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Ease of predication does not account for imageability effects in performance: A reply to Jones (2002)

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Abstract

In this paper we defend our views against Jones' (2002) claim that the criticism of the ease of predication hypothesis (Jones, 1985) made by de Mornay Davies and Funnell (2000) is "fundamentally flawed." Jones raises five issues concerning the content of the text, the reliability of effects of ease of predication, the generation of predicates, semantic features, and memory retrieval. We address each of these issues in turn and show that either a critical point raised is not made, or the point is mistaken. More importantly we show that our empirical findings, which are entirely overlooked by Jones, unequivocally support the view that ease of predication does not account for imageability effects in performance.
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1. Introduction

Jones (2002) argues that the criticism made by de Mornay Davies and Funnell (2000) of the ease of predication hypothesis (as described in Jones, 1985) is flawed, and that ease of predication continues to provide "a reliable and a valid semantic substrate for imageability" (p. 165). He lists four deficiencies in our paper: (i) we attribute to Jones (1985) a definition of ease of predication that is incorrect; (ii) we claim that ease of predication is an unreliable measure, when in fact we obtained high measures of (statistical) reliability; (iii) we claim that the ease of predication judgements of Jones (1985) had not been compared with the generation of actual predicates (carried out by Jones, 1988); and (iv) we attribute to Jones the assumption that features and predicates are one and the same.

Before addressing these criticisms, we will consider Jones' conclusion that the concept of ease of predication as an explanation of imageability effects in reading has not been challenged by our paper, for here we disagree

entirely. We believe that Jones (2002) has seriously misrepresented the basis on which we have challenged the ease of predication theory, as he ignores completely the empirical sections of our paper which show that ease of predication does not account for effects of imageability and concreteness. When we have made our case on this main point, we will return to consider Jones' specific comments listed above.

2. Ease of predication, imageability, and concreteness

Jones (1985) set out to investigate the possibility that ease of predication (hereafter, EoP) could provide a more cognitively plausible account of the reading pattern found in deep dyslexia than measures of imageability and concreteness. People with deep dyslexia (an acquired disorder of reading) typically read aloud highly imageable concrete words, such as *horse* with more success than less imageable concrete words such as *beauty*, which in turn are read more successfully than abstract words like *liberty*. Function words, such as *and* or *the*, which lack imageable/concrete properties, are generally not read aloud at all, despite being among the

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most frequent words in the English language. The fact that semantically related errors (such as horse → *cow*) commonly occur in deep dyslexia indicates that written words are named aloud on the basis of their meaning.

To explain the effects of imageability and concreteness in deep dyslexia, Jones (1985) turned to the psychological theories of meaning around at that time, which assumed that words were associated in semantic memory with "... distributions of features, or more fully, predicates" (p. 2). He suggested that variations in the ability to read particular words aloud and variations in the imageability and concreteness of these words might both be explained by "variations in the distributions of the associated predicates" (p. 3). On the basis of this, Jones predicted that subjective ratings of the ease with which "predicates of the stimulus words can be summoned" (p. 3) should correlate highly with ratings of imageability taken from published norms. Jones did not define the nature of the 'variations in the distributions of the associated predicates,' but his instructions to subjects emphasised the ease with which a good number of predicates might be produced to particular words, giving as examples 10 predicates to the imageable word *dog* (e.g., a dog has four legs; a dog barks when angry) and no predicates to the abstract word *idea*. Jones went on to show that EoP ratings correlated very highly with ratings for imageability ($r = .88$). On the basis of these data (and other data showing that ease of predication ratings varied with grammatical class), Jones concluded that ease of predication offers a parsimonious account of the pattern of reading found in deep dyslexia.

Jones (1985) did not collect measures of the actual number of predicates that subjects could generate for the words he used. So, in our study (de Mornay Davies & Funnell, 2000) we collected written lists of predicates generated to a list of words, with each word presented for 90 s. Two sets of words were mixed up in this list: 20

words from Jones (1985) and 40 new words (taken from Paivio, Yuille, & Madigan, 1968). In each set, half the words were concrete and half were abstract. The number of predicates generated to Jones' word set correlated highly ($r = .85$, $p < .01$) with the ratings of EoP obtained by Jones (1985) indicating a strong association between the two. Also, the number of predicates generated for the combined word sets correlated highly with published ratings of imageability ($r = .87$, $p < .01$). Thus our paper provides confirmation of a strong statistical relationship between EoP, imageability ratings, and the number of predicates generated (as inferred by Jones, 1985).

