SELECTIVE IMPAIRMENT IN FIRST LANGUAGE WITH PRESERVED SECOND LANGUAGE ARTICULATION: A CASE STUDY*

PATRICK CHIRORO, ISAAC MUKURA AND CLARA SHANA
Department of Psychology, University of Zimbabwe

Abstract

In this article, we report the case of patient KK who, following cerebral infection, appears to have lost communicative ability in her first language but can communicate effectively in a second language. In experiments I and 2, KK made a disproportionately greater number of speech production errors in response to orthographically and phonologically presented Shona words compared to control subjects. No difference was observed between KK's performance and that of the control subjects when the same tasks were administered using common English words. The results obtained in experiment 3 showed that although KK found it extremely difficult to read aloud (or repeat after the experimenter) common Shona words, her ability to access the correct meanings of these words was not impaired. KK's performance in a task which required her to select the correct meaning in English of 60 common Shona words was well above chance (90%+ correct). It is argued that KK's problems occur at the phonological output level. The theoretical implications of these results are discussed.

INTRODUCTION

It is generally believed that the human language processing system consists of relatively independent components which can be selectively impaired by brain damage. For example, studies of monolingual patients with brain damage have shown differential impairments in the processing of high versus low frequency words (Patterson, Marshall and Coltheart, 1985), words of different grammatical classes (Coltheart, Patterson and Marshall, 1980), and words belonging to different semantic categories (Hart, Berndt and Caramazza, 1985; Warrington and McCarthy, 1987). Selective impairments in comprehension and naming restricted to animals and vegetables have also been reported (*see* Hillis and Caramazza, 1991).

* All communication relating to this article should be sent to: Dr Patrick Chiroro, Centre for Applied Psychology, Department of Psychology, University of Zimbabwe, P. O. Box MP 167, Mount Pleasant, Harare. Electronic mail should be addressed to: <*pchiroro@esanet.zw*>.
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However, the case of a long-term *permanent* and all-encompassing selective impairment in articulation of one's first language with preserved articulation of a second language has, to our knowledge, not been reported in the literature. In this article, we report the case of patient KK who, following cerebral infection, appears to have lost communicative ability in her first language but can communicate effectively in a second language.

Paradis (1980)[1] documented cases of bilingual patients who experienced a *temporary* and alternating loss of speech in one language with preserved speech in another. One such case involved a 48 year-old female who spoke both French (the first language) and Arabic (the second language) fluently before she suffered a cerebral concussion in a moped accident in Casablanca. Upon regaining consciousness, she was able to speak in Arabic but, 10 days later, she regained her French but could not speak in Arabic. On the following day, she again regained her Arabic but her French was very poor while on the 12th day, she was again able to speak French but not Arabic. The patient was discharged from hospital and for several weeks, she remained fluent only in French but could not find her words in Arabic. After three months, the patient recovered her ability to speak in *both* languages.

The second patient described by Paradis (1980) was a 23 year-old male who spoke both French (the first language) and English (the second language) fluently before a venous malformation deep in the left parietal lobe was surgically removed. For the first 7 days after the operation, the patient could speak in English but could not speak in French. Later, he regained his French but could no longer speak in English. Subsequently, the patient recovered his ability to speak both French and English. Segalowitz (1983) interprets these findings as strong evidence for separate representations in the brain for different languages. However, it is not clear at present what form these 'different representations' might take. Furthermore, unlike the case described in this article, the studies cited above showed temporary and alternating recovery of speech in bilingual patients after which *both* languages were subsequently restored.

