

Translational MR-imaging in dementia diagnostics --- DGPPN 2012 - Berlin

Segmentation of the Hippocampus: Towards a Joint EADC-ADNI Harmonized Protocol

Marina Boccardi, Giovanni B Frisoni

LENITEM - Laboratory of Epidemiology, Neuroimaging & Telemedicine



IRCCS
CENTRO SAN GIOVANNI DI DIO FATEBENEFRAELLI – BRESCIA
Centro Nazionale per lo Studio e la Cura
della Malattia di Alzheimer e Malattie Mentali



DGPPN KONGRESS 2012

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Ich erkläre hiermit, dass ich seit dem 1. November 2011 geschäftliche, persönliche oder materielle Beziehungen zu den folgenden Industrieunternehmen unterhalten habe oder gegenwärtig unterhalte:

➔ Name des Unternehmens // Art der Beziehung

Disclosure Information

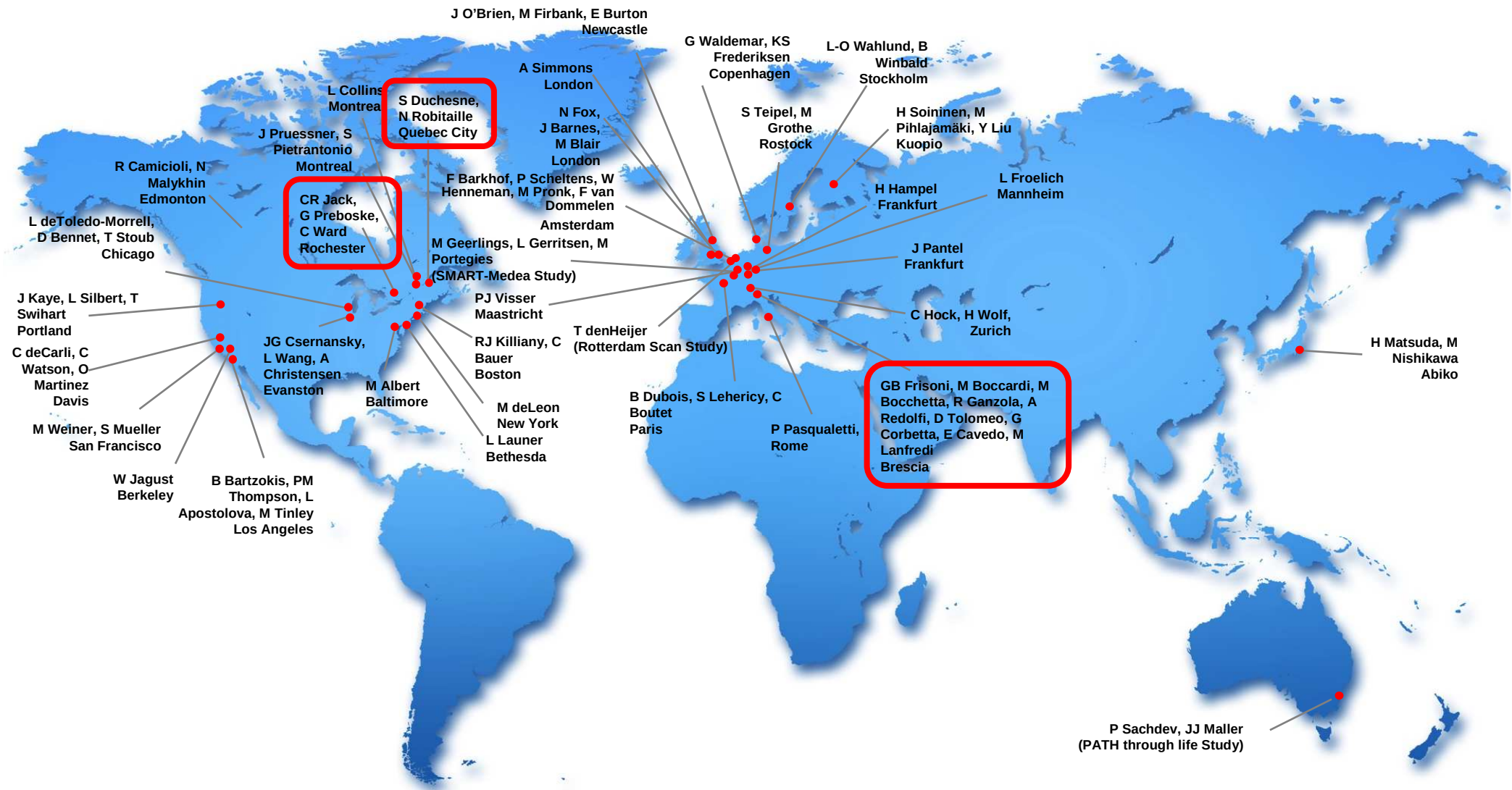
I hereby declare that I have had business or personal interests in the following industrial enterprises since 1 November 2011:

