Demonstratives as dimension shifters[1]

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Abstract. Drawing on earlier work by Ebert and Ebert (2014), we argue that co-speech gestures contribute non-at-issue information by default (cf. Schlenker, 2018), flesh out their proposal that gestural content can be shifted via demonstratives (i.e. demonstratives function as *dimension shifters* from the non-at-issue to the at-issue dimension), and present experimental validation for this claim.

Keywords: gesture, demonstratives, German *so*, at-issueness.

1. Gestures

Pioneering work from Kendon (1980) and McNeill (1992) has shown that gesture information can contribute additional semantic content to an utterance that is not already present in the speech signal. In line with these authors we understand gestures as communicative movements of hands and arms transporting emotions, intentions, and thoughts as in the following example.[2]

(1) Die Skulptur, die hat ['n Betonsockel].
ROUND
'The sculpture has a base made of concrete.'

The utterance in (1) as a whole conveys that the sculpture has a round base made of concrete. The information that the base is round does not stem from the speech signal, however, but from the speech-accompanying gesture. In more traditional gesture research, it is well-known that gestures can add information to an utterance. Kendon (1980) and McNeill (1992) point out that gesture and speech work together to convey one thought. This holds for different types of gestures alike.

While there are many different types of gestures (McNeill, 1992), we will be concerned only with *iconic* and *pointing* gestures in this paper. Iconic gestures, as in (1), represent a property of an object or an event and show some direct similarity to what they depict. They are not conventionalized: a round object can be represented gesturally in many different ways (via

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[2]The example is from the 'Speech and Gesture Alignment' (SaGA) corpus (Lücking et al., 2013) Square brackets around a verbal expression indicate that there is an accompanying gesture that is performed co-verbally. The gesture will be given below the verbal expression. 'ROUND' stands for an iconic gesture that depicts roundness. In the corpus example, it was a dynamic gesture performed with both hands in the central gesture space in front of the speaker's torso.

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forming a round shape with the hands, making a circular movement with one hand or with two, etc.) and yet the gesture always means more or less the same, namely 'round (object)'. Pointing gestures, usually performed with the stretched index finger in our cultural community, identify an object by directing the attention to the object itself. They serve to point to concrete or abstract objects and they can also locate such objects in the gesture space for further reference to them (see Kendon, 2004). Note that pointing gestures can also be used co-speech and then function very much like iconic gestures.

(2) Die Skulptur, die hat ['n Betonsockel].
POINTING
'The sculpture has a base made of concrete.'

If the speaker points to a picture of a round base, the recipient will also conclude that the base mentioned in the verbal utterance is or looks similiar to the depicted base, i.e. that it is round.

2. The (non-)at-issue status of co-speech gestures

In this section, we will pursue the question **how** co-speech gesture meaning interacts with the verbal meaning. The main claim is that run-of-the-mill co-speech gestures contribute meaning that is not at issue in the sense of Potts (2005).

As we know, words, phrases, and entire sentences can contribute meanings in different dimensions. This idea, which goes back to Grice (1975) at least, is modeled in different recent frameworks (Potts, 2005; Anderbois et al., 2013; and others). For illustration consider the adjective *damn*, which has an *expressive* meaning component indicating that the speaker is emotionally involved and has negative feelings towards the associated concept or object. *Nominal appositives* as in (3a) and appositive relative clauses as in (3b) are also conceived to contribute non-at-issue material.

(3) a. John, an excellent tennis player, lost five matches in a row.
b. John, who is an excellent tennis player, lost five matches in a row.

Expressives and appositives are argued to bring in information that is not at issue at the time of utterance, but sneaked in as secondary information. Their contribution is not the main aim of the utterance and not towards what the speaker wants to drive the conversation. Farkas and Bruce (2010) elaborate on the concept of at-issueness vs. non-at-issueness and put forth that at-issue contributions are 'put on the table' for discussion, while non-at-issue contributions can enter the common ground without ever being on the table. As such they are silently imposed and enter the common ground without the need for approval by the hearer. For instance, both sentences in (3) communicate 1. that John lost five matches in a row, and 2. that the speaker thinks that John is an excellent tennis player. This second proposition, however, is just sneaked in as secondary information and clearly not what is for disposition.

The following characteristics can be used to test a piece of propositional information for non-at-issueness (Potts, 2005; Potts et al., 2009): 1. it cannot directly be denied in discourse, 2. it cannot be interpreted in the scope of modal operators or negation (i.e. it projects), and 3. it can

be ignored in ellipsis constructions. For instance, if a listener wants to object to the speaker's assessment of John's skills as a tennis player, she cannot felicitously do so by a simple denial with '*No! That's not true*'. Instead, she would have to use some kind of discourse interrupting protest (cf. von Fintel, 2004; Potts, 2015; and Syrett and Koev, 2014, for critical discussion), as in (4).

(4) Hey, wait a minute – actually he is a lousy tennis player.

We argue that co-speech gestures also share these characteristics and thus have to be treated as non-at-issue information. Consider the following utterances (including an iconic co-speech gesture BIG indicating bigness, which we depict here for clarity):

(5) a. I brought [a bottle of water] to the talk.
BIG


b. I brought a big bottle of water to the talk.

(5a) conveys that the speaker brought a bottle of water to the talk and that the bottle was big, hence roughly the same as (5b). The crucial difference between these utterances lies in the deniability of the size information. While it is perfectly possible to directly deny the bigness of the bottle in (5b) with *'No! The bottle was small'* one has to use a discourse interrupting protest along the lines of (4) to do so for (5a).

Likewise, if (5a) is modified by a negation ('*I did not bring...*') it cannot be felicitously continued by '*A small one is enough for me*'. Thus, the information conveyed by the gesture cannot be targeted by negation. After all, the negated multi-modal utterance appears infelicitous altogether due to the uninterpretable co-speech gesture. Finally, co-speech gesture content can also be ignored in ellipsis constructions just like other non-at-issue content (see also Potts et al., 2009). (5a) could be felicitously continued by the listener by '*I also brought one, but actually a small one*' indicating that the gestural bigness information is ignored. Summing up, the co-speech gesture in (5a) contributes information that bears all three characteristics of non-at-issue information discussed above.

