



HAL
open science

Interpreting spatial dysgraphia after stroke: straight-ahead of straight above

Caroline Jolly, Céline Piscicelli, Laure Mathévon, Claire Berenger, Dominic A.
Perennou

► To cite this version:

Caroline Jolly, Céline Piscicelli, Laure Mathévon, Claire Berenger, Dominic A. Perennou. Interpreting spatial dysgraphia after stroke: straight-ahead of straight above. 10th World Congress for Neurorehabilitation, Feb 2018, Mumbai, India. hal-02408935

HAL Id: hal-02408935

<https://hal.univ-grenoble-alpes.fr/hal-02408935v1>

Submitted on 24 Dec 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Introduction

Spatial dysgraphia, frequently observed after a right hemisphere stroke (1), associates signs of spatial compression in relation to spatial neglect, and a tilted writing which remains to be explained. Here we present a case study showing that tilted writing is due to a tilted representation of the vertical.

Materials and Methods

Case presentation

JW was a 75 year-old male, right-handed, who underwent a hemorrhagic right hemisphere stroke causing a total left hemiplegia with pronounced hemianesthesia, left hemianopsia and signs of unilateral spatial neglect (UNS). At entry, balance disorders were particularly severe, with a pusher syndrome. Stroke also induced a spatial dysgraphia characterized by a counterclockwise tilt of the writing lines (Fig. 1).

Handwriting evaluation

- **Tasks:** Copy of the 5 first lines of the BHK test, at M3 and M9, and after modulation of verticality representation (M3). Several types of cueing were tested: blank paper (reference condition) and spatially indexed paper (12° or 24° upwardly or downwardly sloping lines).
- **Parameters analysed:** inclination of each writing line in respect to Earth vertical (°) or to the cueing lines, inclination of the left-hand margin in respect to the Earth vertical, and the mean time to write a letter (sec).
- **Statistics:** comparison of JW's results with a peered healthy participant (JB).

Representation of the verticality

- Postural vertical (VP) [2]
- Visual vertical (VV) [3]
- Modulation: tilt for 10 minutes at 30° in the dark

UNS

Body and non-body UNS evaluation using a battery of well-known tests.

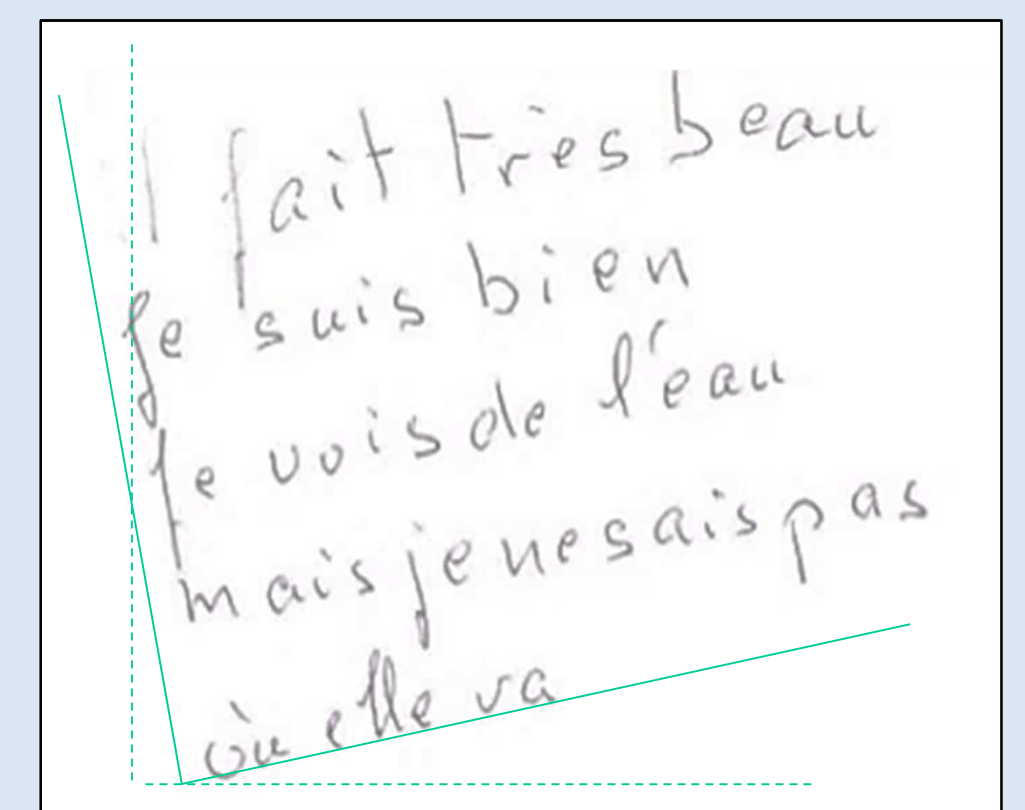


Figure 1. Sample of JW's handwriting at M3 on blank paper.

