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► **To cite this version:**

Angela Bartolo, Sergio Della Sala, Roberto Cubelli. Effect of test instructions: The example of the pantomime production task. *Brain and Cognition*, 2020, 139, pp.105516 -. <10.1016/j.bandc.2020.105516>. <hal-03489758>

HAL Id: hal-03489758

<https://hal.science/hal-03489758v1>

Submitted on 21 Jul 2022

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Effect of test instructions: the example of the pantomime production task

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Running title: Pantomime production

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Abstract (162 words)

The production of pantomime is a sensible task to detect praxis deficits. It is usually assessed by presenting objects visually or by verbal command. Verbal instructions are given either by providing the name of the object (e.g., “Show me how to use a pen”) or by requiring the object function (e.g., “Show me how to write). These modes of testing are used interchangeably. The aim of this study is to investigate whether the different instructions generate different performances. Fifty-one healthy participants (17-89 years old) were assessed on three pantomime production tasks differing for the instruction given: two with verbal instructions (Pantomime by Name and Pantomime by Function) and one with the object visually presented (Pantomime by Object). Results showed that Pantomime by Function produced the poorest performance and the highest frequency of Body Parts as Tool (BPT) errors, suggesting that the way the instructions are given may determine the performance in a task. Nuances in test instructions could result in misleading outcome.

Keywords: pantomime, apraxia, action semantic, function knowledge, task instruction

1. Introduction

In neuropsychology, pantomime is defined as the ‘gestural description’ of object use (Hécaen, 1978; Bartolo et al., 2003). Examining the production of pantomimes is an integral aspect of assessing apraxia (Cubelli, 2017). Participants are asked to pretend to perform an action with an object without actually holding the object in their hand. They are required to configure hand and fingers as if holding the object and to reproduce the appropriate gesture to use it. A correct pantomime requires bearing in mind the shape and size of the object to set the hand’s posture (e.g., the distance between fingers to grasp a pen), the distance of the object from the goal (the table in the case of pretending to write with a pen), and the action to be mimed (moving the wrist as if writing).

Defective production of pantomimes can be due to apraxia (Wang, and Goodglass, 1992; Niessen et al., 2014; Sperber et al., 2018) or to working memory deficits (Bartolo et al. 2003).

Errors occurring during pantomime production can be of content (e.g., semantically related or unrelated to the object), or of motor acts, either in temporal features (e.g., ordering and duration) or spatial characteristics (e.g., amplitude, hand, finger configuration, and undue contact) (McDonald et al., 1994; Peigneux and Van der Linden, 2000; Bartolo et al., 2008; Bartolo et al., 2016). The most frequently reported error is the so called ‘body part as tool’ (BPT), which occurs when the examinees use a part of their body as if it were a tool (Peigneux and Van der Linden, 1999). For instance, they move their index finger horizontally back and forth close to their lips, rather than closing their hand as if holding a toothbrush.

Healthy participants also produce BPT gestures (Duffy and Duffy, 1989). Some objects (e.g., a gun, scissors) are particularly prone to BPT (*cf.* Duffy and Duffy, 1989, Appendix pp. 234-235; Peigneux and Van der Linden, 1999, Appendix p. 552; Bartolo et al., 2008, Table 3, p. 38). In fact, it is not unusual for healthy people to produce iconic gestures in

a symbolic or conventional way, reproducing the object shape rather than the appropriate mimed action. BPT performances can be viewed as the production of signs stored in long-term memory to represent objects or actions and often used for communication purposes. As such, gestures finalized to represent the function of objects should not be conceived as errors. On the contrary, when the requested gesture ought to represent the actual use of an object, the mimed action should show its correct manipulation; hence, the symbolic representation of the shape of the object is an error. When Raymer and colleagues (1997) made explicit to participants that they had to pretend to use the object, imagining holding it “*as they would if they had the actual tool*” (p. 290), healthy control reduced the number of BPT, which instead were still present among left-brain damaged patients. Therefore, the task instructions to elicit pantomime production is crucial in how we vet performance.

