TIME
PERCEPTION
LAB

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DOMENICA BUETI (Ph.D)

Current position Since October 2024 I am full professor of Cognitive Neuroscience at SISSA where I lead a group (i.e., the "Time Perception Lab") of 4 post-docs (one of whom is a Marie Skłodowska-Curie grantee) and 2 PhD students.

Previous academic positions

- From 2016-2024 I was associate professor of Cognitive Neuroscience at SISSA, Trieste.
- From 2011 to 2015 I was senior research scientist at
  - the Biomedical Imaging Research Center of the École Polytechnique Fedédérale de Lausanne (EPFL).
  - the Department of Clinical Neurosciences of the Lausanne University Hospital.
- From 2004 to 2010 I was post-doctoral research fellow at
  - Neuroimaging Lab, Santa Lucia Foundation, Rome, Italy (2007-2010).
  - Visual Cognition Lab, Institute of Cognitive Neuroscience (ICN), University College London (UCL), UK (2004-2006).
- From 2002-2004 I was visiting PhD student at ICN, UCL, London.

Maternity leave

- 2017 (June – Sept), 2014 (May– October).

Education In 2004 I was awarded a PhD in Cognitive Neuroscience from the University of Rome "La Sapienza" and in 2000 I obtained a degree in Psychology from the University of Padua.

Grants and Awards

My research is financially supported by the following *on-going grants*:

- the Italian "Ministero dell'Istruzione, dell'Università e della Ricerca (MUR)"
  - 2023-2025. Call PRIN2022 project RIGHTSTRESS: Tuning arousal for optimal perception (233.854 €)
- the European Union's Horizon Europe (Marie Skłodowska-Curie Actions). I am coordinator of following project:
  - 2023-2026. Call Horizon MSCA2021-PF-01, global fellowship. Project ID 101064781 "Neuromodulation of episodic memory - how stress influences Time in Memory and perception- TIME". Grantee: Dr. Monika Riegel. (262.295 €).

Previous grants

- European Research Council (ERC)
  - 2016-2022. Consolidator grant (call ERC-2015-CoG, project ID 682117) on the project "How the Human Brain Masters Time- BiT", 1.700.000 €,
- European Union's Horizon 2020 (Marie Skłodowska-Curie Actions). I was coordinator of the following two projects:
  - 2019-2021. Project coordinator of the H2020-MSCA-IF-2018 project ID 838823 "Neural mechanisms of perceptual stability in magnitude perception-NetSet". Grantee: Dr. Michele Fornaciai (171.473 €).
  - 2022-2024. Call H2020-MSCA-IF-2019. Project ID 894955 "Shaping time through action learning-Time in Action". Grantee: Dr. Nicola Binetti (171.473 €).
- MUR
  - 2017-2023. Call FARE2017 on the project "Mapping Perceptual and Motor Time in the Adult and in the Baby Brain", (269.532 €).
  - 2018-2022. Call PRIN2017 on the project "Environmental statistics and the representation of space, time and numbers magnitude", (512.836 €).
- 2015 Travel Award of the Japan Neuroscience Society (3000 €).
- Italian "Ministero della Salute"

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- 2013-2015 PI on a collaborative project: "Preparatory, response-related, outcome-evaluation and predictive components of attentional orienting in right brain damage: clues for diagnosis and rehabilitation", RF-2010-2319059 (274.000 €).
- 2003-2004 Marie Skłodowska-Curie scholarship (FP6, RTN-training site student. 21.000 €).

Awards

- ERC Proof of Concept grant (POC22). Project title: "Real-time Decoding of Brain States via Deep Learning (RIDDLE)" not financed for insufficient funds but awarded with the "*Seal of Excellence*".

Metrics I have 38 publications (24 of them 65%- as first or last author) in international peer-reviewed journals including Neuron, Plos Biology, Current Biology, Journal of Neuroscience, Nature Neuroscience, Brain.
I have 2241citations (Scopus) and a h-index equal to 20 (source Scopus).
I am eligible to be full professor ("*abilitazione scientifica nazionale*" SSD 11/E1, M-PSI/02 Psicobiologia e Psicologia Fisiologica).

