter can be descriptively referred to as **multifunctionality**, and defined as follows: an expression is *multifunctional* if its use has different functions depending on the context. We define **function** as the communicative effect of a gesture, e.g., as measured by an appropriate response of the recipient. 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 such contexts, the function of the gesture is to stop the recipient from approaching. 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: what does the gesture in (3) denote (= its semantics), and which aspects of the gesture's use are due to pragmatic/contextual enrichment? Accordingly, we define the **meaning** of a gesture as the lexical entry associated with the gesture, i.e., its semantic denotation. The distinction between meaning and function will be crucial for a true understanding of directive gestures, particularly when we compare the gestures of humans to the gestures of non-human great apes.

Two concepts from linguistics are relevant for the analysis of 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

⁸ URL: https://commons.wikimedia.org/wiki/File:NO_road_sign_565.svg Legal source text for the sign: <https://lovdata.no/dokument/SF/forskrift/2005-10-07-1219> (Both links last accessed on 21st June 2024.)

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.⁹ The question of whether the case of multifunctional directive gestures involves homonymy or non-specification will be central to the discussion in Section 5.

Note that the closest spoken-language counterpart to multifunctional directive gestures are one-word directive utterances such as the imperative *Stop!* (which shares most of the properties of the *STOP* gesture), or the exclamation *Here!* Two contexts for *Here!* are provided in (6) and (7); crucially, the meaning of Alex’s utterance in (6b) and (7b) cannot be equated with the pragmatically enriched communicative intention in (6c) and (7c), which amounts to its function. Most plausibly, *Here!* has a quite minimal (and not inherently directive) semantics, roughly along the lines of ‘(this is) my location’.¹⁰ The non-trivial semantics-pragmatics mapping from such a minimal semantics to the perceived communicative intention will often be at fault for the observed multifunctionality of expressions such as directive gestures.

- (6) a. *Context: Alex is sitting at a table in a moderately busy restaurant. Sam enters the restaurant, scanning the room for a familiar face.*
 b. *Alex exclaims: Here!*
 c. ↷ communicative intention: ‘Come and join me at my table!’
- (7) a. *Context: Alex is sitting at a table with five other people. The waiter arrives, holding a glass of orange juice, and looks at the table in a confused way.*
 b. *Alex utters: Here!*
 c. ↷ communicative intention: ‘Give the orange juice to me!’

In the same way in which an utterance of *Here!* is not inherently directive or imperative, directive gestures may not be inherently directive. Most gestures that have a representational use (= a “declarative gesture” use) can also be used in a directive way (= an “imperative gesture” use). A directive use is illustrated for the *SLAP* gesture in (9), which contrasts with the more familiar representational use in (8).

- (8) *SLAP as a representational gesture*
 a. Sam fixed+*SLAP* the vending machine.
 b. ↷ Sam fixed the vending machine by slapping it.

⁹ *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.

¹⁰ More formally, we could say that, in a given utterance context *c*, the following holds, where *here* denotes the location in which it is uttered, i.e., the location of the speaker (see Kaplan 1989, Predelli 1998):

i. $[[here]]^c = \text{location}_c$

(9) *SLAP as a directive gesture*

- a. *Context: Alex has put money into a vending machine in order to purchase a snack. However, nothing is happening. Alex turns to Sam.*
Alex: It stopped working again.
Sam looks at Alex and responds with a silent gesture: *SLAP*
- b. ↷ communicative intention: ‘Give it a slap!’ / ‘Slap it!’

Similarly, there is a long tradition of research on pointing gestures in children, which compares representational uses (typically labeled *declarative pointing*) and directive uses (typically labeled *imperative pointing*); see Bates et al. (1975), Camaioni (1997), Tomasello et al. (2007), and Cochet & Vauclair (2010, 2014). A connection between gestural pointing and human-language expressions such as *Here!* and *There!* is self-evident.

2.3 The view from primatology and human meaning universals

An issue that dates back to the teachings of Quintillian in 95 C.E is whether there are universals in human gestures. 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, recent advances in primatology (such as Byrne et al. 2017, Graham et al. 2018 and Kersken et al. 2019) allow us to take the gestures of great apes as our point of departure. Specifically, we expect to gain insight in human gesture universals by looking at gestures that humans appear to be share with bonobos, chimpanzees, gorillas and orangutans.