In clinical practice as well as in research setting, the production of pantomime is assessed by means of either visual or verbal input. The visual condition is always assessed by showing an object (hereafter Pantomime by Object) and instructing participants to “*Show me how you use this*”, without naming the object or allowing participants to touch or hold it (Bartolo et al., 2008; Buxbaum and Saffran, 2002). Two versions of verbal instructions can be gleaned from the literature. In one version, participants are provided with the verbal description of the action to be performed (e.g., Dumont et al., 1999): “*Show me how you would brush your teeth*” (Pantomime by Function). Alternatively, pantomime production is assessed by providing the name of the object (e.g., Bartolo et al., 2008): “*Show me how you would use a toothbrush*” (Pantomime by Name).

These types of instructions rely on different semantic processes (Roy, 1996; Buxbaum and Saffran, 2002; Stamenova et al., 2012, Garcea and Mahon, 2012; Collette et al., 2016; Ruotolo et al., in press). Pantomime by Object and Pantomime by Name make explicit reference to an object, hence relying on Action knowledge (sometimes called manipulation

knowledge, Buxbaum et al., 2000), that concerns the gesture to be accomplished with a given object (i.e., how an object is used). Pantomime by Function instead refers to Function knowledge, that concerns the use of the object independently of its actual manipulation (i.e., what the object is for).

Given the above, we predict that healthy participants would or not make BPT errors in pantomiming depending on the task instructions. BPT should be more frequent in the Pantomime by Function procedure, which emphasizes the functional role of objects rather than their actual manipulation. To test this hypothesis, we assessed a group of healthy participants with three tasks commonly used to assess pantomime production.

2. Methods

2.1 Participants

Fifty-one French native right-handed healthy volunteers (33 females; range age 17-89 years, $M = 54.5$ years, $SD = 20.5$ years; range education = 5 -17 years, $M = 11.4$ years, $SD = 3.6$ years; Edinburgh Handedness Inventory score > 05 , Oldfield, 1971) with normal or corrected-to-normal vision entered this study. All the participants gave written informed consent to participate in the study. They had normal Mini Mental State Examination scores (Folstein et al., 1975; Kalafat et al., 2003; range = 25-30; $M = 28.8$, $SD = 1.3$). Younger adults were undergraduate students of the University of Lille. Older participants were recruited among the examiner' acquaintances or from leisure associations. The experimental protocol was approved by the local ethical committee in behavioral sciences of the University of Lille III (Reference number 2013-4-S17).

2.2 Procedure

Participants have been tested on three tasks requiring pantomime execution (see Appendix for the list of stimuli). They all performed the gestures using the right dominant hand as no difference between the right and the left hand in gesture performance has never been reported in healthy participants (Bartolo et al., 2008; De Renzi et al., 1980; Roy et al., 1991; Goldenberg and Strauss, 2002). For each task, participants were presented, one at a time, with 15 items that were used in each version of the test and presented in a pseudo-random order (*cf.* Table 1):

- Pantomime by Function: participants were asked to perform the gesture when the object function was given. Instructions were as follows (original French version followed by the English translation): «Je vais vous donner le nom d'une action à réaliser. On fait normalement cette action avec un objet. Attention, vous devez faire comme si vous aviez l'objet dans la main. Montrez-moi comment vous (nom de l'action) / I will give you the name of an action to execute. We normally perform this action with an object. Be careful, you must act as if you have the object in your hand. Show me how you (action name)».

- Pantomime by Name: the object's name was given. «Je vais vous donner le nom d'un objet. Vous devrez me montrer comment l'utiliser. Attention, vous devez faire comme si vous aviez l'objet dans la main. Montrez-moi comment utilisez-vous un/e (nom de l'objet) / I will give you the name of an object. You will have to show me how to use it. Be careful, you must act as if you have the object in your hand. Show me how you use (object name)».