Professional Responsibilities

- Teaching and supervisions
  - I currently supervise *4 post-doctoral research fellows* (Gianfranco Fortunato, Valeria Centanino, Monika Riegel and Anna Tonon Appiani) and *2 PhD students* (Francesca Bellotti, Aybuke Durmaz).
  - From 2016 I have supervised at SISSA
    - 6 PhD students who have successfully obtained a PhD (name, current position): Andrea Solmi (University of Milan, research project manager), Gianfranco Fortunato (SISSA, post-doc), Dunia Giomo (Polish Academy of Sciences, post-doc), Filip Agatic (data scientist at BrainTrip, Slovenia), Anna Tonon Appiani (SISSA, post-doc), Valeria Centanino (SISSA, post-doc).
    - 9 post-docs (name, current position): Foteini Protopapa (data scientist at Bosch, Stuttgart), Shrikanth Kulashekhar (University Hospital of Helsinki), Irene Togoli, (UC Lauvain with independent funds), Michele Fornaciai (UC Lauvain with a second Marie Skłodowska-Curie grant), Yelena Tonoyan (IIT, Genova), Federico Mancinelli (University of Bohn), Brent Parsons (Smith-Kettlewell Eye Research Institute, San Francisco, CA) Romain Brasselet (CNRS, INSERM, Sorbonne University), Nicola Binetti (assistant professor at University of Rome "Tor Vergata").
    - 10 MSc students (name, current position): Gianfranco Fortunato (SISSA), Frank Sierra (University of Dublin), Anna Fehrenbach (PearUp/Eduki startup), Chiara Zanonato (Max Planck, Tübingen), Emma Visibelli (University of Padova), Aybuke Durmaz (SISSA), Giulia Pizzoleo (Fatebenefratelli, Brescia), Dario Tascio (University of Bohn), Sarah Maass (University of Groningen), Mahlet Kassa (Berlin school of Mind and Brain).
  - 2016-to present: I'm giving a theoretical course on spatial and temporal cognition and a methodological course on human brain imaging to SISSA PhD students.
  - In 2021 I gave a course on "the neuroscience of time" to the Spring College on the Physics of Complex Systems, Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy.
  - In 2016 I gave a course on research methods in cognitive neuroscience at the Scuola Galileiana di Studi Superiori (Padova, Italy).

- Reviewing activity
  I have served as reviewer for
  - a total of 26 biological and psychological journals including Current Biology, Plos Biology, Nature Communications, PNAS, eLife, Science Advances, Trends in Cognitive Sciences, Proceedings of the Royal Society-B, Journal of Neuroscience.

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- the following funding agencies: European Research Council, French National Funding Agency, Swiss National Funding Agency, Israel Science Foundation, Netherlands Organization for Scientific Research, Polish Academy of Sciences, National Science Foundation (US).

- Editorial activities
  - I am consulting editor for "Timing and Time perception" (Brill Publisher).
  - Guest editor for "Neural Plasticity" in occasion of a special issue on "The Neurobiology of Time Processing"

- Administrative roles at SISSA
  - Since 2016 I am member of the teaching board ("collegio dei docenti") of the Cognitive Neuroscience PhD.
  - Since November 2022 I am chairing the SISSA wellbeing and equal opportunities committee (Comitato Unico di Garanzia, CUG).
  - Since November 2022 I am the SISSA Director delegate on gender issues and on issues related to the psychological counselling service.
  - Since 2019 I am member of the "SISSA Medialab Scientific Council".
  - 2017-2022 I was member of following SISSA committees:
    - student-professor joint committee ("Commisione Paritetica Allievi Docenti").
    - Chair of the Ethics committee.
    - Office space committee ("Commissione Spazi").
    - Kindergarten committee ("Commissione Nido").

Public scientific engagement

- Because of my international reputation, I have been invited speaker and symposia organizer at international conferences including:
  - Annual meeting of the "French Timing Network" (keynote speaker, Paris, October 2024)
  - "Consciousness and computation conference" (keynote speaker, April 2024, Zagreb).
  - "Timing Research Forum- TRF", the biennial biggest conference in the field of time perception and processing (2023 invited speaker, 2019 symposium organizer).
  - "Organization for Human Brain Mapping- OHBM" the biggest conference in the field of human brain neuroimaging (2019, invited speaker).
  - "Society for Neuroscience" (2022, 2018, 2012, nano-symposia, invited speaker).
  - "European Conference on Visual Perception- ECVP" (2018 symposium organizer, 2019 invited speaker).
  - "European Workshop on Cognitive Neuropsychology- EWCN" (2022 invited speaker, 2015 symposium organizer).
  - Annual meeting of the Japan Neuroscience Society, symposium organizer (2016).
  - Keynote lecture, at the "Timing and Time Perception" conference (2014, older version of TRF meeting).
  - TEX 2017 (Trieste) "Time in the Brain" workshop organizer.
- I have been invited speaker at the following events/seminars (only the most relevant are listed):
  - Justus-Liebig-Universität Gießen, Zentrum für Psychiatrie (invited speaker, summer seminar series, Giessen, June, 2024).
  - Spinoza Centre for Neuroimaging, (invited speaker, May 2024, Amsterdam).
  - BIU Vision Science seminar (2023).
  - TRF on-line seminar series (2023).
  - University of California Irvine (CogSci Time Perception Colloquium Panel, 2022).
  - Université Aix-Marseille, Workshop on "Temporal Cognition" (2022).
  - University of Bologna, Workshop "Brain -Storm Time" (2022).
  - CIFAR (Canadian Institute for Advanced Research) meeting (2021).
  - University of Magdeburg, Germany. Training summer school "Imaging Time" (2013).

