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Ambiguous Idioms Understanding In Italian Aphasic Patients

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Abstract

The ability to understand ambiguous idiom was assessed in aphasic patients with preserved comprehension at a single word level. A string-to-word matching task was used in which patients were requested to choose one among four alternatives: a word associated with the figurative meaning of the idiom string; a word semantically associate with the last constituent of the idiom string; and two unrelated words. The results showed that patients' performance was impaired with respect to a group of matched controls. The most affected patients showed a frontal and/or temporal lesion.

Introduction

Idioms are among the most common forms of figurative language, but they do not constitute a unitary class varying along a number of syntactic and semantic dimensions (Nunberg et al., 1994; Cacciari & Glucksberg, 1991). First, idioms are highly conventional expressions in that their meaning generally cannot be predicted applying the rules that determine the meaning or use of their constituent parts when they occur in isolation. Notwithstanding, the syntactic as well as the semantic features characterizing for instance the verb are still preserved when this is inserted in an idiom string (e.g., one cannot slowly "kick the bucket", neither idiomatically nor literally, since "to kick" cannot be used to refer to a slow action; see Glucksberg, 1993; Hamblin & Gibbs, 1999). Second, idioms vary as to their semantic transparency, namely in the ease with which the motivation for their structure can be recovered. Idioms can involve figuration and can be originally metaphorical (e.g., "take the bull by the horns"), even if speakers may not always perceive the precise motive for the figure involved (Nunberg et al., 1994). There also are idioms not involving figuration at all (e.g., "by dint of"). Third, idioms vary as to their decomposability, namely in the extent to which the idiomatic interpretation can be mapped onto single constituents (Gibbs et al., 1989). Fourth, idioms vary in the extent to which they can be syntactically transformed and still retain their idiomatic meaning (Gibbs & Gonzales, 1985). Finally, many idioms can also be assigned a literal interpretation (e.g., "break the ice"), compositionally determined by the morpho-syntactic and semantic rules of the language.

Early theories of idiom comprehension were based on a pragmatic approach to figurative language understanding that assumed a literal meaning priority. A search for a figurative interpretation was started only when the literal one was defective. For example, Bobrow and Bell (1973) proposed the Idiom List hypothesis according to which idioms were fixed expressions whose meaning was sought in an idiom list whenever the literal reading of the string made no sense in context. Differently, the most influential Lexical Representation hypothesis posited that idioms behaved as long, morphologically complex words stored in the mental lexicon together with the other lexical units (Swinney & Cutler, 1979). Linguistic processing of the string and retrieval of the idiomatic meaning was supposed to proceed in parallel. Gibbs (1980) proposed a more extreme version of this hypothesis arguing that people did not engage in any linguistic analysis at all and could entirely bypass literal meaning directly accessing the figurative interpretation of the idiom string. Finally Cacciari and Tabossi (1988) proposed the Configuration hypothesis according to which idioms were considered as configurations of words that underwent a linguistic analysis until a key part was processed that prompted recognition of the idiomatic nature of the string and activation of the related figurative meaning.

All these hypotheses implicitly share the assumption that, in order to understand an idiom, lexical integrity is required. In fact evidence has already accumulated suggesting that idioms are processed in much the same way as any other sentence up to recognition of their figurative nature that triggers access to the figurative interpretation (Cacciari & Tabossi, 1988; Cacciari & Corradini, in press; Tabossi & Zardon, 1993, 1995). Indeed, it has been shown that a lexical-semantic impairment has a detrimental effect on figurative language comprehension in aphasic patients (Papagno et al., 2004).

Idiom comprehension in aphasic patients

Aphasic patients are particularly interesting for assessing figurative language comprehension. A consistent body of evidence already exists (e.g., Oliveri et al., 2004; Papagno et al., 2004; Papagno & Genoni, 2004; Tompkins et al., 1992) questioning the received view that the right hemisphere is particularly, if not solely, involved in idiom

understanding (e.g., Kempler et al., 1999; Van Lancker & Kempler, 1987). Van Lancker and Kempler (1987), for instance, claimed that idiom processing was especially subserved by the right hemisphere. They assumed that idioms are processed like unitary, syntactically non analysed chunks. However, Peterson et al. (2001) showed that language-unimpaired participants syntactically parsed the idiom string even after its idiomatic meaning was retrieved. Hence, a left hemisphere involvement should be presupposed for idiom comprehension as well. Furthermore, many studies now question a strict dichotomy of roles of the two hemispheres in language processing (Burgess & Chiarello, 1996).

