Lexical and morphosyntactic minimal pairs: Evidence for different processing and implications in language pathology treatment

Minimal pairs are defined as pair of words in a particular language which differ in only one phonological element and have a different meaning (Roach, 2000). Several authors argued their relevance in the treatment of phonological disorders (for instance, Barlow and Gierut, 2002). In this study we investigate the nature of minimal pairs showing that a subtype of them entails a peculiar form of processing. In many languages bound morphemes used to mark inflection generate minimal pairs. In English, the present third person singular morpheme -s and the past tense morpheme -ed generate in most cases minimal pairs, such as “asks / asked”. Several authors (Stemberger and MacWhinney, 1986, Bertram et al, 2000) have argued that inflected forms may be stored in the lexicon as units, i.e. together with the bound morpheme. If inflected forms are stored as units in the lexicon, discriminating lexical minimal pairs and morphosyntactic minimal pairs should not be different processes. Elements should be stored similarly in the lexicon, and then compared phonologically when the subject is presented with a minimal pair. In this study we addressed this question presenting 20 monolingual native speakers of English with lexical and morphosyntactic minimal pairs (30 per condition, frequency differences not significant), and with pairs of identical words (leading, thus, to 120 trials). Participants were asked to press “white” if words were different and “black” if words were identical. Conditions were matched on word length. Results show that subjects are significantly faster in discriminating words generating a lexical minimal pair, such as “back / badge” than words generating a morphosyntactic minimal pair, such as “asks / asked”, $t(19) = -4.486$, $p < .001$. A third condition was also present to deepen our understanding of the processing of morphosyntactic minimal pairs. In this condition subjects were presented with morphosyntactic minimal pairs generated by very infrequent verbs. Unexpectedly, minimal pairs generated by infrequent verbs revealed to be faster recognised $(19) = 2.120$, $p < .05$ than the other morphosyntactic minimal pairs. Even if this may be

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interpreted as a consequence of attention arousal for unexpected stimuli, the result is problematic if we assume inflected forms to be stored in the lexicon as units. Together, these results suggest that inflected forms are not stored as units and that the discrimination of morphosyntactic minimal pairs relies on the discrimination of inflectional morphemes. As such, we suggest that increasing the sensibility to morphosyntactic minimal pairs in people with a morphosyntactic disorder, such as children with Specific Language Impairment (SLI), should improve their language performance.

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Introduction

Minimal pairs are defined as pair of words in a particular language which differ in only one phonological element and have a different meaning (Roach, 2000). In many languages bound morphemes used to mark inflection generate minimal pairs. These sets are referred to as “morphosyntactic minimal pairs” (Law and Strange, 2010), indicating a set of at least two inflected forms of a verb that differ in only one phoneme which is, at the same time, a bound morpheme. In Italian, for instance, the mini-paradigms acquired during infancy are typically morphosyntactic minimal pairs (mangio/mangia/mangi), as showed in different terms by the work of Guasti (2009).

In English, the present third person singular morpheme -s and the past tense morpheme -ed generate in most cases minimal pairs, such as “asks / asked”. Several authors (Stemberger and MacWhinney, 1986, Bertram et al, 2000) have argued that inflected forms may be stored in the

lexicon as units, i.e. together with the bound morpheme. In the last years the idea that inflected units are stored in the lexicon gained popularity also in the theory of language acquisition, with a growing number of researchers arguing that the application of inflection rules is the result of a generalization we operate over a large number of stored inflected forms (Tomasello, 2006, Diessel, 2012).

If inflected forms are stored as units in the lexicon, discriminating lexical minimal pairs and morphosyntactic minimal pairs should not be different processes. Elements should be stored similarly in the lexicon, and then compared phonologically when the subject is presented with a minimal pair. Even if is unclear whether open and closed class words entail a similar accessing process, there is substantial agreement in that, within the group of open class words, differences are not significant (Diaz and McCarthy, 2009). Given that, we expect the discrimination between lexical and morphosyntactic minimal pairs to be different only if we assume that the processing of bound morphemes is in some way different from the processing of a normal phoneme.