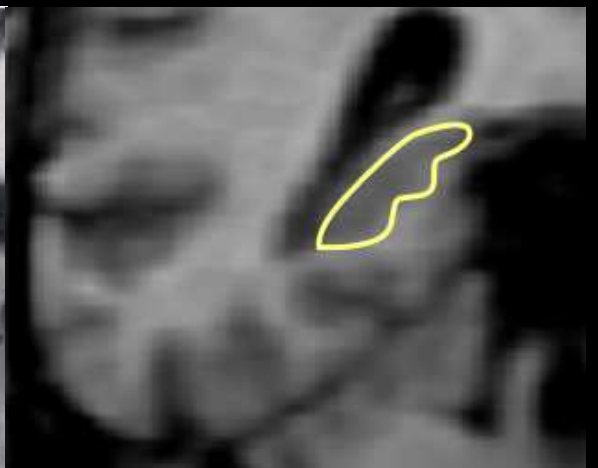
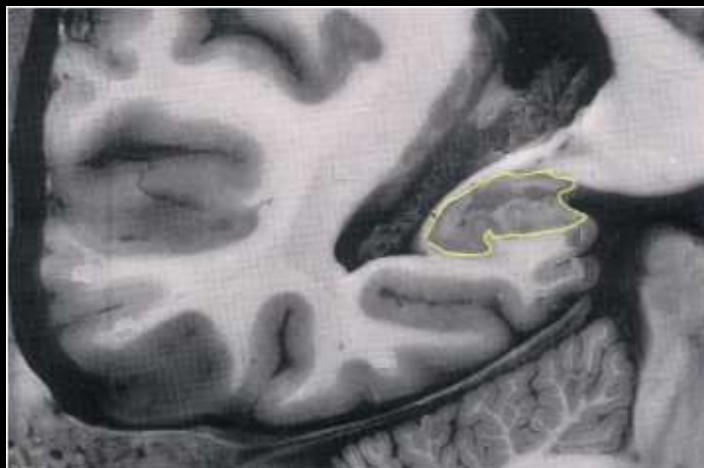
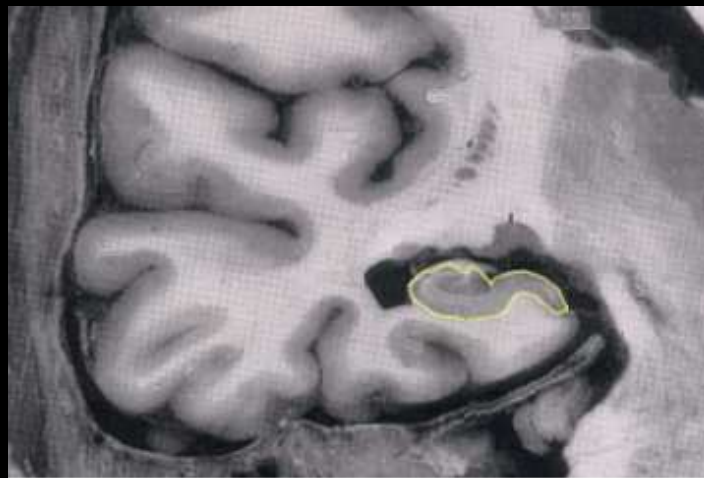
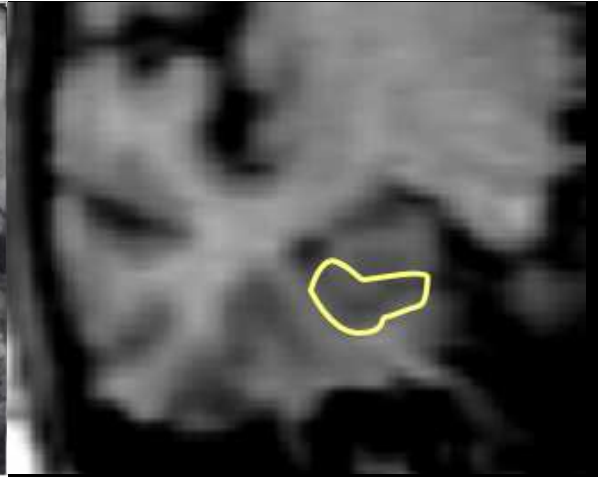
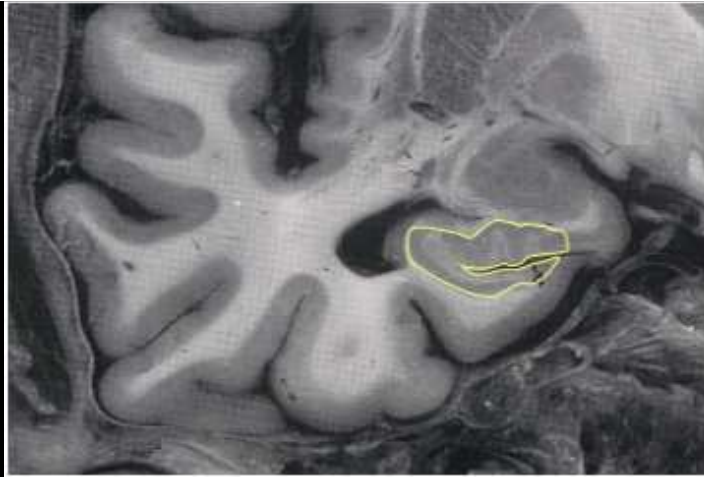
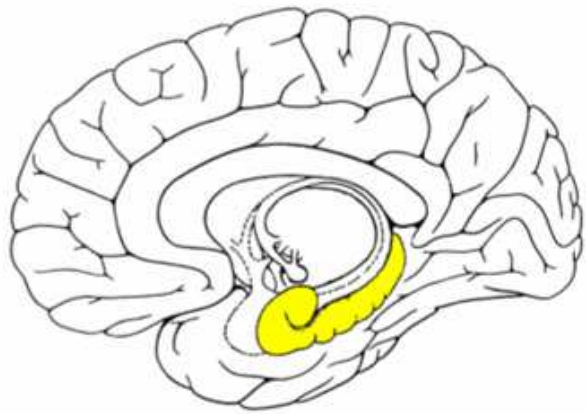
➔ *Name of the enterprise // Nature of the interest*

