Research Article

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Transitivity, Events, and Gesture: The Case of the Causative-inchoative Alternation

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Abstract: An increasing number of studies are being devoted to the investigation of what aspects of grammar, and of events, expressed in speech are coordinated with gesture. However, previous studies have focused on gesture use in relation to either transitivity or event properties, without considering how these factors interact. In this study, we consider how gesture use relates to transitivity when the type of event in the causative-inchoative alternation is considered, and also how gesture use relates to properties of the events when the type of transitivity is considered. We found various relations both between gesture use and transitivity on the one hand, and between gesture use and certain properties of events on the other hand. Whereas some of the results contrast with the findings in previous studies about the relation between gesture and transitivity, other results obtained actually reinforce and complement some previous findings. The results concerning event properties and gesture also add to previous studies about which properties of certain motor-spatial events relate to gesture and how they do so. The study thus provides a more nuanced understanding of the relation between gesture and language.

Keywords: Co-speech gesture, The causative-inchoative alternation, Transitivity, Events

1 Introduction

When we communicate, we not only produce speech but also spontaneously make so-called co-speech gestures. An increasing number of studies have been devoted to the investigation of what grammatical categories and aspects of expressing events in spoken language are coordinated with gesture, with a particular focus on representational gestures, e.g. Duncan (2002), Parrill (2010), and Lis and Navarretta (2013).

Some studies have shown that one grammatical category that gesture use relates to is that of *transitivity*. On a fine-grained level of gesture use, Martinec (2000, 2004) proposed how form parameters of gesture, such as, hand shape and movement, relate to transitive and intransitive events, although no reliable empirical studies were carried out to verify this proposal. McNeill (1992), Parrill (2010), and Beattie and Shovelton (2002) examined the relation between transitivity and gesture use on a more general level: concerning the choice of Character Viewpoint gestures (CVPT) gestures—in which the speaker re-enacts someone else's actions, such as moving one's arms as if running quickly—or Observer Viewpoint gestures (OVPT)

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gestures—in which one uses one's hands to depict a scene as viewed, such as tracing a horizontal line in the air with one's index finger to show the path that someone ran. Using a small dataset (i.e. four narratives of a single stimulus), McNeill (1992) first suggests that in narratives in American English, transitive utterances tend to be accompanied by CVPT gestures, while intransitive utterances tend to be accompanied by OVPT gestures. Parrill (2010), furthermore, verified McNeill's claim based on a larger dataset of narrative language in American English (23 narrations of three different stimuli, or 69 narrations). Their findings are also supported by Beattie and Shovelton (2002), who found that CVPT gestures were significantly more likely to be accompanied by transitive descriptions, while OVPT gestures were more likely to be accompanied by intransitive ones. All these studies aimed to indicate a relation between gestural representation and transitivity in speech.

However, prototypical transitive and intransitive events examined in these studies also involve different types of events, such as handling events (e.g. clauses with *put* or *throw*) as prototypical transitive events, and agentive motion events (e.g. clauses with *go* or *dance*) as prototypical intransitive events. It remains unknown to what extent the difference found in gesture is caused by transitivity or simply by the types of events being described. Therefore, the present study aims to investigate gesture in relation to transitive and intransitive constructions with the same types of events. The study specifically considers the causative-inchoative alternation (e.g. *She opened the door* vs. *The door opened*), since this alternation is a common one in English, and also it usually involves an entity's change of location, which may play a role in gesture, regardless of transitivity, as predicted in Parrill (2010), as will be noted in Section 4.1.

It is a prevalent view that gesture use is closely linked with motoric and spatial properties of events, as argued in the Free Imagery Hypothesis (de Ruiter 2000, Krauss et al. 1996) and in the Gestures-as-Simulated-Action framework (Hostetter & Alibali 2008). For instance, Feyereisen and Havard (1999) and Hostetter and Alibali (2010) found that speakers gestured more in the motor imagery condition (e.g. explaining how to change the wheel of a car or describing images that activated motor simulation) than they did in the visual imagery condition (e.g. describing the room in which you live most often or describing images that were less likely to activate simulated action). Krauss (1998) suggests that spatial phrases occur more frequently with gesturing than non-spatial ones. The present study investigates whether these findings can be corroborated when transitivity is controlled for.

Therefore, the present study aims to determine whether, and if so, how, gesture relates to transitivity differences when the same type of event is considered. At the same time, we consider whether, and if so, how, gesture relates specifically to properties of events when a given type of transitivity is considered. Specifically, we look at techniques by which ideas are depicted gesturally, the so-called Modes of Representation (Müller 1998, 2014), presented in section 2.4.3, whereby the hands either Act as if performing an action, Trace an outline of a form, Mold or hold a shape in the air, or stand for some entity by Embodying it. The main reasons for considering gestural Modes of Representation are as follows. These Modes of Representation are good indicators of the dynamicity and the complexity of the action that a speaker wants to express in gesture (i.e. Acting and Tracing gestures usually express dynamic activities while Molding and Embodying gestures usually express the referents; Acting gestures are formally/semantically more complex than Tracing ones, i.e. the former could express object-oriented activities such as the activity of someone opening a door, whereas the latter usually express the movement of entities such as the opening movement of a door). In addition, this research is interested in whether the dynamic activities expressed in speech can be depicted in gestures or not (e.g. using gestures of the Tracing mode, depicting a path of motion, or of the Embodying mode, simply objectifying an entity) and if so, in which ways (that is, with dynamic gestures of the Acting-with-object mode or Tracing mode). Through our analysis, the roles of events and transitivity in gesture use can be identified, thereby providing further understanding of events and syntactic structure in relation to gesture use. In the following, we first give a brief introduction to the alternation and then formulate more specific research questions in the present study. Next, we present the method and results for the research question. We end by discussing the implications of the present study.

1.1 What is the causative-inchoative alternation?

1.1.1 Events and their sub-types involved in the alternation

Both transitive and intransitive constructions of the causative-inchoative alternation could express the same events, ones which consist of external causation and an entity's change of state or location that the causation brings about. Specifically, a transitive construction, such as *She opened the door*, refers to an event in which an agent—*she*—transferred energy to a patient—*door*, and causes the patient to change from one state to another (from a closed state to an open state in this case). Even in terms of intransitive clauses, such as *The door opened*, the external causation is not absent, although it is not expressed in language. We know that there is a backgrounded external force, which causes the entity to change (causing the *door* to open in this case). It might be a person, the wind, or other forces (Langacker 2008, 370-371). Thus, like transitive clauses, intransitive clauses also evoke events in which one entity caused another to experience a change of state or location.

These events can be further classified into sub-categories according to the nature of external causation and the type of the change.