The results collected so far on aphasic patients show that they generally are impaired in assigning a figurative interpretation to an idiom string (Hillert, 2004; Papagno & Genoni, 2004; Papagno et al., 2004). In particular, these patients show a strong bias toward the literal interpretation even when the idiom only has a non-literal interpretation (Papagno et al., 2004). The modality of testing is extremely relevant in neuropsychological studies, and figurative language comprehension assessment is no exception (see also Tompkins et al., 1992). For instance, the two tasks more often used in idiom studies with patients, the string-to-picture matching task and the oral explanation task (but see Hillert, 2004), are both problematic. From one side, the string-to-picture matching task can underestimate idioms comprehension, because the picture representing the literal interpretation (often a bizarre image, especially when there is no well-formed literal meaning) can strongly interfere with the correct response, similarly to what happens in the Stroop effect (Stroop, 1935; MacLeod, 1991). This has proved to be the case especially for patients with probable Alzheimer's disease (Papagno et al., 2003) and with right frontal patients (Papagno et al., submitted). On the other side, a deficit in speech output, as that found in non-fluent aphasic left brain-damaged (LBD) patients, can produce an underestimation of their ability to understand idioms insofar as they might be unable to provide a verbal explanation.

The present study

The aim of this study was to investigate idiomatic meaning comprehension in aphasic patients, without a semantic deficit at a word level, using idiomatic expressions that have both a figurative and a literal interpretation (i.e., ambiguous idioms) using a testing modality (a sentence-to-word matching task) that should avoid the limitations just outlined. Since ambiguous idioms have not yet been tested in aphasic patients, the results of the present study might extend what we currently know on idiomatic processing, allowing a more fine-grained assessment of idiomatic meaning comprehension impairments in aphasia. Given the heterogeneity of idiomatic expressions in terms of syntactic structure, literal ambiguity, semantic transparency, and so forth (see Nenonen et al., 2002), we cannot exclude that

different processing mechanisms might be responsible for processing different types of idioms.

Ambiguous idioms can be assigned either a literal interpretation, based on the compositional meanings of its constituents, or a figurative meaning associated with the whole string. The evidence on idiomatic meaning activation in unimpaired speakers is not conclusive: in a reading time study, Colombo (Colombo, 1993, 1998), found that idiomatic meaning required a biasing context for being activated. When the idiomatic expression was interpreted figuratively, the literal processing of the string was not terminated (Needham, 1992). Cacciari and Corradini (in press), using a cross-modal lexical decision paradigm, found that the availability of an idiomatic interpretation depended on the point in time in which the string was recognized as idiomatic: the earlier was its recognition, the fastest its activation.

In this study the patients were advised that the idiom string was meant idiomatically even though it also had a literal interpretation. It should however be noted that the figurative interpretation of familiar idiom strings, as those employed in this study, is usually more frequent than the literal one. Consequently, the idiomatic interpretation is almost always the dominant one, and the literal one the subordinate (Popiel & McRae, 1988). If the retrieval of idiomatic meaning is automatic and independent from linguistic processes, as suggested by the right hemisphere hypothesis, we should expect a normal performance in aphasic patients. Such a result would be consistent with the view of idioms as long words proposed by the Lexical Representation hypothesis since our patients had a preserved single word comprehension skill. On the contrary, if idioms are not processed holistically, as long words, but require morpho-syntactic and lexical-semantic processing up to identification of their figurative nature (Cacciari & Tabossi, 1988; Cacciari & Corradini, in press; Nenonen et al., 2002), then we should expect aphasic patients to be impaired in understanding idiomatic expressions as shown for idioms without a literal meaning (Papagno & Genoni, 2004; Papagno et al., 2004) and for verb phrase idioms (Nenonen et al., 2002).