Nothing to disclose



The EADC-ADNI Working Group on the Harmonized Protocol for Hippocampal Volumetry



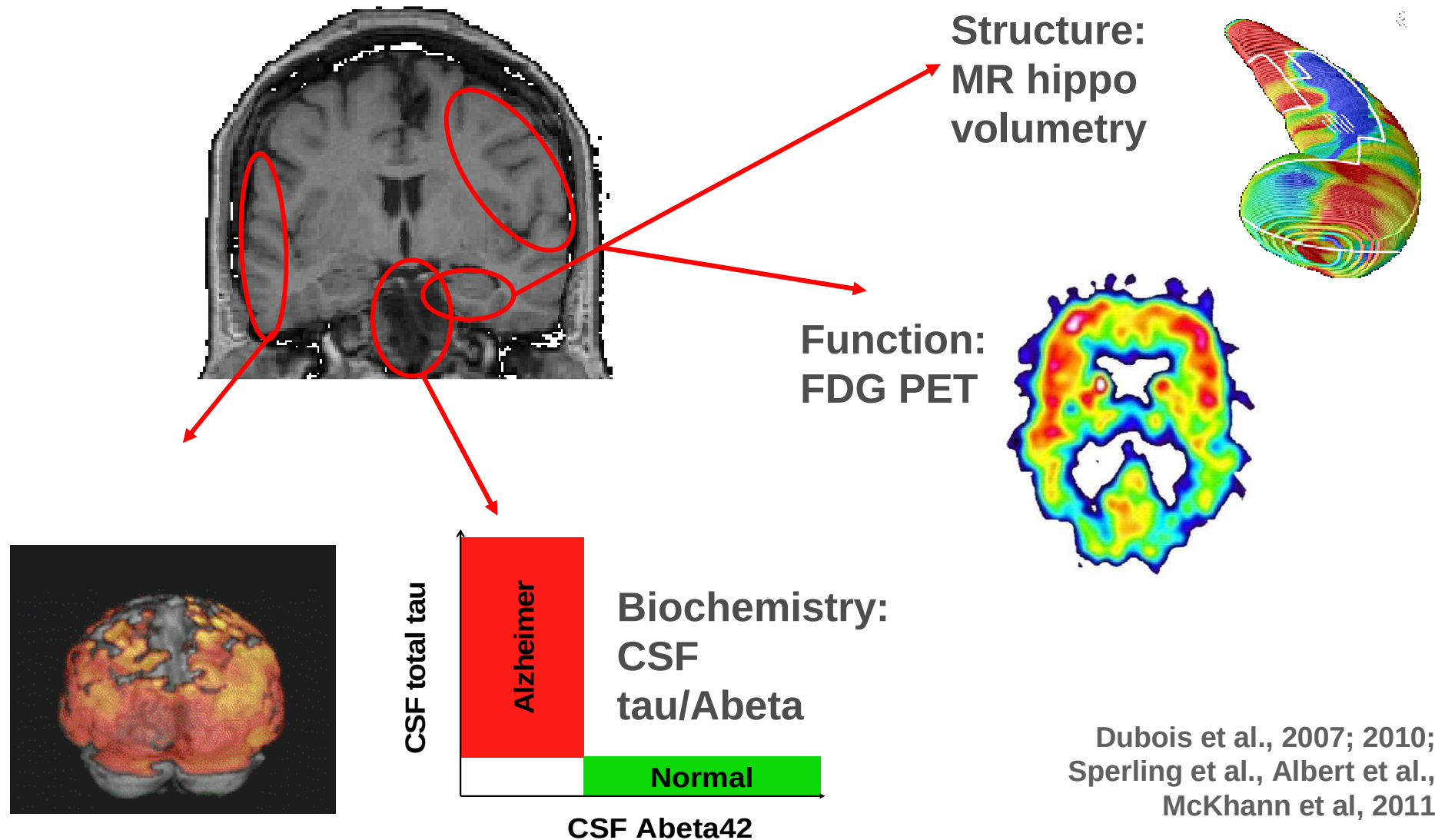


Geuze et al., 2005
Konrad et al., 2009

Standard Operating Procedures needed

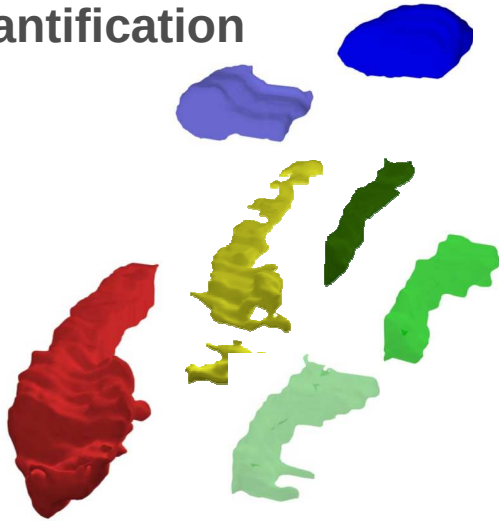
Ref.	Med border	Lat border	Inf border	Norm. hippo vol (cm ³)	
				Left	Right
Watson et al.	Mesial edge of temporal lobe	Temp horn of lat ventr	Incl subicular complex & uncus cleft w/ border separating subicular complex from parahippo gyrus	4.903	5.264
Zipursky et al.	Regional outline at choroidal fissure	Not mentioned	The interface of hippocampal tissue and parahippocampal gyrus white matter	1.990	2.070

