

Explorative, perceptual and representational unilateral spatial neglect: guidelines and updated norms in the Italian population

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Background and Aim

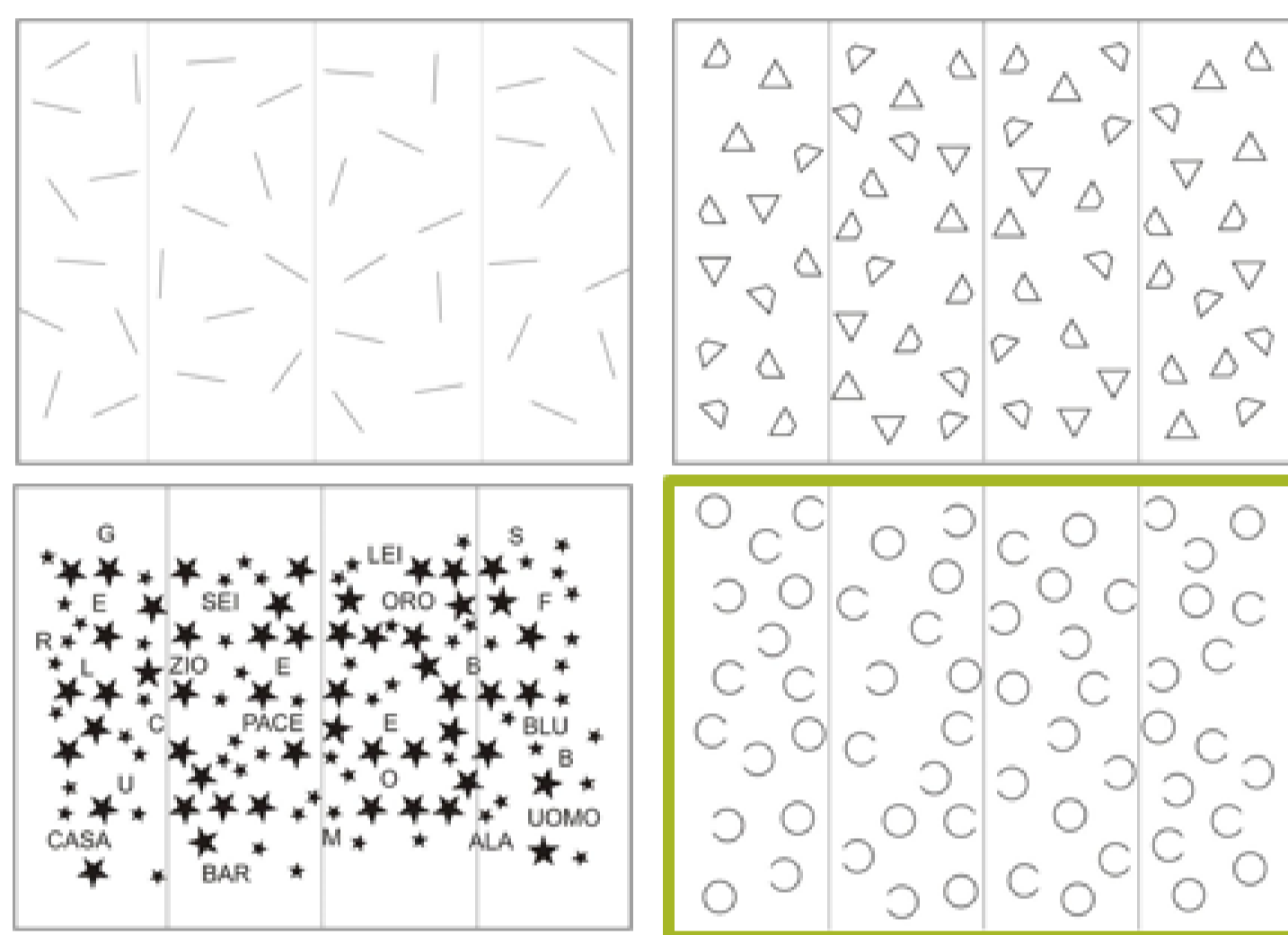
Many neuropsychological tests commonly employed in clinical practice for assessing unilateral spatial neglect (USN) lack of updated norms and standardized procedures (1). Thus, this study aims to provide **regression-based norms** and **equivalent scores** for the most widely used USN tests, considering a large subset of symptoms affecting negative and positive manifestations (e.g., **allocentric/egocentric asymmetries, perseverations, execution times, constructional apraxia**).