3. Demonstratives and their dimension-shifting potential

Although we have seen that co-speech gestures usually contribute non-at-issue meanings there are ways to make gesture contributions at-issue. A case in point is stress, i.e. making a gesture more salient by using more gesture space and possibly adding accompanying facial gestures such as eye-brow raise (see also Esipova, 2018, for discussion of co-speech gestures with contrastive focus). One further important and canonical way to make gesture contributions at-issue content is the use of a demonstrative. For a start, consider the German translation of (5a) in (6) where we added the negative adverbial *niemals* (engl. *never*).

(6) Ich bringe niemals [eine Flasche Wasser] mit zu Vorträgen.
I bring never a bottle water with to talks
BIG
'I never bring a bottle of water to talks.'

(6) appears odd due to the uninterpretable accompanying gesture. Like in the case of the negated version of the English original above, the gesture cannot be interpreted as providing a property of the bottle that is explicitly negated by the negative temporal adverb, which is evidenced by the fact that a continuation such as "*Eine kleine reicht mir nämlich*" (engl. '*A small one is enough for me*') is clearly infelicitous. Now consider a minimal variant of (6) in (7) that makes use of the German demonstrative *SO*.

(7) Ich bringe niemals [SO] eine Flasche Wasser mit zu Vorträgen.
I bring never SO a bottle water with to talks
BIG
'I never bring a bottle of water like that to talks.'

Interestingly, here the same elaboration is perfectly felicitous. This shows that the gesture content in (7) now can be targeted by the adverbial. In other words, the size property that the gesture contributes is affected by the semantics of the adverb *niemals* (engl. *never*) in the same way as it would be if it was introduced by an adjective (as in "*Ich bringe niemals eine große Flasche Wasser mit zu Vorträgen*"; engl. '*I never bring a big bottle of water to talks*'). This in turn shows that the gestural meaning component in (7) must have entered the at-issue dimension. We argue that it is the demonstrative *SO* (engl. *so/such/like this*) which is responsible for this effect. We analyze *SO* as a semantically vacuous item whose first and only function it is to shift whatever non-at-issue meaning is expressed by a co-occurring gesture from non-at-issue to at-issue, thus making it available for fully integrated interaction with the semantics of the speech signal.[3]

We claim that demonstratives in general show this domain-shifting behavior. In particular, we suggest that German *dies* (engl. *this*) is actually the shifted version of the definite article (cf. Roberts 2002, who also treats demonstratives as definites that presuppose an accompanying demonstration, and Wolter 2006, who treats them as definites which are interpreted relative to other salient situations than non-deictic definites), or in other words: the spell-out of *SO der*/*SO die*/*SO das*. We find support for this construal by looking at diachronic developments in West- and North-Germanic languages (Pfeifer, 1997). Interestingly, after the definite article had developed from the demonstrative, a new strengthened demonstrative evolved that was built from the definite form plus a deictic particle *-se*, which is the origin for the German demonstrative we use now. At the time, we would find internally inflected forms of this demonstrative such as Germanic *den-se* (lit. *the*-ACC.M.SG + deictic particle *-se*), which overtly illustrate what we propose.

[3]Note that Potts (2005: p. 36) explicitly argues against the existence of this kind of dimension-shifters from non-at-issue to at-issue. We claim that *SO* and demonstratives in general are precisely this.

4. Semantic Gesture Contributions

To get at a precise formal account we have to ask **what** the meaning contribution of a gesture is. As a first step towards an answer we take it that an iconic gesture and a pointing gesture make exactly the *same* kind of meaning contribution. To underpin this idea consider a variant of (5a), where the iconic gesture is replaced by a pointing gesture to a big bottle.

(8) I brought [a bottle of water] to the talk.
POINTING AT A BIG BOTTLE OF WATER

Crucially, both (5a) above and (8) convey the at-issue meaning that the speaker brought a bottle to the talk while silently imposing the non-at-issue meaning that this bottle was big. Pointing to a big bottle while talking about a bottle, we claim, makes the (non-at-issue) contribution that what the speaker talks about should bear some similarity to what the speaker points to. And the same, we conjecture, holds for iconic gestures: what the speaker talks about should bear some relevant similarity to what the gesture depicts.

Given this equal treatment of iconic and pointing gestures we put forth that both make the same basal '*lexical*' meaning contribution: they both refer to an object/individual. While this idea of referring to a gesture referent (the *demonstratum* in Kaplan's terms) is straightforward for a pointing gesture,[4] it requires us to think of an *abstract* object in case of an iconic gesture that carries at least the features which are crucial for the comparison/similiarity that is needed in context. Hence, while the concrete bottle in (8) bears itself the contextually salient *size* feature, it is an abstract object (filling the space between the palms) that does so in (5a).

What is hence depicted by the iconic gesture in (5a) is not the size property of the bottle, it is the bottle itself (cf. Ehlich, 1986; Umbach and Ebert, 2009) – abstracted over all properties but the contextually relevant one, i.e. size. Just as we do not point to the size property when we point to a big bottle in (8), we do not depict bigness by the iconic gesture in (5a). If pointing just to a property was possible, it should be felicitous to point to an object of about the size of a big bottle (a book, say) in (8). In fact, however, this would lead to infelicity of the utterance. In full analogy to the pointing case, we thus assume that the iconic gesture in (5a) depicts the bottle itself and not just its size property. To sum up: the basal meaning of an iconic and pointing gesture is the establishment of a gesture referent.

However, this meaning component alone cannot account for interactions with the verbal signal in general, and with verbal referents in particular. To this end it is noteworthy that gesture and speech are temporally aligned (McNeill, 1992). This is supposed to mean that the timing of gesture performance w.r.t. the production of the speech signal is decisive for the emergence of gestural meaning contributions. As a particularly simple example consider an utterance of (9) with the iconic BIG gesture co-occurring to the verbal utterance of the noun *talk*:

[4] As a disclaimer let us note at this point that *deferred reference* in the sense of Nunberg (1993) is also possible, i.e. the intended referent is not neccessarily the pointing referent, but can be a referent that stands in some obvious relation to it.

(9) I brought a bottle of water to the [talk].
BIG

It is the mere temporal coincidence of the utterance of the noun and the performance of the gesture that lets an interpreter conclude that the abstract gestural referent must be iconically related to the noun meaning (here: *talk*). As a relation between a talk and an abstract upright object of the size of a big bottle is hard to construe, the gesture seems to be misplaced and the utterance as a whole slightly odd.