New diagnostic criteria and biomarkers for AD

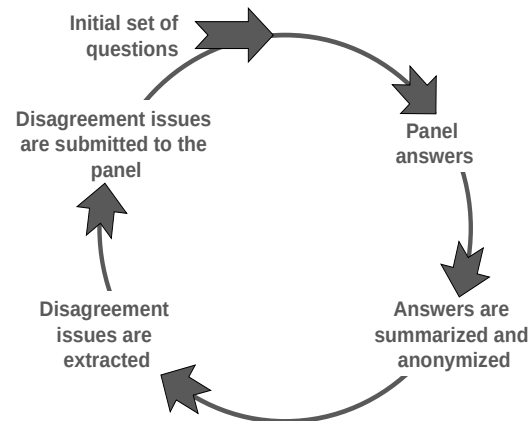


Aims & Project structure

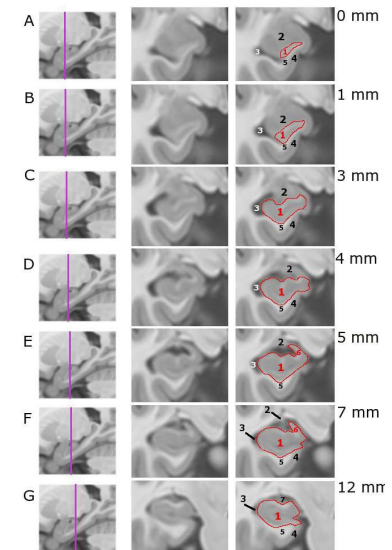
Operationalization & quantification



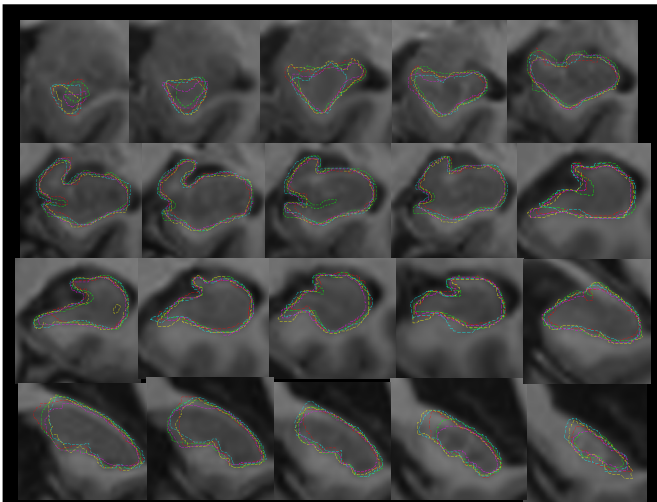
Delphi panel



Harmonized Protocol



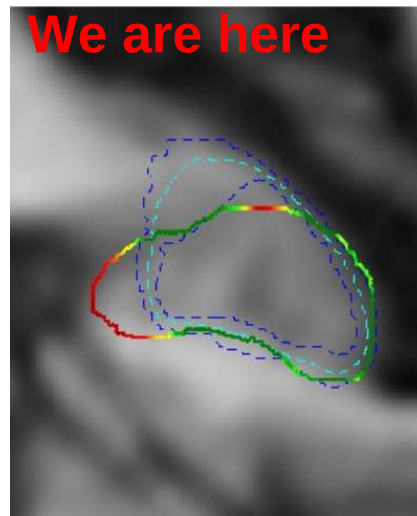
Benchmark images



Qualification platform



We are here



Validation

Naïve Tracers



Authors of the Hippocampal Segmentation Protocols



G. Bartzokis
Los Angeles



J. Csernansky
Chicago



M. de Leon
New York



L. deToledo-Morell
Chicago



C.R. Jack Jr.
Rochester



R. Killiany
Boston



S. Lehericy
Paris



N. Malykhin
Edmonton



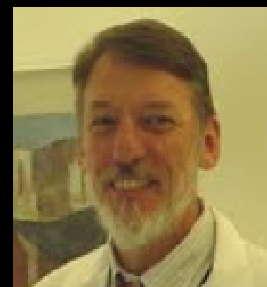
J. Pantel
Frankfurt



J. Pruessner
Montreal



H. Soininen
Kuopio