- Pantomime by Object: the real object was presented to the participants. «Je vais placer un objet devant vous. A vous ensuite de me montrer comment vous allez l'utiliser sans avoir l'objet dans la main. Attention, vous devez faire comme si vous aviez l'objet dans la main. Montrez-moi comment utilisez-vous cet objet / I'm going to place an object in front of

you. Then you will show me how you use it, without holding the object in your hand. Be careful, you must act as if you have the object in your hand. Show me how you use this object ».

For each task two example-trials were given. In the first, the examiner gave the instruction and made the gesture. In the second example-trial, the examiner gave the instruction and asked the participant to make the gesture. If participants made an incorrect gesture, feedback was provided and the correct gesture was shown.

The tasks and the order of stimuli presented in the production of pantomimes tests have been randomized across participants (pseudo random order). One point was given for a correct performance, also after auto-correction, 0 for the incorrect (i.e., presence of content, temporal or spatial errors in the executed gesture; range 0-15 in each task). Participants were tested by trained research assistant. To check for inter-rater reliability, data from 18 participants whose performance was recorded (270 items per each task) have been blindly scored by a trained coder. The percentage of agreement between the two rates on item level revealed that ninety-one percent of the pantomimed items resulted in overlapping coding in the Pantomime by Function task; 94% in the Pantomime by Name and 93% in the Pantomime by Object task. Furthermore, high correlations were registered between the two coders in the total number of BPT errors detected in each task (.98 for the Pantomime by Function, .97 for both Pantomime by Name and Pantomime by Object task).

2.3. Data analyses

Normal distribution of accuracy scores has been ascertained by means of the Kolmogorov-Smirnov test ($p > .05$ in the three tasks). Accuracy scores on any of the three tasks did not correlate significantly with age and level of education (Pearson correlation, $p > .05$ in all cases). Hence, the data obtained from the 51 participants were analysed as a single

group. As the assumption of sphericity was respected (Mauchley test, $p > .05$), differences in the accuracy scores in the three tasks have been explored using a one-way ANOVA for repeated measures and Tukey's test was used for post hoc comparisons. The presence of BPT errors was investigated by running two separate analyses: one on the total number of BPT in each task and one on the proportion of BPT with respect to the total number of errors in each task. Given that normal distribution was not respected (Kolmogorov-Smirnov, $p < .05$) and correlation with age and education was lacking (Spearman correlation, $p > .05$ in all cases), non-parametric analyses were run on the performance of all the 51 participants considered as a single group (Friedman test for the across tasks comparison and Wilcoxon test for the between tasks comparisons).

3. Results

A one-way ANOVA for repeated measures showed a significant effect of the pantomime production tasks ($F(2, 100) = 27.28, p < .001, \eta_p^2 = .35$). Tukey post hoc analyses showed that all tasks differ across them: The Pantomime by Function task differs from both the Pantomime by Name ($p = .009$) and the Pantomime by Object tasks ($p < .001$); the Pantomime by Name differs from the Pantomime by Object task ($p < .001$). In sum, the Pantomime by Function was the least accurate (see Figure 1).

----Insert Figure 1 about here----

3.2. BPT errors

- Total number of BPT errors: Friedman ANOVA shows a significant difference among the number of BPT errors committed in the three pantomime tasks ($\chi^2(N = 51, df = 2) = 22.78; p < .001, W = .223$). Wilcoxon test shows that: BPT errors in the Pantomime by Function task differs from both the BPT errors registered in the Pantomime by Name task ($Z = 3.46, T = 45.0, p < .001, r = .48$) and the Pantomime by Object tasks ($Z = 4.11, T = 38.0, p < .001, r = .58$). A difference between the number of BPT errors in the Pantomime by Name and the Pantomime by Object task was also observed ($Z = 2.25, T = 79.0, p = .025, r = .32$; see Figure 2). The visual information seems to help in reducing the number of BPT errors.

