Brain & Language 125 (2013) 118–127

Contents lists available at SciVerse ScienceDirect

Brain & Language

journal homepage: www.elsevier.com/locate/b&l

Recognizing the emotional valence of names: An ERP study

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ARTICLE INFO

Article history:
Accepted 14 January 2013
Available online 5 March 2013

Keywords:
Emotional valence
Common nouns
Proper names
Recognition
ERP

ABSTRACT

Unlike common nouns, person names refer to unique entities and generally have a referring function. We used event-related potentials to investigate the time course of identifying the emotional meaning of nouns and names. The emotional valence of names and nouns were manipulated separately. The results show early N1 effects in response to emotional valence only for nouns. This might reflect automatic attention directed towards emotional stimuli. The absence of such an effect for names supports the notion that the emotional meaning carried by names is accessed after word recognition and person identification. In addition, both names with negative valence and emotional nouns elicited late positive effects, which have been associated with evaluation of emotional significance. This positive effect started earlier for nouns than for names, but with similar durations. Our results suggest that distinct neural systems are involved in the retrieval of names' and nouns' emotional meaning.

1. Introduction

The distinct use of common nouns and proper names has an evolutionary advantage (Müller & Kutas, 1996; Semenza, 2006). For instance, common nouns allow for an efficient warning by using categorical labels to mark entities (e.g., calling 'snakes' for a kind of thin, long and legless animal), whereas proper names serve similar warning functions by calling a specific name of the individual in danger (e.g., calling 'Bill' for the youngest child). Person name is a typical kind of proper name (Hollis & Valentine, 2001).

Common nouns and person names differ from each other in several aspects. First, common nouns refer to a class of objects while proper names refer to unique entities (Semenza & Zettin, 1989). For example, the common noun 'snake' represents a class of snakes and it can refer to any one, while a person name 'Albert Einstein' normally refers to only one of the kinds. Second, common nouns intrinsically have meanings and imply attributes, whereas it is controversial whether names intrinsically carry any meaning. Kripke (1981) pointed out that a name does not carry meaning as it only identifies an individual without providing any attribute. In contrast, Sciarone (1967) proposed that the associated description (e.g., Albert Einstein as a famous physicist) constitutes the meaning of a name, which differs from the linguistic (lexical) meaning of a noun.

The difference between these two categories of words raises the question of whether they are represented or processed differently in the human brain. Empirical studies suggest a difference between them. For instance, the reaction time for names was found to be faster than for nouns both in a category decision task (Müller, 2010; Yen, 2006) and in a semantic association task (Proverbio, Mariani, Zani, & Adorni, 2009), but to be slower in a phonological decision task (Proverbio, Lilli, Semenza, & Zani, 2001). The difference seems to indicate that for names, categorical judgment (which entails word recognition in comprehension) is easier whereas the phonological retrieval (which entails word retrieval in production) is more demanding compared to nouns.

Further evidence for the processing difference between names and nouns comes from neuropsychological studies. Neurological damage can cause a double dissociation (only proper names are disturbed while common names are unaffected or vice versa) between retrieval or recognition of names and nouns at different levels of processing, such as phonological retrieval, semantic access and application of syntactic rules (for a review see Semenza (2009)). Both neuropsychological and neuroimaging studies have indicated that proper name processing requires the involvement of a large neural network (e.g., temporal cortex and ventro-medial prefrontal cortex), and the exact location is still a matter of debate (for reviews on this issue, see Semenza (2006, 2009, 2011)).

The different processing between names and nouns has also found support in several ERP studies. During auditory sentence

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http://dx.doi.org/10.1016/j.bandl.2013.01.006

comprehension, Müller and Kutas (1996) reported larger N1 and P2 amplitudes for names than for nouns, which according to the authors could be caused by differences in their inherent phonetic features. For instance, the phoneme [x] can be found more often in common nouns than in person names. In a word retrieval experiment, Proverbio et al. (2001) presented short, written, unequivocal definitions of names and nouns to participants. The participants were asked to silently retrieve the defined words in order to perform a phonological decision task. The results showed that the retrieval of names elicited larger N1 and P3 than nouns. Recently, Proverbio et al. (2009) employed a semantic association task where the participants were asked to judge the semantic relatedness between two sequentially presented words (e.g., 'Woody' vs. 'Allen', 'social' vs. 'security'). Although similar N400 effects were found between names and nouns in response to the semantic relatedness, names elicited smaller N400 amplitudes than nouns regardless of the semantic relatedness. Overall, the processing difference between names and nouns could occur at any stage depending on the stimuli and task. Since names and nouns differ in many aspects, it is difficult to directly compare their processing. However, both names and nouns convey emotional meaning, which makes the emotional variable ideally suitable for studying the processing difference between names and nouns.