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. While published studies on the gestures of human children and chimpanzees focus on the form of the gestures,¹¹ 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 more than 1 million years ago. More recently, it has been shown that human adults perform above chance in correctly guessing established functions of great ape gestures, both when watching videos of actual great apes in the wild (Graham & Hobaiter 2023), and when watching videos in which the gestures are performed by a human expert (Henderson et al. 2024). We thus observe that human children produce similar gestures to the ones found in non-human apes, and human adults correctly recognize the functions of non-human ape gestures; this indicates an overlap in form and meaning between the gestures of humans and non-human great apes. It is an open question whether this overlap is due to a shared innate gestural repertoire (as suggested in some of the primatology literature), or alternatively, to resemblance-based (iconic) properties of the gestures coupled with general cognitive abilities.

¹¹ For example, the *BECKON* gesture is defined as “Hand moved in a sweep from elbow or wrist towards signaller” (Byrne et al. 2017:758).

The hypothesis space is as follows:

(i) **Gestural innateness:** individual gestural form-meaning pairings are inherited and hard-wired in the brain of a newborn human or ape (see Byrne et al. 2017); let us exemplify this hypothesis for a *BECKON* gesture a signaler produces with the intention of getting the recipient to move closer. Under the gestural innateness hypothesis, human and non-human apes are born with knowledge about the form and meaning of the *BECKON* gesture; the evolution of such innate knowledge is attributed to **phylogenetic ritualization**, where body movement that originally amounted to a functional action (e.g., pulling the recipient closer) has been detached from its original function and become a communicative signal (see Perlman et al. 2012:56-58).

(ii) **Iconicity:** a repertoire of gestural forms are innate (see Hobaiter & Byrne 2017, Kersken et al. 2019 for arguments), but shared meanings are associated with gesture forms on the basis of an iconic system: infants who learn to communicate associate a gesture form with its meaning on the basis of resemblance between the gesture and the actions that it is intended to evoke (see Perlman et al. 2012:58-59). In order to account for form-meaning overlap between the gestures of humans and non-human great apes, the iconicity hypothesis would require an assumption that the iconic system itself is innate, even though individual form-meaning pairings in gestures may not be innate.

(iii) **Ontogenetic ritualization:** The most deflationary view maintains that form-meaning overlap is due to an association of body movements with a possible function through the lifetime of an individual infant, without either the form or the meaning being innate (Call & Tomasello 2007, Tomasello 2008; see Perlman et al. 2012:58). To exemplify, young children may experience body movements that resemble a *BECKON* gesture as part of a functional action of being pulled closer by somebody, as a consequence of which they would associate the gesture with the same function (“come closer”) even in the absence of the pulling action.

The jury is still out on which hypothesis is ultimately correct, and a hybrid outcome is conceivable, where some individual gestures find an explanation in the gestural innateness hypothesis whereas others are explained by iconicity (or ontogenetic ritualization). However, as argued by Perlman et al. (2012), the variability in how gestures are realized generally favors iconicity over ontogenetic ritualization, since ontogenetic ritualization would predict that the gestures are realized in a more stable manner.

The overlap between human children and chimpanzees with regards to the form of gestures, and the plausible assumption that there is also an overlap in meaning as detectable in the behavior of human adults, 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, more than 6 million years ago (see, e.g., Pozzi et al. 2014), and would thus be shared by *all* present-day humans, who plausibly share the same ancestor. This is a prediction from the gestural innateness hypothesis (though some meaning similarities shared by humans and non-human great apes may have arisen by chance or due to convergent evolution). A variant of this prediction also arises under the iconicity hypothesis, if we make the plausible assumption that an innate iconic system generates analogous iconic

inferences from innate gesture forms across species and individuals. 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.¹² We may now proceed to address the question of what such universal building blocks of meaning may look like.

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, a formalism is needed 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 3 sketches an outline of a formal semantic approach to directive gestures. Subsequently, Sections 4 and 5 return to the comparison between humans and great apes, while Section 6 illustrates how the proposed semantics can be expanded to pragmatic gestures, plausibly unique to our species.

