Pantomime Strategies: On Regularities in How People Translate Mental Representations into the Gesture Modality

Karin van Nispen (k.vannispen@tilburguniversity.edu)[1]
[1]Tilburg center for Cognition and Communication (TiCC), Tilburg University, The Netherlands

Mieke van de Sandt-Koenderman (m.sandt@rijndam.nl)[2]
[2]Rotterdam Neurorehabiltation Research (RoNeRes), Erasmus University Rotterdam, The Netherlands

Lisette Mol (l.mol@tilburguniversity.edu)[1]

Emiel Krahmer (e.j.krahmer@tilburguniversity.edu)[1]

Abstract

Pantomimes are gestures that occur in absence of speech, which have no conventional meaning. Since their meaning is not conventionalized, the question arises as to what extent they are idiosyncratic. To study this, we collected pantomimes for a standardized set of objects and annotated what representation techniques people used. This resulted in the (to our knowledge) first database of pantomimes. Analyses show that there are regularities in the use of pantomime. That is similar techniques are used for objects across individuals. This shows that pantomime is not fully idiosyncratic. As pantomime is based on people's mental representation of objects, the observed regularities seem to be a result of intrinsically similar mental representations. Our database gives insight into pantomime 'norms' and could be used as a baseline against which clinical groups (e.g., people with aphasia) can be compared.

Keywords: Pantomime; Mental representation; Iconicity; Idiosyncrasy; Non-verbal communication

Introduction

Pantomimes are hand gestures that occur in absence of speech (McNeill, 2000). They may not be used as frequently as co-speech gestures, but their use can be convenient in situations where speaking is difficult (for instance in a bar, where the music is very loud). The meaning of pantomime is not determined by any convention (McNeill, 2000). That is, the form and meaning of pantomime gestures does not meet any kind of socially constituted group standard (in contrast to emblematic gestures, whose meaning is culturally defined, as for instance for 'the thumps up' emblem). Does this mean that the construction of pantomime is idiosyncratic? We know that in the production of co-speech gestures, which are assumed to be non-conventionalized as well, certain similarities between speakers may nevertheless arise. Turkish and Japanese speakers, for instance, represent manner and trajectory in separate gestures more often than English speakers. This is thought to be a result of conventions in spoken language (Kita & Özyürek, 2003). Language is unlikely to influence pantomime though (Goldin-Meadow, So, Özyürek, & Mylander, 2008), as it is produced in absence of speech. Does this mean that different people use different pantomimes for the same concepts, or will there be certain regularities?

If people cannot rely on linguistic knowledge when producing pantomime, what other sources can they draw from? They may rely on the mental concept of an object[1], such as a whistle. According to Barsalou (1999), one's mental representation of an object includes perceptually based representations, such as knowledge of the shape, use and sound of a whistle. Although individual experiences with the world (and for this example with 'whistles') may differ, for people within a certain culture or community there probably is a great deal of overlap or correspondence between such experiences. This results in similarities across individual's mental representations. When producing a pantomime, people probably rely on these representations and translate them into pantomime. To this aim, they might use iconicity, which is a similarity between form and meaning (Müller, 1998). For a whistle, iconicity may for instance show in a mapping between the shape of the object (a cylinder with a small extension, see Figure 1) and a hand shape that is similar to this (a fist with slightly stretched index and middle finger).

Importantly, not everything is easily represented in pantomime. A first restriction lays in the constraints of the gesture modality. In the gesture domain, one can easily depict physical or spatial properties (e.g. Alibali, 2005), but other properties (for instance color and sound) may be more challenging. As a consequence, for depicting an object in pantomime, people have to select a conceptual feature from their mental representation that meets the constraints of the pantomime domain. Second, for reasons of efficiency people will not express all features that meet these criteria.

This leads to the question of how people select the features suitable to depict in pantomime. As McRae, Cree, Seidenberg, and McNorgan (2005) describe in their database of semantic object norms, there may be many features associated with an object (see Table 1 for an overview of features related to a whistle). These features can reflect a variety of basic knowledge types, such as information on its sound, shape and function (based on Wu & Barsalou, 2009). These features can be divided into salient or distinctive and non-distinctive features. In the dataset of McRae et al. (2005), a feature is distinctive when it is not used for any of the other objects.