----Insert Figure 2 about here----

- Percentage of BPT errors with respect to the total number of errors (data of 10 participants have been removed as no error was registered in at least one task). Friedman ANOVA shows a significant difference among the percentage of BPT errors committed in the three production of pantomime tasks ($\chi^2(N = 41, df = 2) = 12.67; p = .002, W = .155$). Wilcoxon test shows that the percentage of BPT errors in the Pantomime by Function differs from that of BPT errors registered in both the Pantomime by Name ($Z = 2.17, T = 137.0, p = .029, r = .34$) and Pantomime by Object tasks ($Z = 3.09, T = 116.5, p = .002, r = .48$). No difference between the percentage of BPT error in the Pantomime by Name and the Pantomime by Object task was observed ($Z = .99, T = 147.5, p = .31 ns$, see Figure 3). Independently of the modality of stimulus presentation, referring to the object to be used reduces the occurrence of BPT responses. The percentage of participants committing BPT errors on each stimulus according to the type of instruction is reported in Figure 4. Our results are coherent with previous findings showing that some objects are particularly prone to elicit a BPT performance (i.e., scissor, binoculars, gun, telephone, sponge, pen, lipstick, *cf.* Peigneux and Van der Linden, 1999 for a discussion on this point). The novelty is that the occurrence of this type of error depends on the type of instructions given.

----Insert Figure 3 and 4 about here----

4. Discussion

The present study was aimed to investigate the effect of three different instructions in the production of pantomime task. The Pantomime by Function elicited the production of pantomime by providing the action to be performed (e.g., “*Show me how to write*”); the Pantomime by Name provided the object name (e.g., “*Show me how to use a pen*”) and the Pantomime by Object provided by presenting the real object to be used. We hypothesized an effect of task-instructions on the performance of healthy participants.

No age and level of education effect was observed on accuracy and BPT errors in our group of participants; this outcome is consistent with results from some previous studies (Bartolo et al., 2008; Mantovani-Nagaoka and Ortiz, 2016), but not with other findings (e.g., Ska and Nespoulous, 1987; Peigneux and Van der Linden, 1999). The pass/fail score we used, the number of items included (N=15) or the number of participants tested might have nuanced the age difference in performances.

We observed that the performance on the Pantomime by Function task was poorer than in the other two pantomime tasks. The best performance was achieved under visual priming. This may be accounted for by an affordance effect, insofar as participants need not imagine the shape of the object and adjust their hand posture accordingly. Rather, perceiving objects’ affordances per se may facilitate their use (Randerath et al. 2011), since a direct visual route is influenced by affordances for action (Yoon, Humphreys and Riddoch, 2010). Liepmann (1908) originally acknowledged the potential advantage of visual presentation in pantomime tasks by postulating “the enormous advantage provided by the sight ... of an object” (p. 49).

A similar pattern was observed with the total number of BPT errors. Explicit information about objects facilitated the pantomime production. Presenting the real object is more effective than providing its name in accessing and retrieving all semantic and procedural information that are necessary to describe the object's use. The proportion of BPT errors in the Pantomime by Function task was greater with respect to the other two tasks, and this effect was evident for all the items (see Figure 4). As predicted, stressing the action facilitates the production of symbolic gestures representing the object's function rather than its actual use. Resorting on symbolic representation, notwithstanding the overt instructions, may induce participants to produce gestures not as one would if actually handling the object but showing its abstract use as one would in a word guessing game. It has been shown previously that pantomimes by function left healthy volunteers prone to BPT errors (Dumont, Ska, and Schiavetto, 1999). Such errors were greatly reduced when healthy controls were asked specifically to imagine holding the object and then show its use (Raymer et al., 1997).