This issue has consequences on language remediation because minimal pairs are shown to be useful in the treatment of phonological disorders. However, no studies were performed on their impact on morphosyntactic treatment. It is well known that from a developmental point of view phonological and morphosyntactic disorders have the same incidence in the population (around 5%), and in more than 50% of cases they are also co-morbid (McArthur, 2000). Considering that minimal pairs have shown to be useful in phonological treatments, the finding of morphosyntactic processing in a subtype of minimal pairs could suggest that morphosyntactic minimal pairs are a useful therapy tool for children with co-morbid phonological and morphosyntactic disorders.

Materials and methods

Ethics:

All investigators on this project have had criminal records checks. The health and safety of participants in research projects is paramount. In line with this, this application has been reviewed by the University of Reading Research Ethics Committee and has been given a favourable ethical opinion for conduct. Before testing, each subject has given written consent to participate.

Subjects:

Subjects were recruited through wall advertising in the Department of Clinical Language Sciences. Subjects were mostly postgraduate students. 20 subjects in total participated, 9 males, 11 females, mean age 25.5, standard deviation, 2.03.

Procedure:

Contrast 1.
Subjects were presented with lexical and morphosyntactic minimal pairs and with pairs of identical words. Participants were asked to press “white” if words were different and “black” if words were identical. Stimuli were presented visually. There were 30 lexical minimal pairs and 30 morphosyntactic minimal pairs. In the control condition 30 of the elements belonging to the minimal pairs were repeated twice. So, for instance, subjects could be presented with the string “back badge”, the string “back back”, the string “cared cares”, and the string “cared cared”. Conditions were matched on word length and overall frequencies were not significantly different. Subjects were presented with a short practice session and after that with the actual test. The overall testing session for this task lasted approximately 20 minutes The test was written and performed on E-prime. Reaction times and accuracy were recorded.

Contrast 2.
In order to better understand the role of frequency the task included a third condition consisting of minimal pairs obtained from very infrequent verbs (less than 5 per million in the British National Corpus). This condition was compared to the other morphosyntactic one, in which verbs had a frequency of at least 20 per million in the British National Corpus. In the third condition, randomized as part of the task, subjects were presented with 30 minimal pairs of infrequent verbs and 30 infrequent verbs repeated twice.

Contrasts:

Condition 1 (lexical)	Condition 2 (morphosyntactic, frequent)
30 lexical minimal pairs	30 morphosyntactic minimal pairs
30 nouns repeated twice	30 verbs repeated twice

Condition 1 (infrequent)	Condition 2 (frequent)
30 morphosyntactic minimal pairs	30 morphosyntactic minimal pairs
30 verbs repeated twice	30 verbs repeated twice

Results and discussion

Accuracy was at ceiling for all subjects in all conditions. The task was easily comprehended and, according to several subjects, quite boring. However, reaction times analyses reveal a strong condition effect. Results show that subjects are significantly faster in discriminating words generating a lexical minimal pair, such as "back / badge" than words generating a morphosyntactic minimal pair, such as "asks / asked", $t(19) = -4.486$, $p < .001$. The result shows that more complex operations take place for the processing of inflected verbs, suggesting that verbs are decomposed in root and affix in order to be analysed (Pinker and Ullman, 2001). Interestingly, and quite oddly for proposals which assume inflected forms to be stored as units, the condition with infrequent verbs (less than 5 per million in the British National Corpus) revealed that their processing for this task is faster than that of frequent verbs $t(19) = 2.120$, $p < .05$. Even if this may be related to attention arousal for unexpected stimuli, the results together are quite problematic for the idea that inflected forms are stored as units and underlie that minimal pairs generated by bound morphemes are substantially different entities from what are normally considered minimal pairs, even if they meet the requirements of the definition. In pure lexical access tasks frequent elements are more readily recognised (Taft, 1979). At the same time, there is evidence that lexical access is similar for all content words (Diaz and McArthy, 2009), so it would hard to explain the result as a verb/noun difference.

