Hemispheric Asymmetries in Handwritten Word Recognition

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Background:

Although the LH tends to be dominant for most linguistic processes, Lindell (2006) noted that the RH does evince a number of special linguistic capabilities including:

- Generation of non-propositional speech.
- Perception & production of prosody.
- Strong sensitivity to word class (imageability/concreteness)

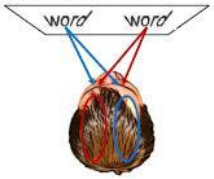
The RH's contributions become apparent under conditions that are typically not present in the laboratory. Manifesting under conditions of:

- **Visual ambiguity.**
- **Orthographic ambiguity.**
- **Semantic ambiguity.**

Lateralized Visual Half-Field Presentation Method

(Franz, 1933)

- Participants fixate on center of screen.
- Stimulus is presented in the periphery (too briefly for saccade).



Visual Ambiguity Resolution in the Brain

Marsolek's (2004) Visual Subsystems Hypothesis

LH houses "Abstract Visual Form Subsystem" (Deason & Marsolek, 2005; Marsolek, 1995).

- Generates common responses to variant inputs
- Detrimental effect of distance from prototype

RH houses "Specific Visual Form Subsystem" (Marsolek, 2004; Marsolek, Kosslyn, & Squire, 1992)

- Generates different outputs for each instance of a word form

Orthographic Ambiguity Resolution

The RH demonstrates an increased reliance on top-down, word level knowledge.

- Increased orthographic neighborhood density effects in the RH (Lavidor & Ellis, 2001; Perea, Acha, & Fraga, 2008).

Semantic Ambiguity Resolution

RH shows prolonged, diffuse activation of semantic neighborhoods, while LH quickly narrows activation to only dominant meanings (Burgess & Simpson, 1988).

Abstract

Despite the amount of convergent evidence suggesting that the brain's right hemisphere (RH) may have capabilities that make it especially adept at recognizing handwritten words in strongly right-handed individuals, only one study has looked specifically at the topic (Hellige & Adamson, 2007), and its findings were equivocal as it employed only three-letter nonwords. Research has shown that the RH relies more heavily on top-down information for recognition of words than does the left hemisphere (LH). In addition, the RH seems to be equipped with a visual subsystem that allows it to deal more efficiently with novel word forms. In two lexical decision tasks using the traditional lateralized visual half-field presentation methodology, we examined whether the RH exhibits benefits in handwritten word recognition relative to the LH and whether these benefits may be due to differences in accessing top-down information. Experiment 1 studied word frequency effects for laterally-presented printed and cursive words, finding that frequency effects (in error rates) were magnified for printed words in the RH and cursive words in the LH. Experiment 2 employed a primed lexical decision task to study differences in meaning selection between the hemispheres. Although the LH evinced greater priming overall, a complex interaction occurred for cursive words wherein the RH showed a strong sensitivity to meaning dominance and SOA.

Support provided by NIDCD Grant #DC04535. References provided on accompanying handout.

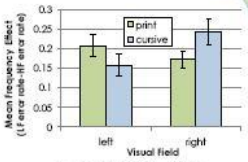
Experiment 1: Word Frequency

Few studies have observed a Visual Field X Frequency interaction (Coney, 2005), but handwriting may elicit the effect.

- Manso De Zuniga, Humphreys, & Evett (1991) and Barnhart & Goldinger (submitted) both observed magnified frequency effects for centrally-presented handwritten words.
- Presence of specific visual form subsystem in RH.
- Increased access to top-down word-level information in RH.

Results

- Counter to prediction, error rates revealed a reliable VF X Script X Frequency interaction, with reduced frequency effect for cursive words in the RH.
- Increased top-down activity in RH could impede lexical decision.



Visual Field $F(1, 29) = 17.17^{***}$
Script $F(1, 29) = 88.76^{***}$
Frequency $F(1, 29) = 195.94^{***}$
VF X Script X Freq. $F(1, 29) = 6.64^{*}$

Method

A reduced stimulus set from Coney (2005) was generated in printed and cursive forms.

- 256 five-letter words (half high-frequency, half low-frequency), balanced for imagery and concreteness.

Standard lateralized visual half-field lexical decision methodology with response method adopted from Hellige & Sergent (1986).

Experiment 2: Semantic Priming

The hemispheres show different activation patterns during meaning selection (Atchley, Burgess, & Keeney, 1999; Burgess & Simpson, 1988; Peleg & Eviatar, 2008).

- LH: *controlled* activation. Shows diffuse activation of neighborhood initially, but quickly narrows to only dominant neighbors.
- RH: *passive* spread of activation. Slower build-up, but prolonged, diffuse neighborhood activation.

Method

Primed lexical decision task with laterally-presented targets & varied SOA.

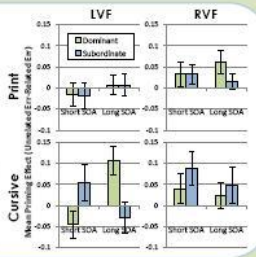
Target stimuli from Hasbrooke & Chiarello (1998) generated in print and cursive.

- Primes: 216 homograph
- Targets: Two per prime (one related to dominant meaning, one to subordinate). Targets matched for frequency and length.

Results

- Greater overall priming in RVF.
- Greater priming for dominant targets at long SOAs, subordinate targets at short SOAs.
- SOA X VF X Script X Dominance

Printed items elicited similar priming patterns across hemispheres, but priming for cursive words was strongly dependent on word class and time course of lexical access.



Visual Field $F(1, 46) = 4.99^{*}$
SOA X Dominance $F(1, 46) = 5.24^{*}$
SOA X VF X Script X Dominance $F(1, 46) = 4.64^{*}$

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