Current word recognition models have mainly dealt with the processing of common nouns, adjectives or verbs (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Grainger & Holcomb, 2009; Plaut, McClelland, Seidenberg, & Patterson, 1996). These models are used to describe how orthographic and phonological information cooperate in order to access semantic information of the words. Various factors have been shown to influence this process, such as word length, word frequency, concreteness and imageability. Surprisingly, none of these models has taken emotional variables into consideration. Emotional information allows for rapid and privileged access due to its intrinsic significance, i.e., potentially threatening or rewarding stimuli are biologically relevant to species survival (Lang, Bradley, & Cuthbert, 1997). The priority of emotional information processing has been demonstrated in both behavioral and ERP studies (for reviews see Vuilleumier (2005) and Vuilleumier and Huang (2009)). ERP technique provides us with an excellent tool to measure the time course of different types of information activated in word reading (e.g., Sereno & Rayner, 2003). It has been shown, although not always consistently, that emotional meaning can be processed automatically at a very early stage, as indicated in some early ERP differences (such as N1, P1 and early posterior negativity) between the emotional and neutral information (for a review, see Citron (2012)). Although the exact underlying processes (visual process, selective attention or lexical activation) remain unclear, such early effects suggest that the emotional feature of words can be identified very rapidly. Besides these early effects, another ERP component that is modulated by emotional words is a late positive complex (LPC), peaking between 500 and 800 ms, with a centroparietal distribution. Its amplitude has been found to be larger for both positive and negative words (Frischen, Eastwood, & Smilek, 2008; Hinojosa, Méndez-Bértolo, & Pozo, 2010), only for positive words (Herbert, Kissler, Junghöfer, Peyk, & Rockstroh, 2006), or only for negative words (Bernat, Bunce, & Shevrin, 2001; Kanske & Kotz, 2007). The LPC presumably reflects a less automatic evaluation of the emotional valence.

The ERP studies on emotional valence were primarily concerned with common nouns, adjectives and verbs, with the emotional processing of names not being taken into consideration so much. Neuropsychological and neuroimaging studies have shown that name processing activated right hemisphere in the brain, which has been related to the processing of emotion. This, according to the authors, might be due to the fact that information associated with familiar names provokes an emotional reaction in the individual (Damasio, Tranel, Grabowski, Adolphs, & Damasio, 2004; Ohnesorge & Van Lancker, 2001; Van Lancker, 1991; Van Lancker & Ohnesorge, 2002). Given the referential nature of names, the emotional information that is activated by a name can only be derived from the characteristics of the name bearer. So far no study has directly studied the emotional valence of names. Therefore, it remains an open question when the emotional meaning carried by names can be identified.

In order to account for the difference between names and nouns, Valentine, Moore, and Brédart (1995) proposed a model of name processing based on Bruce and Young's (1986) face recognition model and Morton's (1969) word recognition model. In this model, the initial processing of names involves the analysis of an input code that is similar to ordinary word recognition. After this initial word form analysis, name recognition units which are equivalent to face recognition units are activated if the presented name is familiar. Then the person identity node (i.e., a multimodal representation of the name bearer) and identity-specific information (e.g., the occupation or the emotional valence associated with the name bearer) are activated. Therefore, the access of a name's semantic information takes place after name recognition and person identification, which in turn are subsequent to word recognition, whereas a noun's meaning can be accessed directly from the word recognition units. The model further implies that there is only a single connection between a name and its referential meaning, whereas multiple connections exist during the retrieval of noun. For instance, the proper name *Baker* is connected to semantic information only via lexical nodes for a known individual with the family name *Baker*. It does not have a set of connections representing information about this name, such as *Baker is an English name*. Nevertheless, the noun *baker* as a common noun is connected to a large number of nodes representing semantic information about bakers, such as *bakes bread* and *wears white uniforms*. Moreover, Tacikowski, Jednoróg, Marchewka, and Nowicka (2011) attempted to map the processing stages postulated by the model with ERP components. They proposed that word form analysis is associated with N170, name recognition is related to N250, while person identification and semantic information activation are linked to N400 or P300. Based on this model, we hypothesize that the emotional valence of names can only be activated after identity-specific information is available, which should then be reflected by late ERP components such as N400 or P300. Nevertheless, given the behavioral significance, the emotional meaning should be identified rapidly in both person names and common nouns.

The current study aims to examine the temporal characteristics of emotional processing in names and nouns. We manipulated the emotional valence of names and nouns separately and measured the ERPs elicited by the words in each condition. Since no direct measure of name frequency is available in Chinese corpus, it is difficult to match the names and nouns for their frequency. However, it has been shown that familiarity and frequency are highly correlated (Balota, Pilotti, & Cortese, 2001), so we matched the familiarity of names and the frequency of nouns between different emotional valence conditions. Moreover, since we are mainly interested in comparing the retrieval of emotional meaning between names and nouns, we only compared the effects caused by emotional valence of names and nouns. Based on previous studies, we expect to find both early ERP effects (such as P1, N1, P2 and EPN) and late positive effect for nouns. Nevertheless, it remains an open question as to the ERP effects elicited by names. Under the name processing model (Valentine et al., 1995), no early ERP effect is expected because the emotional meaning of a name can only be available after word recognition. Alternatively, early ERP effects would be generated if the emotional significance can be