A) Sub-types of the external causation

"Agency" and "volitionality", among others, have been studied quite extensively in the analysis of types of causation (Croft 1991; Delancey 1987; Givon 1985; Hopper & Thompson 1980; Lakoff 1977; Rice 1987; Talmy 1972, 1976). Based on the "agency" and the volitionality of the participants, the following sub-types are particularly relevant for the present study: those with a volitional agent; those with a non-volitional agent, and those with natural force (non-agent) as external causation. Examples are given in Table 1.

Table 1. Events with various types of causation and their examples[1]

Type of external causation	Examples
Events with a volitional agent as external causation (+human; + volitional)	*He opened the door* (transitive); [*He was trying to speed up to catch up, and*] *a secret service door opened,* [*and he flew 100 feet*][2] (intransitive)
Events with a non-volitional agent as external causation (+human; -volitional)	*I dropped my ring by mistake* (transitive); [*They're wheeling out the cake. Suddenly it overturned and*] *rolled down an embankment* (intransitive)
Events with natural force as external causation (-human)	*The wind broke the window* (transitive); [*The paper lantern caught fire.*] *It dropped onto a couch* (intransitive)

1 The examples are attested ones from the UCLA Library Broadcast NewsScape database, as described in the Methods section below, except *the wind broke the window,* one we came up with for the purpose of illustration.

2 When a speaker (the daughter of a former US president) was describing that once her boyfriend was trying to catch up with her father while cycling and suddenly her father's bodyguards came out of a car, she said the above utterances: "And so he was trying to speed up to catch up, and a secret service door opened, and he flew 100 feet."

B) Sub-types of the change in the events

According to the nature of the change, the events are usually classified into two sub-categories: verbs of change of state and verbs of change of location. The former entail changes in a property of an entity, as in cases like *She broke a vase*, *She bent the stick* and *She opened the door*, whereas the latter entail changes in a location of an entity, as in, for example, *She rolled the car down the embankment* and *She moved the picture to that room*.

In addition, the path (change of location) of events can refer to the path of the Figure (also referred to as "mover" in cognitive grammar or "theme" in case grammar) or that of the Agent. According to Talmy (1985, 2000), Figure is defined as an entity that moves in a motion event, as in (1), (2), and (3).

(1) *The car rolled down an embankment.*
Figure

(2) *The painting has moved from the bedroom to the garage.*
Figure

(3) *The magazine dropped.*
Figure

Agent refers to an instigator of a motion event, as in (4), (5), and (6).

(4)	*We*	*rolled*	*the rock*	*out of the way*.
	Agent		Figure	
(5)	*I*	*moved*	*the couch*	*into the bedroom*.
	Agent		Figure	
(6)	*I*	*dropped*	*my ring*.	
	Agent		Figure	

All motion events encoded in the causative-inchoative alternation prototypically involve a path of a Figure. And yet, the path of the Figure can be implicit or explicit in speech; that is, it may be represented in a directional oblique phrase (abbreviated as OBL hereafter) or not in speech to specify the path, such as *She dropped the ring* and *He rolled the car* (with implicit path; -OBL) vs. *She dropped the ring on the floor* and *He rolled the car down an embankment* (with explicit path; +OBL). As for the path of the Agent, it can be absent or present. For instance, the motion event in *He moved his toupee up* does not involve a displacement of the agent, whereas the motion event in *He moved the sofa out of the bedroom* prototypically involves a displacement of the Agent. Since the two types of path in motion events may concern different relations to gesture, both of them are considered in the present study.

1.1.2 Event construal of transitive and intransitive constructions

The choice of transitive or intransitive constructions in speech reflects speakers' different construals of the above events. Langacker (2008: 385) proposes that, by using a transitive construction, a speaker profiles the whole chain of the event, namely, both an external causation and an entity's change of state/location; by using an intransitive construction, a speaker has an absolute construal of an event, that is, only the change of state or location of an entity is profiled, rather than the external causation which brings about the change.

1.2 The present study: research questions

As noted above, the present study aims to examine the relation between transitivity and gesture on the one hand and events and gesture on the other hand. Specifically, the research questions are formulated as follows:

1) Does gesture use (i.e. the frequency of gestures being produced and the Mode of Representation being used) relate to properties of events when the type of transitivity is kept constant, with each transitivity type (e.g. transitive or intransitive involving a human agent vs. a natural force, or a volitional vs. non-volitional agent)?

a) Does gesture relate to the agency of the participants with respect to each type of transitivity?

b) Does gesture relate to the volitionality of the participants with respect to each type of transitivity?

c) Does gesture relate to the Figure's path (explicit or implicit path) of the motion events with respect to each type of transitivity?

d) Does gesture relate to the Agent's path (+/- Agent's path) of the motion events in transitive constructions (since this property of event is not applied to intransitive constructions)?

2) Does gesture use (i.e. the frequency of gestures being produced and the Mode of Representation being used) relate to transitivity when the type of event is kept constant, with each event type?

a) Does gesture use relate to transitivity when the agency of the participants in the causation is considered?

b) Does gesture use relate to transitivity when the volitionality of the participants in the causation is considered?

c) Does gesture use relate to transitivity when the path of the Figure (that is, +/- an explicit Figure's path / +/- OBL) in motion events is considered?

d) Does gesture use relate to transitivity when the path property of the Agent (that is, +/- an Agent's path) in motion events is considered?

3) This will lead to a discussion of the following question: To what extent do the above gestural behaviors relate to the ways in which speakers conceptualize transitive and intransitive constructions of the alternation (that is, in terms of a +/- profile of external causation)?

2 Method

2.1 Database

The present study is based on 12 American talk show programs in English from the UCLA Library Broadcast NewsScape database, accessed using facilities of the Distributed Little Red Hen consortium, co-directed by Francis Steen and Mark Turner. The talk show programs cover a range of different types, and include *Late Night with Conan O'Brien, Late Night with Jimmy Fallon, Late Night with Seth Meyers, The Ellen DeGeneres Show, The Jay Leno Show, The Megan Mullally Show, Tonight Show with Conan O'Brien, Tonight Show with Jay Leno, Tonight Show with Jimmy Fallon*, *The Late Late Show with James Corden, The Late Show with Stephen Colbert*, and *Jimmy Kimmel Live*.

Only the monologue and interviewing portions of talk show programs were included, thereby excluding the following portions: playing games on the show, singing (some talk shows invite singers to sing at the beginning), advertisements, reading portions, parts where speakers' hands were usually invisible, parts where hosts hold a piece of paper as they read something, and phone calls, in which the speaker is not interacting with the interlocutor face-to-face.