Current models of language processing suggest that the lexical system consists of modality-specific input and output components that are interconnected by a general semantic system (e.g. Hillis and Caramazza, 1991). Such models assume that whether one reads the word 'car' (orthographic input), sees a car (structural/visual input), or hears the word 'car' (phonological input), the same *meaning* in the semantic system is accessed. However, the production of spoken language and written language are thought to each involve different components of the lexical

[1] Cited in Segalowitz (1983).

system (see also Ellis, 1992). The dissociation between spoken language and written language has been demonstrated in several studies. For example, it has been shown that in some patients, the ability to name pictures can be impaired yet the same patients can write down names of the same pictures with little or no difficulty (Heir and Mohr, 1977; Ellis, Miller and Sin, 1983; and Caramazza and Hillis, 1990). Also, it has been shown that when the semantic component is impaired, some patients have difficulty in both spoken and written language (Hillis, Rapp, Romani and Caramazza, 1990).

Such findings suggest, therefore, speech failures can either result from impaired semantic processing or from a failure to access the correct phonological or orthographic representations of known words. In the case of impaired semantic processing, all forms of language production would be affected. Presumably, in bilinguals, both languages would be impaired. However, if the impairment is due to a failure to access the correct phonological representations of words in a particular language, subjects could still be able to access the meaning of phonologically and orthographically presented words yet fail to articulate them orally. In the present study, we examined the nature, extent and source of KK's lexical problem.

CASE DESCRIPTION

KK is a 45 year-old female police officer who, until 1984, spoke both English (her second language) and Shona (her first language) fluently before she suffered from acute cerebral malaria. In Zimbabwe, English serves both as the language of instruction in schools and as the official language in business, government, and law. Like many Zimbabweans, KK began to learn English at the age of 7 years in school. Shona is a local Bantu language spoken by over 80% of the indigenous population in Zimbabwe. KK was married between 1966 and 1973. However, although English is the official language used at KK's work place, both Shona and Ndebele are widely used when officers deal with clients who cannot speak English. She is now divorced and lives with one of her three daughters and two grandchildren. There is no history of language problems in KK's family. An examination of KK's medical records showed that soon after being hospitalised, KK was unable to speak for three days. On the fourth day, she spontaneously regained her speech but could only communicate in English. Since then (more than 10 years ago), KK has failed to regain the ability to communicate effectively in Shona, her first language, this despite very supportive workmates and family members. KK has not received and is currently not receiving any medical or psychological help regarding her language problem.

Experiment 1

In this experiment, we compared KK's ability to *read aloud* common English and Shona words to that of four control subjects in order to establish the extent of KK's impairment. On the basis of our informal observation, we predicted that KK would make a substantially greater number of errors on the Shona words than the control subjects but show a comparable level of performance to that of the controls on the English words. The four control subjects who participated in all the experiments reported in this article matched KK's educational level, profession, marital status, sex, and age. All the control subjects were native Shona speakers.

Method

Stimuli. First, a list of 60 common English words was prepared. Of these words, 20 referred to objects (e.g. broom), 20 referred to animals (e.g. lion), and 20 referred to actions (e.g. walk). A further 20 common English names (e.g. Peter) were added to this list. A "Shona expert" from the Department of Linguistics at the University of Zimbabwe was asked to supply Shona equivalents for each of the 20 object words (e.g. *mutsvairo* => broom), 20 animal words (e.g. *shumba* => lion), and 20 action words (e.g. *famba* => walk). The same expert also provided 20 common Shona names (e.g. *Tatenda*). Thus, altogether, a total of 160 words were used in the experiment.

Apparatus. A NECTAR (486DX-66) IBM-compatible PC was used to present the stimuli to KK and to all the control subjects. A programme written in Borland C++ was used to present stimuli on the computer screen. A computer was used to present the words in this experiment in order to familiarise the subjects with computer-controlled experiments as preparation for their participation in experiment 3 which required the use of a computer.

Procedure. The subjects were tested individually in a room that was sound-proof at the University of Zimbabwe. Each subject sat next to the experimenter facing the computer screen on which the words were to be presented. Subjects were given the following instructions:

> I will show you some common English and Shona words on this computer screen. The words will be shown to you one word at a time at the centre of the screen. I would like you to read aloud each of the words.