Given the heterogeneity of USN, it is unlikely that a single test can fully capture all its components. In line with literature (2), we propose a **minimal assessment battery** including: one *cancellation task* (assessing both egocentric and allocentric neglect), *line bisection*, a *copying task* (preferably with multiple components) and a *representational task*. We report the results of normative data for a subset of these tests.

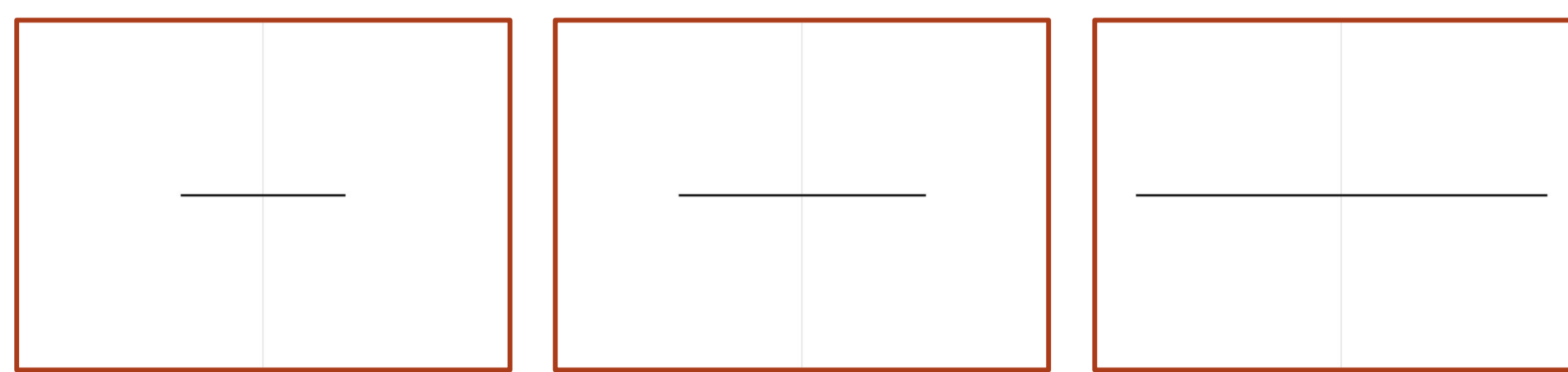
Methods and materials

- 270 healthy participants
- 139 females, 131 males;
- mean age: 60.57 ± 12.79 years, range 40–89;
- mean education: 11.58 ± 4.65 years, range 5–18