2.2 Data collection

2.2.1 Verbal item selection

A widely acknowledged list of verbs licensing the causative-inchoative alternation is provided by Levin (1993: 28), including *Break* verbs (e.g. *break*, *tear, shatter*), *Bend* verbs (e.g. *bend*, *fold, wrinkle*), *Roll* verbs[3] (e.g. *roll*, *drop*, *drift*), and Others (e.g. *open*, *close*, *widen*, *blacken*). For the categories of breaking, bending, and rolling, the two most frequent verbs in the Red Hen database were chosen: *break, tear, bend, fold*, *drop, move*. As for the category 'Others', the verbs examined were *open* and *close*, since a) these two verbs are widely used as good examples to illustrate the causative-inchoative alternation and its construal (Hale & Keyser 1986, Langacker 2008); and b) they might be more likely to be accompanied by representational gestures than the other verbs in this category such as *intensify, purify, solidify,* because of their spatial-motoric nature. In addition, the motion verb *roll* was also included in the research, since intransitive motion events relating to this verb were frequently examined in previous studies, and thus it is of interest to examine whether the accompanying gestures would differ depending on the transitivity of this verb in speech. Consequently, the following verbs were included in the data retrieval: *break, tear, bend, fold, drop, move*, *open, close,* and *roll*.

2.2.2 Data retrieval

The verbs chosen were retrieved in the above talk show programs one by one. The access period was almost 11 years, ranging from January 1st, 2005 to November 18th, 2015, which was the longest possible access period at the point of the data search. Note that only the simple past tense and past participle forms of verbs were included in the retrieval, excluding the present tense of verbs or the progressive forms. The present tense was excluded because intransitive clauses with the present tense of these verbs (e.g. *The door opens easily)* usually denote entities' properties rather than their changes of state or location, which therefore belong to the category of the middle alternation rather than the causative-inchoative alternation under investigation. Exclusion of the progressive aspect of verbs attempts to rule out the possibility that the prospective gestural difference is simply caused by the difference in the verbs' aspects (as found, for example, by Parrill et al. 2013), such as different aspects used in *He's opening the door* vs. *The door opened*.

2.2.3 Data filtering

The present study only considers literal meanings of the verbs, thus excluding metaphorical expressions such as *That opened the door to all pop music*, since the issue of metaphor is not a concern of the present research. Transitive and intransitive activities depicting bodily motions, such as *He opened his eyes*, fall outside the scope of the present study as well, since in these activities the agents and patients are body parts belonging to the same participants (that is to say, they lack external causation). In addition, we excluded intransitive cases which depicted agentive internally caused motion, such as *I rolled over* [*and walked into work*], since in the causative-inchoative alternation, the intransitive clauses depicted changes with an external causation in the frame, as discussed above, whereas these cases were self-propelled activities. Furthermore, the following situations were excluded from the data retrieved: a) cases in which both of the speakers' hands were invisible on the screen; and b) cases in which speakers were performing real actions.

This yielded a corpus of 710 clauses involving the above verbs.

3 This term, as well as the other terms, is from Levin (1993). According to Levin, Roll verbs, together with Run verbs (e.g. *jump* and *fly*), constitute verbs of 'manner of motion'.

2.3 Speech coding

2.3.1 Transitivity coding

Transitivity was coded in terms of whether there was an object in the clause or not. If there was an object involved, it was coded as "transitive"; if not, it was coded as "intransitive", e.g. *She opened the door* (transitive) and *The door opened* (intransitive).

The verbs *tear, bend,* and *fold* were hardly used in intransitive clauses in the corpus. For instance, in the case of the verb *tear*, there were 61 transitive uses but only 4 intransitive uses in the corpus. Clauses with these three verbs were therefore excluded from the research (total N=65).

This yielded a total corpus of 527 transitive clauses and 118 intransitive clauses with verbs of *break*, *open*, *close*, *move*, *drop,* and *roll*.

2.3.2 Coding of the agency of the participants

The clauses were coded for the agency of the participants involved in the events. An event with an animate agent as the external causation was coded as an event with "human causation",[4] e.g. *They opened the door* and *[I knocked on the door, and] the door opened*. An event with a natural force as the external causation was coded as an event with "natural force", e.g. *The wind broke the window* and [*You know those Chinese paper lanterns that are made of paper, we had one hanging up backstage and it caught fire.*] *It dropped onto a couch*. The clauses which lack sufficient context to allow coders to decide their types of causation were coded as "unclear". This label always applied to intransitive clauses, since transitive clauses have subjects, which could indicate the agency of the participants. Note that the following button-pushing activity events with human causation were excluded from the analysis (transitive N=8; intransitive N=29), since they are intuitively different from other activities (mostly directly manipulating an object and a tool), including: *Someone opened or closed the elevator doors; The elevator door opened or closed; Someone opened the chute or the chute opened; X dropped the things from the plane by parachute; Somebody or some entity dropped down in a ball* [presumably initiated via some mechanical procedure] and *They dropped you down (in a ball) in Jersey*.

All intransitive clauses were given to a second coder to label the agency of the participants: "human causation", "natural force", and "unclear". The agreement between coders was 0.76 according to the test of Cohen's kappa (the agreements in the study were all based on this test). Note that only intransitive clauses were checked by the second coder, since the agency of the participants in transitive clauses does not involve subjectivity. All subjects in the transitive clauses were human referents in the corpus, and thus these events were coded as events with "human causation".

The cases of disagreement were solved through discussion or noted as "unclear". Subsequently, the corpus contains 460 clauses referring to events with human causation, 10 clauses referring to events with natural force, and 43 clauses with unclear causation.

2.3.3 Coding of the volitionality of the participants

The clauses depicting events with "human causation" were further coded for the volitionality of the participants. The categories include "a volitional agent", "a non-volitional agent", and "unclear", e.g. [*He knocked on the door and*] *they opened the door* (event with a volitional agent), *I dropped my computer on my toe* (event with a non-volitional agent), and *They broke the glass* (unclear in terms of the volitionality of the participants).

4 In theory, causation can be non-human animate in nature, such as with animals, but in the corpus, there were no such data. Therefore, only the label "human causation" was applied to the coding.

50 clauses were given to a second coder for a data check. The agreement was 0.63 using Cohen's kappa. The cases of disagreement were solved through discussion or noted as "unclear". After this, the main coder re-coded all the remaining data in the corpus. Consequently, the corpus contains 384 clauses with a volitional agent and 76 clauses with a non-volitional agent, as well as 94 clauses with unclear causation.

2.3.4 Coding of Figure's path: explicit or implicit path

In order to investigate the relation between the path property of Figures in motion events, transitivity, and gesture use, clauses with the verbs referring to changes of physical location—including uses of *move*, *drop,* and *roll*—were further coded as to whether or not they involved an explicit path in Figures, that is: whether a directional oblique phrase (OBL) is involved or not, such as *He dropped a fork off the boat* (+OBL) vs. *Our waiter dropped a fork* (-OBL). In the corpus, a directional phrase mostly referred to a directional prepositional or an adverb phrase, as in *We moved the items out of the way* and *I just moved his chair closer to the one we already have*. Note that the oblique phrases (OBL) sometimes simply consisted of an adverb, as in *He rolled down the window*.