When the subject was ready, the experimenter started the programme which presented the words. Immediately after each subject's response, the experimenter pressed a button on the keyboard and the next word appeared. This procedure was followed until all the words had been presented. The programme presented the words in a semi-random order with the only constraint being that no more than three words from the same referral category or language were to appear consecutively. Responses made by each subject were noted by the experimenter in terms of whether the response was 'correct' or 'incorrect'.

Results and Discussion

The number of errors made by KK and the mean number of errors made by the four control subjects in this experiment are shown in Table 1.

Table 1

NUMBER OF ERRORS MADE BY KK AND MEAN NUMBER OF ERRORS MADE BY FOUR CONTROL SUBJECTS IN EXPERIMENT 1. PERCENTAGE ERROR RATES ARE SHOWN IN PARENTHESES

	REFERRAL CATEGORY			
	Actions	**Objects**	**Animals**	**Names**
English Words				
KK	2.0 (10%)	3.0 (15%)	3.0 (15%)	0 (0%)
Controls	3.0 (15%)	2.0 (10%)	2.0 (10%)	0 (0%)
s.d.	1.13	1.64	2.11	—
Shona Words				
KK	11 (55%)	12 (60%)	13 (65%)	0 (%)
Controls	1.0 (5%)	1.0 (5%)	2.0 (10%)	0 (0%)
s.d.	1.54	1.33	2.17	—

It can be seen from Table 1 (column 5) that both KK and the control subjects made no errors when reading aloud people's names, regardless of whether these were English names or Shona names. Furthermore, no significant difference was observed between KK and the four control subjects in their ability to read aloud English words referring to actions, objects, and animals. However, as predicted, KK made a disproportionately greater number of errors when reading aloud Shona words referring to actions (55% *vs.* 5% for controls), objects (60% *vs.* 5% for controls), and animals (65% *vs.* 10% for controls).

Three hypotheses may account for KK's errors. First, it could be argued that KK experienced difficulty at the visio-perceptual level in terms of encoding the orthographic structure of the letters that make up Shona words. Second, it could be argued that KK had difficulty in matching the orthographic structure of the Shona words to appropriate phonological representations of the familiar words used in this experiment. Contemporary theories of word production distinguish between the availability of a semantic specification of a word and subsequent retrieval of its phonological form (*see* Howard, 1995 for an alternative view). Finally, it is possible that KK's impairment is characterised by a failure to produce the appropriate sounds for the words. In the next experiment, the 'visio-perceptual encoding deficit' hypothesis was tested. Instead of presenting *written* words (orthographic input) to KK and the control subjects, a different mode of presentation was used, namely, phonological input.

Experiment 2

It was hypothesised in this experiment that if KK's Shona articulation problems are even partially due to failure to encode the orthographic structure of Shona words, then, presenting the stimuli auditorily might improve her performance. However, if KK's Shona articulation problems emanate from either a failure at matching lexical input to appropriate phonological representations of Shona words or to a failure at the phonological output stage, then, KK should once again show a disproportionate number of errors compared to control subjects in a task in which she is asked to repeat after the experimenter some common Shona words.

A second aim of the present study was to establish more precisely the nature of KK's Shona articulation problems. In the previous experiment, the errors made by KK were simply counted for each referral category and for each language. No attempt was made to categorise the errors. In the present experiment, KK's errors were categorised into errors involving (i) wrong pronunciation (ii) hesitation and halting, (ii) phonemic omission, (iv) phonemic inclusion, and (v) complete failure to say the word. These categories were based on an analysis of KK's responses in the previous experiment.

Method

Stimuli and Apparatus. A list of 40 common Shona words was obtained from another "Shona expert" in the Department of Linguistics at the University of Zimbabwe. Of these, 20 were action words and 20 were proper nouns. None of the words used in the previous experiment were used in this experiment. The words were printed on white cards in bold black ink.