3. Directive gestures and the semanticist’s toolbox

Historically, much research on the semantics of human-language expressions focused on declarative statements and, at a later point, interrogative questions. The last 20 years have seen an increased focus on the third major sentence type, namely imperatives. As of now, a range of competing approaches to imperatives are on the market, three of which are illustrated in (10) for the human-language imperative *Move closer!* (modeled after Rudin 2018:106-109). Portner’s (2007) approach, (10a), 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 make true 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*), (10b). Condoravdi & Lauer (2012, 2017), by contrast, argue that imperatives encode a preference of the speaker, (10c), which the imperatives make public.

(10) *Informal renderings of different approaches to human language imperatives*

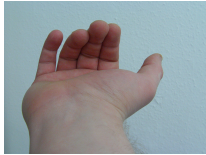
- a. $[[\textit{Move closer}]] \approx_{\text{(à Portner)}} [\lambda x : x \text{ is the recipient} . x \text{ moves closer to the speaker}]$
- b. $[[\textit{Move closer}]] \approx_{\text{(à Kaufmann)}} [[\textit{I hereby decree that you must move closer to me}]]$
- c. $[[\textit{Move closer}]] \approx_{\text{(à Condoravdi \& Lauer)}} [[\textit{I want you to move closer to me}]]$

For our illustration in (10), the imperative *Move closer!* was chosen on the grounds that the set of directive gestures in humans cross-culturally includes a *BECKON* gesture, (11), which has a roughly equivalent communicative function.¹³ We can thus hypothesize that an analysis along the lines of the options in (10) would also apply to the gestural counterpart in (11).

¹² On the topic of semantic universals, see, e.g., Wierzbicka (1996), von Stechow and Matthewson (2008).

¹³ Note that the palm-up variant of the *BECKON* gesture is not in universal use; in many countries, a palm-down version is used (see, for example, Bishop & Cartmill 2021:269 for discussion). Both (11) and a version that uses an index finger rather than the open hand for beckoning is considered to be offensive in many cultures (see, for example, Brookes 2014:1151 on Bantu language speakers in South Africa).

(11)



Beckoning hand

Author: Richard North

File source: Wikimedia Commons (CC BY 2.0 license)¹⁴

Out of the approaches in (10), Portner's in (10a) has a clear advantage for the analysis of gestures in that it assumes a minimal semantics with a richer pragmatics. Alternative approaches such as (10b-c) typically assume the presence of a covert modal in human language imperatives (e.g., *must*), and there is no reason to assume that such linguistic entities are covertly present in a beckoning gesture or a stop gesture. Moreover, the observation that many representational gestures can also be used directly, as illustrated in example (9) of Section 2.2.2, naturally falls out of a Portner-style approach. Formal semantics approaches to representational gestures typically focus on how the gestures interact with accompanying speech (see Ebert 2024 for an overview), and do not extensively explore the denotations of the gestures themselves. However, it seems straightforward to assume that a slapping gesture denotes an event description, (12a), or, to facilitate a connection to Portner's imperative semantics, a property of an individual (much like the denotation of Verb Phrases assumed in Heim & Kratzer 1998:29), (12b).

- (12) a. $[[SLAP]] = [\lambda e . e \text{ is a slapping event}]$
b. $[[SLAP]] = [\lambda x . \text{there is a slapping event and } x \text{ is its agent}]$

A directive use of the *SLAP* gesture (along the lines of 'Slap it!' or 'Give it a slap!' in the vending machine example (9)) would require a minor modification to (12b) in Portner's model, namely the addition of a presupposition that the denoted property has the recipient as its property-holder, as given in (13).

- (13) $[[SLAP_{\text{directive}}]] = [\lambda x : x \text{ is the recipient} . \text{there is a slapping event and } x \text{ is its agent}]$

The semantics of (13) 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. We can thus provide a formal semantic analysis of the beckoning gesture, (14); since many directive gestures involve indexical reference towards the speaker/signaler as well, we can add a context parameter *c* and relativize the speaker/signaler and recipient to the context in which the gesture is performed. The analysis (14) glosses over one important fact: even the beckoning gesture is multifunctional in that it also has a use where it communicates 'Give it to me!' or 'Bring it over to me!' rather than 'Come closer!' – an adequate analysis should posit a much more general lexical entry than (14), which would allow for the multifunctionality to arise in a suitable context. We now turn to the comparison between human and non-human ape gestures, and revisit the multifunctionality issue in Section 5.