Among the 297 clauses referring to physical change of location, there are 153 with oblique phrases (+OBL) and 144 cases without (-OBL).

2.3.5 Coding of the Agent's path: +/- path

In order to investigate the relation between the Agent's path property in motion events, transitivity, and gesture use, clauses with the verbs referring to changes of physical location—including *move*, *drop,* and *roll*—were also coded as to whether Agents were necessarily involved in a displacement or not in a certain context, such as *He moved his toupee up* or *He rolled down the window* (- Agent's path) vs. *He moved the sofa out of the bedroom* or *He rolled the car down the embankment* (+ Agent's path). The category "Unclear" was also included as a label, since there were cases in which it was difficult to tell whether Agents were involved in a displacement or not. For instance, in the case of *He moved his basket* [*to make room for others in the supermarket*], the Agent *he* could stand in a location and simply move his basket, and with equal likelihood he could move the basket as he moved his location. Note that all dropping activities were considered as events without the Agent's path, since the Agent's displacements were not involved in these activities, either in activities of making or letting objects fall, such as *He dropped the fork* and *I dropped eggs out of the window,* or in delivering activities such as *He dropped off some cookies for us*. Note also that this category (+/- Agent's path) is not applied to intransitive clauses, given that intransitive clauses do not explicitly express Agents.

All the cases with Agents (N=108) except those involving the verb *drop* (N=146) were given to a second coder, since subjectivity is probably involved in the coding of this category. The agreement was Cohen's kappa = 0.43, which is moderate. A major disagreement concerned cases of rolling vehicles (42% among all the disagreements), such as in *I rolled my mom's car*. These cases indeed involved displacement of the Agent, but motions of these cases were different from those of other cases, as in *They rolled in a trophy*. The former cases (cases like *I rolled my mom's car*) mostly referred to motion of the Figure and the latter (cases like *They rolled in a trophy*) referred to motion of the Agent. These cases related to the rolling activities, therefore, were noted separately, rather than included in the category "Agent with path" or "Agent without path". All the rest of the cases of disagreement were discussed between coders. They were either solved through discussion or simply were collapsed into the label "Unclear" when there was disagreement between coders. The corpus ultimately consists of 29 events with the Agent's path, 202 events without Agent's path (including all cases of 146 dropping activities), and 9 cases which were unclear, as well as 14 cases of rolling.

2.4 Gesture coding

2.4.1 Gesture identification

All 645 clauses were coded as to whether they were accompanied by a gesture or not. In the corpus, there are 569 clauses accompanied by gestures and 76 clauses that are not.

2.4.2 Gesture type coding

All gestures (N=569) were further coded according to gesture types adapted from McNeill (1992), Kendon (2004), and Kita (2000). The categories include representational and non-representational gestures. A representational gesture refers to manual movement which can represent the physical property of an object or event, such as the size, quantity or shape of an object, or the trajectory movement of an event (Kendon 2004; Kita 2000; McNeill 1992). Other gesture types (deictic and discourse-related gestures) are grouped together as non-representational gestures.

50 gestures were given to a second coder for a cross-check. The reliability between coders was Cohen's kappa = 0.7. After a discussion of cases of disagreement, the main coder re-coded the rest of the data. That yielded 412 representational gestures and 149 non-representational gestures as well as 8 unclear cases.

2.4.3 Gestural Modes of Representation (MoR) coding

All representational gestures (N=412) were further coded in terms of their MoR (Müller 1998, 2014). The categories comprise Acting with object, Acting only, Tracing, Molding, and Embodying.

a) A gesture was coded as belonging to the Acting-with-object mode when a speaker moved as if miming an object-oriented activity, such as transferring an object. Technically, the mode involves acting as if with the object. The physical object is not actually present, so it is not a matter of actual object manipulation but of manipulating the imagined object. For instance, when a speaker said *I opened the door* [*and walked straight into their dressing room*], he made the gesture shown in Figure 1. He held two fisted hands and then moved them from the center to the sides, as if opening a sliding door.

Figure 1. Gesture with *I opened the door*

b) A gesture was coded as one belonging to the Acting-only mode when a speaker moved as if miming a non-object-oriented activity, such as dancing.

c) A gesture was coded as belonging to the Tracing mode when a speaker moved his/her hands or fingers as if to trace a line, like outlining an object or the path of a motion. For example, together with the utterance

My mom opened the door, a speaker made a gesture as follows (see Figure 2). She used one left open flat hand and moved from her center to the left, in which she simply traced a general movement of the activity, rather than specifying the agentive opening activity.

Figure 2. Gesture with *My mom opened the door*

d) A gesture was coded as the Molding mode when a speaker moved as if to mold, touch or feel the shape of an object (see also Streeck 2008). For example, when the thumb and forefinger were crooked as if touching the top and the bottom of a cigarette holder.

e) A gesture was coded as an instance of the Embodying mode when a speaker used his/her hands to represent an object. For example, a flat open hand was used to represent a piece of paper or a towel.

Sometimes, the speaker combined more than one mode from those above. In these cases, the order of coding priority was "Acting with object" or "Acting only"> "Tracing"> "Molding" or "Embodying", since this research is interested in whether the dynamic activities can be depicted in gestures or not (e.g. via gestures of the Tracing mode versus the Embodying mode) and if so, in which ways (that is, with gestures of the Acting-with-object, Acting-only or Tracing mode), as noted in Section 1. For instance, if the Embodying mode was combined with the Tracing mode in one gesture (as in Figure 2), it was coded as the Tracing mode.

Again, 50 gestures were given to a second coder for a cross-check. The agreement rate between coders was Cohen's kappa = 0.85. The disagreements were resolved through discussion. The coding yielded 244 gestures of the Acting mode, 1 gesture of the Acting-only mode, 143 gestures of the Tracing mode, 11 cases of the Molding mode, and 6 cases of the Embodying mode, as well as 7 uncertain cases. Due to the rare or infrequent occurrence of the Acting-only gestures (miming intransitive actions, such as miming a dancing activity, N=1), Molding gestures (N=11), and Embodying gestures (N=6), these categories were not considered further in the analyses of gestural Modes of Representation.

3 Results

The subsections below describe how gesture use relates to the four relevant event properties—agency of the participants, volitionality of the participants, Figure's path, and Agent's path—in both transitive and intransitive constructions.

3.1 Gestures and the causative-inchoative alternation with human/non-human causation (agency of events)

This section examines gesture use with respect to constructions of the following types: transitive and intransitive with natural force as external causation/non-human causation, e.g. *The wind broke the window* and [*You know those Chinese paper lanterns that are made of paper, we had one hanging up backstage and it*

caught fire.] *It dropped onto a couch*; transitive and intransitive with human causation, e.g. *They opened the door* and [*I knocked on the door and*] *the door opened*.