Procedure. KK and all the four control subjects were tested individually in the same room that was used during experiment 1. The experimenter sat directly in front of each subject. Between the subject and the experimenter was a large square table on which the word cards were placed in a pile. The following instructions were given to each subject in English:

> With me here I have forty cards. On each card, a word is written. I will pick one card at a time and read to you what is written on the card. I would like you to simply repeat the word after me until we have finished all the forty words.

The experimenter then read out each of the 20 action words and each of the 20 proper nouns in random order. As each subject repeated the words, errors were noted by both the experimenter and an assistant for wrong pronunciation, hesitation and halting, phonemic omission, phonemic inclusion, and failure to say the word.

Results and Discussion

Table 2 shows the number of errors made by KK and the mean number of errors made by the four control subjects in this experiment.

Table 2

NUMBER OF CORRECT RESPONSES AND ERRORS MADE BY KK AND MEAN NUMBER OF CORRECT RESPONSES AND MEAN NUMBER OF ERRORS MADE BY THE FOUR CONTROL SUBJECTS IN EXPERIMENT 2. PERCENTAGE ERRORS ARE SHOWN IN PARENTHESES

	Action Words			**Proper Nouns**		
	Correct	**Failure**	**Others**	**Correct**	**Failure**	**Others**
KK	4.0 (20%)	9.0 (45%)	7.0 (35%)	2.0 (10%)	11 (55%)	7 (35%)
Controls	20 (100%)	—	—	20 (100%)	—	

Once again, KK made a disproportionately greater number of errors compared to the control subjects. She was able to say out correctly only 20% of the action words and 10% of the proper nouns, compared to 100% accuracy for the controls on both action words and on proper nouns. Of the errors she made on action words, 45% involved a 'complete failure' to repeat the target word. Of the errors she made on proper nouns, more than half (55%) also involved a 'complete failure' to say the target word. The category 'Others' in Table 2 involved such errors as incomplete articulation (e.g. SIM for Simukai), hesitations, and mispronunciations. These results clearly show that KK has a major Shona articulation problem. This problem occurs regardless of whether KK is asked to read aloud Shona words (orthographic input - experiment 1) or to repeat Shona words after someone (phonological input - experiment 2). In both cases, KK made a substantially greater number of errors compared to control subjects. Thus, the perceptual encoding deficit hypothesis is not supported by the results obtained in this experiment.

One question that has not been addressed so far is whether KK can attach the correct meaning to a Shona word that is presented orthographically. Failure to attach meaning to Shona words may prevent KK from accessing the correct phonological representations for each word that is presented to her. Therefore, before the next experiment was conducted, KK was simply asked: "When people talk in Shona, can you **understand** what they will be saying?". KK did not hesitate to provide the answer "yes" but she qualified her answer by saying "... provided the speaker is not too fast". This suggested that KK's problem may have little to do with semantic processing of the Shona input (orthographic or phonological). The next experiment was designed to establish whether this is indeed the case.

Experiment 3

The results obtained in experiments 1 and 2 showed that KK's Shona articulation problem occurred regardless of whether the words were presented orthographically or phonologically. In the present experiment, it was hypothesised that KK's Shona articulation problem may be due to a failure to attach the correct meaning to orthographically and phonologically presented Shona words which, in turn, would prevent her from accessing the correct phonological representations of the words. If this hypothesis is to be supported, KK should make a significantly greater number of errors than control subjects in a task that requires selecting the correct English translation for a presented Shona word regardless of whether or not KK can say the word aloud. However, if KK is capable of accessing correct semantic representations of Shona words, no significant difference between her performance and that of controls should be observed in this task.