In sum, the test instruction modulates the performance on the pantomimes assessment. The outcome of our study might account for the controversial results obtained in patients' and neuroimaging studies. In the studies carried out by Goldenberg and collaborators, the pantomime production task is proposed by providing participants with both the object name and the object function (e.g. "cutting with scissors") while showing the photograph of the object. In these studies, difficulties in pantomime production have been found associated to lesions in the inferior frontal gyrus when the object visually presented was removed before performing the pantomime (Goldenberg et al., 2007), and to the inferior frontal gyrus, the temporal and the inferior parietal regions when the object was left until gesture execution (Finkel et al., 2018). When using a Pantomime by Object task, defective pantomime production has been found associated to parietal lesions (supramarginal gyrus, Hoeren et al., 2014). Concerning neuroimaging studies, results showed that pantomime production activates

a left fronto-temporal-parietal network when using a Pantomime by Object (Hermsdörfer et al., 2007; Vingerhoets et al., 2013) and a Pantomime by Name task (Johnson-Frey et al., 2005) and only parietal structures (the intraparietal sulcus, the supramarginal gyrus, and the superior parietal lobule) when using a Pantomime by Function task (Kroliczak and Frey, 2009). Hence, it appears that instructions have an impact on the strategies used to address the task which reflect in the neuroanatomical network involved.

Furthermore, our findings resonate with other similar instances whereby small differences in task instructions determine the success or the failure on a neuropsychological test. For example, in the Fluff test (Cocchini et al., 2001), assessing personal neglect, participants are asked to pick targets attached to their limbs; if the experimenter fails to stress that the task entails finding “all” targets, several healthy participants omit a few of them (N. Beschin, personal communication, 2019). Similarly, the FAB (Frontal Assessment Battery – Dubois et al., 2000), has been translated in several languages (Apollonio et al., 2005; Moreira et al., 2017). When the translation, in the item presenting two fruits, is “how are they similar?”, the responses (wrongly) focus on perceptual features, like “the texture of their skin is the same”. On the other hand, if the question is rendered as “what do they have in common?”, the answer is frequently categorical, like “they are both fruit” (which is the expected answer). Another example comes from MacPherson (2001). She failed to replicate the original findings on the Iowa Gambling Task published by Bechara et al. (1994), insofar as her healthy participants preferred the decks offering less frequent punishments rather than the decks offering long-term profits. It turned out that this difference could be due simply to difference in instructions. In the Bechara et al. studies (1994; 1999), participants were informed that there were some decks that were worse than others. In the MacPherson’s study, participants were not given any information about the decks, so they could not realize that the decks were different.

Nuances of test instructions may be misleading. Clinicians and researchers alike should be aware of this possible bias, as errors may not reflect the presence of a deficit, rather be due to slight differences in the wording of the instructions.

In conclusion, the way the instruction is given to participants assessed with pantomime tasks determines the success in the task as well the occurrence of BPT errors, thus, in case of pathology, these differences might lead ~~leading~~ to false positives and diagnostic errors. Indeed, the differences in task performance should be enhanced in apraxic patients unable to associate the proper action to an object (i.e. having deficits at the level of output gestural lexicon, (Cubelli et al., 2000) or action semantic (Buxbaum et al., 2002). These patients are expected to show more BPT errors when the object function is given (Pantomime by Function) than when the object name is provided (Pantomime by Name), revealing the retrieval of the preserved symbolic description of the function elicited by the task instructions. Action and function knowledge play a different role according to the modality in which the instruction is given influencing the performance of the tasks. A possible solution would be to present both instructions, as in the Florida Apraxia Battery (Power et al., 2010) and the Batterie d'Évaluation de l'Apraxie (Peigneux and Van der Linden, 2000), in which both the name and the action are given when pantomime production is required (“*show me how you would use a pair of scissors to cut paper*”). This is not the case for all the tasks available from all the off-the-shelf tasks. The production of pantomime task in both the Test of Upper Limb Apraxia (TULIA by Vanbellingen et al., 2010) and the Test Lillois de l'Apraxie (TLA - Anicet et al., 2012) is assessed by intermingling Pantomime by Name (e.g., “*use a screwdriver*”) and Pantomime by Function (e.g., “*eat a soup*”) instructions within the same test. Special care should be taken in evaluating the responses given by participants, so to interpret BPT either as errors or as adequate answers according to the instructions given. When assessing pantomimes, using multiple versions of the test and different instructions for

the same items may make explicit whether the different responses observed are dissociating or are qualitatively equipose. This may prove particularly relevant when aiming at profiling the precise deficits shown by neurological patients.