3.1.1 Gestural rate

Table 2 displays the count and proportion of representational gestures occurring with transitive and intransitive clauses with human or the natural force as external causation. Note that "With Rep." means constructions with representational gestures, while "Without Rep." means constructions without representational gestures, including those with non-representational gestures and those without any gestures.

Table 2. Frequencies of representational gestures accompanying the causative-inchoative alternation with human or the natural force as external causation

	With Rep.		Without Rep.		TOTAL	
	N	%	N	%	N	%
TRAN -- human/agent (e.g. *They opened the door*)	300	**71**	121	**29**	421	100
INTR -- human/agent (e.g. [*I knocked on the door and*] *the door opened*)	26	**76**	8	**24**	34	100
TRAN -- natural force (e.g. *The wind broke the window*)	0	**0**	0	**0**	0	0
INTR -- natural force (e.g. [*Because of fire,*] *the paper lantern dropped onto a couch*)	5	**50**	5	**50**	10	100

The table shows a number of results. First, many more intransitive constructions with human beings as external causation were accompanied by representational gestures than those that were not (76% vs. 24%), whereas in the case of intransitive constructions with natural forces as external causation, there was equal use of "With Rep." and "Without Rep." (50% vs. 50%). However, this difference between intransitive constructions with humans versus with natural forces as the external causation is not statistically significant ($p>0.05$, $\chi^2=1.48$, df=1), probably due to the small sample size of such events with natural force (N=10). Such an analysis was not applied to transitive clauses with the two types of causation, since no events with natural force as external causation were depicted in transitive clauses in the corpus. This result suggests that gestural rate possibly does not significantly relate to the agency of the participants in intransitive clauses, but the situation in transitive clauses remains unclear.

Next, the relation between the frequency of gestures produced and the type of transitivity was examined, when a given type of event is considered. When events with human being as external causation were considered, 71% (N=300) of transitive constructions were accompanied by representational gestures and 29% (N=121) of them were not, while 76% (N=28) of intransitive constructions were accompanied by representational gestures and 24% (N=8) of them were not. This difference is not significant ($p>0.05$, $\chi^2=0.2$, df=1). Again, the data did not allow us to compare transitive and intransitive constructions with natural force as external causation, since such events did not occur with transitive constructions in the data. These results indicate that the gestural rate does not relate to the type of transitivity concerning events with a human being, although it remains unknown whether or not the gestural rate relates to the type of transitivity concerning events with natural force as external causation.

3.1.2 Gestural Modes of Representation

Table 3 shows the results of Acting and Tracing gestures occurring with transitive and intransitive events with human or the natural force as external causation.

Table 3. Gestural Modes of Representation with respect to the causative-inchoative alternation with human or the natural force as external causation

	Acting		Tracing		TOTAL	
	N	%	N	%	N	%
TRAN -- human/agent (e.g. *They opened the door*)	196	**73**	72	**27**	268	100
INTR -- human/agent (e.g. [*I knocked on the door] and the door opened*)	5	**22**	18	**78**	23	100
TRAN -- natural force (e.g. *The wind broke the window*)	NA	**NA**	NA	**NA**	NA	NA
INTR -- natural force (e.g. [*Because of fire,*] *the paper lantern dropped onto a couch*)	0	**0**	5	**100**	5	100

Because of a small sample size of events with natural force as causation in the corpus, only constructions with a human being are considered. As shown in Table 3, transitive constructions with a human being were more likely to be accompanied by Acting gestures than by Tracing gestures (73% vs. 27%), whereas intransitive constructions with a human being were more likely to be accompanied by Tracing gestures than by Acting gestures (78% vs. 22%). This difference is statistically significant ($p<0.01$, $\chi^2=23.84$, df=1, phi=0.3). This result indicates that Acting gestures preferably accompanied transitive constructions whereas Tracing gestures preferably accompanied intransitive constructions, even when both constructions expressed the same events, that is, events with a human being. Note that, however, no conclusions could be drawn about the relation between gesture and transitivity in speech concerning events with natural force.

3.2 Gestures and the causative-inchoative alternation with (non-)volitional agent (volitionality of the participants)

This section considers gesture use with respect to the causative-inchoative alternation with volitional or non-volitional agent, e.g. *He opened the door* and [*He was trying to speed up to catch up,*] *and a secret service door opened,* [*and he flew 100 feet*] (transitive and intransitive with volitional agent); *I dropped my ring by mistake* and [*They're wheeling out the cake. Suddenly it overturned and*] *rolled down an embankment* (transitive and intransitive with non-volitional agent).

3.2.1 Gestural rate

Table 4 displays the count and proportion of representational gestures occurring with transitive and intransitive constructions with volitional or non-volitional agent.

We can see from Table 4 that a majority of transitive events with a volitional agent were accompanied by representational gestures and a small proportion of them were not (77% vs. 23%), whereas only a small proportion of transitive events with a non-volitional agent were accompanied by representational gestures and a majority of them were not (35% vs. 65%). This difference is statistically significant ($p<0.01$,

Table 4. Frequencies of representational gestures accompanying the causative-inchoative alternation with volitional or non-volitional agent

	With Rep.		Without Rep.		TOTAL	
	N	%	N	%	**N**	**%**
TRAN -- volitional agent (e.g. *He opened the door*)	279	**77**	82	**23**	361	100
INTR -- volitional agent (e.g. [*He was trying to speed up to catch up,*] *and a secret service door opened,* [*and he flew 100 feet*])	16	**76**	5	**24**	21	100
TRAN -- non-volitional agent (e.g. *I dropped my ring by mistake*)	21	**35**	39	**65**	60	100
INTR -- non-volitional agent (e.g. [*Suddenly the cake overturned and*] *rolled down an embankment*)	10	**77**	3	**23**	13	100

χ^2 = 42.88, df=1, phi=0.3). By contrast, there is no significant difference in frequencies of representational gestures with intransitive clauses with a volitional agent and those with a non-volitional agent as external causation—76% vs. 24% and 77% vs. 23% ($p>0.05$, $\chi^2=0$, df=1). These results suggest that the rate of gestures produced relates to the volitionality of the participants, although this relation only applies to transitive constructions rather than intransitive ones.

Next, gestures with transitive clauses were compared with those with intransitive clauses when the type of causation was kept constant. When events with a volitional agent were considered, 77% of transitive constructions were accompanied by representational gestures and 23% of them were not, while 76% of intransitive constructions were accompanied by representational gestures and 24% of them were not. The difference between them is not significant ($p>0.05$, $\chi^2=0.01$, df=1). This result suggests that gestural rate does not relate to the type of transitivity when volitional events are considered. By contrast, when events with a non-volitional agent were considered, a majority of intransitive constructions were accompanied by gestures and a small proportion of them were not (77% vs. 23%), whereas only a small proportion of transitive constructions were accompanied by gestures and a majority of them were not (35% vs. 65%). This difference is statistically significant ($p<0.05$, $\chi^2=6.07$, df=1, phi=0.3). The result seems to indicate that gesture frequency relates to the type of transitivity (different from the results in the other sections).