Stimuli and Apparatus. Sixty translated **pairs** of common *English*-to-*Shona* words were used in the experiment. Twenty of the words referred to objects, 20 referred to actions, and 20 referred to animals. These were not the same words that were used in experiment 1. The present experiment was conducted four weeks after the first experiment. A further list of 60 English words were added to this list to serve as distracters. A 486DX-66 IBM-compatible PC controlled by a Borland C++ programme was used to present the words to the subjects. The programme was written in such a way as to randomise the presentation of the words in terms of referral category.

Procedure. Subjects were tested individually in a specially prepared room in the Department of Psychology at the University of Zimbabwe. Each subject was asked to sit in front of the computer screen and given the following instructions:

> I am going to show you some common Shona words, one word at a time on this computer screen. Each word will be shown for 5 seconds. After the word has disappeared from the screen, two English words will

> appear on the screen. I would like you to decide which of the two English words has the same meaning as the Shona word that you will have just seen.

The experimenter sat next to each subject throughout the experiment. When the subject was ready, the experimenter pressed a key to begin the experiment. Each subject responded by *pointing* at the word of her choice after which the experimenter entered either "1" for correct responses or "0" for incorrect responses. The computer logged these responses and the programme calculated the total number of errors made by each subject for each of the four referral categories of words.

RESULTS AND DISCUSSION

The results obtained in this experiment are shown in Table 3. For the control subjects, mean and standard deviation scores are given.

Table 3

NUMBER OF CORRECT RESPONSES MADE BY KK AND FOUR CONTROL SUBJECTS IN EXPERIMENT 3. PERCENTAGE ERRORS ARE SHOWN IN PARENTHESES

	Objects *n=20*	**Actions** *n=20*	**Animals** *n=20*
KK	18.00 (90%)	19.00 (95%)	19.00 (95%)
Controls	18.75 (94%)	17.75 (89%)	19.25 (96%)
sd	2.14	2.10	1.23

It is clear from Table 3 that KK's ability to associate Shona words with their correct meanings in English was comparable to that of the control subjects. Also, given the fact that the target Shona words appeared on the screen for only 3 seconds, KK's performance on this task is quite remarkable. KK made only 2 errors (an error rate of 10%) on the 'objects' list, 1 error (an error rate of 5%) on the 'actions' list, and 1 error (an error rate of 5%) on the 'animals' list.

It can be concluded from these results that KK appears to have no difficulty what-so-ever in encoding and accessing the meanings of orthographically presented Shona words regardless of the category to which the words belonged.

GENERAL DISCUSSION

The results obtained in the three experiments presented in this article strongly suggest that KK's speech problems occur at the *phonological* *output* level of the lexical system. In experiment 1, KK made a substantially greater number of errors compared to control subjects in a task which required subjects to *read aloud* orthographically presented Shona words. However, KK's ability to read aloud orthographically presented English words was comparable to that of the control subjects. Both KK and the control subjects did not make any errors when they were asked to read aloud common Shona and English names. In experiment 2, KK also made a substantially greater number of errors compared to control subjects when asked to *repeat* after the experimenter 20 action words and 20 common nouns in Shona. KK showed no impairment in a similar task in which 20 common action words and 20 common nouns were presented in English.

Taken together, the results obtained in experiments 1 and 2 suggest that KK's articulation problem occurs only when she attempts to read or pronounce Shona words and not when English words are involved. This is the puzzling bit. It is not possible, on the basis of the results obtained in experiments 1 and 2, to advance a firm theoretical explanation of KK's errors. However, the possibility that KK's articulation problem might be due to failure to encode the *meanings* of orthographically presented Shona words which, in turn, would prevent access to correct phonological representations of the words can be ruled out on the basis of the results obtained in experiment 3. In the latter experiment, KK demonstrated an extra-ordinary ability to choose the correct English words for each of the 60 Shona words that were presented to her. This, she managed to do despite the fact that the target Shona words were each presented for only 3 seconds. Thus, it could be argued that KK's ability to access the meaning of written Shona words is still intact. Furthermore, KK appears to have no serious processing deficits at the visual and auditory analysis stages of lexical processing (see Ellis, 1992).