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- University of Granada, Spain; workshop on "Temporal Prediction" (2013).
- Clinical Imaging Sciences Center (CISC), Brighton and Sussex Medical School, Falmer, UK (2011).
- University Hospital of Lausanne, FENS-IBRO Imaging Training Center (seminar, 2011).
- Institute for Advanced Studies, Hebrew University of Jerusalem, Israel. Workshop "The Functions of the Parietal Lobes" (2009).
- Menéndez Pelayo International University of Barcelona (CUIMPB - Centre Ernest Lluch), Spain. Workshop "The Nature of Time. From Physics to Psychology", (2008).
- UCL, London, UK. Workshop "The anatomy of Time" (2007).

Outreach activities

I am often engaged in popular science activities. Among the most relevant ones:

- Podcast: the Naked Scientist
- TV: TG Leonardo, Rai Scuola, "Memex: Vita da Ricercatore" (link here), Swiss-Italian television RSI
- Radio interviews: "RAI-Radio3-Scienza", Radar.
- Magazines: Wired Italia, , BBC FUTURE, Le Scienze, Nature *Italy* (Research Highlight).
- Talks: TEDx Lausanne; "Festival della Scienza", Genova; Teatro "Piccolo Eliseo", Roma.

Professional Membership

I'm member of the *Society for Neuroscience (SfN).*

Active collaborations

- Dr. Wietske Van der Zwaag and Dr. Ben Harvey (Spinoza Centre for Neuroimaging, Amsterdam and University of Utrecht): time processing in the cerebellum.
- Prof. Hedderik van Rijn (University of Groningen): auditory chronomaps.
- Prof. Ulrike Rimmele (University of Geneva): the effects of stress on working memory and time perception.
- Prof. Mathew Diamond (SISSA): the physiological mechanisms underlying duration perception in flanked and continuous stimuli.
- Dr. Edgar Roldan (ICTP, Trieste) and Prof. Mathew Diamond (SISSA): perceptual decision making under non-equilibrium fluctuations.
- Prof. Alessandro Laio (SISSA, Trieste): inference of causality to test functional connectivity on EEG data.
- Prof. Paola Binda (University of Pisa) and Prof. Olivier Wolf (University of Bochum): the physiological response to a mild stressor during attention and perception of time.

Full list of peer-reviewed publications

1. Centanino, V., Fortunato, G., **Bueti, D.** (2024) The representation of space and time along the human cortical hierarchy (https://www.biorxiv.org/content/10.1101/2024.04.15.589551v1.full.pdf) *Nature Communications* (in press).
2. Togoli, I., Colignon, O., **Bueti D.** Fornaciai, M. (2024). The mechanisms and neural signature of average numerosity perception, *Journal of Cognitive Neuroscience*
3. Del Tatto, V., Fortunato, **Bueti, D**., Laio, A. (2024) Robust inference of causality in high-dimensional processes from the Information Imbalance of distance ranks. Accepted in *Proceedings of the National Academy of Sciences PNAS*. https://arxiv.org/abs/2305.10817
4. Protopapa, F., Haysahi, M.J., Kanai, R., **Bueti, D.** (2023) Topographic Connectivity in a Duration Selective Cortico-Cerebellar Network. *Scientific Reports* Nov 24;13(1):20674DOI: 10.1038/s41598-023-47954-4
5. Fornaciai, M., Togoli, I., **Bueti, D.** (2023) Perceptual history biases are predicted by early visual-evoked activity. *Journal of Neuroscience*