Method

Participants. Fifteen aphasic patients were selected on the basis of the following criteria: a. they should be left brain-damaged right-handed with a single focal vascular lesion. The site and extension of the lesion was evaluated by means of a CT-scan; b. a minimum of 5 years of education; c. a diagnosis of aphasia of a mild to moderate severity, as assessed using a standardised language examination (AAT) and the Token Test (De Renzi & Faglioni, 1978), but a good comprehension of single words and verbs, as assessed using the word comprehension subtest of the language examination and a test by Miceli et al. (unpublished) for verbs; d. absence of further neuropsychological deficits, such as visuo-perceptual or non verbal intelligence deficits. Fifteen

normal participants, matched one by one with the patients by age, geographical area, sex and education, were selected as controls.

Materials. Twenty-three familiar verbal idioms were selected. They were ambiguous in that the string could have a literal meaning as well. In order to control for the semantic transparency of the idiom string, a rating study was run on 30 healthy participants. We also controlled for the plausibility of the literal meaning that one might assign to the idiom string.

In order to avoid the interference of the literal interpretation of the idiom string, observed in previous picture-to-string matching studies (Papagno et al., 2004) and the problems of the oral explanation task, we used a sentence-to-word matching task. Each idiomatic expression was paired with four target words matched in terms of length and frequency: one target word corresponded to the idiomatic interpretation of the string (henceforth idiomatic target; e.g., WINE, for “alzare il gomito”, “to raise the elbow”, i.e. to drink too much); one was a literal associate of the last constituent word of the idiom string (henceforth literal associate target; LEG); and two were different types of unrelated foils (henceforth unrelated targets) (TREE, BOX). Specifically, the first type of unrelated target was either an abstract or concrete word depending on the nature of the idiomatic target: the unrelated target was abstract if the idiomatic target was abstract, and concrete if the idiomatic target was concrete. The second type of unrelated target was a word that could plausibly complete the verb phrase (BOX). Each idiom was presented in a syntactically simple sentence (e.g. “He has raised the elbow”). The sentence and related targets remained in front of the patient to prevent working memory limitations. The task was to point to the word that matched the idiomatic meaning of the sentence.

The word comprehension test administered to the patients and controls (Laiacina et al., 1993) consisted of 80 common nouns belonging to eight different categories (fruits, vegetables, animals, furniture, vehicles, tools, body parts, musical instruments). For each stimulus, five pictures, corresponding to the target and to four foils respectively, were arranged vertically in a column on a card. The foils belonged to the same category. For example, if the target word was “strawberry”, other four words denoting fruits were presented together with the correct one. A stimulus word was read aloud by the examiner. The task of the patient was to choose the picture corresponding to the target. Patients also performed a literal sentence comprehension task, in a pointing-to-picture modality (from a battery designed by Miceli & Capasso, unpublished). The task includes 64 sentences. The examiner reads the sentence to the patient, who had to choose between two, three or four alternatives. There are 8 different types of syntactically different sentences.

Procedure. The examiner read the sentence followed by the four alternatives that were written on cards and remained in front of the patient or of the control

participants until a decision was taken. For example, the examiner read the sentence “he has raised the elbow” and then the four alternatives (“WINE, LEG, BOX, TREE”) were presented. As in previous studies (Papagno & Genoni, 2004; Papagno et al., 2004), participants were informed that they would be read sentences having a non literal meaning used in everyday conversations. An example was provided to clarify that the string was meant figuratively.

Results and Discussion

On the basis of their performance on the AAT, six patients were diagnosed as Broca’s aphasic, five as Wernicke’s aphasic, and the remaining four as amnesic aphasic. The severity of aphasia varied from mild to moderate, without significant difference between non fluent and fluent aphasics [$U(6, 9)=17, p=.24$].