¹⁴ [https://commons.wikimedia.org/wiki/File:Beckoning_hand_\(6884592914\).jpg](https://commons.wikimedia.org/wiki/File:Beckoning_hand_(6884592914).jpg) (Last accessed on 21st June 2024.)

(14) *Analysis sketch of a beckoning gesture*



$\llbracket \text{ } \rrbracket^c = [\lambda x : x \text{ is the recipient}_c . x \text{ moves closer to the signaler}_c]$

4. From humans to non-human great apes (and back)

4.1 Apparently Satisfactory Outcomes as a tool to gauge gesture functions

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 an 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 2.2.1 of this chapter; in other words: they are attempts by the signaler to elicit an action from the recipient (see, e.g., Gómez et al. 1993, Tomasello & Camaioni 1997 for discussion).

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 S1,¹⁵ “Move closer” is defined more technically as “recipient moves closer to signaler”.¹⁶ The notion of ASOs is quite parallel to our definition of *function* in Section 2.2.2, but note that research in biology/primatology uses the term *function* differently (see Allen & Neal 2000).

4.2 Comparing ASOs to denotations

There is a non-trivial question of how ASOs relate to meanings in the linguistic sense, as defined in Section 2.2.2, i.e., the denotations or lexical entries of given expressions. 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”. Generalizing over these two templates, we can say that ASOs are oriented exclusively towards a recipient and an outcome. In a linguistic analysis, this is equivalent to rendering the meaning of the human-language imperative *Move closer!* by virtue of the paraphrase “addressee moves closer to speaker” – which we have done in (10a) and (14). We can thus apply Portner’s (2007) approach to imperatives to the semantics of ape gestures, using ASOs as our point of departure. This further corroborates the intuition pursued in Section 3 that Portner’s approach is more suitable for directive gestures than the

¹⁵ Table S1 and S3 of Hobaiter & Byrne (2014) are found in the *Supplemental Information* document.

¹⁶ 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*).

alternatives in (10b) and (10c). The alternative approaches entail semantically represented modality (e.g., *must* or *want*), and there is no reason to assume that the meanings of ape gestures contain the respective modal operators. As a general approach, we can thus use Portner’s approach to model the semantics of directive gestures, both in non-human apes and in humans.

An informal notation for translating ASOs into semantic denotations is given in (15), where Hobaiter & Byrne’s (2014) “Move closer” ASO in non-human apes is mapped onto a Portnerian denotation by virtue of a wave arrow. It is no coincidence that the Portner-style rendering of the “Move closer” ASO is equivalent to the denotation of the beckoning gesture in (14).

(15) 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 (16) for Hobaiter & Byrne’s (2014) “Initiate grooming” ASO.

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

Note that the lambda notation in (14)-(16), which treats gesture meanings as expressions of property type $\langle e, t \rangle$ may suggest a compositionality of gesture meanings that has not been demonstrated in non-human great apes. However, 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. The question to be addressed in Section 5 is whether (14)-(16) are an adequate representation of the gestures’ *meanings*, as defined in Section 2.2.2; in what follows, we will answer this question in the negative, i.e. we will treat ASOs as gesture functions, and not as gesture meanings in a linguistic sense.

5 Core Meanings: towards meaning atoms of ape gestures

5.1 Revisiting the multifunctionality problem

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 of gestures. 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. (This selection is not exhaustive in that, e.g., Hobaiter & Byrne 2014:1596 document 19 ASOs and 66 gestures.)

To make 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 exclusively 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.

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 chapter, 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 Section 5.4 that assumes non-specification rather than lexical ambiguity (see Section 2.2.2), suggesting that abstract semantic analyses of this type are possible for many multifunctional gestures.

5.2 A formal semantics solution to the multifunctionality problem

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%),¹⁷ 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 5.3–5.4 show that a formal semantics toolkit, as introduced in Section 3, 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.

Many elements in human language 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 (17)

¹⁷ Graham et al. (2018) use the label “Stop behaviour”, while Hobaiter & Byrne (2014) use “Stop that”.

(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).

- (17) *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 directive utterances in human language may easily involve non-specification. In Sections 5.3–5.4, this is illustrated for the exclamation *Here!* and the imperative *Stop!*, which can serve as a blueprint for the analysis of two distinct sets of great ape ASOs.

