

# Influence of handedness and bilateral eye dominance on ceiling

Elizabeth R. Shobe<sup>a,\*</sup>, Nicholas M. Ro<sup>b</sup>, Jessica I. Fleck<sup>a</sup>

<sup>a</sup>The Richard Stockton College of New Jersey, Pomona, New Jersey, United States

<sup>b</sup>Rutgers University, New Brunswick, New Jersey, United States

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## ARTICLE INFO

### Article history:

Accepted 27 August 2009

Available online 2 October 2009

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### Keywords:

Handedness

Ceiling

Eye dominance

Lateral

Hemisphere

Alphabet

Diagnosing

Bain

Cognition

Bilateral

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## ABSTRACT

We investigated the effects of increased in-eye hemispheric action (IHI) on ceiling dimensions (aerobic energy, deaerobic, caloric, diener, and originality) of the Alphabet Test. To measure eye dominance, we used a degree of IHI. The IHI also indicated bilateral differences in handedness, mixed-handedness, and right-handedness. Since IHI also demonstrated lateral bias (control) and bilateral eye dominance of a 30-degree eye dominance (EM). Results indicate significant higher ceiling for mixed-handedness, compared to right-handedness, for all

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For example, Chikman (2001) observed handedness, a more mixed-handed population than right-handedness (Biden & Seeholzer, 1991; Chikman, 1995; Hellige, 1993), exhibited gender-specific differences in the frequency and gender local/global in frequency, which are in the expected direction of interaction between LH-handed and local/local occurrence and RH-handed chromosomal/global occurrence. Furthermore, Pore, Chikman, and Phang (2005) observed an advantage for mixed-handedness over right-handedness on the dichotic listening task, consistent with the biological explanation of enhanced dichotic listening memory tasks (Platel, Baron, Degangue, Benard, & Escalache, 2003; Tilling, Kaur, Chak, Mochizuki, & Helle, 1994). Mixed-handedness also has an advantage over right-handedness for the memory task, but not for the dichotic listening task (e.g., face recognition) (Lyle, McCabe, & Roediger, 2008). While cerebral lateralization and degree of handedness have not been directly studied (although there are some direct studies that have examined the relationship of handedness and cerebral lateralization), mixed-handedness has been associated with the gender magical ideation (Bane & Collin, 2002), and a task that has a high incidence of right-handedness and mixed-handedness (Pee & Vellane, 2007). Furthermore, mixed-handedness gene is a novel gene ending in a CAG repeat (i.e., a non-coding region) that is associated with right-handedness (Jaffe, Bane, & Chikman, 2008), and the functional copy of both hemispheres is associated with the non-coding region (Gomez-Beldarrain,

Edinburgh Handedness Inventory (EHI) of the Edinburgh Handedness Inventory, the mean  $M = 77.5$  and  $SD = 10.5$ . Because the EHI is a continuous measure of handedness, a score of 80 and higher indicates right-handed and a score of 75 and lower indicates left-handed. The mean score of 30 indicates mixed-handed and 32 indicates left-handed (only left-handed score = -100).

## 2.2. Materials/apparatus

An adaptation of the Alena and Ullrich Test (Chamois-Premic, 2006) was used to measure ceiling. This adaptation consisted of 20 common items (e.g. pencil, hoe, football, etc. (Arendt & A)). We used 15 items from the original Alena and Ullrich Test (Chamois-Premic et al., 1960) and 5 items from a common word bank (Snodgrass & Vander Lely, 1980). Each item was presented on a card of an  $8.5'' \times 11''$  size of high contrast, printed in 16-point Times New Roman font. The common items were arranged in a horizontal line on each item. Pictures included in the items included in a booklet suitable for age had been included in the 16-point Times New Roman font. Pictures included in the remaining 15 items included in the adaptation booklet, also suitable for age containing the included items. To avoid an order effect, the items were randomized by age and gender, and items were randomized in each.

Results on the Alena and Ullrich Test were coded on the difference between scores: (a)  $M = 10$ , indicating the total number of items included in the adaptation of 'all' or 'almost all'; (b) original items, indicating the number of items included by 0-5% of all participants (3 items), 6-10% (2 items) or 11-15% (1 item) of all participants in the sample; (c) amount of detailed elaboration provided for each item (on a 0-5 scale); (d) reliability of the items

ceae ad an age, and hehe ceae i a diffeniall affec ed e-and q mani la ion, he e e b̄ co e of he Al e na e U e T̄ enc , de ail, o iginali , ca ego ical d̄i inc i enḡ and a o ia enḡ), e e e b̄mi ed o a 2 (Condi ion: con ol, bila e al EM) × 2 (Handedne : mi ed, e ong) × (2)(T̄ : e, q )mi ed fac o ial MANOVA. M l i a ia e e e e ealed a igni can main effec fo Handedne (Will' Λ = .779, F(5, 54) = 3.06, p = .017, (η² = .221) and T̄ (Will' Λ = .735, F(5, 54) = 3.89, p = .004, (η² = .265) hen he de enden a iabl̄ a e linea l combined ac q̄ all ial. No main effec fo Condi ion (Will' Λ = .959, F < 1), o in e ac ion of Handedne × T̄ (Will' Λ = .907, F < 1), Handedne × Condi ion (Will' Λ = .978, F < 1), T̄ × Condi ion (Will' Λ = .947, F < 1), o Handedne × Condi ion × T̄ (Will' Λ = .927, F < 1) e e o b̄ e ed fo he linea l combined e b̄ co e. Uni a ia e ANOVA al o ealed no igni can diffe enc̄ fo T̄ fo he e e b̄ co e, e gḡ ing ha he main effec in he m l i a ia e e e of e e. q - e o b̄ e ed o be an o e all ac ice effec ha i no e e ci c o an of he indi id al e b̄ co e.