To account for this well-established insight from the more traditional gesture literature we propose that a co-speech gesture performance introduces a type of *constructional* meaning, depending on the type of the temporally aligned verbal item, in addition to its basal meaning. Let us take a closer look at three instances of verbal items, which are of particular interest to us in the context of demonstratives: 1. indefinite and 2. definite determiners and 3. their noun phrase complements.

Indefinite article. To illustrate the type of additional constructional meaning that we are after consider utterance (5a) again. As discussed in section 2, the utterance as a whole conveys a non-at-issue statement that the bottle brought by the speaker is big. Given that the iconic gesture refers to an object (as argued in the preceding section), the actually conveyed constructional meaning component is a statement about the *similarity* of the verbal referent and that gesture object/referent. Here similarity is to be understood as 'similarity in the relevant dimension in the context', where we have nothing more to say about the nature and the determination of the relevant dimension at this point. We hence argue that the property information that an iconic gesture often seems to add (such as the size property in example (5a)) comes about by temporal alignment of the gesture with the indefinite, which induces comparison of gesture and speech referent.[5]

Definite article. For the definite article matters are slightly different. Consider a context involving two playing cards: an ace of spades to the left and a seven of clubs to the right: **A♠ 7♣** In this context assume the following utterance:

(10) [The card on the left] is an ace.
POINTING TO THE **7♣**

Intuitively speaking, something feels not quite right. The speaker refers to the card on the left and makes a true statement about it with his verbal utterance. But the pointing seems to be incorrect to the extent that it does not identify that verbal referent, i.e. the card on the left. In other words, we expect the gesture referent to be *identical* to the verbal referent. We put forth that this identity of referents is the constructional meaning component that arises from the temporally aligned performance of gesture and utterance of a definite article.[6] In a sense we might say that identity is a strengthened version of similarity, i.e. similarity w.r.t. *all*

[5]Note that Umbach and Gust's (2014) approach is related to ours in several respects, e.g. w.r.t. the assumption that pointing and iconic gestures refer to individuals, and the involved similarities. However, in their approach similarity is not introduced by gesture-speech alignment, but by demonstrative expressions (cf. section 6).
[6]The same holds for gesture and aligned proper names.

dimensions.

Noun phrase. In example (9) we saw already that there seems to be an additional constructional meaning component at play. The BIG-gesture did not seem to fit the kind expressed by the verbal noun phrase *talk*. In other words, we expected the gesture referent to be of the same kind as expressed by the verbal noun phrase. More precisely, the temporal alignment of gesture and noun phrase is responsible for the existence of this *exemplification* (cf. Lascarides and Stone, 2009; Fricke, 2012; Lücking, 2013): the gesture referent must satisfy the property expressed by the verbal noun phrase.[7]

This concludes the informal discussion of the meaning contributions of co-speech gestures. Crucially, as argued for above, all these meaning contributions come in as non-at-issue meanings by default. In the following we will turn to a formalization of these ideas.

5. The Formal Semantics of Co-Speech Gestures

In order to give a formal account we extend the system of Anderbois et al. (2013) (henceforth abbreviated as ABH) slightly. They put forth a dynamic uni-dimensional system for treating appositives in discourse that accounts for the non-at-issue status of the appositives while at the same time allowing for possible anaphoric references across dimensions, i.e. between appositives and the surrounding at-issue material. Since we also need to establish relations between verbal at-issue and gestural non-at-issue discourse referents the ABH system makes a particularly well-suited point of departure. In the following we will discuss the key features of the analysis of co-speech gestures and demonstratives. The interested reader is referred to the appendix of this paper for detailed definitions and to the seminal paper (Anderbois et al., 2013) for further explanation and background.

Like ABH we make use of two distinct propositional variables p and p^* to keep track of the meaning contributions of at-issue and non-at-issue material, respectively. While the at-issue proposition designated by p can be regarded as a *proposal* by the speaker to update the context set, which is open for discussion, the non-at-issue proposition p^* is silently imposed and not open for discussion (cf. Farkas and Bruce, 2010).

We also adopt ABH's definition of discourse referents $x, y, z, \ldots$ as individual concepts of type $\langle s, e\rangle$. Since we take it that the basal '*lexical*' meaning contribution of an iconic or pointing gesture is mere reference to an individual g (as pointed out above), we capture this meaning contribution by establishment of a novel discourse referent for a rigid designator I_g to the gesture referent g.

(11) $\quad [z] \wedge z = \mathrm{I}_g \quad$ where for all $w \in W : [\![\mathrm{I}_g(w)]\!] = g$

At the same time we extend the system of ABH by *relativized identity* $=_p$ that is only evaluated

[7]Note that the gesture in (9) is temporally aligned only with the nominal. In fact, there is not even a separate preceding determiner since it occurs only in a contracted form *zum* (= *zu* + *dem*; engl. *to the*) with the preposition. Therefore exemplification really is a distinct meaning component. The same case can be made with co-speech gestures aligned with NPs in quantificational DPs and bare plurals.

w.r.t. the subscripted proposition p as an addition to the standard identity of ABH $=$ that is evaluated w.r.t. all possible worlds. This notion of relativized identity is crucial for an account of the full range of examples and the differences of definites and demonstratives in particular. The gist of the analysis is the following: while the mere act of pointing is one of rigid designation (i.e. across all possible worlds) this designation enters into propositional meanings on different dimensions via these relativized identities. We refer the reader to the appendix for more formal details and two worked-out examples.

As argued in the preceding section, co-speech gesture performance also introduces a type of '*constructional*' meaning, depending on the type of the temporally aligned verbal item, in addition to the basal meaning in (11). Crucially, these meaning contributions are all non-at-issue. The following three cases of co-speech phrases were discussed, where x and z stand for the verbal and gestural discourse referents, respectively.