[1]This paper will only focus on objects, animals and plants. For reasons of efficiency we will refer to these categories as 'objects'.

How do people select from these different features? In Sign Languages, in which particularly the iconic signs show great similarity to pantomime, objects are often represented by a salient feature. In American Sign Language, for instance, a lion is represented by its salient feature 'manes' (Perniss, Thompson, & Vigliocco, 2010). This could be applied in pantomime as well. For instance for the object 'whistle' both its use and sound would be salient. The first feature seems more likely to be selected though, since the other is not as easily translated into pantomime. Importantly though, there could be multiple salient features that can be depicted in pantomime (for our whistle example this may be its use but possibly also its shape). Furthermore, a feature in itself may be depicted by various representation techniques. 'Whistling' could be represented by pretending to hold a whistle, but also by shaping the fingers in front of one's mouth as if the hand is a whistle, also see Müller (1998) for a more elaborate description of the different ways in which objects can be depicted. This illustrates that people have many possibilities at their disposal. We do not know yet how people choose from those possibilities when having to depict an object in pantomime.

Table 1 Semantic features associated with a whistle (based on the database of McRae et al., 2005)

Whistle			
Distinctive		**Non-distinctive**	
Feature	(class)[1]	Feature	(class)[1]
used for alerting	F	made of metal	V
makes high pitched noise	S	Used by blowing air through	F
produces loud noise	S	produces noise	S
has a ball inside	V	is small	V
used by lifeguards	F	made of plastic	F
used in games	F	is loud	S
		used for sports	F
		used by the police	F

[1]F = Function, S = Sound, V = Visual form and surface

Current study: Gesture is a growing field, in which a lot of attention has been paid to co-speech gestures and their underlying processes (e.g. De Ruiter, 2000; Kita & Özyürek, 2003; Krauss, Chen, & Gottesman, 2000) and function (e.g. Alibali, Heath, & Myers, 2001; Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001). Pantomime however, remains understudied. How do people construct pantomime? And which mental processes are involved? The current study aims to shed light on these questions. Twenty participants used pantomime to 'name' the 60 objects of the Boston Naming Test, BNT (Kaplan, Goodglass, & Weintraub, 1983). We assessed the way in which objects are (in an iconic way) represented by annotating the representation techniques used for each object. To our knowledge, these data constitute the first pantomime database. Besides its theoretical relevance, it is also clinically relevant. Our database provides 'pantomime norms' for the BNT (a test that is used widely to assess word finding difficulties in people with aphasia), which could be used as a baseline against which clinical groups (e.g., people with aphasia) can be compared.

For the representation of an object in pantomime, people have to rely on their mental representation. As mental representations are intrinsically similar, we expect to find regularities in the way in which objects are represented in pantomime across participants for the tested objects. As pantomime is very suitable for representing spatial and/or physical information, we expect that the representation techniques used are based on spatial and/or physical features that are, similar to what we see in Sign Language, distinctive for an object.

Methods

Participants

Twenty native speakers of Dutch participated in the experiment (5 male), age 32-65 (M=53). They were all right handed (assessed by means of the Edinburgh Handedness Inventory; Oldfield, 1971).

Procedure

Participants were asked to convey 60 objects from the Boston Naming Test, BNT (Kaplan et al., 1983) through pantomime. The object-pictures in the BNT vary from objects that are easy to name (named with highly frequent words) such as a 'whistle', to more difficult ones (named by low frequent words), such as 'compasses' (see Figure 1 and 2). The order in which the objects were presented is linked to their naming difficulty, meaning that naming difficulty increases as one progresses in the task. Participants were only allowed to use pantomime gestures; speaking was explicitly forbidden. Participants gave their consent to be videotaped during the experiment.