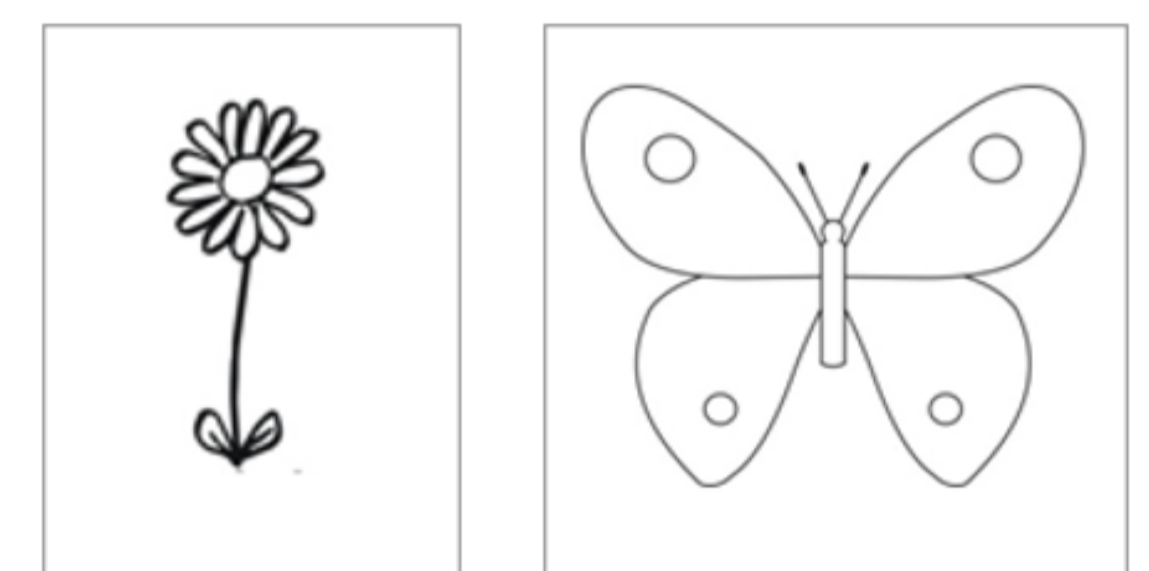
Cancellation tasks



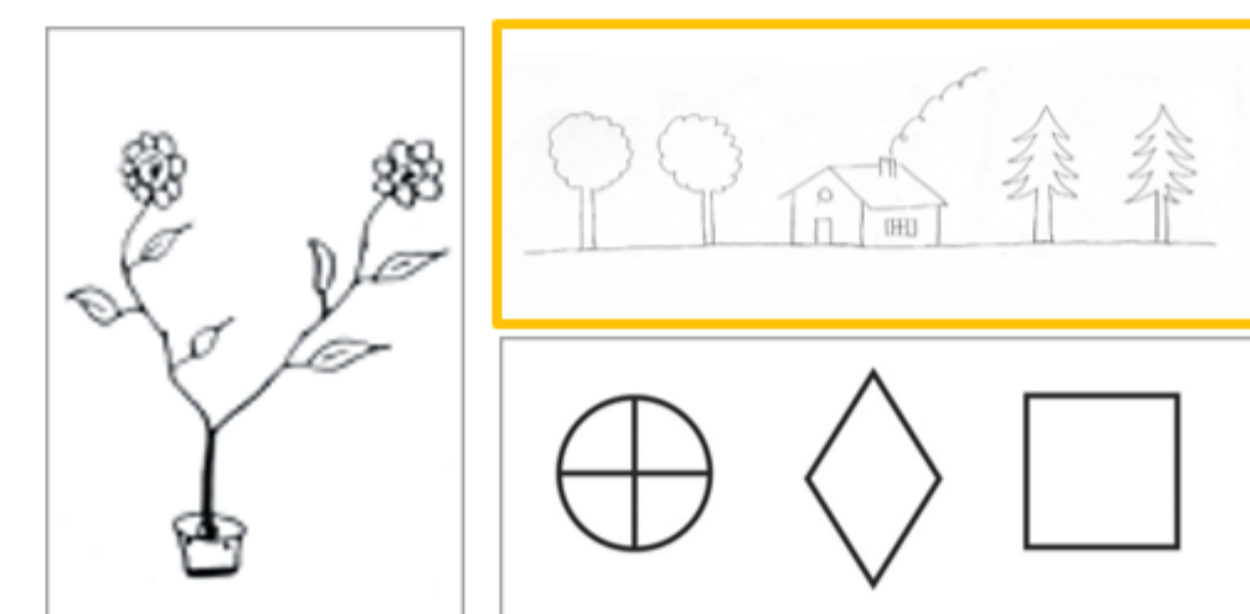
Line bisection



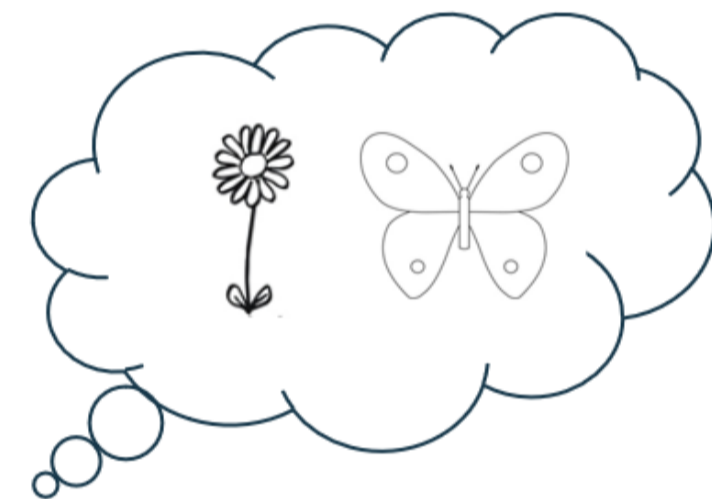
Copy of simple drawings



Copy of complex drawings



Drawings from memory



Clock Drawing Test



The Northern Italy Cities Test



Analyses and Results

CIRCLE CANCELLATION	Equation
Accuracy	No adjustment
Egocentric Asymmetry	No adjustment
Allocentric Asymmetry	AS=RS+0.273726*[(ln(100-age))-3.611272]
Perseveration Score	No adjustment
Perseveration Index	No adjustment
Execution Time	AS=RS+15.20439*[(ln(100-age))-3.611272]-27.13393*[(1/edu)-0.105054]

CIRCLE CANCELLATION	oTL	iTL	ES=0 cut-off	ES=1	ES=2	ES=3	ES=4
Accuracy	17	-	≤ 17	-	-	-	-
Egocentric Asymmetry	2	-	≥ 2	-	-	-	-
Allocentric Asymmetry:							
- Rightward	1.01	0.12	≥ 1.01	1 - 0.11	0.10 - 0.08	0.07 - 0.02	< 0.02
- Leftward	-0.23	-0.14	≤ -0.23	-0.22 - -0.13	-0.12 - -0.05	-0.04 - -0.03	> -0.03
Perseveration Score	1	-	≥ 1	-	-	-	-
Perseveration Index	1.05	-	≥ 1.05	-	-	-	-