Indefinite article. We put forth that the temporally aligned performance of an indefinite article and a gesture results in an expression of similarity of the gestural referent and the designated indefinite. Formally, we deal with this similarity by a two-place predicate SIM such that the co-speech performance of an indefinite article (construed as introducing a novel discourse referent x) and a gesture (introducing a novel discourse referent z as in (11)) results in a non-at-issue predication $\mathrm{SIM}_{p^*}(x,z)$. It is evaluated on the non-at-issue proposition p^* and true if the objects designated by x and z are similar in the relevant dimension in the context.[8]

Definite article. In the case of definite articles similarity is strengthened to (relativized) identity $x =_{p^*} z$ (see Roberts 2002 for a related constraint), which comes down to requiring that x and z designate the same object for all worlds of the non-at-issue proposition p^*.

Noun phrase. For NPs we argued that the relation between verbal and gestural referent is one of exemplification. This simply comes down to requiring that the property expressed by the noun phrase (N, say) holds of the gestural referent: $N_{p^*}(z)$.

To illustrate, the utterance of the DP *a bottle* accompanied by a simultaneous pointing gesture to a bottle **b** in (12a) is analyzed as in (12b).

(12) a. [a bottle]
POINTING TO **b**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge [z] \wedge z = \mathbf{I_b} \wedge \mathrm{SIM}_{p^*}(x,z) \wedge \mathsf{bottle}_{p^*}(z)$

This analysis captures the introduction of a novel discourse referent for a bottle, one for the gesture referent (here: the object pointed at), the non-at-issue statement that this bottle and the gesture referent are similar and the non-at-issue statement that the gesture referent is a bottle. To illustrate the impact of the different meaning components it is best to look at cases where mismatches arise and things go wrong. To this end consider an utterance of (13a) where the DP *a bottle* is accompanied by a pointing gesture to a table **t**.

[8] Umbach and Gust (2014) add a third argument to the similarity predicate, which constitutes the set of dimensions with respect to which similarity has to hold.

(13) a. Cornelia brought [a bottle].
POINTING TO **t**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge [z] \wedge z = \mathbf{I_t} \wedge \mathrm{SIM}_{p^*}(x,z) \wedge \mathsf{bottle}_{p^*}(z) \wedge \mathsf{bring}_p(\mathsf{cornelia}, x)$

In our approach this assertion with a pointing gesture to table **t** that accompanies the utterance of the object DP thus comes down to:

at-issue:	an at-issue claim that Cornelia brought a bottle, and
non-at-issue:	a (false) non-at-issue claim that the table is a bottle and similar to it.

Hence, if Cornelia actually brought a bottle (in the context of utterance), the verbal statement in (13a) is true, but the non-at-issue statement (i.e. the exemplification statement) that the table pointed at is a bottle is false. This accounts for the observed fact that a listener might respond with '*Yes, but what you are pointing at is not a bottle*' in such a situation. Another such case might involve the similarity statement. Consider an utterance of the slight variation (14a) where the DP *a bottle* is accompanied by a pointing gesture to a huge 3 litre double magnum bottle **B**.

(14) a. Cornelia brought [a bottle].
POINTING TO **B**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge [z] \wedge z = \mathbf{I_B} \wedge \mathrm{SIM}_{p^*}(x,z) \wedge \mathsf{bottle}_{p^*}(z) \wedge \mathsf{bring}_p(\mathsf{cornelia}, x)$

Again, if Cornelia actually brought a relatively normal-sized bottle, the verbal statement in (14a) is true. In this case also the non-at-issue exemplification claim that the object pointed at is a bottle is true. However, the non-at-issue similarity claim that the bottle Cornelia brought is similar to the huge bottle is false (assuming that size constitutes the relevant dimension for similarity). This accounts for the observed fact that a listener might respond with '*Yes, but the bottle she brought was not that huge*' in such a situation.

For the case of a definite DP the analysis runs entirely parallel with the difference of similarity being strengthened to identity. To make for a plausible context assume the following sentence to be uttered in a party situation with a lot of different gifts on a table, among them one bottle **b**, where we wonder who brought what.

(15) a. Cornelia brought [the bottle].
POINTING TO **b**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge [z] \wedge z = \mathbf{I_b} \wedge x =_{p^*} z \wedge \mathsf{bottle}_{p^*}(z) \wedge \mathsf{bring}_p(\mathsf{cornelia}, x)$

At this point, we do not formally spell out the presuppositions of the definite, but we will include it in the list of propositional meaning components that make up the meaning of an assertion of (15a).

presupposition:	there is a unique (contextually salient) bottle
at-issue:	Cornelia brought that bottle
non-at-issue:	the gesture referent is that bottle and is itself a bottle

In a context where Cornelia actually brought that (unique contextually salient) gift bottle on the table, the presupposition is satisfied and both the at-issue proposition and non-at-issue proposition are true. It is instructive again to look at a related mismatch example. Consider the party scenario from above with TWO bottles on the table of gifts, a normal-sized bottle **b** and a huge 3 litre double magnum bottle **B**. Now let us look at the following example where the verbal utterance mentions the huge bottle, while the pointing is still on the normal-sized one.

(16) a. Cornelia brought [the huge bottle].
POINTING TO **b**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge \mathsf{huge}_p(x) \wedge [z] \wedge z = \mathbf{I_b} \wedge x =_{p^*} z$
$\wedge\, \mathsf{bottle}_{p^*}(z) \wedge \mathsf{huge}_{p^*}(z) \wedge \mathsf{bring}_p(\mathsf{cornelia}, x)$

presupposition:	there is a unique (contextually salient) huge bottle
at-issue:	Cornelia brought that huge bottle
non-at-issue:	the gesture referent is that bottle and is itself a huge bottle

In a context where Cornelia actually brought that huge double-magnum bottle **B** the presupposition is satisfied and the at-issue proposition is true. However, the non-at-issue proposition is false since the gesture referent, the normal-sized bottle **b**, is not identical to that bottle. This explains why a listener might respond with '*Yes, but the bottle you are pointing at is not that bottle/the bottle she brought*' in such a context.

6. The Formal Semantics of Demonstratives

Starting with the formal semantics of co-speech gestures from the preceding section, it takes only one simple step to describe the semantics of demonstration: it acts as a dimension shifter and makes non-at-issue meaning at-issue. As a particularly clear example that transparently illustrates this effect, consider the before-mentioned German demonstrative *SO*, which we might see as an overt realization of a *demonstrative operator* **DEM** that performs the dimension shifting. In our formal setting this simply comes down to a change of the proposition for evaluation from p^* to p and we might specify the effect of this operator as:

(17) $\mathbf{DEM} : \mathscr{P}_{p^*} \rightarrow \mathscr{P}_p$ for any literal $\mathscr{P}$.