However, further investigations of the relationship between the number of predicates generated and ratings of EoP, imageability and concreteness showed that variations in imageability and concreteness were, after all better predictors of the number of predicates generated than were ratings of EoP. We will explain our findings by reference to Figs. 1–4. Fig. 1 shows that the 20 words from Jones (1985) formed a continuous range of number of predicates generated, with abstract words producing fewer predicates than concrete words. However, EoP ratings for these words failed to vary systematically with the number of predicates produced, and instead separated concrete and abstract words into two distinct populations distinguished by high and low EoP ratings. Within these distinct populations, neither the concrete nor the abstract words showed a significant relationship between EoP rating and the number of predicates generated ($r = .11$ and $r = .29$, respectively, $p > .05$ in both cases). Thus the high correlation of $r = .85$ for the Jones word set, found between EoP ratings and the number of predicates generated clearly reflects variations in some other variable than the number of predicates generated.

The concrete and abstract word sets selected from Jones (1985) were drawn from extreme ends of the
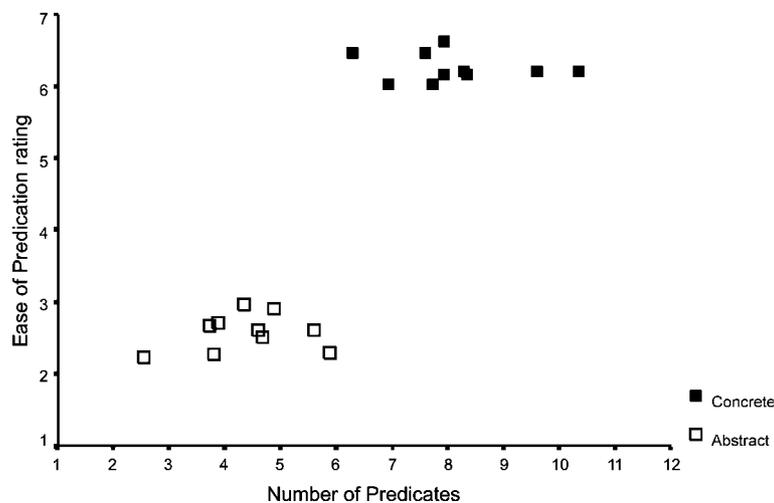

Fig. 1. Ease of predication ratings (Jones, 1985) vs. number of predicates generated: Jones word set.
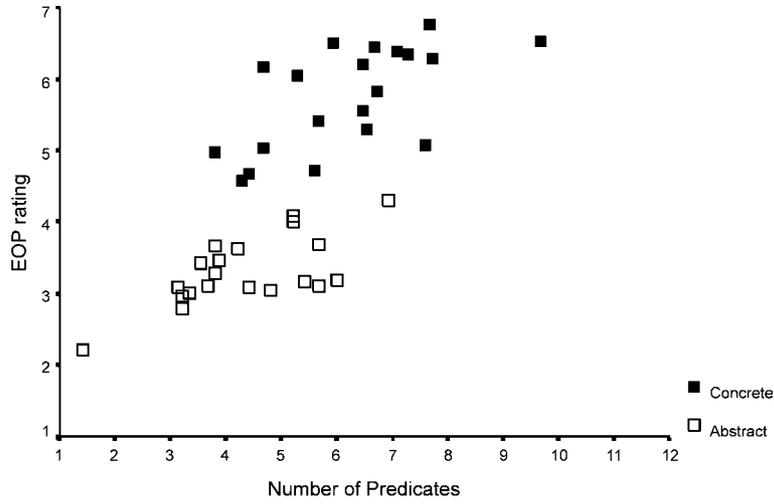
Fig. 2. Ease of predication ratings (de Mornay Davies & Funnell, 2000) vs. number of predicates generated.
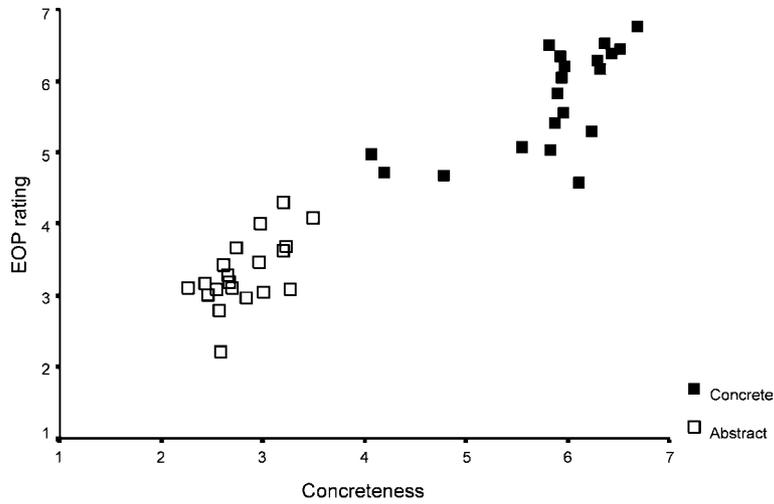