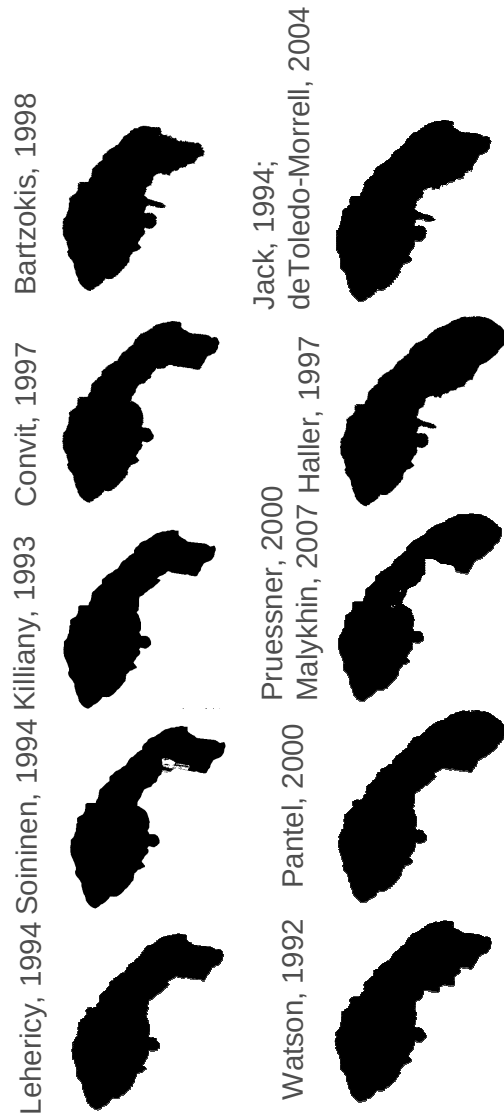


C. Watson
Detroit

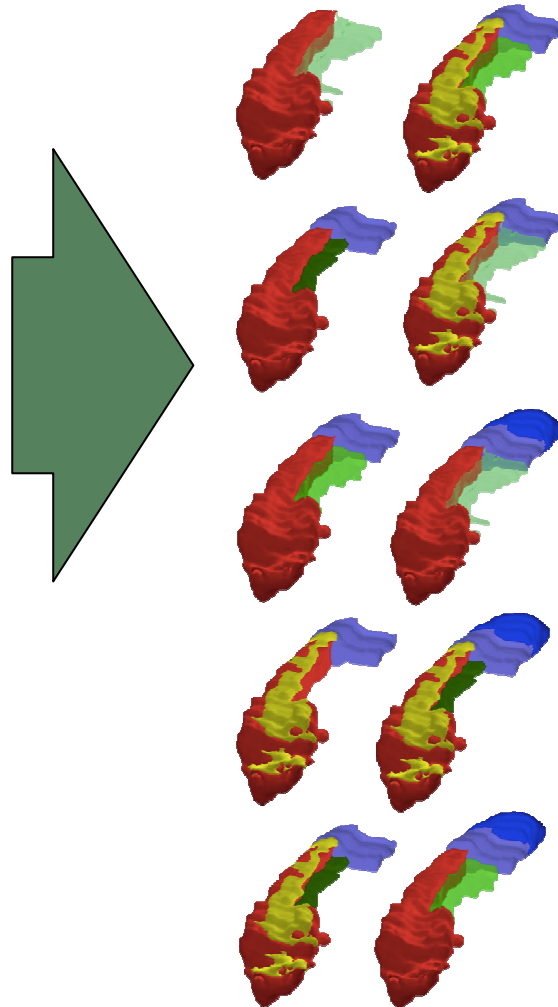
Preliminary Phase

Survey

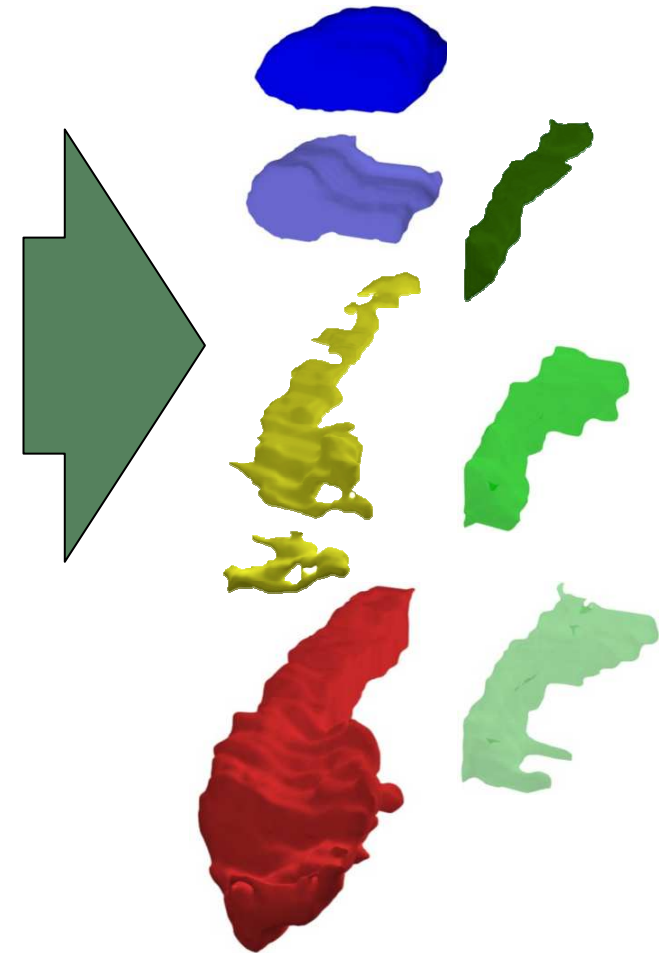
(Boccardi et al., JAD 20119)



Operationalization of differences into segmentation units



Assessment of measurement properties of SUs



SUs Quantification: Reliability

	Intra-rater	Inter-rater
MinH	0.992 (0.980-0.997)	0.974 (0.936-0.990)
Alveus/Fimbria	0.863 (0.687-0.944)	0.885 (0.734-0.953)
Minimum Hippocampus + Alveus/Fimbria	0.993 (0.983-0.997)	0.973 (0.934-0.989)
Subiculum		
Oblique line	0.964 (0.911-0.985)	0.907 (0.781-0.962)
Morphology	0.981 (0.952-0.992)	0.937 (0.848-0.975)
Horizontal line	0.980 (0.951-0.992)	0.932 (0.836-0.972)
Tail		
Crura	0.998 (0.994-0.999)	0.937 (0.847-0.974)