5.3 Case study I: *Here!* as a core meaning

Reconsider the two contexts for an exclamation *Here!* that were provided in (6) and (7) in Section 2.2.2. In one context, (6a), the English-language utterance *Here!* may communicate ‘Come and join me.’ whereas it would communicate ‘Give it to me.’ in a different context, (7a). If we were to apply the ASO methodology from Section 4.1 to humans (compare Kersken et al. 2019) and describe the meaning of *Here!* on the basis of ASOs, we would arrive at exactly the same multifunctionality for *Here!* that has been attested for a range of ape gestures. In fact, gestures that occur with both the ASO “Move closer” and the ASO “Give it to me” in chimpanzees include *ARM-RAISE*, *TOUCH-OTHER*, *DIRECTED-PUSH*, *OBJECT-SHAKE*, and *REACH* (Graham et al. 2018:9), i.e., at least five distinct gestures.

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 (18),¹⁸ 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 (18) are adapted from the ASOs of Hobaiter & Byrne’s (2014) Table S1, see Section 4.2.)

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

¹⁸ Notationally, (18) models ape gesture meanings the way imperatives are modeled in (10a), while sketching an approach based on lexical ambiguity, i.e., homonymy, which subscripts the ASOs onto 5 distinct lexical entries.

For a researcher pursuing an explanatory 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 (18) derive from one single abstract lexical entry (= the **non-specification hypothesis**), which would eliminate homonymy from the analysis of *ARM-RAISE* in favor of non-specification; but it is equally conceivable that the five observed readings derive from two abstract lexical entries, allowing for residual homonymy in combination with non-specification (= the **homonymy plus non-specification hypothesis**). The worst-case scenario would be one in which five distinct lexical entries are needed (= the **homonymy hypothesis**), 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. The connection between “Move closer” and “Give it to me” that we not only observed in great ape gestures, but also in the English language expression *Here!* strongly suggests that at least the ASOs in (18a) and (18c) can be reduced to one core meaning (with non-specification); this core meaning plausibly builds on whatever is the most adequate semantic analysis of the deictic adverb *here*; an illustration of what directive *Here!* may denote is given in (19), which amounts to an imperative that means ‘Engage with my location!’ – depending on the context, this may be pragmatically enriched to mean ‘Move yourself into my location!’ or ‘Put the object that you are holding into my location!’

(19) $[[\textit{Here!}]]^c = [\lambda x : x \text{ is the recipient}_c . x \text{ engages with the location of signaler}_c]$

5.4 Case study II: *Not...!* as a core meaning

Turning our attention to “Move away” in (18b) and “Stop that” in (18d), we observe that both of them are negative in nature. Once again, we observe that negative/prohibitive human language imperatives may easily involve non-specification, as illustrated by the English imperative *Stop!*, which is as multifunctional as the corresponding gesture discussed in Section 2.2.1. 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” (to capture a use along the lines of *Stop coming closer!*) and “recipient is silent” (to capture a *Stop speaking!* use).

Looking at the findings of Hobaiter & Byrne (2014) and Graham et al. (2018), one noticeable ASO overlap concerns the ASOs “Move away”, “Stop that” and “Follow me”, as defined in (20). Cumulatively, the two articles 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.

(20) *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 (20), 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 5.1 (= 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 (20) is *ARM-RAISE*, which occurs in the “Move away” meaning 19% of the time and in the “Stop that” meaning 11% of the time.¹⁹ *ARM-RAISE* is most frequently associated with “Acquire object” (48%) and counts as an “ambiguous” gesture in the sense of our Section 5.1 discussion (= no ASO more than 50% of the time).

What stands out about the set of meanings in (20) 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”). The relevance of locational components such as *Here!* was already discussed in Section 5.3, so we can now turn to the negative component. The idea that such a negative component may be a central feature of relevance 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, 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.

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 5.4.1. This is contrasted with a more minimal analysis in Section 5.4.2. As shown in Section 5.4.3, support for the more complex analysis stems from its potential for unifying “Stop that” and “Move away” at an abstract level.

5.4.1 Formalizing “Not...!”

Focusing on the ASOs “Stop that” and “Move away”, a central commonality 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 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

¹⁹ These two ASOs correspond to (18b) and (18d). A noteworthy observation is that the remaining three ASOs of *ARM-RAISE*, (18a), (18c) and (18e), all involve movement *towards* the signaler.