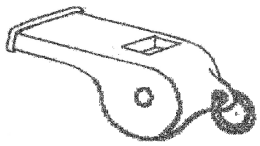

Figure 1 Easy object (verbal naming): Whistle

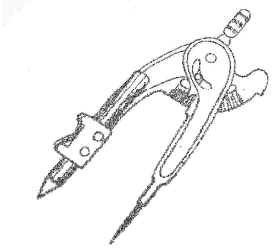

Figure 2 Difficult object (verbal naming): Compasses

Analysis

For each object, the pantomimes produced were annotated into different representation techniques using the ELAN gesture coding software package (Wittenburg, Brugman, Russel, Klassmann, & Sloetjes, 2006). Based on Müller (1998), we identified six representation techniques: *handling* (e.g., pretending to hold a whistle), *enact* (*handling* without an object, e.g., pretending to swim), *object* (e.g., use fingers to represent a whistle), *shape* (e.g., outlining the shape of a whistle), *deictic* (e.g., pointing at one's mouth) and *other* (all pantomimes that do not fit into previous categories), also see Table 2.

Coding was done by the first author. We performed several analyses. First, we annotated for each of the 60 objects which pantomime techniques were used, and whether any regularities could be detected across participants. We set a threshold: if 80% or more (≥16/20) of the participants used a technique for a specific object, we labeled this as a default technique. To explore potential explanations of why these techniques were applied, we investigated the relation between the use of pantomime techniques and linguistic and perceptual characteristics of the objects. Linguistic variables included 'imageability' (which is the degree in which the word associated with the object evokes a visual represenation; van Loon-Vervoorn, 1985), 'nameability' (which is the average score correct for verbal naming as determined in the norms for the BNT test), and 'age of acquisition of the object names' (see Heesbeen & Van Loon-Vervoorn, 2001).

Table 2 Coding scheme for representation techniques used (van Nispen, van de Sandt-Koenderman, Mol, & Krahmer, 2014).

Representation Technique	Definition	Example
Handling	Pretending to use an object	Pretending to write with a pencil
Enact	One pretends to be in a different situation, without using an object	Pretending to be cold by rubbing one's hands to opposite shoulders
Object	Using one's hands to represent (part of) an object	Holding a hand in front of one's face for representing a mask
Shape	Outlining or molding the shape of an object	Drawing the outline of a house with one's index finger
Deictic	Pointing (index finger) at object, location or trajectory	Pointing at one's chair
Other	All gestures that do not fit into previously named categories	Showing three fingers for representing the number 'three'

To investigate what criteria related to perceptually based features of an object influence the decision for a pantomime technique we used the classification of McRae et al. (2005). For our analysis we looked into a subset of our objects that matched the objects in their dataset (N=24). We analyzed objects for 2 classifications: 1) objects that had function as a distinctive feature (described as 'Visual motion' and/or 'Function' in Wu & Barsalou's taxonomy) and 2) objects that had shape as a distinctive feature (described as 'Visual shape' in Wu & Barsalou's taxonomy).

Results

As shown in Figure 3, for 52 out of 60 objects we found that a specific technique was used by 80% or more of the participants for that object, see Figure 4 for examples of these default techniques. This suggests that there are regularities in the way people refer to objects in pantomime. Objects can have one or more techniques that are used as default. For 44 out of 60 objects people used only a single technique as default. As shown in Table 3a *handling* was the default technique for 18 objects, *enact* for 2 objects, *object* for 10 objects and s*hape* for 24 objects. For 5 objects people used either *handling* or *object* (see table 3b). These techniques mostly reflected the same information (use of an object) depicted by different techniques (*e.g.* for saw: pretending to hold a saw and move it back and forth or showing a flat hand perpendicular to the table and move it back and forth).
For 7 objects two techniques were used by 80% or more of the participants. These defaults were always combinations of *shape* and another technique. For 'igloo' and for 'cactus' the combination of the two techniques in itself were used by more than 80% of the participants, see Table 3b. Besides, for 'cactus' there is even a third 'default' technique, *enact,* which is used 85% of the participants (but is not used by 80% or more in combination with both *shape* and *handling*). For only 8 out of 60 objects no default technique was found. In addition to the above named default techniques people may have added other techniques in their pantomime behavior. Those techniques though were not used by 80% or more of the participants and are not reported here.