Reminding ourselves that it is the similarity statement $\mathrm{SIM}_{p^*}(x,z)$ that comes about by co-speech performance of a gesture with the indefinite article, the effect of *SO* on the German indefinite article *ein* will quite simply be a shift of that statement to $\mathrm{SIM}_p(x,z)$ (mind the change of the propositional variable). Therefore the demonstrative German version of (12a) will be:

(18) a. [SO eine Flasche]
POINTING TO **b**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge [z] \wedge z = \mathbf{I_b} \wedge \mathrm{SIM}_p(x,z) \wedge \mathsf{bottle}_{p^*}(z)$

In order to see the effect of this change, consider the following German demonstrative variant

of the similarity failure example in (14), where a huge bottle **B** is pointed at.

(19) a. Cornelia hat [SO eine Flasche] mitgebracht.
POINTING TO **B**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge [z] \wedge z = \mathbf{I_B} \wedge \mathrm{SIM}_p(x,z) \wedge \mathsf{bottle}_{p^*}(z) \wedge \mathsf{bring}_p(\mathsf{cornelia}, x)$

Accordingly, the at-issue/non-at-issue contributions differ from those of (14):

at-issue:	Cornelia brought a bottle which is similar to the gesture referent
non-at-issue:	the gesture referent is itself a bottle

Now, if Cornelia actually brought a normal-sized bottle, the verbal statement in (19a) is false. Albeit she brought a bottle, the bottle she brought is not similar to the huge gesture referent.[9] This accounts for the observed fact that a listener might now felicitously respond with (the German translation of) "*No, the bottle she bought was not that huge*" in such a situation, in contrast to what was the case for (14). The seemingly small effect of the demonstrative of shifting the constructional similarity meaning contribution to the at-issue dimension is responsible for a quite severe change in truth-conditions.

Again, the case of the German demonstrative determiner *dies* (engl. *this*) runs parallel. As we argued above, it is reasonable to view these demonstrative determiners as being semantically decomposed into *SO* + definite determiner, such that *this* receives the meaning of [*SO the*]. If we adopt this idea, we will see the effect of shifting the non-at-issue constructional meaning of identity $x =_{p^*} z$ to the at-issue dimension. The demonstrative variant of (15) thus turns out as:

(20) a. Cornelia brought [this bottle].
POINTING TO **b**

b. $[x] \wedge \mathsf{bottle}_p(x) \wedge [z] \wedge z = \mathbf{I_b} \wedge x =_p z \wedge \mathsf{bottle}_{p^*}(z) \wedge \mathsf{bring}_p(\mathsf{cornelia}, x)$

Before turning to the at-issue/non-at-issue contributions we need to take a closer look at presuppositions first. To this end consider an utterance of (21) in the party scenario from (15) above with TWO bottles on the table of gifts (a normal-sized bottle **b** and a huge bottle **B**).

(21) # Cornelia brought [the bottle].
POINTING TO **b**

Empirically the utterance of (21) results in a presupposition failure in this scenario, where two salient bottles are present and thus the uniqueness presupposition of the definite fails. In contrast, an utterance of (20a) in the same context does not leave the listener with a squeamish feeling, which calls for an explanation if we assume that the demonstrative *this* is essentially a shifted version of the definite *the*. Our explanation resorts to the proposed dimension shifting. As shown formally in (20b) the at-issue content of the demonstrative expression *[this bottle]* includes the (shifted) identity statement $x =_p z$. Therefore the content decisive for the evaluation of the uniqueness and existence presupposition is not only the property of *being a bottle* as in

[9] Again, we assume that size constitutes the relevant dimension for similarity (cf. Umbach and Gust, 2014).

the plain definite case, but the property of *being a bottle which is identical to the gesture referent* (see Wolter, 2006). Overall, the propositional meaning components in the analysis (20b) are as follows.

presupposition:	there is a unique (contextually salient) bottle which is identical to the gesture referent
at-issue:	Cornelia brought that bottle
non-at-issue:	the gesture referent is that bottle (and is itself a bottle)

This is the correct analysis. In the two-bottle scenario, (20a) is true if Cornelia actually brought the normal-sized bottle pointed at. Crucially, it is FALSE if Cornelia brought the huge double-magnum bottle, allowing a listener to respond with "*No, in fact she brought the other bottle*" in contrast to (16), where 'false pointing' does not affect the truth value of the sentence and the utterance comes out as true. The analogous case to (21), which gives rise to a presupposition failure with a demonstrative, would be when a speaker utters (20a) in the two-bottle scenario while pointing to both bottles at the same time.

Kaplan (1989) puts forth that demonstratives (as well as pure indexicals) are directly referential, independent of the circumstances of evaluation. Our proposal can be seen as an implementation of this insight. We take the mere act of pointing to be one of rigid designation. Crucially, this designation may enter into propositional meanings on different dimensions. While gestural meaning components start out as non-at-issue by default, demonstrative expressions are responsible for making these components at-issue, allowing them to enter into the truth-conditions proper. In this sense, our approach should be understood as an elaboration of Kaplan's approach (see the appendix for details).

7. Experiment 1: At-Issueness

This section aims at experimentally validating our claim that speech-accompanying gestural contributions are of a different nature than corresponding verbal contributions. In particular, we want to corroborate our claim that co-speech gestures are non-at-issue contributions.[10] Furthermore, we give experimental support to the proposal that German *SO* is a dimension shifter, which can shift gestural material (non-at-issue by default) to the at-issue dimension.

Experiment 1 used a sentence–picture matching task to show that a mismatch induced by at-issue material (a property expressed by an adjective as part of the assertion) impairs matching judgments more strongly than a mismatch induced by non-at-issue material (a property expressed by a speech-accompanying gesture). The two-factorial design crossed the two *within*-factors MODE (*Adjective* vs. *Gesture*) and MATCH (*Match* vs. *Mismatch*). The core hypothesis claims an interaction of the two factors such that the Mismatch effect—the decrease in the perceived conformity between sentence and picture due to the mismatch as indicated by the difference between judgments in the *Match* and the *Mismatch* conditions—is stronger if the mismatch is induced by an adjective compared to a gesture.