5. Conclusion

The performance on the pantomime production task varies according to the type of instruction used. Results showed that when the pantomime was required by verbally providing the object function, healthy participants' performance was poorer than when they were verbally provided with the object name or when the real object was presented. Furthermore, the pantomime by function was the most prone to elicit BPT errors.

Acknowledgements

We thank all the participants who entered the study and Marie Capon and Jennifer Vilain for their contribution in data collection. This work was supported by the BQR (Bonus Qualité Recherche 2009-2012) et BQR-LMCU (Bonus Qualité Recherche - Lille Métropole Communauté Urbaine 2013-2014).

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Captions to figures

Figure 1. Mean performances of participants in the three production of pantomime tasks. Vertical bars represent SEM. Asterisks indicate significant differences.

Figure 2. Mean BPT errors in the three production of pantomime tasks. Vertical bars represent SEM. Asterisks indicate significant differences.

Figure 3. Mean percentages of BPT errors with respect to the total number of errors in the three production of pantomime tasks. Vertical bars represent SEM. Asterisks indicate significant differences.

Figure 4. Percentage of participants committing BPT errors on each item according to the type of instruction.

Appendix.

List of stimuli (original French version and English translation) in the Production by Function, Production by Name and by Object tasks in the way they were presented to the participants (pseudo-random order). In the Pantomime by Object task, the real objects were presented.

Pantomime by Function	Pantomime by Name	Pantomime bu Object
Exemple 1: Se brosser les dents / Brush teeth	Exemple 1: Brosse à dents / Toothbrush	Exemple 1: Brosse à dents / Toothbrush
Exemple 2: Se faire une piqûre / Getting a shot	Exemple 2 : Seringue / Syringe	Exemple 2 : Seringue / Syringe
1. Écrire / Write	1. Éponge / Sponge	1. Verre / Glass
2. Tirer sur quelqu'un / Shoot	2. Tasse / Cup of coffee	2. Tournevis / Screwdriver
3. Ouvrir une serrure / Open a lock	3. Rouleau à peinture / Paint roller	3. Éponge / Sponge
4. Saler un plat / Salt a dish	4. Clé / Key	4. Marteau / Hammer
5. Boire un café / Drink a coffee	5. Yoyo / Yoyo	5 Clé / Key
6. Peindre un mur / Paint a wall	6. Beurre de cacao / Cocoa butter	6. Salière / Salt shaker
7. Essuyer une table / Wipe a table	7. Verre / Glass	7. Beurre de cacao / Cocoa butter
8. Découper une forme / Cut a shape	8. Salière / Salt shaker	8. Tasse / Cup of coffee
9. Jouer au yoyo / Play yoyo	9. Stylo / Pen	9. Ciseaux / Scissors
10. Regarder à la distance / Looking at a distance	10. Marteau / Hammer	10. Téléphone portable / Mobile phone
11. Visser/ Screw	11. Jumelles / Binoculars	11. Pistolet / Gun
12. Boire de l'eau / Drink water	12. Téléphone portable /	12. Jumelles / Binoculars

	Mobile phone	
13. S'hydrater les lèvres / Moisturize lips	13. Pistolet / Gun	13. Stylo / Pen
14. Répondre au téléphone / Pick up telephone	14. Tournevis / Screwdriver	14. Rouleau à peinture / Paint roller
15. Planter un clou / Hammer a nail	15. Ciseaux / Scissors	14. Yoyo / Yoyo







