Language Lateralisation in People Who Stutter across Different Speech & Language Tasks

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Purpose:

To investigate the incomplete cerebral dominance theory in stuttering, which suggests altered patterns of hemispheric specialisation and competition between hemispheres for "dominance" over handedness and speech (Orton, 1927). Here, we revisited this theory using functional MRI data obtained in children and adults who stutter across different language tasks.

Background:

Brain imaging findings in people who stutter of increased activity in the right hemisphere during speech production (Brown et al., 2005) or of shifts in activity from right to left when fluency is increased (de Nil et al., 2003) led to renewed interest in these ideas (Sato et al., 2011).

Participants:

56 people who stutter (PWS) (10 female and 45 male, 7 left handed, Mage = 28 years, SDage = 9 years) and **53 typically fluent speakers (TFS)** (13 female and 40 male, 2 left handed, Mage = 28 years, SDage = 10 years). Chi-squared analysis showed that the groups did not differ in terms of handedness ($\chi 2 = 2.83$, $p < 0.09$).

Contingency Tables

Handedness	Group PWS	TFS	Total
L	7	2	9
R	48	51	99
Total	55	53	108

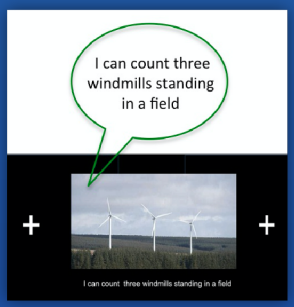
Chi-Squared Tests

	Value	df	p
X^2	2.833	1	0.092
N	108		

Methods and Tasks:

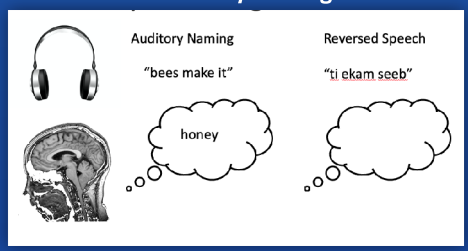
Laterality indices (LIs) were calculated for the frontal lobes from the fMRI data using the LI toolbox (Wilke & Lidzba, 2007) running in Statistical Parametric Mapping where positive values indicate left - and negative ones right - lateralisation and values between $-0.2 \leq LI \leq 0.2$ indicates bilateral representation. We analysed LIs in 3 different language tasks performed by different subgroups.

Overt Sentence Reading Task



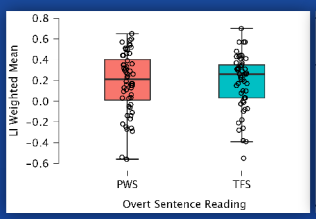
Overt Picture Description Task

Covert Auditory Naming Task



Results - Overt Sentence Reading Task:

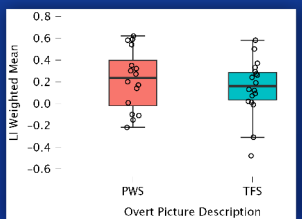
The average LI in PWS was 0.18 (SD = 0.29) and in TFS it was 0.18 (SD = 0.26). A Bayesian independent samples t-test (two-sided) revealed a Bayes factor of 4.922 indicating moderate evidence in support of the null hypothesis (LIs are similar between PWS and TFS) rather than the alternative hypothesis. Chi-squared statistics confirmed that the number of individuals in each group who showed the typical pattern of leftwards laterality compared with atypical (right or bilateral LIs) did not differ (PWS 28 typical, 28 atypical; TFS 31 and 22; $\chi 2 = 0.79$, $p < 0.37$).



Group		Left vs Non-Left: Left	Non-Left	Total
PWS	Count	28.000	28.000	56.000
	% within column	47.458 %	56.000 %	51.376 %
TFS	Count	31.000	22.000	53.000
	% within column	52.542 %	44.000 %	48.624 %
Total	Count	59.000	50.000	109.000
	% within column	100.000 %	100.000 %	100.000 %

Results - Overt Picture Description Task:

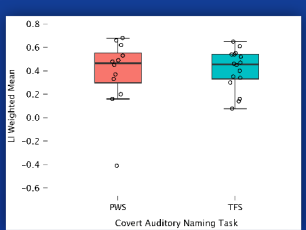
The group mean LI in PWS was 0.21 (SD = 0.27) and in TFS 0.14 (SD = 0.25). A Bayesian independent samples t-test revealed a Bayes factor of 2.416, indicating anecdotal evidence supporting the null hypothesis. Chi-squared analysis verified that the groups did not differ regarding the number of typically or atypically lateralised individuals (PWS 9 and 7; TFS 8 and 10; $\chi 2 = 0.47$, $p < 0.49$).



Group		Left vs Non-Left: Left	Non-Left	Total
PWS	Count	9.000	7.000	16.000
	% within row	56.250 %	43.750 %	100.000 %
TFS	Count	8.000	10.000	18.000
	% within row	44.444 %	55.556 %	100.000 %
Total	Count	17.000	17.000	34.000
	% within row	50.000 %	50.000 %	100.000 %

Results - Covert Auditory Naming Task:

The group mean LI in PWS was 0.38 (SD = 0.29) and in TFS 0.41 (SD = 0.17). A Bayesian independent samples t-test revealed a Bayes factor of 2.695, indicating anecdotal evidence in support of the null hypothesis (no group difference). Chi-squared analysis also confirmed that the groups did not differ in terms of the number of typically or atypically lateralised individuals (PWS 9 and 3; TFS 13 and 3; $\chi 2 = 0.15$, $p < 0.69$).



Group		Left vs Non-Left: Left	Non-Left	Total
PWS	Count	9.000	3.000	12.000
	% within row	75.000 %	25.000 %	100.000 %
TFS	Count	13.000	3.000	16.000
	% within row	81.250 %	18.750 %	100.000 %
Total	Count	22.000	6.000	28.000
	% within row	78.571 %	21.429 %	100.000 %

Conclusions:

1) Our analyses find no support for the theory that laterality is reduced or differs in PWS compared with TFS.
2) The sentence reading and the picture description tasks are not strongly left lateralised, whereas the auditory naming task is more robust in this respect. Therefore, task choice plays an essential role for assessing language laterality.

References

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Sato, Y., Mori, K., Koizumi, T., Minagawa-Kawai, Y., Tanaka, A., Ozawa, E., Wakaba, Y., & Mazuka, R. (2011). Frontiers in Psychology, 2, 70.
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