[10] See Tieu et al. (2017, 2018) for experimental studies on the nature of the non-at-issueness of co-speech gestures.

Method

Participants. 40 native speakers of German, all of them students of the University of Stuttgart, took part in Experiment 1. They were paid 4 € for the session which took about half an hour.

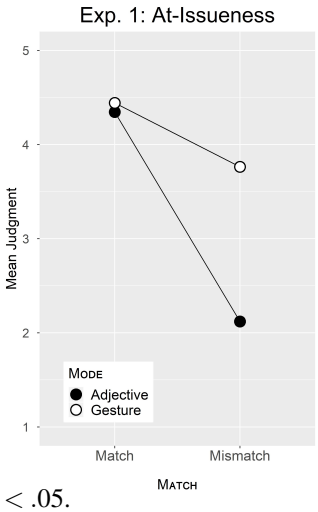
Materials. 24 experimental items were constructed, each one pairing an utterance with a picture. A male student assistant verbalized all sentence stimuli of Experiment 1 while being video taped. In the *Adjective* condition, the speaker verbalized the sentence with an adjective (*rund*, engl. *round*) in sample (22), but without accompanying gesture; in the *Gesture* condition, he verbalized the sentence without an adjective, but with an iconic gesture temporally aligned with the indefinite. As for (22), the speaker traced a circle with his index fingers in front of him while uttering the indefinite *einem Fenster* (engl. *a window*).

(22) In diesem Bild ist eine Mauer mit einem {runden} Fenster zu sehen.
'In this picture you see a wall with a {round} window.'

The videotaped utterance was paired with a matching picture (*Match* condition) or a mismatching picture (*Mismatch* condition). As for (22), the matching picture showed a wall with a round window, the mismatching picture showed a wall with a rectangular window. The four variants of the 24 experimental items were assigned to four lists according to a Latin square design. The same 48 filler items were added to all four lists.

Procedure. Participants were tested individually at a PC. The session started with a practice trial followed by the experimental items intermixed with the fillers in a randomized order for each participant. Trials began with the presentation of the picture. With a press of the space bar, the picture disappeared and the video started. After the video had finished, a scale appeared on the screen extending from 1 = 'no match' to 5 = 'perfect match'. Participants had to rate how well they thought that the description given in the video matched the picture they saw. They gave their judgment by means of a mouse click on the number of the scale.

Results and Discussion



The data were aggregated per condition per participant (F_1 analysis) or item (F_2 analysis) and subjected to a repeated measures ANOVA.[11] The analysis confirmed the predicted interaction of MODE×MATCH [$F_1(1,39) = 93.7^{***}$; $F_2(1,23) = 68.6^{***}$]. The graph to the right shows that the Mismatch effect is stronger in the *Adjective* conditions than in the *Gesture* conditions. In addition, there were significant main effects of both factors [MATCH: $F_1(1,39) = 556.1^{***}$; $F_2(1,23) = 127.9^{***}$; MODE: $F_1(1,39) = 164.0^{***}$; $F_2(1,23) = 102.1^{***}$].

To summarize, Experiment 1 clearly supports the stronger Mis-

[11] Significance levels are indicated by asterisks: *** if $p < .001$; ** if $p < .01$; * if $p < .05$.

match effect induced by adjectives compared to gestures and thus corroborates the assumption that the noun modification is at-issue if conveyed by adjectives, but remains non-at-issue if conveyed by speech-accompanying gestures.

8. Experiment 2: At-Issueness Shift

Experiment 2 extended the design of Experiment 1 by adding a third level to the factor MODE: a gesture accompanied by the German demonstrative *SO* (*Dem+Gest* conditions). The hypothesis claims that the demonstrative shifts the gesture meaning from non-at-issue to at-issue. The demonstrative is hence expected to boost the Mismatch effect of the gesture to the strength of adjectives and thus to a higher strength than for gestures without a demonstrative. It is predicted that MATCH interacts with MODE if *Dem+Gest* is compared to *Gesture* but not if it is compared to *Adjective*.

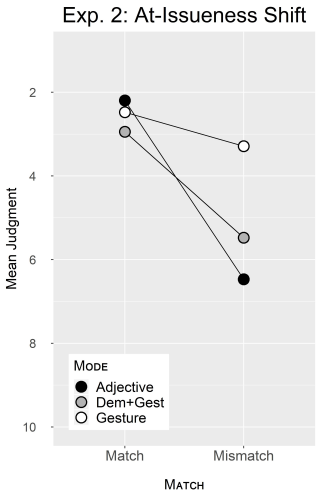
Method

Participants. 32 native speakers of German were acquired as participants of Experiment 2 via ZAS Berlin. They were paid 5 € for the session, which took about half an hour.

Materials. For Experiment 2, the 24 experimental items from Experiment 1 were supplied with a third video taped description for the new condition *Dem+Gest*. The sentence was the same as the one in condition *Gesture* except that simultaneously with the performance of the gesture the speaker uttered the demonstrative *SO*, illustrated in (23). It was taken care that the speaker pronounced the demonstrative with a strong accent. All sentence stimuli were verbalized by a female student assistant while being video-taped. The six variants of the 24 experimental items were assigned to six lists according to a Latin square design, with all lists also equipped with the 48 fillers.

(23) In diesem Bild ist eine Mauer mit SO einem Fenster zu sehen.
'In this picture you see a wall with a window like this.'

Procedure. The procedure was the same as in Experiment 1 except that participants judged the sentence–picture pairs on a scale from 10 = 'no match' to 1 = 'perfect match'.



Results and Discussion

The data were analyzed as in Experiment 1. Repeated contrasts were applied to the three-level factor MODE in a way that the *Dem+Gest* condition was compared to both the *Adjective* and the *Gesture* condition. The results are shown in the graph to the right (for the sake of comparability, the values at the *y*-axis are plotted oppositely to those of Experiment 1).