In conclusion, the experiments presented here demonstrate two things. First, the results demonstrate the existence of selective impairment at the phonological output stage of the lexical system with preserved understanding of meanings of words. An opposite effect, that involving a remarkable ability to read words aloud without understanding their meaning, has been reported in the literature (Schwartz, Marin, and Saffran, 1979; Schwartz, Saffran and Marin, 1980). Thus, the results obtained in the present study are consistent with the view that the phonological word production system is functionally independent from the semantic system. Second, KK's problem, which is characterised by a long-term permanent selective impairment in first language with preserved second language articulation is surprisingly unique. This type of impairment could be taken as evidence that different phonological output systems are used when communicating in phonetically different languages (a view favoured by Segalowitz, 1983). However, before this theoretical position can be accepted, more evidence must be obtained. Use of brain-scanning techniques might provide such evidence.

References

CARAMAZZA, A. AND HILLIS, A. E. (1990) "Where do semantic errors come from?", *Cortex*, 26, 95-122.

COLTHEART, M., PATTERSON, K. AND MARSHALL, J. C. (1980) *Deep Dyslexia* (London, Routledge and Kegan Paul).

ELLIS, A. W. (1992) *Reading, Writing and Dyslexia: A Cognitive Analysis* (London, Lawrence Erlbaum Associates).

ELLIS, A. W., MILLER, D. AND SIN, G. (1983) "Wenerkie's aphasia and normal language processing: A case study in cognitive neuropsychology", *Cognition*, 15, 111-144.

HART, J., BERNDT, R., AND CARAMAZZA, A. (1985) "Category-specific naming deficit following cerebral infection", *Nature*, 301, 338.

HEIR, D. B. AND MOHR, J. P. (1977) "Incongruous oral and written naming", *Brain and Language*, 4, 115-126.

HILLS, A. E. AND CARAMAZZA, A. (1991) "Mechanisms for accessing lexical representations for output: Evidence from a category-specific semantic deficit", *Brain and Language*, 40, 106-144.

HILLIS, A.E., RAPP, B. C., ROMANI, C. AND CARAMAZZA, A. (1990) "Selective impairment of semantics in lexical processing", *Cognitive Neuropsychology*, 7, 191-244.

HOWARD, D. (1995) "Lexical Anomia: Or the case of missing Lexical entries", *The Quarterly Journal of Experimental Psychology: Section A – Human Experimental Psychology*, 48A (4), 999- 1023.

PATTERSON, K.E., MARSHALL, J. AND COLTHEART, M. (1985) *Surface Dyslexia* (London, Lawrence Erlbaum Associates).

SEGALOWITZ, J. S. (1983) *Two Sides of the Brain: Brain Lateralization Explored* (New Jersey, Prentice Hall), 153 -156.

SHALLICE, T. AND MCCARTHY, R. A. (1985) "Phonological reading: From patterns of performance to possible procedures", in K. E. Patterson, J. C. Marshall and M. Coltheart (eds.) *Surface Dyslexia* (London, Lawrence Erlbaum Associates).

SCHWARTZ, M. F. MARIN, O.S.M., AND SAFFRAN, E.M. (1979) "Dissociations of language function in dementia: A case study", *Brain and Language*, 7, 277-306.

SCHWARTZ, M. F., SAFFRAN, AND E. M. MARIN, O.S.M. (1980) "Fractionating the reading processes in dementia: Evidence for word-specific print-to-sound associations", in M. Coltheart, K.E. Patterson and J. C. Marshall (eds.) *Deep Dyslexia* (London, Routledge and Kegan Paul).

WARRINGTON, E. K. AND MCCARTHY, R. A. (1983) "Category-specific access dysphasia", *Brain*, 106, 859-879.

— (1987) "Categories of knowledge: Further fractionations and an attempted explanation", *Brain*, 110, 1273-1296.