Tail End	0.988 (0.971-0.995)	0.905 (0.775-0.961)

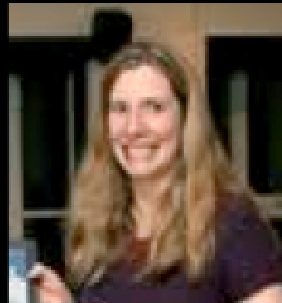
SUs Quantification: Informative Value

LEFT HIPPOCAMPUS						
	CTR (n=31)	% of total hippo	MCI (n=23)	AD (n=23)	% diff MCI vs CTR	% diff AD vs CTR
MinH	1,467 (204)	60%	1,122 (263)	1,023 (251)	23.5% **	30% **
Alveus/Fimbria	248 (45)	10%	232 (61)	200 (48)	6.5%	19% **
Subiculum	243 (72)	10%	220 (84)	213 (64)	9.5%	12%
Oblique line	196 (67)	8%	178 (66)	176 (53)	9 %	10%
Morphology	243 (72)	10%	220 (84)	213 (64)	9.5%	12%
Horizontal line	234 (72)	9%	210 (78)	211 (62)	10%	10%
Tail	485 (131)	20%	383 (99)	353 (101)	21% *	27% **
Crura	190 (74)	8%	177 (70)	146 (69)	6.5%	23% *
Tail End	296 (120)	12%	206 (76)	206 (86)	30% *	30% *
MaxH	2,443 (291)	100%	1,957 (348)	1,788 (342)	20% **	27% **