The analysis confirmed an overall interaction of MODE×MATCH

[$F_1(2,62) = 26.8^{***}$; $F_2(1,23) = 22.4^{***}$]. The contrasts revealed a significant interaction for both comparisons, for *Dem+Gest* vs. *Gesture* [$F_1(1,31) = 9.6^{**}$; $F_2(1,23) = 14.3^{**}$], as predicted, and, contrary to our expectation, for *Dem+Gest* vs. *Adjective* [$F_1(1,31) = 19.3^{***}$; $F_2(1,23) = 10.8^{**}$]. As in Experiment 1, there were also main effects of both factors [MATCH: [$F_1(1,31) = 182.5^{***}$; $F_2(1,23) = 70.0^{***}$; MODE: $F_1(2,62) = 22.7^{***}$; $F_2(2,46) = 18.2^{***}$].

Experiment 2 confirms the predicted stronger Mismatch effect of mismatching gestures with the demonstrative *SO* than without a demonstrative. This finding agrees with the hypothesis that the demonstrative shifts the gesture meaning from non-at-issue to at-issue. However, the Mismatch effect in the *Dem+Gest* conditions turns out to be still less strong than in the *Adjective* conditions.

9. General Discussion

We presented an analysis of the semantic contribution of co-speech gestures to the meaning of verbal utterances. The analysis resulted in two main claims. 1. the semantic contribution of a co-speech gesture, by default, has the status of non-at-issue information, and 2. an accompanying demonstrative like German *SO* shifts this non-at-issue meaning to the at-issue dimension. Experiment 1 addressed the first claim by hypothesizing that the perceived mismatch between a picture and a description of it is impaired less if the mismatch is due to non-at-issue gestural information compared to a mismatch induced by at-issue verbal information. Experiment 1 confirmed a less strong Mismatch effect for co-speech gestures than for adjectives and thus provides strong evidence in favor of the assumed difference in status with respect to at-issueness. Experiment 2 replicated the result of Experiment 1 by demonstrating again a less strong Mismatch effect for co-speech gestures without accompanying demonstrative in comparison to adjectives. In addition, Experiment 2 partly supported our second claim that demonstratives like German *SO* are dimension shifters. The experiment showed that the Mismatch effect induced by a co-speech gesture is significantly stronger if accompanied by the demonstrative *SO*. Our hypothesis, however, was not completely affirmed, as this Mismatch effect was still weaker than the one induced by an adjective. Thus, we must assume some kind of gradedness in the categorical distinction between at-issue and non-at-issue.

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Appendix

The formal system listed here is a modified version of the formal apparatus of Anderbois et al. (2013). The most important change is the introduction of a relativized identity $=_p$ that is only evaluated w.r.t. the subscripted proposition p in addition to the standard identity of ABH $\doteq$ that is evaluated w.r.t. all possible worlds. As in the main text, presuppositions are not spelled out formally. This and further elaboration of the system are future work.

Interpretation of symbols and variables.

for every predicate symbol P: $[\![P]\!]^{w,g} = \mathfrak{I}(P)(w)$
for every constant symbol c: $[\![c]\!]^{w,g} = \mathfrak{I}(c)(w)$
for every variable $x_{\langle s,e\rangle}$: $[\![x]\!]^{w,g} = g(x)(w)$

Interpretation of literals.

a. $[\![P_p(t_1,\ldots,t_n)]\!] = \{\langle g,h\rangle \mid g=h$ and for all worlds $w \in h(p)$: $\langle [\![t_1]\!]^{w,h},\ldots,[\![t_n]\!]^{w,h}\rangle \in [\![P]\!]^{w,h}\}$

b. $[\![t_1 =_p t_2]\!] = \{\langle g,h\rangle \mid g=h$ and for all worlds $w \in h(p)$: $[\![t_1]\!]^{w,h} = [\![t_2]\!]^{w,h}\}$

$[\![t_1 \neq_p t_2]\!] = \{\langle g,h\rangle \mid g=h$ and for all worlds $w \in h(p)$: $[\![t_1]\!]^{w,h} \neq [\![t_2]\!]^{w,h}\}$

$[\![t_1 \doteq t_2]\!] = \{\langle g,h\rangle \mid g=h$ and for all worlds $w \in W$: $[\![t_1]\!]^{w,h} = [\![t_2]\!]^{w,h}\}$

c. $[\![[v]]\!] = \{\langle g,h\rangle \mid g[v]h\}$

d. $[\![\varphi \wedge \psi]\!] = \{\langle g,h\rangle \mid$ there is a k such that $\langle g,k\rangle \in [\![\varphi]\!]$ and $\langle k,h\rangle \in [\![\psi]\!]\}$

e. $[\![\mathbf{max}^p(\varphi)]\!] = \{\langle g,h\rangle \mid \langle g,h\rangle \in [\![[p] \wedge \varphi]\!]$ and there is no h' s.t. $\langle g,h'\rangle \in [\![[p] \wedge \varphi]\!]$ and $h(p) \subsetneq h'(p)\}$

f. $[\![\textsc{might}_p^{p'}(\varphi)]\!] = \{\langle g,h\rangle \mid \langle g,h\rangle \in \mathbf{max}^{p'}(\varphi)$ and for all worlds $w \in h(p)$: $\mathbf{MB}(w) \cap h(p') \neq \emptyset\}$

($\mathbf{MB}$ modal base of *might*)

g. $[\![\textsc{not}_p^{p'}(\varphi)]\!] = \{\langle g,h\rangle \mid \langle g,h\rangle \in \mathbf{max}^{p'}(\varphi)$ and $h(p) \cap h(p') = \emptyset\}$

The meaning of a pointing gesture to an object g is captured by a rigid designator I_g, i.e. an individual concept for which we require

$$\text{for all } w \in W : \mathfrak{I}(\mathrm{I}_g)(w) = g.$$

In the following we give two worked out examples of a possibility modal statement which differ minimally in the choice of a definite vs. a demonstrative expression. The context of utterance is supposed to be one involving two playing cards: an ace of spades to the left and a seven of clubs to the right:

A♠ 7♣

Example 1: Definite Description and Pointing in Modal Context.

a. It is possible that [the card on the left] is not the ace of spades.
POINTING TO **A♠**

b. $\textsc{might}_p^{p'}\big([z] \wedge z \doteq \mathbf{I}_{\mathbf{A}\spadesuit} \wedge [x] \wedge \mathsf{left\_card}_{p'}(x) \wedge x =_{p^*} z \wedge \mathsf{left\_card}_{p^*}(z) \wedge x \neq_{p'} \mathsf{ace\_of\_spades}\big)$