Considering our result it may be argued that the processing of morphosyntactic minimal pairs involves two stages: a first stage in which the two words are compared phonologically, and a second stage in which the phonological difference is identified and associated with an inflectional morpheme. In the second stage the two morphemes are compared, and processed independently from the verb stem. Improvements that take place after remediation that relies on lexical minimal pairs have been analysed in detail (Barlow and Gierut, 2002): primarly, treatments based on the use of lexical minimal pairs improve the child ability to represent phonemes. The understanding of specific contrasts is based on a detailed representation of the two phonemes that form the minimal pair. With the therapy, children with a phonological disorder improve their ability to classify phonemes according to the set of articulatory traits that identify them. For many children, however, problems are not limited to phoneme representation. For English speaking children with SLI, for instance, a major problem is the tendency to omit inflectional morphemes. Children with SLI tend to omit the third person morpheme, producing sentences such as "she ask", and often omit the past morpheme, producing sentences such as "yesterday she ask" (Van der Lely and Ullman, 2001). From a phonological point of view what we observe in these sentences is phoneme deletion, /s/ in the first case, /t/ in the second one. However this interpretation is trivial. What we showed with this study is that these phonemes are processed differently, requiring more effort than "normal" phonemes. As such, we believe that morphosyntactic minimal pairs could be used in remediation together with lexical minimal pair, in order to face in parallel phonological and morphosyntactic problems.

Conclusions

In this paper we defend two theses, one as a consequence of the other. The first one is that lexical and morphosyntactic minimal pairs require two different forms of processing. More specifically, we suggest that the first stage is similar in the two conditions, consisting of a phonological comparison of the two words, but that a second stage, in which morphemes are compared, is present only in the morphosyntactic minimal pairs condition. This thesis relies on the result we obtained with our reaction times task. Even if accuracy is at ceiling in both conditions, morphosyntactic minimal pairs require a significantly bigger amount of time be processed. This suggests that inflected forms are not stored as lexical entries, and that a comparison of morphemes is performed. The hypothesis is strengthened by the follow up test on frequency effects: the fact that morphosyntactic minimal pairs generated by infrequent verbs are processed faster than morphosyntactic minimal pairs generated by frequent verbs clashes with previous studies on lexical access if we assume these forms to be stored in memory as lexical entries. A decompositional process of inflected forms seems more likely.

The second thesis relies on this finding. If it is true that the processing of morphosyntactic minimal pairs requires phonological and morphological analyses, their use in the treatment of morphosyntactic disorders should improve the child ability to associate "inflectional phonemes" with their morphological meaning. If our interpretation of the result is correct, the discrimination of elements belonging to a morphosyntactic minimal pairs should consist in two stages deeply connected: a phonological and a morphological one. We suggest, then, that children with co-morbidity of phonological and morphosyntactic disorders, such as children with Dyslexia and SLI, could best profit of the use of this tool in remediation.

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ID	NAME	RT1	RT2	RT3	AGE
1	david	978	1202	1198	26
2	catherin	778	839	896	25
3	emily	819	912	923	27
4	jo	738	790	769	30
5	anthony	667	668	647	28
6	mark	724	775	693	25
7	jess	1082	1156	1093	28
8	faith	767	983	810	23
9	james	728	816	771	24
10	suzannah	755	785	842	24
11	victoria	915	997	977	24
12	jayne	803	925	880	25
13	holly	659	745	752	25
14	dan	1056	1263	1152	30
15	rob	734	921	894	24
16	matt	949	1107	1054	24
17	will	982	966	1006	24
18	emma	835	1273	938	25
19	chris	987	1017	1046	24
20	hannah	925	902	860	25

(RTs values are average per subject per condition)

RT1= lexical minimal pairs
RT2= morphosyntactic minimal pairs
RT3= infrequent morphosyntactic minimal pairs

T test 1 comparisons: RT1 VS RT2
T test 2 comparisons: RT2 VS RT3