In summary, these results suggest that the gestural rate seems to relate to the volitionality of the participants, although this relation is only restricted to transitive constructions. However, it does not relate to the type of transitivity either in terms of volitional or non-volitional events.

3.2.2 Gestural Modes of Representation

Table 5 shows the results of Acting and Tracing gestures occurring with transitive and intransitive events with volitional or non-volitional agent.

As shown in Table 5, both transitive events with a volitional agent and those with a non-volitional agent were more likely to be accompanied by Acting gestures than Tracing gestures (73% vs. 27% and 61% vs. 39%). There is no significant difference between them ($p>0.05$, $\chi^2=0.69$, df=1). Both intransitive events with a volitional agent and those with a non-volitional agent were more likely to be accompanied by Tracing gestures than Acting gestures (79% vs. 21 and 78% vs. 22%) ($p>0.05$, $\chi^2=1.41$, df=1). These results indicate that the gestural Mode of Representation seems not to relate to the volitionality of the participants, either in terms of transitive or intransitive constructions.

Table 5. Gestural Modes of Representation with respect to the causative-inchoative alternation with volitional or non-volitional agent as external causation

	Acting		Tracing		TOTAL	
	N	%	N	%	N	%
TRAN -- volitional agent (e.g. *He opened the door*)	196	**73**	72	**27**	268	100
INTR -- volitional agent (e.g. [*He was trying to speed up to catch up,*] *and a secret service door opened,* [*and he flew 100 feet*])	3	**21**	11	**79**	14	100
TRAN -- non-volitional agent (e.g. *I dropped my ring by mistake*)	11	**61**	7	**39**	18	100
INTR -- non-volitional agent (e.g. [*Suddenly the cake overturned and*] *rolled down an embankment*)	2	**22**	7	**78**	9	100

Next, the relation between gestural mode of representation and the type of transitivity was examined, when a given type of event was considered. When events with a volitional agent were considered, transitive clauses were more likely to be accompanied by Acting gestures than Tracing gestures (73% vs. 27%) whereas intransitive clauses were more likely to be accompanied by Tracing gestures (79% vs. 21%). This difference is statistically significant ($p<0.01$, $\chi^2=14.73$, df=1, phi=0.2). When events with a non-volitional agent were considered, transitive events with a non-volitional agent were more likely to be accompanied by Acting gestures than by Tracing gestures (61% vs. 39%), whereas intransitive events with a non-volitional agent were more likely to be accompanied by Tracing gestures than by Acting gestures (78% vs. 22%). However, this difference is not statistically significant ($p>0.05$, $\chi^2=2.24$, df=1) probably due to the small sample size of such intransitive clauses in the corpus (total N=23). These results indicate the gestural Mode of Representation is sensitive to the type of transitivity, in particular for volitional events.

3.3 Gestures and the causative-inchoative alternation with implicit or explicit Figure's path

We now turn to a subset of the causative-inchoative alternation—motion constructions, which refer to changes of physical location in entities (including transitive and intransitive uses of *move*, *drop,* and *roll* in the corpus). More specifically, this section investigates transitive and intransitive motion constructions of the alternation which involve explicit or implicit path in the Figure (that is, the mover in motion events) respectively, namely with/without directional oblique phrases (OBL), e.g. *She dropped the ring* (TRAN - OBL) vs. *The ring dropped* (INTR - OBL), *She dropped the ring off the boat* (TRAN + OBL) vs. *The ring dropped off the boat* (INTR + OBL).

3.3.1 Gestural rate

Table 6 displays the number and proportions of representational gestures accompanying transitive and intransitive constructions with and without directional oblique phrases (OBL).

Overall, more representational gestures accompanied constructions with OBL than without OBL. Specifically, a majority of transitive constructions with OBL were accompanied by gestures and a small proportion of them were not (71% vs. 29%), whereas less than half of transitive constructions without OBL were accompanied by gestures and more than half of them were not (47% vs. 53%). This difference is statistically significant ($p<0.01$, $\chi^2=12.1$, df=1, phi=0.2). The same goes for intransitive constructions. A majority of intransitive constructions with OBL were accompanied by gestures and a small proportion of

Table 6. Frequencies of representational gestures accompanying the causative-inchoative motion constructions with/without OBL

	With Rep.		Without Rep.		TOTAL	
	N	%	N	%	N	%
TRAN - OBL (e.g. *He dropped the ring*)	60	47	67	53	127	100
INTR - OBL (e.g. *The ring dropped*)	5	33	10	67	15	100
TRAN + OBL (e.g. *He dropped the ring off the boat*)	84	71	35	29	119	100
INTR + OBL (e.g. *The ring dropped off the boat*)	21	66	11	34	32	100

them were not (66% vs. 34%), whereas only a small proportion of intransitive constructions without OBL were accompanied by gestures and a majority of them were not (33% vs. 67%). However, the difference is not statistically significant ($p>0.05$, $\chi^2=3.1$, df=1), probably due to the low frequency with which intransitive constructions without OBL (INTR-OBL, N=15) occurred in the data. The results indicate that the gesture production likelihood tends to increase as there are oblique phrases (OBL) to encode the Figure's path versus if there are not, that is, explicit versus implicit path of the Figure in motion constructions.

However, the frequency of representational gestures tends not to differ with respect to transitive and intransitive constructions in speech, when a given type of motion event is considered. Specifically, the use of gestures accompanying transitive motion constructions without OBL is not significantly different from that accompanying intransitive motion constructions without OBL ($p>0.05$, $\chi^2=0.40$, df=1). Similarly, the uses of representational gestures accompanying transitive and intransitive constructions with OBL do not differ significantly ($p>0.05$, $\chi^2=0.11$, df=1). These results indicate that the quantities of gestures produced tend not to relate to transitivity in speech.

3.3.2 Gestural Modes of Representation

This section deals with gestural Modes of Representation with respect to the causative-inchoative alternation with or without directional oblique phrases. The results are displayed in Table 7.

Table 7. Gestural Modes of Representation with respect to the causative-inchoative alternation with/without directional oblique phrases (+/-OBL)

	Acting		Tracing		TOTAL	
	N	%	N	%	N	%
TRAN - OBL (e.g. *He dropped the ring*)	42	76	13	24	55	100
INTR - OBL (e.g. *The ring dropped*)	2	50	2	50	4	100
TRAN + OBL (e.g. *He dropped the ring off the boat*)	53	66	27	34	80	100
INTR + OBL (e.g. *The ring dropped off the boat*)	0	0	20	100	20	100

Gestures occurring with transitive constructions with OBL (TRAN+OBL) were compared to those occurring with transitive constructions without OBL (TRAN-OBL). Table 7 shows that 66% of transitive constructions with OBL (TRAN+OBL) were accompanied by Acting gestures and 34% of them by Tracing gestures, while 76% of transitive constructions without OBL (TRAN-OBL) were accompanied by Acting gestures and 24% of them by Tracing gestures. This difference is not statistically significant ($p>0.05$, $\chi^2=1.15$, df=1). That is to say, a significant relation between the Figure's path property with transitive constructions and the gestural Mode of Representation was not found.