Fig. 3. Ease of predication ratings (de Mornay Davies & Funnell, 2000) vs. concreteness.
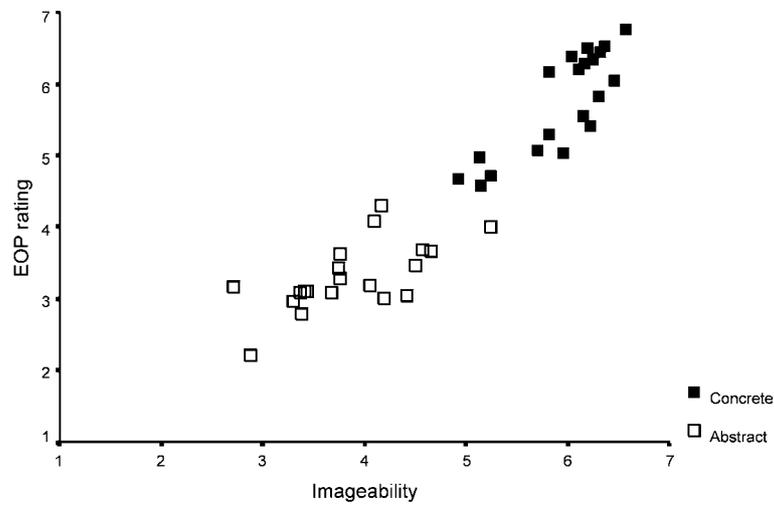

Fig. 4. Ease of predication ratings (de Mornay Davies & Funnell, 2000) vs. imageability.

concreteness rating scale (mean concreteness rating for concrete words = 5.98, range 6.17–5.81; for abstract words = 2.90, range 3.15–2.43). Our new set of 40 words, referred to above, represented a continuum of concreteness from high to low (mean concreteness rating for concrete words = 5.83, range 4.06–6.68; for abstract words = 2.82, range 2.26–3.98). We collected EoP ratings for these words using the instructions from Jones (1985). Fig. 2 shows that when the number of predicates generated by these words is plotted against ratings for EoP, there is again a significant correlation ($r = .75$, $p < .01$). However, apart from a few abstract words, to which very low numbers of predicates were generated, and a few concrete words for which very high numbers of predicates were generated, most estimates of the number of predicates generated do not distinguish between concrete and abstract words. Nevertheless, EoP ratings separate concrete and abstract words into distinct populations along the EoP axis. Again, it appears that variations in EoP relate to a variable other than the number of generated predicates.

While the number of predicates generated failed to separate concrete and abstract words into the two word groups distinguished by EoP ratings, variations across ratings of concreteness (Fig. 3) and imageability (Fig. 4) did distinguish between these groups. Thus, our findings suggest that EoP ratings reflect differences in imageability and concreteness, rather than the reverse. Our investigations thus refuted the proposal by Jones (1985) that variations in EoP can account for both the variation in imageability found across words, and for the effect of imageability on the reading pattern found in deep dyslexia.

We have shown unequivocally that variations in EoP reflect variations in imageability and concreteness, rather than differences in the number of predicates that words generate. We regret the failure of Jones (2002) to comment on these findings. In our view, Jones' (2002) conclusion that contrary to de Mornay Davies and Funnell (2000) "... a word's predicability provides both a reliable and a valid semantic substrate for imageability" (p. 165), completely disregards the empirical findings of our paper.

3. Specific criticisms of our paper

3.1. Textual content

Jones (2002) claims that we have misquoted Jones (1985), and by so doing have misrepresented the concept of 'ease of predication.' He further states that our "purported definition links together features and predicates" (p. 161). One of these criticisms is true: we have misquoted him by mistakenly inserting the word 'summons' into a quotation from Jones (1985). Our reference

to Jones' description of ease of predication states that he wrote "This is the ease with which any particular word "summons" the element representing [it] in semantic memory [which] is associated with a number of features, or, more fully, predicates" (1985, p. 2). Jones (2002) points out that he actually wrote, "... the element representing a word in semantic memory is associated with a number of features or, more fully, predicates."