$\textsc{might}_p^{p'}\big([z] \wedge z \doteq \mathbf{I}_{\mathbf{A}\spadesuit} \wedge [x] \wedge \mathsf{left\_card}_{p}(x) \wedge x =_{p^*} z \wedge \mathsf{left\_card}_{p^*}(z) \wedge x \neq_{p} \mathsf{ace\_of\_spades}\big)$
$= \big\{\langle g,h\rangle \mid \langle g,h\rangle \in \mathbf{max}^{p'}([z] \wedge z \doteq \mathbf{I}_{\mathbf{A}\spadesuit} \wedge [x] \wedge \mathsf{left\_card}_{p'}(x) \wedge x =_{p^*} z \wedge \mathsf{left\_card}_{p^*}(z) \wedge x \neq_{p'} \mathsf{ace\_of\_spades})$
and for all worlds $w \in h(p) : \mathbf{MB}(w) \cap h(p') \neq \emptyset\big\}$
$= \big\{\langle g,h\rangle \mid \langle g,h\rangle \in [\![[p'] \wedge [z] \wedge z \doteq \mathbf{I}_{\mathbf{A}\spadesuit} \wedge [x] \wedge \mathsf{left\_card}_{p'}(x) \wedge x =_{p^*} z \wedge \mathsf{left\_card}_{p^*}(z) \wedge x \neq_{p'} \mathsf{ace\_of\_spades}]\!]$
and there is no h' s.t. $\langle g,h'\rangle \in [\![[p'] \wedge [z] \ldots]\!]$ and $h(p') \subsetneq h'(p')$
and for all worlds $w \in h(p) : \mathbf{MB}(w) \cap h(p') \neq \emptyset\big\}$
$= \big\{\langle g,h\rangle \mid g[p',z,x]h \;\&\; \forall w : h(z)(w) = \mathbf{A}\spadesuit \;\&\; \forall w \in h(p') : h(x)(w) \in \mathfrak{I}(\mathsf{left\_card})(w) \;\&$
$\forall w \in h(p^*) : h(x)(w) = h(z)(w) \;\&\; \forall w \in h(p^*) : h(z)(w) \in \mathfrak{I}(\mathsf{left\_card})(w) \;\&\; \forall w \in h(p') : h(x)(w) \neq \mathbf{A}\spadesuit$
and there is no h' s.t. $\langle g,h'\rangle \in [\![[p'] \wedge [z] \ldots]\!]$ and $h(p') \subsetneq h'(p')$
and for all worlds $w \in h(p) : \mathbf{MB}(w) \cap h(p') \neq \emptyset\big\}$

modal claim	$\forall w \in h(p') :$	$h(x)(w) \in \mathfrak{I}(\mathsf{left\_card})(w) \;\&\; h(x)(w) \neq \mathbf{A}\spadesuit$
non-at-issue imposition	$\forall w \in h(p^*) :$	$h(x)(w) = \mathbf{A}\spadesuit \;\&\; \mathbf{A}\spadesuit \in \mathfrak{I}(\mathsf{left\_card})(w)$

This is the desired analysis. The modal claim comes down to the statement that it is possible that the card to the left is different from the ace of spades. The non-at-issue imposition states that the card to the left IS the ace of spades. Since the modal proposition p' and the non-at-issue imposition p^* are independent there is nothing contradictory about this arrangement – the modal claim is about a possibility while the non-at-issue imposition is about the pointing gesture in the actual state of affairs.

Example 2: Demonstrative and Pointing in Modal Context.

a. #It is possible that [this card] is not the ace of spades.
POINTING TO $\mathbf{A}\spadesuit$

b. $\textsc{might}_p^{p'}\big([z] \wedge z \doteq \mathbf{I}_{\mathbf{A}\spadesuit} \wedge [x] \wedge \mathsf{card}_{p}(x) \wedge \underline{x =_{p'} z} \wedge \mathsf{card}_{p^*}(z) \wedge x \neq_{p'} \mathsf{ace\_of\_spades}\big)$

$\textsc{might}_p^{p'}\big([z] \wedge z \doteq \mathbf{I}_{\mathbf{A}\spadesuit} \wedge [x] \wedge \mathsf{card}_{p'}(x) \wedge x =_{p'} z \wedge \mathsf{card}_{p^*}(z) \wedge x \neq_{p'} \mathsf{ace\_of\_spades}\big)$
$= \big\{\langle g,h\rangle \mid g[p',z,x]h \;\&\; \forall w : h(z)(w) = \mathbf{A}\spadesuit \;\&\; \forall w \in h(p') : h(x)(w) \in \mathfrak{I}(\mathsf{card})(w) \;\&$
$\underline{\forall w \in h(p')} : h(x)(w) = h(z)(w) \;\&\; \forall w \in h(p^*) : h(z)(w) \in \mathfrak{I}(\mathsf{card})(w) \;\&\; \forall w \in h(p') : h(x)(w) \neq \mathbf{A}\spadesuit$
and there is no h' s.t. $\langle g,h'\rangle \in [\![[p'] \wedge [z] \ldots]\!]$ and $h(p') \subsetneq h'(p')$
and for all worlds $w \in h(p) : \mathbf{MB}(w) \cap h(p') \neq \emptyset\big\}$

modal claim	$\forall w \in h(p') :$	$h(x)(w) \in \mathfrak{I}(\mathsf{card})(w) \;\&\; h(x)(w) = \mathbf{A}\spadesuit \;\&\; h(x)(w) \neq \mathbf{A}\spadesuit$
non-at-issue imposition	$\forall w \in h(p^*) :$	$\mathbf{A}\spadesuit \in \mathfrak{I}(\mathsf{card})(w)$

In contrast to the definite case above the modal claim is contradictory. It requires the existence of an object with the property of being a card that is AND is not identical to the ace of spades. The non-at-issue imposition simply comes down to the statement that the ace of spades (the object pointed at) has the property of being a card. This accounts for the infelicity of this utterance.

Our notion of relativized identity is crucial for accounting for both examples. While the modal non-identity and gestural identity contribution contradict each other in Example 2, they do not interfere in the definite case as they are evaluated w.r.t. different propositions. In other words: while the mere act of pointing is one of rigid designation (i.e. across all possible worlds) this designation enters into propositional meanings on different dimensions. Overall this implements Kaplan's insights.