Delphi Panel



L. Apostolova
Los Angeles



J. Barnes
London



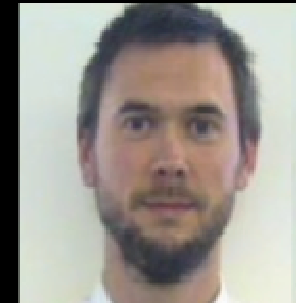
G. Bartzokis
Los Angeles



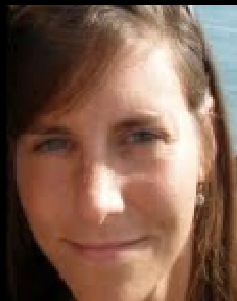
C. DeCarli
Sacramento



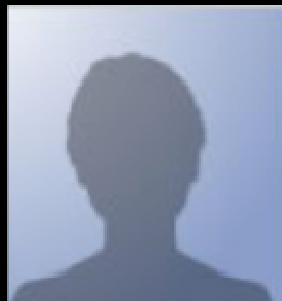
L. de Toledo-Morell
Chicago



M. Firbank
Newcastle



L. Gerritsen
Stockholm



W. Henneman
Amsterdam



C.R. Jack Jr.
Rochester



R. Killiany
Boston



N. Malykhin
Edmonton



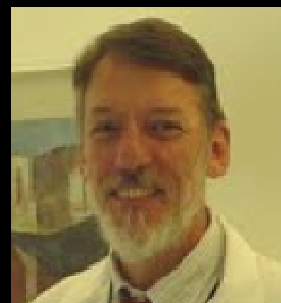
J. Pruessner
Montreal



H. Soininen
Kuopio



L. Wang
Chicago



C. Watson
Detroit



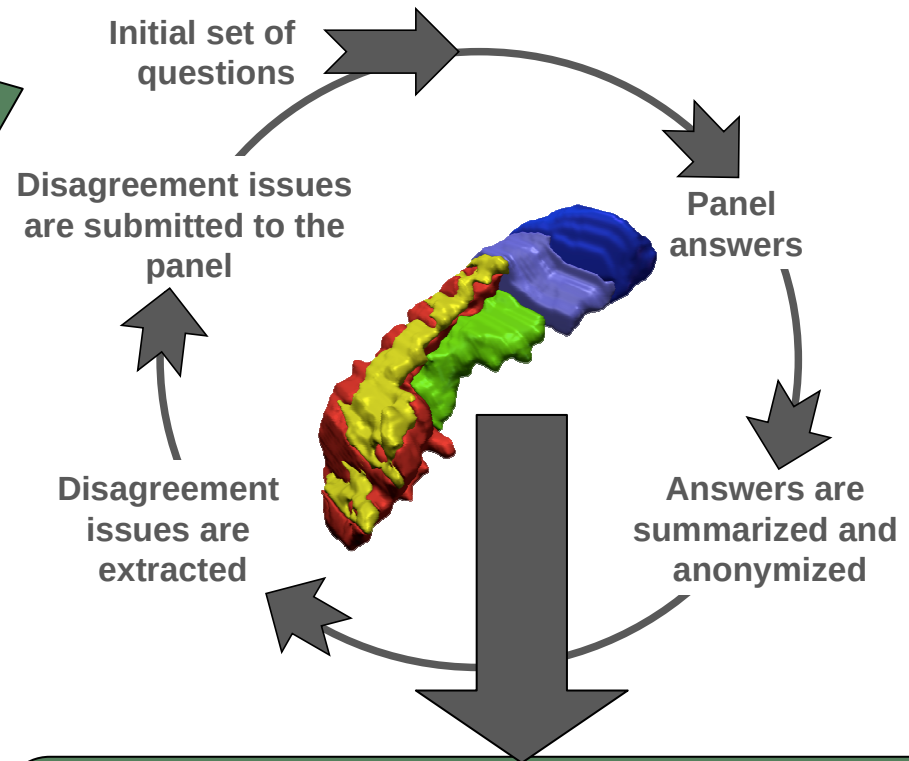
H. Wolf
Zurich

Consensual Definition of Harmonized Protocol

Assessment of
measurement
properties of SUs

- Stability of segmentation
- Contribution to total hippocampal volume
- Contribution to AD-related atrophy