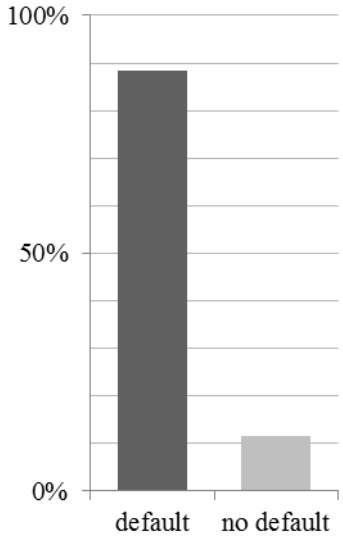

Figure 3 Percentage of objects that did or did not have a default technique

Table 3a Pantomime techniques, 'defaults', used by 80% or more of the participants for a certain object. The ranking of the objects in the BNT (indicating verbal naming difficulty) are given between square brackets. Objects that occur twice in the table, because for two techniques the threshold was met, are shaded grey.

Handling		***Object***		***Enact***		***Shape***	
Accordion [47]	100%	Helicopter [11]	100%	Igloo [33]	90%	Acorn [32]	100%
Broom [12]	100%	Bed [1]	90%	Cactus [36]	85%	Globe [27]	100%
Dart [25]	100%	Compasses [50]	90%			Plants rack [57]	100%
Harp [38]	100%	Muzzle [44]	85%			Pyramid [43]	100%
Pallet [58]	100%	Snail [22]	90%			Camel [17]	95%
Pencil [3]	100%	Pelican [41]	90%			Funnel [46]	95%
Racket [21]	100%	Volcano [23]	85%			Igloo [33]	95%
Scroll [53]	95%	Mask [18]	80%			Mushroom [14]	95%
Comb [7]	95%	Octopus [13]	80%			Rhino [31]	95%
Door knocker [40]	95%	Sphinx [55]	80%			Cactus [36]	90%
Harmonica [30]	95%					Unicorn [45]	90%
Stethoscope [42]	95%					Wreath [28]	90%
Toothbrush [10]	95%					Yoke [56]	90%
Whistle [5]	95%					Abacus [60]	85%
Wheelchair [16]	95%					Asparagus [49]	85%
Abacus [60]	90%					Bench [20]	85%
Canoe [26]	90%					Hangman's rope [48]	85%
Cactus [36]	85%					House [4]	85%
						Snail [22]	85%
						Protractor [59]	85%
						Tripod [52]	85%
						Coat Hanger [15]	85%
						Pelican [41]	80%
						Tree [2]	80%

Table 3b Combination of gesture techniques used by 80% or more of the participants for a certain object.

Either/Or			**Combination**		
Saw [9]	*Handling* (65%) or *Object* (40%)	100%	Cactus [36]	*Shape + Handling*	90%
Scissors [6]	*Handling* (35%) or *Object* (70%)	100%	Igloo [33]	*Shape + Enact*	85%
Sugar Tongs [54]	*Handling* (40%) or *Object* (65%)	100%			
Bolt [51]	*Handling* (90%) or *Object* (35%)	95%			
Hangman's rope [48]	*Handling* (50%) or *Object* (45%)	85%			

To explore potential explanations for the selection of these default techniques, we first looked into the relation between the used default techniques and the linguistic variables related to the objects. Pearson's correlation for percentage of people that used a technique for an object and scale scores for 'imageability', 'nameability' and 'age of acquisition' for that object did not show any significant correlations.

Second, for a subset of 24 objects that matched objects in the database of McRae et al. (2005), we split the objects up into different groups. For the first list we made a division between objects that did or did not have 'function' as distinctive feature and for the second list we made a division between objects that did or did not have 'shape' as a distinctive feature. Objects that had 'function' as a distinctive feature, were depicted more often with *object*: $t(21)=1.20$; $p<.01$, and *handling* (marginally significant): $t(21)=1.27$; $p=.09$, than objects that did not have 'function' as a distinctive feature. No differences were found between objects that did or did not have shape as distinctive feature for the different pantomime techniques

Discussion

Our results show that there are 'default' ways in which certain groups of people pantomime objects. These default techniques concern specific features of the object (a *handling* technique represents the function of the object, such as the function 'used for blowing air through' of a whistle, see Figure 4). This implies that, even though there are no conventions on the use of pantomime, its production is not idiosyncratic. Rather, the observed regularities seem to be a result of people's intrinsically similar mental representations.