Stop doing that) is not expressed at the clausal level, but contained in the predicate *stop*. Similarly, the negativity of *Move away (from me)* is not expressed at the clausal level in spoken language, but contained in the locative adverb *away*.

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 (20a) 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.²⁰ 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 (21), which models it as the denotation of an English-language utterance for ease of exposition; (21) incorporates the meaning of the word *stop* from Zehr & Schwarz (2018:465).

In the denotation part of (21), 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 (21) are, of course, possible; however, as of now, (21) 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.

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

One central implication of (21) is that a lexical entry along these lines contains logical negation, 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. A minimal alterative is introduced and rejected in Section 5.4.2-5.4.3 due to its lack of explanatory adequacy. At present, we address whether such meaning components — temporal reference, presuppositions and negation — have cognitive reality in non-human great apes.

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 (21) is conceptually sound. (For discussions of whether chimpanzees remember past events, see Janmaat et al. 2013.)

Let us consider the consequences of assuming presuppositional meaning in lexical entries associated with chimpanzee gestures. In humans, the presuppositions of the imperative *Stop*

²⁰ I am grateful to Paul Portner (p.c.) and Chris Barker (p.c.) for consultation on this matter.

doing that would map onto its felicity conditions (or use conditions): 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, we predict a similar reaction, i.e., bewilderment on part of the recipient if a signaler were to communicate (21) in a situation in which the recipient is not engaging in any activity. In line with this prediction, the lexical entry of a gesture such as (21) encodes the signaler's assumptions on the recipient's current or prior behavior, and presuppositions are one way of modeling them. 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 presuppositions in non-human great apes. It remains an open question whether presuppositional meaning is present in non-human primates.

Finally, (21) suggests that the gestural meanings of great apes, which have been conjectured to be present in human children, contain something along the lines of logical/propositional negation. Here, it is critical that the relevant notion of negation is understood to encode REJECTION, a mental state, rather than a logical operation that reverses the truth value of propositional content (if $p(w)=1$, then $\neg p(w)=0$); the lexical entry glosses over this distinction and models REJECTION in terms of logical negation for reasons of simplicity. REJECTION is one of the earliest communicative acts attested in human children (see Beaupoil-Hourdel et al. 2016; McDermott-Hinman & Feiman, in press), and plausibly found in non-human great apes as well.²¹

To conclude this section, we review the question of how the lexical entry in (21) sets *Stop doing that* apart from a garden-variety imperative command such as *Close the window*. Every imperative command may be construed as 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 doing something else at the time, which is not a *closing-the-window* activity; this resembles the presupposition in (21). Subsequently, the recipient would stop engaging in the *not-closing-the-window* activity in order to close the window; this resembles the main contribution suggested by (21). In other words, aspects of (21) may be found in a larger number of imperative commands, beyond the specific meaning of "Stop that".²² Crucially, what sets *Stop doing that* apart from *Close the window* (in humans) is its presuppositional component. 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 (22a), it seems rather deviant to do so in response to a regular 'garden-variety' imperative, (22b). This means that the presuppositionality of (21) is central to an understanding of what *Stop doing that* communicates.

(22) *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!

²¹ Many thanks to Cat Hobaiter (p.c.) and Catherine Crockford (p.c.) for exchanges on this point from a primatology perspective.

²² I am grateful to Mats Rooth (p.c.) and Uli Sauerland (p.c.) for highlighting this concern.

We may take the discussion one step further, by slightly modifying the semantics of *Stop that* in (21) in order to model the semantics of *Move away*, given in (23). This is desirable, since the two functions are often associated with the same gesture. The presuppositional nature of “Move away” can also be brought out by a mini dialogue, (24), where B denies A’s presupposition (see Francis 2019 on *even* in presupposition denial).

(23) $[[\textit{Move away (from here)}]]^c \approx [[\textit{Don't be so close to me}]]^c \approx [\lambda x : x \text{ is the recipient}_c \ \& \ x \text{ is close to the location of the signaler}_c \text{ at } t_c \text{ in } w_c . \exists t [t_c \gg t \ \& \ \neg[x \text{ is close to the location of the signaler}_c \text{ at } t \text{ in } w_c]]]$

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

We return to the similarity between (21) and (23) in Section 5.4.3.