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6. Fortunato, G., Togoli, I., **Bueti, D.** (2023) The more numerous the longer: how the integration between numerosity and time leads to a common neural response. *Proceedings of the R Soc Lond B Biol Sci* 10.1167/jov.22.11.11
7. Tonoyan, Y., Fornaciai M., Parsons, B., **Bueti, D.** (2022) Subjective time is predicted by local and early visual processing. *Neuroimage 10.1016/j.neuroimage.2022.119707*
8. Togoli,I., **Bueti, D.**, Fornaciai, M. (2022) The nature of magnitude integration: contextual interference vs. active magnitude binding. *Journal of Vision* 10.1167/jov.22.11.11
9. Togoli, I., Fornaciai, M. **Bueti, D.** (2021) The specious interaction of time and numerosity perception. *Proceedings of the R Soc Lond B Biol Sci.* https://doi.org/10.1098/rspb.2021.1577
10. Togoli, I., Fedele, M. Fornaciai, M. **Bueti, D.** Serial dependence in time and numerosity perception is dimension-specific. *Journal of Vision* (2021), 21(5):6, 1-15 https://doi.org/10.1167/jov.21.5.6.
11. **Bueti, D**. (2020) Time Processing: Multiple Topographic Representations of Time across Human Cortex. *Curr. Biol.* doi:10.1016/j.cub.2020.02.05.
12. Protopapa F., Hayashi M.J., Kulashekhar S., van der Zwaag W., Battistella G., Murray M.M., **Bueti D.** (2019) Chronotopic maps in human supplementary motor area. *PLoS Biol* 17(3): e3000026. https://doi.org/10.1371/journal.pbio.3000026
13. Hendriks-Balk, M.C., Megdiche, F., Pezzi, L., Reynaud, O., Da Costa, S., **Bueti, D.**, Van De Ville, D., Wuerzner, G. Brainstem (2020). Correlates of a Cold Pressor Test Measured by Ultra-High Field fMRI. *Front Neurosci*.
14. Cecchetto, C., Lancini, E., **Bueti, D.**, Rumiati, R. I., & Parma, V. (2019). Body odors (even when masked) make you more emotional: behavioral and neural insights. *Scientific Reports*, *9*(1), 5489. https://doi.org/10.1038/s41598-019-41937-0
15. Hayashi, M. J., van der Zwaag, W., **Bueti, D.**, & Kanai, R. (2018). Representations of time in human frontoparietal cortex. *Communications Biology*, *1*(1), 233. https://doi.org/10.1038/s42003-018-0243z
16. Lasaponara S, D'Onofrio M, Pinto M, Dragone A, Menicagli D, **Bueti D.**, De Lucia M., Tomaiuolo F., Doricchi F. EEG correlates of preparatory orienting, contextual updating and inhibition of sensory processing in left spatial neglect (2018). *J Neurosci.* doi: 10.1523/JNEUROSCI.2817-17.2018
17. Frassinetti F., Cappelletti M., **Bueti D**. The Neurobiology of Time Processing (2016). *Neural Plast.*
18. **Bueti, D**., Buonomano, D.V. Temporal Perceptual Learning (2014). *Timing and Time Perception.* 2, 261-89.
19. Salvioni, P., Murray, M.M., Kalmbach, L., **Bueti, D**. (2013). How the visual brain encodes and keeps track of time, *J Neurosci*. 33,12423-12429.
20. Binetti, N., Siegler, I., **Bueti, D.***, Doricchi, F.* (2013). Adaptive tuning of perceptual timing to vestibular stimulation. *Neuropsychologia*, 51,197-210 - special issue on 'Time processing'. *Equal contribution.
21. Spierer, L., Manuel, A., **Bueti, D**., Murray, M.M. (2013). Contributions of pitch and bandwidth to sound-induced enhancement of visual cortex excitability in humans. *Cortex*, 49, 2727-33.
22. **Bueti, D.**, Lasaponara, S., Cercignani M., Macaluso, E. (2012). Learning about time: Plastic Changes and Individual Brain Differences. *Neuron*, 75, 725–737.
23. Aiello, M., Courtois, S.J., Merola, S., Ottaviani, T., Tomaiuolo, F., **Bueti**, **D.,** Rossetti, Y., Doricchi, F. (2012). No inherent left and right side in human "mental number line": evidence from right brain damage. *Brain*. 135, 2492-2505.
24. **Bueti, D**. (2011). The sensory representation of time. *Front Integr Neurosci 5*, 34.
25. **Bueti, D.**, and Macaluso, E. (2011). Physiological correlates of subjective time: evidence for the temporal accumulator hypothesis. *Neuroimage 57*, 1251-1263.
26. Kanai, R., Lloyd, H., **Bueti, D.**, Walsh, V. (2011). Modality-independent role of the primary auditory cortex in time estimation. *Exp Brain Res 209*, 465-471.
27. Kalla, R., Muggleton, N., Spiegel, R., **Bueti, D**., Claassen, J., Walsh, V., Bronstein, A. (2011). Adaptive motion processing in bilateral vestibular failure. *J Neurol Neurosurg Psychiatry 82*, 1212-1216.
28. Rusconi, E., **Bueti, D**., Walsh, V., Butterworth, B. (2011). Contribution of frontal cortex to the spatial representation of number. *Cortex 47*, 2-13.