Some remarks could be made with respect to these findings. We assumed that the regularities found do not arise from some sort of cultural or linguistic based convention on how to produce specific pantomimes (Goldin-Meadow et al., 2008; McNeill, 2000). After all, it is unlikely that our Dutch participants had ever thought about how to pantomime, for instance, a sphinx. Our analyses did not reveal what selection process does lead to the observed regularities, as the database of McRae et al. (2005) was not able to predict this. This illustrates the surplus value of our pantomime database, as it gives insight into spatial information related to objects. McRae et al. (2005) point out that this kind of information is to a large extend omitted in their linguistic based database, as this is typically something that is difficult to verbalize. Furthermore, it shows that distinctive features are not necessarily the same for language and gesture. A feature as 'used to blow air through' may not be distinctive in language (as it applies for whistle, but also for harmonica), but in pantomime the different *handling* techniques are distinctive.

Pantomime, just as well as language, has its own 'typicalities'. Features, for instance, may differ in their degree of difficulty to express in pantomime. The pictures used in the task provide information on the shape of the objects. Therefore, in this task, *shape* pantomimes may be cognitively less effortful than for instance *handling* pantomimes. On the other hand, for *handling* pantomimes one could propose that this is natural or embodied movement (something we do in our daily lives as well; Hostetter & Alibali, 2008). As Ellis and Tucker (2000) have shown, viewing an object may even prime the actions associated with grasping the object. This implies that *handling* pantomimes could even be naturally evoked by some of the objects. For *shape* or *object* pantomimes on the other hand one has to perform a 'new' action. Finally, it is unclear to what extent the different features vary in the degree to which they are 'cognitively accessible'. Possibly, some features are accessed more easily, or faster than others.

Possibly, our design using pictures has also influenced the 'accessibility' of certain features and/or mental representations. First, pictures obviously visualize the shape of the depicted object, which may partly explain why *shape* gestures were relatively often relied upon as a representation technique. Second, the pictures used might influence the conceptualization of the observed object. For instance, a picture of an igloo, with the entrance towards the viewer, may elicit other representations (entering the igloo), than a picture with an entrance facing the side. However, our data show that our participants frequently express information through gesture that is not depicted in the target picture (as for instance showing 'pain' for cactus and 'cold' for igloo). Nevertheless, it would be interesting for future research to repeat this experiment with spoken and/or written presentation of the targets

Although we do not know what processes lead to selection of specific pantomimes, we can speculate as to why these regularities occur. Would the observed regularities aid its comprehensibility? Goldin-Meadow, McNeill, and Singleton (1996) discuss that gesture takes on linguistic properties when it has to carry the 'burden' of communication. The observed regularities in pantomime may be a first 'step' in this process. In our experiment and in a speaking community, there is no need and not enough 'pantomime interaction' for pantomime to take on linguistic properties and develop into a more conventionalized gesture system, such as home sign or sign language. The question of whether the use of the observed default techniques in pantomime aids comprehensibility will be addressed in future studies where we will take the comprehensibility of pantomime into account.

In future studies we plan to look closer into the use of pantomime and its implications for clinical settings. In addition to the current study, we will look at pantomimes used by people with aphasia and the features they express. Hopefully this will shed more light on the question of whether some features are cognitively more easily accessed and/or produced than others. In addition to these analyses we will also assess the comprehensibility of the studied pantomimes and assess their added value for communication.

Figure 4 Participants using a default pantomime technique for the objects 'whistle' and 'compasses' (figure 1 and 2). Above: *Handling* techniques for the object 'whistle' (used by 95% of the participants). Below: *Object* techniques for the object 'compasses' (used by 90% of the participants). (Participants gave informed consent for the use of their pictures.)