All patients showed a good comprehension of single words ranging from 71/80 to 80/80 (mean 78.2, 97.75%). Also syntactic comprehension was good, ranging from 34 to 61 (mean 50.8, SD 7.76). The mean number of correct responses produced in the idiom comprehension task by aphasic patients was 15.33 (66.67%) (SD 4.43; range of correct responses produced by the patients: 5-20). Controls produced on average 22.13 (96.22%) correct responses (SD 1.19, range 19-23). An ANOVA was performed with number of errors as dependent variable and Group (patients vs. controls) and Error type (literal associate vs. unrelated) as independent variables. Since the numerical difference between the two types of unrelated errors was small, and statistically not significant (14.78% of unrelated abstract/concrete errors vs. 20.86% of verb completion errors, $t < 1$), the two error types were pooled together in this ANOVA. A significant effect of the Group factor was observed [$F(1, 28)= 32.91, p < .0001$], being patients’ performance significantly worse than that of controls. Also the Error type factor was significant [$F(1, 28)= 6.48, p= .01$], being literal associate errors (64.34%) more frequent than unrelated errors (35.65%). The interaction between Group and Error type was also significant [$F(1, 28) = 7.32, p = .01$]. Post-hoc analyses (Sheffé test) showed that patients produced significantly more literal associate errors ($p < .0001$) and more unrelated ($p < .0001$) errors than controls. Moreover, aphasic patients produced significantly more literal associate errors than unrelated errors ($p < .01$), while this difference was not significant for controls ($p = .99$). No significant correlation was found between number of correct responses and idiom familiarity ($r = .19, p < .38$), nor between idiom comprehension and the following factors: education level ($r = .47, p < .07$), word comprehension ($r = .23, p < .41$), sentence comprehension ($r = .02, p = .95$), and Token Test ($r = .06, p < .83$). Literal associate errors in the idiom comprehension test and semantic errors in the word comprehension test were not correlated ($r = -.35, p < .19$), although a ceiling effect in word comprehension answers (97.75% correct responses)

might account for this lack of significant correlation. No effect of the semantic transparency of the idiom string emerged on the choice of the correct (idiomatic) target ($r = .005$, $p < .98$), nor of the plausibility of the literal meaning of the idiom string ($r = -.08$, $p < .71$).

Previous evidence (Franklin, 1989) has showed that aphasic patients are more impaired in comprehending abstract/low imageability words than concrete/high imageability words. In fact abstract targets elicited more errors than concrete ones [$F(1,21) = 4.74$, $p < .05$]. On the contrary, the abstract vs. concrete nature of the action/state denoted by the idiom string had no influence on the errors performed by patients [e.g., “alzare il gomito”, to lift the elbow, i.e., to drink too much, refers to a concrete action vs. “perdere la testa”, to lose the head i.e., to get mad, to an abstract one] [$F < 1$].

Idiom comprehension was slightly more impaired in non fluent than in fluent aphasics (57.24% vs. 72.94%), although these differences were not statistically significant [$U(6, 9) = 18$, $p < .29$] and the limited number of patients does not allow further considerations. Moreover, Wernicke’s patients produced significantly less unrelated errors than Broca (6.9% vs. 18.1%).

Conclusion

We assessed the ability of 15 LBD aphasic patients to understand ambiguous idioms using a string-to-word matching task. Aphasic patients were significantly more impaired in idioms comprehension than matched controls. Previous studies (Papagno & Genoni, 2004; Papagno et al., 2004) showed that the comprehension of idioms with only a figurative interpretation (non ambiguous idioms) was seriously impaired in aphasic patients. In the present study, another class of idioms proved to be impaired, namely ambiguous idioms that have a literal interpretation as well. Interestingly, if we compare the severity of the impairment of aphasic patients in non-ambiguous and ambiguous idioms, we can observe that the patients were less impaired in comprehending ambiguous idioms than non-ambiguous ones. Apparently this is not due to familiarity, because this is approximately the same for non-ambiguous, neither it depends on the semantic transparency of the idiom strings that had no correlation whatsoever with patients’ accuracy. Even the level of impairment of the patients participating in the two studies was similar. Six of the patients tested in the present study were also included in the study on non-ambiguous idiom comprehension (Papagno et al. submitted) and they were more severely impaired in comprehending non-ambiguous than ambiguous idioms. A possible explanation for the less impaired performance of aphasic patients in the present study has to do with the testing modality: here we employed a string-to-word matching task, instead of a string-to-picture matching task. The latter is the most frequently used task, together with the oral explanation one (but see (Hillert, 2004; Nenonen et al., 2002)). Both