Execution Time	52.92	43.73	≥ 52.92	52.91 - 41.22	41.21 - 33.92	33.91 - 28.92	< 28.92

CLOCK DRAWING TASK	oTL	iTL	ES=0 cut-off	ES=1	ES=2	ES=3	ES=4
Numbers	9.21	10.9	≤ 9.21	9.22 - 11.52	11.53 - 11.7	11.71 - 11.83	> 11.83
Hands	2.98	3.41	≤ 2.98	2.99 - 3.92	3.93 - 4.78	4.79 - 4.90	> 4.90
Total	13.09	14.84	≤ 13.09	13.10 - 15.47	15.48 - 16.38	16.39 - 16.71	> 16.71
Asymmetry	1	-	≥ 1	-	-	-	-
Perseveration	3	-	≥ 3	-	-	-	-

LINE BISECTION	Equation
Total lengths: mean % Deviation	AS=RS+1.417312*[(sex)-0.5148148]
Short lines (10 cm): mean % Deviation	AS=RS+1.236515*[(sex)-0.5148148]
Medium lines (15 cm): mean % Deviation	AS=RS+1.599813*[(sex)-0.5148148]
Long lines (25 cm): mean % Deviation	AS=RS+1.415608*[(sex)-0.5148148]

CLOCK DRAWING TASK	Equation
Numbers	AS=RS+0.000096*[(age^2)-3831.82963]+4.539185*[(1/edu)-0.105054]
Hands	AS=RS+0.133469*[(age^2)-7.739267]+2.470652*[(1/edu)-0.105054]
Total Accuracy	AS=RS+0.020094*[(age^2)-60.57037]+6.894949*[(1/edu)-0.105054]
Asymmetry	No adjustment
Perseveration	No adjustment