Conclusion

Similar techniques are used across individuals to depict objects in pantomime. This shows that pantomime is not fully idiosyncratic. As pantomime is based on people's mental representation of objects, the observed regularities seem to be a result of intrinsically similar mental representations. Our study has resulted in a first pantomime database, which we will make publicly available on https://www.dataverse.nl/dvn/. It provides pantomime norms for 60 well documented objects from the Boston Naming Task that could be used to compare clinical groups to.

References

Alibali, M. W. (2005). Gesture in spatial cognition: Expressing, communicating, and thinking about spatial information. *Spatial cognition and computation, 5*(4), 307-331.

Alibali, M. W., Heath, D. C., & Myers, H. J. (2001). Effects of visibility between speaker and listener on gesture production: Some gestures are meant to be seen. *Journal of Memory and Language, 44*, 169-188.

Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences, 22*(04), 577-660.

De Ruiter, J. P. (2000). The production of gesture and speech. In D. McNeill (Ed.), *Language & Gesture* (pp. 284-311). Cambridge: Cambridge University Press.

Ellis, R., & Tucker, M. (2000). Micro-affordance: The potentiation of components of action by seen objects. *British journal of psychology, 91*(4), 451-471.

Goldin-Meadow, S., McNeill, D., & Singleton, J. (1996). Silence is liberating: Removing the handcuffs on grammatical expression in the manual modality. *Psychological Review, 103*(1), 34-55.

Goldin-Meadow, S., Nusbaum, H., Kelly, S. D., & Wagner, S. (2001). Explaining math: Gesturing lightens the load. *Psychological Science, 12*(6), 516-522.

Goldin-Meadow, S., So, W. C., Özyürek, A., & Mylander, C. (2008). The natural order of events: How speakers of different languages represent events nonverbally. *Proceedings of the National Academy of Sciences, 105*(27), 9163-9168.

Heesbeen, I. M. E., & Van Loon-Vervoorn, W. A. (2001). *Diagnostiek en herstelmeting van taalproblemen na niet-aangeboren hersenletsel.* Universiteit Utrecht, Utrecht.

Hostetter, A., & Alibali, M. (2008). Visible embodiment: Gestures as simulated action. *Psychonomic bulletin & review, 15*(3), 495-514.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *The Boston Naming Test*. Philadelphia: Lea & Febiger.

Kita, S., & Özyürek, A. (2003). What does cross-linguistic variation in semantic coordination of speech and gesture reveal?: Evidence for an interface representation of spatial thinking and speaking. *Journal of Memory and Language, 48*(1), 16-32.

Krauss, R. M., Chen, Y., & Gottesman, R. F. (2000). Lexical gestures and lexical access: A process model. In D. McNeill (Ed.), *Language & Gesture*. Cambridge: Cambridge University Press.

McNeill, D. (2000). *Language and Gesture*. Cambridge: Cambridge University Press.

McRae, K., Cree, G., Seidenberg, M., & McNorgan, C. (2005). Semantic feature production norms for a large set of living and nonliving things. *Behavior Research Methods, 37*(4), 547-559.

Müller, C. (1998). Iconicity and Gesture. In S. Santi, I. Guatiella, C. Cave & G. Konopczyncki (Eds.), *Oralité et Gestualité*. Montreal, Paris: L'Harmattan.

Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia, 9*(1), 97-113.

Perniss, P., Thompson, R., & Vigliocco, G. (2010). Iconicity as a general property of language: evidence from spoken and signed languages. *Frontiers in Psychology, 1*.

van Loon-Vervoorn, W. A. (1985). Voorstelbaarheidswaarden van Nederlande woorden. Zeist: Swets & Zeitlinger.

van Nispen, K., van de Sandt-Koenderman, M., Mol, L., & Krahmer, E. (2014). Should pantomime and gesticulation be assessed separately for their comprehensibility in aphasia? A case study. *International Journal of Language and Communication Disorders, 49*(2), 265-271.

Wittenburg, P., Brugman, H., Russel, A., Klassmann, A., & Sloetjes, H. (2006). ELAN : a professional framework for multimodality research.

Wu, L.-l., & Barsalou, L. W. (2009). Perceptual simulation in conceptual combination: Evidence from property generation. *Acta Psychologica, 132*(2), 173-189.