Our inclusion of the word 'summons' in the quotation is regrettable, but we do not agree that inclusion of this word has misrepresented the EoP hypothesis as Jones (2002) claims. He argues that "Ease of predication does not refer to the ease with which a word summons the element representing it in semantic memory. Rather, it refers to the ease with which associated predicates can be activated" (p. 161). He denies that he used the word 'summons' anywhere in his paper. However, this turns out not to be true, for the word appears in the abstract, to quote: "... the effects of imageability ... occur as a result of variation in the ease with which individual words summon semantic predicates" (p. 1). It also appears twice on p. 3, first to explain that words access the cognitive system "... by attempting to summon one or more matching predicates," and again a little further on to explain that "... it is the ease with which predicates of the stimulus word can be summoned which is the determinant of its likelihood of being read correctly." Our misquotation therefore captures very accurately the meaning Jones (1985) assigns to the concept of ease of predication elsewhere in the paper.

Apart from the introduction of the word 'summons' (and the bracketed word substitutions), our quotation is identical to that of Jones (1985). Thus we do not agree with Jones' further claim that, in our misquotation, we erroneously link together features and predicates, since our reference to 'a number of features, or more fully, predicates' is a direct quotation from his paper.

Jones (2002) also criticises us for attributing other words to him that did not appear in Jones (1985). These words, 'richer,' 'select,' 'narrow down,' 'neighbours,' and 'ease of predication effect' appeared in double quotation marks in our paper (which must be why Jones interpreted these as quotations from his work, although such usage is commonplace). Most of the words that Jones has highlighted appear in general discussions of theory, rather than being direct references to his statements. Thus, we suggest that words with more predicates might produce more errors, because of the need to 'select' one word from many other possibilities; that visual errors in reading are likely to occur to abstract words because they have fewer semantic 'neighbours'; and that the EoP hypothesis proposes that semantic errors in reading occur when the predicates 'narrow down' the semantic field, rather than providing a precise specification. We do state that because Jones' ease of predication measure is argued to reflect differences in the number of predi-

cates assigned to concrete and abstract words that the semantic representation of a concrete word will be 'richer' than that of an abstract word. This seems a reasonable assumption and one shared by others. For example, Plaut and Shallice (1993) also use the term "richer" to refer to Jones' theory: "Following Jones (1985) and others, we develop a semantic representation in which concrete words have "richer" representations, in terms of number of active features, than do abstract words" (p. 398). We also state that Jones argues that imageability effects are really an 'ease of predication effect,' but this is the main point of his paper and hardly misrepresents his case. Thus we cannot agree with Jones (2002) that our account of his theory "cannot be relied on" (p. 161).

3.2. Reliability of predicability

Jones argues that we have ignored the fact that we found a high degree of (statistical) reliability with which ratings of ease of predication, on a subset of the Jones (1985) word set, produce closely similar results across both Jones' and our study. In support of this he refers to a statement that we make in the discussion section claiming that ease of predication is an unreliable measure. But he fails to note that immediately following our report of the very high correlation ($r = .97$, $p < .01$) between EoP ratings collected by Jones (1985) and ourselves on the Jones word subset, we reported that different levels of statistical reliability were obtained for the concrete and abstract words within the set (de Mornay Davies & Funnell, 2000, p. 109). While the concrete words produced a statistically significant correlation ($r = .69$, $p < .05$) between EoP ratings across Jones' experiment and our own, the abstract words within the set failed to do so ($r = .36$, $p > .05$). On the basis of this finding we argued that EoP ratings are not a reliable index of imageability, since the reliability of the ratings differed with variations in concreteness of the to-be-rated words. We went on to show that while Jones' EoP ratings for our subset of words correlated highly with imageability ratings for the word set overall ($r = .87$, $p < .01$), neither the concrete words, nor the abstract words within the set correlated significantly with variations in imageability ($r = .02$, $r = .07$, respectively, $p > .05$ in both cases). Thus, we repeat the conclusion reached by de Mornay Davies and Funnell (2000): EoP "... does not accurately reflect predicate distributions or differences in imageability" (p. 92).