Next, gestures accompanying intransitive constructions with OBL (INTR+OBL) were compared with those accompanying intransitive constructions without OBL (INTR-OBL). As shown in Table 7, all of the intransitive constructions with OBL (INTR+OBL) in the corpus were accompanied by Tracing gestures (100%), whereas only half of intransitive constructions with OBL (INTR+OBL) were accompanied by Tracing gestures and the other half by Acting gestures. Given the small data size of intransitive constructions without OBL accompanied by representational gestures (N=4), a quantitative comparison of gestural modes in terms of intransitive constructions with and without OBL would not be reliable, and therefore a statistical test was not carried out. To determine whether or not there is a correlation in this regard requires further research.

In addition, transitive and intransitive constructions with/without OBL were examined. We can see from the table that transitive constructions with OBL (TRAN+OBL) were more likely to be accompanied by gestures of the Acting mode as opposed to the Tracing mode (66% vs. 34%), whereas all intransitive constructions with OBL (INTR+OBL) were accompanied by gestures of the Tracing mode (100%) versus the Acting mode (0%). This difference is significant ($p<0.01$, $\chi^2=25.60$, df=1, phi=0.5). However, due to the small data size of the set of intransitive constructions without OBL accompanied by representational gesture (N=4), gestural modes with respect to transitive and intransitive constructions without OBL are not considered.

The above results very tentatively indicate that gestural Modes of Representation appear rather sensitive to the type of transitivity concerning speech with OBL but not to the choice of OBL (namely, events with explicit versus implicit Figure's path).

3.4 Gestures and the causative-inchoative alternation with and without the Agent's path

Like Section 3.3, the current section considers gestures occurring with a subset of the causative-inchoative alternation: transitive and intransitive motion constructions (including transitive and intransitive uses of *move*, *drop,* and *roll* in the corpus). It specifically examines gestures accompanying transitive motion constructions with and without the Agent's path, such as *He moved his toupee up* and *He rolled down the window* (transitive motion constructions usually without Agent's displacement) vs. *He moved the sofa out of the room* and *They rolled a trophy in* (transitive motion constructions usually involving the Agent's displacement), and gestures occurring with intransitive motion constructions, such as *The painting moved from the bed room to the garage*.

As noted in Section 2.3, this category (+/- Agent's path) is not applied to intransitive clauses, given that intransitive clauses do not explicitly express Agents nor can we deduce them from the context. It follows that unlike the previous sections, the relation between transitivity and gesture could not be examined in this section, when the type of Agent's path is considered.

3.4.1 Gestural rate

Table 8 displays the number and proportions of representational gestures occurring with transitive motion constructions with/without the Agent's path and intransitive motion constructions.

We can see that most of transitive constructions with Agent's path were accompanied by gestures and a small percentage of them were not (83% vs. 17%), whereas only around half of transitive constructions without Agent's path were accompanied by gestures and a half were not (55% vs. 45%). This difference is statistically significant ($p<0.01$, $\chi^2=7.15$, df=1, phi=0.2). This suggests that the frequency of representational gestures produced relates to the property of the Agent's path in events for transitive clauses. This finding is consistent with the one in the previous section concerning the path of the Figure in relation to the frequency of the accompanying gestures. Considered together, the results indicate that gestures are more likely to occur with events involving a path (of the Figure and the Agent) than those not involving one.

Table 8. Frequencies of representational gestures occurring with the causative-inchoative alternation with and without the Agent's path

	With Rep.		Without Rep.		TOTAL	
	N	%	N	%	N	%
TRAN - Agent's path (e.g. *He moved his toupee up*)	108	55	90	45	198	100
TRAN + Agent's path (e.g. *He moved the sofa out of the bedroom*)	24	83	5	17	29	100
INTR (e.g. *The ball moved*)	27	56	21	44	48	100

3.4.2 Gestural Modes of Representation

Table 9 shows gestural Modes of Representation used with respect to transitive motion constructions with/without the Agent's path and intransitive motion constructions accompanied by these gestures.

Table 9. Gestural Modes of Representation with respect to the causative-inchoative alternation with and without the Agent's path

	Acting		Tracing		TOTAL	
	N	%	N	%	N	%
TRAN - Agent's path (e.g. *He moved his toupee up*)	76	77	23	23	99	100
TRAN + Agent's path (e.g. *He moved the sofa out of the bedroom*)	13	54	11	46	24	100
INTR (e.g. *The ball moved*)	2	8	22	92	24	100

From Table 9 we can see that Acting gestures occurred with transitive motion constructions without Agent's path (77%) about three times more often than Tracing gestures did with such constructions (23%), whereas there was roughly equal use of Acting and Tracing gestures in transitive motion constructions without Agent's path (54% vs. 46%). That is to say, Acting gestures were slightly more likely to accompany transitive motion constructions without Agent's path than transitive motion constructions with such a path, whereas Tracing gestures were slightly more likely to accompany transitive motion constructions with Agent's path than transitive motion constructions without such a path. This difference is statistically significant ($p<0.05$, $\chi^2=3.87$, df=1, phi=0.2). This result is different from the one in Section 3.3.2 concerning the relation between gestural modes and (transitive or intransitive) motion events with the Figure's path, in that it indicates that Tracing gestures seem to be related to the property of the Agent's displacement in transitive motion events. Specifically, as transitive motion constructions involve displacements of the Agent, the production likelihood of Tracing gestures increases.

4 Discussions and conclusions

This study aimed to investigate whether, and if so, how gesture relates to transitivity on the one hand, and how gesture relates to certain properties of events on the other hand. Through examining gesture use (gestural rate and gestural Modes of Representation) accompanying the causative alternation, it was found that gesture use relates to both properties of events and the type of transitivity, but it does so in different ways. More specifics follow below.

4.1 Gesture and events

Gesture use was found to relate to various properties of events in various ways in this study. The results are summarized in Table 10.