### 3.3. Handedness findings for individual sub-scores of the Alternate Uses Test (post circle task)

The anal e e e en ed in h̄ e ec ion a e b̄ ed on a i c i an e ' e o n̄ e o e all 15 ial of he Al e na e U e T̄ k fo each e b̄ co e. Uni a ia e e e indica e ha mi ed-hande e ho ed g ea e enc (M = 3.09, SE = .19) han̄ ong-hande (M = 2.44, SE = .18), F(1, 58) = 6.15, p = .016, (η² = .096); mi ed-hande (M = 2.45, SE = .142) ho ed g ea e ca ego ical d̄i inc i enḡ in hei an̄ e e han̄ ong-hande (M = 1.67, SE = .13), F(1, 58) = 15.576, p < .001, (η² = .21); mi ed-hande (M = 2.70, SE = .16) had mo e a o ia e e o n̄ e han̄ ong-hande (M = 1.84, SE = .15), F(1, 58) = 14.40, p < .001, (η² = .20); and mi ed-hande (M = 3.35, SE = .28) ho ed mo e o iginali han̄ ong-hande (M = 1.84, SE = .27), F(1, 58) = 13.80, p < .001, (η² = .19). Mi ed-hande (M = 2.5, SE = .13) e e ma ginall highe han̄ ong-hande (M = 2.1, SE = .18) on he de ail e b̄ co e, F(1, 58) = 3.64, p = .06, (η² = .06). The e e l e o he h o h̄ i ha mi ed-handed indi id al o ld demon a e inc e a ed ceae i i on h̄ e indi id al e co e han̄ ong-hande.

Addi onall , a priori e e e gḡ ha he highe ceae i i of mi ed-hande com a ed o e ong-hande a d i en̄ olel b̄ diffe enc̄ in he con ol go , b̄ no he bila e al EM go . Com a i o n̄ be een mi ed and e ong hande in he con ol go (no bila e al EM) e ealed diffe enc̄ on all e e b̄ co e of ceae i i enc , F(1, 28) = 4.2, p = .05, η² = .13 (M<sub>mi ed</sub> = 3.05, SE = .24; M<sub>ong</sub> = 2.3, SE = .26); de ail, F(1, 28) = 5.4, p = .03, η² = .16 (M<sub>mi ed</sub> = 2.54, SE = .17; M<sub>ong</sub> = 1.95, SE = .18); o iginali , F(1, 28) = 9.14, p = .005, η² = .25 (M<sub>mi ed</sub> = 3.06, SE = .39; M<sub>ong</sub> = 1.03, SE = .42); ca ego ical d̄i inc i enḡ , F(1, 28) = 9.46, p = .005, η² = .25 (M<sub>mi ed</sub> = 2.4, SE = .20; M<sub>ong</sub> = 1.5, SE = .21); and a o ia enḡ , F(1, 28) = 9.5, p = .005, η² = .25 (M<sub>mi ed</sub> = 2.75, SE = .22; M<sub>ong</sub> = 1.75, SE = .23).

The e diffe enc̄ be een e ong and mi ed-hande d̄i a e ead fo he bila e al EM go fo enc (F < 1), de ail (F < 1), o iginali [F(1, 30) = 2.06, p = .16], ca ego ical d̄i inc i enḡ [F(1, 30) = 3.08, p = .09], and a o ia enḡ [F(1, 30) = 2.6, p = .11].

for categorical dependent variable,  $F(1, 30) = 4.71, p = .04, \eta^2 = .14$  ( $M_{bilateralEM} = 2.22, SE = .20; M_{control} = 1.56, SE = .23$ ). No condition difference was observed for each trial of mixed-handing ( $F < 1$ ), lateralized mixed-handing ( $F < 1$ ), or lateralized mixed-handing ( $F \leq 1$ ).

Taken together, these results suggest that the bilateral EM manipulation affected original and categorical dependent variable scores of mixed-handing differently, but this effect did not differ by lateralization. Additionally, the longer EM effect held for mixed-handing in older age groups. To analyze this, a one-way ANOVA was conducted on the mean lateralized increment (Trial 1-3, Trial 4-6, Trial 7-9, Trial 10

ion. However, for the categorical dependent variable, only Trial 13 (e o ed abo e) reached significance, and Trial 46 (e e ma ginall igni can,  $F(1, 30) = 3.6, p = .06$ ). Trial 79 [ $F(1, 30) = 2.4, p = .13$ ], 10-12 [ $F(1, 30) = 2.5, p = .11$ ], and 13-15 ("la e ial, e o ed abo e) e e no igni can (see Fig. 3). This suggests that the effect of bilateral EM on originality of song-handers may last 9 min before it disappears. But, the effect of bilateral EM on categorical dependent variables lasted 3 min and may be 6 min (see Fig. 2 and 3, and Table 2).

While significant differences between control and bilateral EM conditions of song-handers were only observed for originality (total 6.9) and categorical dependent variables (total 3) scores, additional analyses revealed general downward linear trends in the bilateral EM condition across the verbal increment for a total of  $F(1, 17) = 8.03, p = .01$ , originality,  $F(1, 17) = 8.2, p = .008$ , and categorical dependent variables,  $F(1, 3$





the e bal LH i he ca e of bila e al ac i i . In addi ion o he bila e al a e p of ac i i e o ed b Folle and Pa k (2005) ho iñ ed ic e im li and allo ed fo a ial mani la ion of hq e ic e befo e gi ing a e bal e on e, a io c ea i i a k ha e been a ocia ed i h ac i i in LH fon al and em e o- a ie al c e in ol ed in a ial e ce ion of objec (J ng-Beeman e al., 2004



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