3.3. Generation of predicates

Jones (2002) points out that we queried whether Jones' (1985) EoP ratings of the ease with which predicates can be produced actually reflect this when measured directly. We did query this, quite reasonably, since

he had not included the generation of predicates in his 1985 study. We are criticised however for not knowing that Jones (1988) collected measures of the *time* it took subjects to produce two predicates to each word and went on to show that measures of the time taken correlated highly with EoP ratings. We admit the oversight. However, our paper does not suggest, as Jones (2002) states, "... that ease of predication ratings do not map onto the actual generation of predicates" (p. 162), since we ourselves showed that they do. We simply stated (as Jones, 2002, points out) that Jones (1985) provided "... no indication that Jones' ease of prediction ratings map onto the actual predicates of words" (de Mornay Davies & Funnell, 2000, p. 162).

3.4. Semantic features

Jones (1985) states that "... a word in semantic memory is associated with a number of features or, more fully, predicates" (p. 2). As Jones (2002) points out, we have assumed in our paper that by this he means "predicates and features are one and the same" (de Mornay Davies & Funnell, 2000, p. 99). His statement left us with little choice, since his use of the words 'more fully' suggested to us that he viewed semantic features as subsumed within predicates. We did not criticise him for this: our problem was in understanding what Jones considered to be the difference (if any) between predicates and features, since others (such as Barry, 1984, whose theory we were contrasting) have distinguished between the two. Jones (2002) argues that the statement that 'features or more fully, predicates' by Jones (1985) indicates that he considered "... the term 'predicate' as more theoretically precise than the word feature" (p. 163) and that, as a result he did not mention features further in the paper. But this does not clarify the issue of to what extent, in his view, the concepts of features and predicates differ.

Jones (2002, p. 163) argues that the relationship between semantic features and predicates cannot be investigated empirically in the way attempted by de Mornay Davies and Funnell (2000). He suggests that "... the appropriate procedure was to examine the relation (between predicates and semantic features) to the present predicational approach of specific rather than generic theoretical characterizations of semantic features" (we have added the words in parenthesis). He gives as examples two possible interpretations of a semantic feature, one by Jackendoff, the other by Hinton, Plaut, and Shallice (1993). He states that Jackendoff (1983) views semantic features as semantic primitives (although it is worth noting, as we point out in our paper, that Jackendoff (1992) argues that concepts cannot be broken down into conceptual primitives on the basis of their features). In contrast, the view of Hinton et al. (1993) accords more closely with his own.

But it is not explained how these two interpretations of semantic features might be used to generate an alternative method of investigation to the empirical method that we chose to use.

Jones (1988) argues that the method of predicate and feature generation we chose is a "relatively insensitive procedure" (p. 92). Nevertheless, this procedure is now widely used and is generally viewed as a valid means of acquiring 'property norm' data for building connectionist models (e.g., Devlin, Gonnerman, Andersen, & Seidenberg, 1998; Tyler, Moss, Durrant-Peatfield, & Levy, 2000).

3.5. Memory retrieval

Jones (2002) finds further support for the role of EoP from a study by Jones (1988), which showed that "... the efficacy of a word as a retrieval cue is dependant upon its predicability" (p. 164). He argues from this that EoP again provides an alternative explanation to variations in imageability or concreteness. However, the relationship under discussion is correlational rather than causal, so it cannot be concluded that retrieval 'depends' upon ease of predication. Further investigations are required. In addition, Jones (2002) cites a paper by Williams, Healy, and Ellis (1999) investigating the role of imageability in autobiographical memory, in which the authors reported that ratings of ease of predication (which they refer to as predicability) and predication time for cue words correlated very highly with imageability. According to Jones (2002) "... the two predicational measures tended to predict memory performance better than did the imagery measure" (p. 164). However, this is not the conclusion reached by Williams et al. They attempted to separate the effects of imageability and predicability, and their results suggested that "... visual imageability was the more significant predictor in autobiographical memory when pitted against predicability" (pp. 573–574). Later in the same section, they wrote "In other words, imageability emerges as the more powerful predictor, and without it, even relatively highly predicable cues are weakened significantly" (p. 574).

4. Conclusions

In our view, *none* of the points raised by Jones (2002) concerning our presentation of Jones (1985) justify his claim that our criticisms are fundamentally flawed. The specific points raised, that we have addressed above, focus on small details of the text, and in each case we have shown either that the point made is mistaken, or that it does not make a critical point. More importantly, none of the criticisms raised are directed towards the empirical sections of our paper, which show quite clearly that EoP varies with differences in imageability and concreteness rather than with the number of predicates associated with a concept. We therefore vigorously reject the claim made by Jones (2002, p. 159) that ease of predication "... continues to identify correctly the semantic substrate of apparent effects of imageability." Our data and those of Williams et al. (1999) support the view that effects of imageability and concreteness on performance in cognitive tasks cannot be explained by ease of predication.

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