modalities, as we said, are problematic for patients: in the former, the presence of a picture (presumably bizarre) corresponding to some form of literal interpretation produced a strong interference effect. An oral explanation can often be problematic in the case of aphasics, especially when non fluent. In the present study the string-to-word matching task, used with patients whose single word comprehension skills were good, minimized the interference of the literal interpretation of the string. The interference of the literal meaning of the constituent words is less robust than that of an image representing a bizarre and semantically ill-formed literal meaning, as suggested by the fact that the aphasic patients tested in the previous study chose the literal picture more often than the literal associate word in the present study even if the strings had no well-formed literal meaning.

In a previous study, Papagno et al. (2004) found that the syntactic ill-formedness of non-ambiguous idioms was a trigger for the rejection of the literal interpretation of the idiom string and for the search for a figurative interpretation. Indeed, aphasic patients gave more idiomatic responses to syntactically ill-formed idioms than to well-formed ones. This result was consistent with a dual stage model of figurative language interpretation (first detection of a violation followed by the search in memory for an alternative interpretation) as the one proposed by Bobrow and Bell (1973). However, the idioms used in the present study were in general syntactically well-formed and nonetheless the patients had a better performance than in previous studies where a string-to-picture matching task was used.

Our patients were not impaired at a word comprehension level. However, semantically-based errors were evident in idiom comprehension: literal associate errors were indeed significantly more frequent than unrelated errors (64.35% vs. 35.65%, respectively). This finding corroborates the view that idioms cannot be considered just as long words, as posited by the Lexical Representation hypothesis. On the contrary, idioms strings are processed in much the same way as any other sentence, that is via a compositional linguistic processing, as proposed by the Configuration Hypothesis. What is deficient in aphasic patients might be the identification of the idiomatic nature of the idiom string that is necessary for accessing and retrieving the corresponding figurative meaning from semantic memory.

Although the mapping procedure we employed has some important limitations, a general analysis of the anatomical localization of the lesions suggests that two sites seem to be relevant for the patients’ performance in idiom comprehension: a frontal, even subcortical area, and a cortical temporal region. This is consistent with what was previously found for non-ambiguous idioms both in rTMS and lesion studies (Oliveri et al., 2004; Papagno et al., submitted). After the linguistic analysis of the string is performed (possibly in the temporal lobe), the choice of the correct response among four alternatives requires a selection process coupled with monitoring of the

response. This selection and monitoring process is likely to be performed by the central executive, the neural correlates of which are located in the frontal lobe (Stuss et al., 1994). rTMS and fMRI studies will be necessary to confirm this hypothesis.

The high percentage of literal associate errors (64.34%) produced by aphasic patients for the familiar idioms used in the present study suggests that, when the linguistic processing of the idiom string is impaired, as in aphasia, the target word literally associate with the last constituent of the idiom string is more likely to be available and selected. Literal errors can indicate that the string is processed literally with no activation of the corresponding, and competing, idiomatic meaning of the string. Unrelated errors can indicate that the activation of the literal meaning of the words composing the string is delayed or deficient, hence they can indicate a reduced lexical processing of the idiom string's constituents. This was precisely the case for unrelated errors. The fact that Broca's patients produced more unrelated errors than Wernicke's ones might signal that these patients refused the literal interpretation of the idiom string (that is less frequent than the idiomatic one) and looked for a possible alternative, being unable to retrieve the idiomatic meaning. Future work is needed to investigate this problem.

The choice of a literal answer might depend on several levels of impairment: first, an impairment of suppression mechanisms, in that patients are unable to get rid of the constituent word literal meanings; second, an impairment in recognition and activation mechanisms, in that the patients' ability to access and retrieve the idiomatic configuration meaning is damaged and they do not recognize the figurative nature of the string; third, a simultaneous impairment of both suppression and activation mechanisms. The current data do not allow us to distinguish among these three alternatives. However, it should be noted that aphasic patients are impaired, and even more, also when idioms do not have any literal interpretation, suggesting a simultaneous damage to linguistic processing and to idiomatic meaning recognition and activation.

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