LINE BISECTION		oTL	iTL	ES=0 cut-off	ES=1	ES=2	ES=3	ES=4
Mean % Deviation Total lengths	Rightward	4.44	2.8	≥ 4.44	4.43 - 2.32	2.31 - 0.6	0.59 - -0.89	< -0.89
	Leftward	-6.67	-5.45	≤ -6.67	-6.66 - -5.05	-5.04 - -3.09	-3.08 - -0.93	> -0.93
Short lines (10 cm)	Rightward	8.60	4.60	≥ 8.60	8.59 - 3.60	3.59 - 1.36	1.35 - -1.14	< -1.14
	Leftward	-9.40	-6.40	≤ -9.40	-9.39 - -5.40	-5.39 - -2.64	-2.63 - -0.40	> -0.40
Medium lines (15 cm)	Rightward	6.78	4.11	≥ 6.78	6.77 - 2.78	2.77 - 0.78	0.77 - -1.49	< -1.49
	Leftward	-8.56	-5.89	≤ -8.56	-8.55 - -5.22	-5.21 - -3.22	-3.21 - -1.16	> -1.16
Long lines (25 cm)	Rightward	5.67	3.09	≥ 5.67	5.66 - 2.29	2.28 - 0.29	0.28 - -1.53	< -1.53
	Leftward	-8.73	-6.51	≤ -8.73	-8.72 - -5.93	-5.92 - -3.53	-3.52 - -1.13	> -1.13

COPY OF 5 ELEMENTS COMPLEX DRAWING	oTL	iTL	ES=0 cut-off	ES=1	ES=2	ES=3	ES=4
Accuracy	9.5	-	≤ 9.5	-	-	-	-
Egocentric Accuracy	9.5	-	≤ 9.5	-	-	-	-
Allocentric Accuracy	9.5	-	≤ 9.5	-	-	-	-
Asymmetry:							
- Rightward	0.92	-	≥ 0.92	-	-	-	-
- Leftward	-1.08	-	≤ -1.08	-	-	-	-
Perseveration Score	3	-	≥ 3	-	-	-	-
Apraxia	7.61	8	≤ 7.61	7.62 - 8.70	8.71 - 9.56	9.57 - 9.73	> 9.73

COPY OF 5 ELEMENTS COMPLEX DRAWING	Equation
Accuracy	No adjustment
Egocentric Accuracy	No adjustment
Allocentric Accuracy	No adjustment
Asymmetry	AS=RS-0.79133*[(1/edu)-0.105054]
Perseveration Score	No adjustment
Apraxia	AS=RS+0.000098*[(age^2)-3831.82963]+7.35392*[(1/edu)-0.105054]

■ significant demographic predictors among age, education and gender
 — only oTL cut-offs are provided when most participants showed ceiling or floor effects, and score variability was insufficient to compute the full range of ESs

Conclusions

The present work provides **updated norms** for **standard** and **new indexes** of visuospatial performance to be used in the neuropsychological assessment of USN and constructional disorders. Norms for **left and right USN** are computed, along with **regression-based norms** and **equivalent scores** for key performance indexes. Results are shown for a subset of tests in perspective of a **minimal assessment battery**. Standardized procedures for test administration and scoring are also provided to support clinical practice.

1) Moore, M., Milosevich, E., Beisteiner, R., Bowen, A., Checketts, M., Demeyere, N., Fordell, H., Godefroy, O., Laczó, J., Rich, T., Williams, L., Woodward-Nutt, K., & Husain, M. (2022). Rapid screening for neglect following stroke: A systematic search and European Academy of Neurology recommendations. *European journal of neurology*, 29(9), 2596–2606. <https://doi.org/10.1111/ene.15381>

2) Verdon, V., Schwartz, S., Lovblad, K. O., Hauert, C. A., & Vuilleumier, P. (2010). Neuroanatomy of hemispatial neglect and its functional components: a study using voxel-based lesion-symptom mapping. *Brain: a journal of neurology*, 133(Pt 3), 880–894. <https://doi.org/10.1093/brain/awp305>