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29. **Bueti, D**., Bahrami, B., Walsh, V., Rees, G. (2010). Encoding of temporal probabilities in the human brain. *J Neurosci 30*, 4343-4352.
30. **Bueti, D**., and Walsh, V. (2010). Memory for time distinguishes between perception and action. *Perception 39*, 81-90.
31. **Bueti, D**., and Macaluso, E. (2010). Auditory temporal expectations modulate activity in visual cortex. *Neuroimage 51*, 1168-1183.
32. Binetti, N., Siegler, I.A., **Bueti, D**., Doricchi, F. (2010). Time in motion: effects of whole-body rotatory accelerations on timekeeping processes. *Neuropsychologia 48*, 1842-1852.
33. **Bueti, D**., and Walsh, V. (2009). The parietal cortex and the representation of time, space, number and other magnitudes. *Philos Trans R Soc Lond B Biol Sci 364*, 1831-1840.
34. **Bueti, D**., van Dongen, E.V., Walsh, V. (2008). The role of superior temporal cortex in auditory timing. PLoS ONE *3*, e2481.
35. **Bueti, D**., Walsh, V., Frith, C., Rees, G. (2008). Different brain circuits underlie motor and perceptual representations of temporal intervals. *J Cogn Neurosci 20*, 204-214.
36. **Bueti, D**., Bahrami, B., Walsh, V. (2008). Sensory and association cortex in time perception. *J Cogn Neurosci 20*, 1054-1062-
37. Doricchi, F., Guariglia, P., Figliozzi, F., Silvetti, M., Gasparini, M., Merola, S., Macci, E., Binetti, N., Bruschini, M., **Bueti, D**. (2008). No reversal of the Oppel-Kundt illusion with short stimuli: confutation of the space anisometry interpretation of neglect and 'cross-over' in line bisection. *Brain 131*, e94; author reply e95.
38. Costantini, M., **Bueti, D**., Pazzaglia, M., Aglioti, S.M. (2007). Temporal dynamics of visuo-tactile extinction within and between hemispaces. *Neuropsychology 21*, 242-250.
39. Avenanti, A., **Bueti, D**., Galati, G., Aglioti, S.M. (2005). Transcranial magnetic stimulation highlights the sensorimotor side of empathy for pain. *Nat Neurosci 8*, 955-960.
40. **Bueti, D.**, Costantini, M., Forster, B., Aglioti, S.M. (2004). Uni- and cross-modal temporal modulation of tactile extinction in right brain damaged patients. *Neuropsychologia 42*, 1689-1696.

Manuscripts in the archives and currently under review

41. Durmaz, A., Sarmiento, Y., Fortunato, G., Das, D., Diamond, E.M., **Bueti, D.**, Roldan, E. (2023) Perceptual decision making of non-equilibrium fluctuations (https://arxiv.org/abs/2311.12692). In revision.
42. Togoli, I., Fornaciai, M., **Bueti, D.** (2023) Different modality-specific mechanisms mediate perceptual history effects in vision and audition (https://www.biorxiv.org/content/10.1101/2022.08.07.503081v1).
43. Togoli, I., Fornaciai, M.,Visibielli, E., Piazza, M., **Bueti, D.** (2022) The neural signature of magnitude integration between time and numerosity (https://www.biorxiv.org/content/10.1101/2022.08.29.505731v1)
44. Kulashekhar, S., Maass. S.C., van Rijn, H., **Bueti, D.** (2022) The Topographic Representation of Time and its Link with Temporal Context and Perception Research Square. https://www.researchsquare.com/article/rs-753370/v1 Currently under review

Manuscripts in preparation

45. Giomo, D., Brasselet, R., **Bueti, D**. Global and local deviance effects in the processing of temporal patterns.
46. Bellotti, F., **Bueti, D**. Time encoding mechanisms across stimulus configurations.

Book chapters

1. In Denes, G., Pizzamiglio, L., Guariglia, C., Cappa, S., Grossi, D., Luzzatti, C.G. 2006. Manuale di Neuropsicologia. Normalità e Patologia dei Processi Cognitivi. Bologna. *Zanichelli* 942–963. **Bueti, D.** and Koch, G. Percezione e produzione del tempo. P. 775-787. University handbook.
2. Merchant, H., De Lafuente, V., 2014. Introduction to the neurobiology of interval timing. *Springer* Invited to contribute to the second edition with a book chapter on “the neuroimaging of time perception.”

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