Results

	JB	JW-M3	JB vs. JW-M3	JW-M9	JB vs. JW-M9	JW-M3 vs. JW-M9
Blank paper			<i>p</i>		<i>p</i>	<i>p</i>
median (°)	-2.1	-9.4	0.008*	-8.8	0.008*	0.08
IQR (°)	1.2	4.6		1.4		
Lines down 24°			<i>p</i>		<i>p</i>	<i>p</i>
median (°)	-0.9	-10.2	0.008*	-8.2	0.008*	0.548
IQR (°)	2	5.7		3.5		
Lines down 12°			<i>p</i>		<i>p</i>	<i>p</i>
median (°)	-1	-3.5	0.008*	-4.4	0.008*	0.89
IQR (°)	1.7	3.9		1.9		
Lines up 12°			<i>p</i>		<i>p</i>	<i>p</i>
median (°)	0	-1.8	0.016	-0.6	0.016	0.08
IQR (°)	0.7	2.1		1		
Lines up 24°			<i>p</i>		<i>p</i>	<i>p</i>
median (°)	-1.1	-0.3	0.548	-1	0.222	0.04
IQR (°)	1.4	1.2		1.1		

Table 1. Inclination of JW's writing lines at M3 and M9 in the different conditions.

	JB	JW-M3	JB vs. JW-M3	JW-M9	JB vs. JW-M9	JW-M3 vs. JW-M9
Tilt of the left-hand margin			<i>p</i>		<i>p</i>	<i>p</i>
median (°)	-0.1	-9.4	0.008*	-8.5	0.008*	0.416
IQR (°)	2.2	4.6		1		
Angle between the margin and the writing lines			<i>p</i>		<i>p</i>	<i>p</i>
median (°)	92	90	0.102	91	0.129	1
IQR (°)	1	2		1		

Table 2. Tilt of JW's left-hand margin and writing orthogonality at M3 and M9 in the 'blank paper' condition.

	JB	JW-M3	JB vs. JW-M3	JW-M9	JB vs. JW-M9	JW-M3 vs. JW-M9
Blank paper			<i>p</i>		<i>p</i>	<i>p</i>
median (sec/lett)	0.9	1.7	0.008*	0.9	0.548	0.008*
IQR (sec/lett)	0.3	0.7		0.4		
Lines down 24°			<i>p</i>		<i>p</i>	<i>p</i>
median (sec/lett)	0.7	1.5	0.008*	0.8	0.151	0.008*
IQR (sec/lett)	0.2	0.2		0.3		
Lines down 12°			<i>p</i>		<i>p</i>	<i>p</i>
median (sec/lett)	0.7	1.4	0.008*	0.8	0.222	0.008*
IQR (sec/lett)	0.3	0.8		0.2		
Lines up 12°			<i>p</i>		<i>p</i>	<i>p</i>
median (sec/lett)	0.7	1.4	0.016	0.9	0.095	0.008*
IQR (sec/lett)	0.3	0.7		0.2		
Lines up 24°			<i>p</i>		<i>p</i>	<i>p</i>
median (sec/lett)	0.7	1.1	0.032	0.8	0.222	0.222
IQR (sec/lett)	0.3	0.5		0.4		

Table 3. JW's handwriting speed at M3 and M9 in the different conditions.

C	Before modulation	After modulation	<i>p</i>
Postural vertical			
mean (°)	-9.8	0.6	0.001*
SD (°)	3.6	3.7	
Writing lines inclination			<i>p</i>
median (°)	-9.4	-5.2	0.043*
IQR (°)	4.6	2.7	
Tilt of the left-hand margin			<i>p</i>
median (°)	-9.4	-3.2	0.008*
IQR (°)	4.6	4.4	
Angle b/w the margin and the writing lines			<i>p</i>
median (°)	90	92	0.279
IQR (°)	2	1	
Writing speed			<i>p</i>
median (sec/lett)	1.7	0.9	0.008*
IQR (sec/lett)	0.7	0.1	

Table 4. Spatial and temporal features of JW's handwriting after verticality normalization.

- **Inclination of handwriting** lines on blank paper and downward sloping lines, both at M3 and M9 (Tab.1)
- No significant line inclination on upwardly sloping lines (Tab.1)
- **Inclination of the left-hand margin** on blank paper at M3 and M9 and conservation of the orthogonality (Tab.2)
- **Writing speed slower than the healthy subject** at M3 but no longer at M9 (Tab.3)
- Signs of UNS at M3 but not M9 (not shown)
- Verticality representation: altered at M3 and M9 (not shown)
- Lines inclination, margin tilt and writing speed **clearly improved after PV normalization** (Tab.4)

Discussion and Conclusion

At 3 months, JW's handwriting was slow and presented an upward tilt and an increased left-hand margin due to a global tilt of his orthogonal scheme. The spatial features of his handwriting were maintained 9 months after stroke, while his writing speed was normalized. JW's handwriting inclination was neither related to spatial neglect nor to a rotated straight-ahead, but was clearly improved by a transient modulation of JW's verticality perception.

After stroke, a tilted handwriting may thus be due to a tilted representation of the vertical.

References

- [1] Pisella L, Mattingley JB. The contribution of spatial remapping impairments to unilateral visual neglect
- [2] Pérennou DA, Mazibrada G, Chauvineau V, et al. Lateropulsion, pushing and verticality perception in hemisphere stroke: a causal relationship? *Brain J Neurol.* 2008;131.
- [3] Piscicelli C, Barra J, Sibille B, Bourdillon C, Guerraz M, Pérennou DA. Maintaining Trunk and Head Upright Optimizes Visual Vertical Measurement After Stroke. *Neurorehabil Neural Repair.* 2016 Jan; 30: 9-18