5.4.2 Exploring the hypothesis space: a more minimal alternative

At this point, the question arises whether complex denotations of the type given in (21) and (23) are justified. To address this question, 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:

(25) *Hypothesis 1: semantically negative gestures*
 $[[\textit{Stop doing that}]]^c \approx [\lambda x : x \text{ is the recipient}_c \ \& \ x \text{ is } \textit{doing-that}_c \text{ at } t_c \text{ in } w_c . \exists t [t_c \gg t \ \& \ \neg[x \text{ is } \textit{doing-that}_c \text{ at } t \text{ in } w_c]]]$

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 (25) may be eliminated by simplifying “Stop doing that” to something along the lines of “Be still” when it amounts to the cessation of an activity, (26), or “Interact with a (contextually salient) other individual” when it amounts to redirecting the recipient’s behavior.

(26) *Hypothesis 2: minimal semantics of negative gestures + pragmatic enrichment*
 $\text{ASO:Stop-that} \rightsquigarrow [[\textit{Be still}]]^c \approx [\lambda x : x \text{ is the recipient}_c . x \text{ is still}]$

A minimal semantics of this type would require a heavier (but not implausible) reliance on pragmatics, e.g., by assuming that great apes (much like humans) only command a 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 *STOP* hand gesture in humans, illustrated in (3)-(5) and analyzed in (27)-(28). 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 (27). Alternatively, the meaning of *STOP* could be rendered in terms of ‘Be still’, as sketched in (28).

(27) *Hypothesis 1: semantically negative gestures*



$$\llbracket \text{Image} \rrbracket^c \approx [\lambda x : x \text{ is the recipient}_c \ \& \ x \text{ is moving towards the signaler}_c \text{ at } t_c \text{ in } w . \\ \exists t [t_c \gg t \ \& \ \neg[x \text{ is moving towards the signaler}_c \text{ at } t \text{ in } w]]]$$

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



$$\llbracket \text{Image} \rrbracket^c \approx [\lambda x : x \text{ is the recipient}_c . x \text{ is still}]$$

One evident drawback of the minimal/deflationary analyses in (26) and (28) 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.

5.4.3 Advocating for a richer semantics: unifying “Stop that” and “Move away”

Having explored a more minimal analysis for gestures with a “Stop that” function, 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 (29).

(29) *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 “Not...!” meaning atom is relatively easy to spell out in the more complex analysis of Section 5.4.1, as given in (30a), which roughly amounts to the general meaning of “Stop!”. Here, P_c would be a contextually provided property, for which the specifications for “Stop that” and “Move away” are given in (30b-c).

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

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

We can thus conclude that (30a) 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 programme involves the determination of a more extensive set of such building blocks by carefully looking at systematic ASO overlaps of the type found in (29).

6. Outlook: from directive gestures to pragmatic gestures

This chapter proposes an expansion of formal semantic inquiry to directive gestures as a new object of study. It outlines 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 directive gestures that humans share with non-human primates and their meanings. We provide a methodology for determining the actual building blocks of meaning that may play a role in such an exploration. In so doing, we introduced the basics of a suitable formal semantic analysis of directive gestures, which was then used to replace the ASOs proposed in primatology, e.g., Hobaiter & Byrne’s (2014) “Stop that” in (31a) and “Move away” in (31b), culminating in the abstract lexical entry in (30a), building on established analyses of imperatives in human language.

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

Importantly, the idea that (30a) may be a universal building block of meaning has consequences not only for our understanding of directive (‘imperative’) gestures in human and non-human great apes, but also for our understanding of semantic universals in pragmatic gestures. A widespread 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 (29), such metaphoric transfer can now be modeled

quite directly. *HAND-FLING*, (29a), has been argued to fulfil the pragmatic function of rejecting a proposition φ_c that has been proposed (by the recipient) as an addition to the common ground (Patel-Grosz et al. 2023). Maintaining the core meaning from (30a), we can transparently derive the pragmatic meaning of *HAND-FLING* in (32a-b).

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

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

This first step from the shared directive gestures found in the primate family to the pragmatic gestures of humans showcases the added potential of the approach presented in this chapter for exploring universals in human pragmatic gestures. It highlights the gestural meaning continuum from gestural form-meaning pairings that are found in humans and non-human great apes, to gestural meanings that are hypothesized to be uniquely human.

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