Table 10. Relations found between behaviors of gesture and properties of events in transitive and intransitive constructions ("–" represents that no relation was found; "+" represents that a relation was found in this study; NA means the property is not applied to the case; "unknown" means the small sample size does not allow the analysis of the relation between events and gesture, and thus the relation remains unknown)

		Gesture frequency	Gesture MoR
Agency of the participants	Transitive	unknown	unknown
	Intransitive	–	unknown
Volitionality of the participants	Transitive	+	–
	Intransitive	–	–
Path of Figure (+/-OBL)	Transitive	**+**	–
	Intransitive	unknown	unknown
Path of Agent	Transitive	+	+
	Intransitive	NA	NA

First, the frequency of representational gestures produced was found to relate to the volitionality of the participants in transitive events, and to the path property of both the Figure and the Agent in transitive motion events, but not to the agency or volitionality of the participants in intransitive events. That is to say, a lot more gestures were made for events with volitional agent than for those with non-volitional agent, and for events with the Agent's path or the Figure's path than for events without such paths. Provided that volitional actions seem to involve a higher degree of strength of action than non-volitional actions do, this result provides support for the Gesture-As-Simulated-Action Framework, which predicates that as the strength of simulated action increases, the likelihood of producing gestures rises (Hostetter & Alibali 2008). By identifying the relation between volitionality of the participants and gestural frequency, this result also offers a more nuanced understanding of which sub-properties of motor actions influence the likelihood of gestures being produced. The reason for more gestures occurring with events with a path is probably that the choice of an explicit path in motion events (with OBL) reflects a profile of the path of the Figure, which in turn could be manifested in the frequency of gestures produced. This finding complements the prevalent view that gestures are likely to occur when a spatial path in events is involved (e.g. Hostetter & Alibali 2008; Krauss 1998), by indicating that the frequency of gestures produced is sensitive to an explicit or implicit encoding of a Figure's path in motion events.

Note that the results in Section 3.2.1 seem to suggest that gesture frequency relates to the type of transitivity in non-volitional events, but it is possibly not transitivity that influences the gesture frequency. Instead, this result might be due to the fact that unlike transitive clauses with non-volitional agents (most concerning other events rather than opening or closing ones), intransitive clauses with such events tended to involve the prepositional phrase to encode the path of events, such as *I rolled my mom's Ford Falcon* (transitive) vs. [*They're wheeling out the cake. Suddenly it overturned and*] *rolled down an embankment* (intransitive).

Second, gestural Modes of Representation were found to relate to the path property of Agents, but not to the path property of the Figure particularly in transitive constructions, nor to the volitionality of

the participants in either transitive or intransitive constructions. It is noteworthy that as transitive motion constructions either involve displacement of the Agent or not, the likelihood of Tracing gestures being chosen increases, but this tendency does not significantly apply to transitive motion constructions with or without the path of the Figure. Whereas Parrill (2010) speculated that events with a path could be easily gestured from an observer's point of view (using the Tracing, Embodying, or Molding modes of representation) and activate visual imagery, the findings reported in this study suggest that motion events with the two types of path may evoke different kinds of mental simulation; that is, only when motion events involve displacement of the Agent, does the likelihood of activating visual imagery increase.

4.2 Gesture and transitivity

Despite the above relations obtained between gestures and various properties of events, gestures were still found to be closely linked with the choice of transitivity in encoding these events. The results are summarized in Table 11.

Table 11. Relations found between transitivity and gesture in various types of events

Type of syntactic encoding	Type of event	Gesture frequency	Gesture MoR
Transitivity	Human as external causation	–	+
	Natural force as external causation	unknown	Unknown
	Volitional human as external causation	–	+
	Non-volitional human as external causation	–	+
	+ OBL (explicit Figure's path)	–	+
	- OBL (implicit Figure's path)	–	Unknown
	+ Agent's path	NA	NA
	- Agent's path	NA	NA

As shown in Table 11, gestural rate does not relate to the type of transitivity, but gestural Mode of Representation does, particularly for those events expressing human, volitional human, or non-volitional human as external causation and events with an explicit path in the Figure. Specifically, Acting gestures preferably accompanied transitive constructions, whereas Tracing gestures preferably occurred with intransitive constructions, when the type of external causation and the type of change above is kept constant respectively. It might be the case that transitive and intransitive constructions reflect different ways in which speakers conceptualize events— +/- profile of external causation, which tend to be associated with the representational forms of the accompanying gestures—Acting or Tracing gestures. To put it another way, the gestures produced appear to relate to speakers' construal of events (in terms of +/- a profile of an external causation reflected by the choice of transitive and intransitive construction in speech) rather than simply to the properties of events, either the agency and volitionality of the participants in the background knowledge or the path property of the Agent and the Figure in motion events.

These findings call for future studies on gestures in relation to events of change of state (such as *break* events) or change of location (such as motion events) to consider syntactic encodings of these events, that is, their transitivity (besides the use of directional oblique phrases as discussed above) because otherwise, notable differences between transitive events and intransitive events with change-of-state/location might possibly be overlooked. Moreover, more care is needed in drawing conclusions about an exclusive relation

between co-speech gestures and stimulus events without consideration of narrators' speech (that is, the syntactic encoding of these stimulus events), given that the syntactic encoding in speech also tends to play a role in relation to gesture use.

One major conclusion that can be drawn from this study is that an exclusive relation either between gesture and events or between gesture and transitivity has not been found. Instead, a complex interaction between gesture, events, and transitivity is suggested, which thereby provides a more nuanced understanding of gestures in relation to transitivity and certain spatial-motoric properties of events. The results reinforce and complement the findings in previous studies about the relation between gesture and transitivity. It is only by considering the relation between gesture and the fundamental grammatical category *transitivity* that we will further our understanding of the relation between gesture and grammar/language.

There are a few possible extensions of the present research that could be made. One would be to examine a larger variety of verbs licensing the causative-inchoative alternation, going beyond the few used in the present study. In this way, a wider picture about gesture, events, and the type of transitivity could be obtained. It would also be of interest to investigate gesture in relation to another type of causative alternation—the induced action alternation (e.g. *He jumped the horse over the fence* vs. *The horse jumped over the fence*), so that more insight can be gained relating to the general question as to whether and how gesture relates to transitivity—a fundamental grammatical category in language.

One additional research direction is to investigate the similarities and differences between gestures and signs (e.g. in the area of classifiers) in their relations to transitivity, thereby proving new insights for understanding potential relationships between gestures and signs in this regard. Initial observations are as follows. On the one hand, co-speech gestures and signs possibly concern similar means to express the transitive-intransitive alternation to some extent. This can be shown by the fact that transitive constructions in American Sign Language tend to be expressed by classifiers with "handling" handshapes, whereas the alternate intransitive constructions by classifiers with "whole entity" or "extension" handshapes (handshapes referring to properties of objects) (Benedicto & Brentari 2004), and also by the findings reported in this study that in spoken language in American English, transitive constructions tend to occur with Acting gestures, gestures formally similar to such verbal classifiers with handling handshapes, whereas intransitive constructions tend to occur with Tracing gestures, gestures bearing similarities to ASL verbal classifiers with "whole entity" and "extension" handshapes. On the other hand, co-speech gestures seem more flexible than signs in encoding the alternation, as shown by the interaction found between properties of events and gesture (besides the above relation between transitivity and gesture) in this study, which is probably due to the fact that gestures do not bear the full communication burden as signs do. Further research is needed to provide more insights in this regard.

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