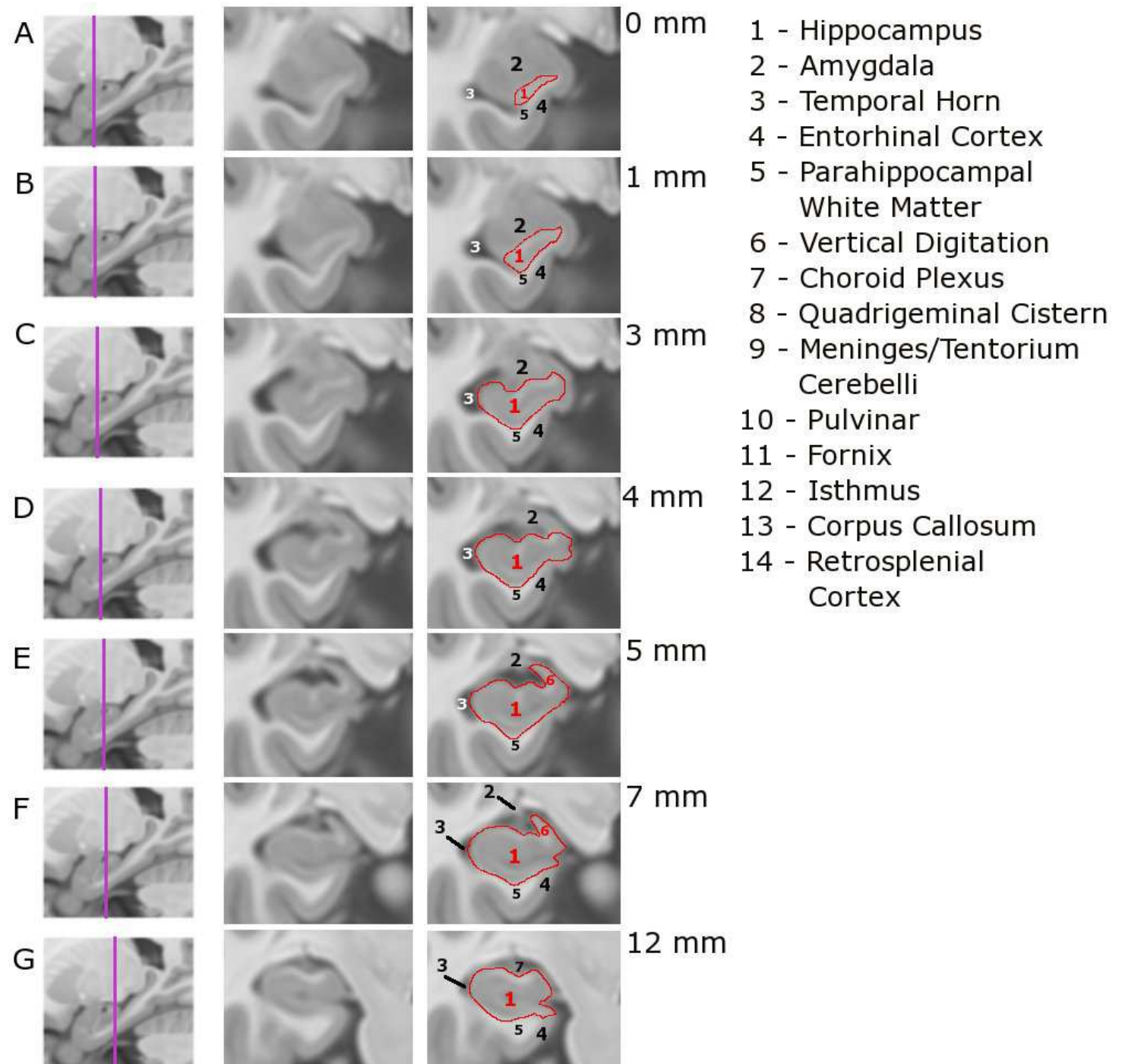
Delphi panel



Covers 100% of hippo proper
Captures 100% of AD atrophy
Very high IRR & TRTR: <.97

Drawing up of the protocol for manual tracing representing the Delphi criteria

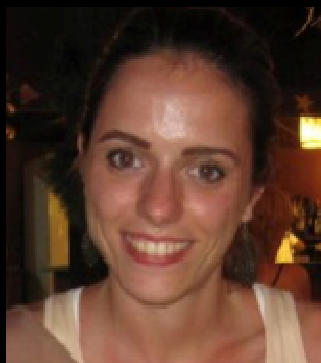
32 pages
23 figures
1 summary-table
1 summary-figure



Master Tracers



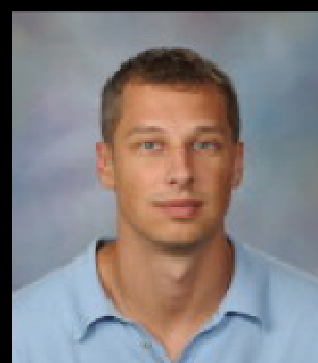
L. Apostolova
Los Angeles



M. Bocchetta
Brescia



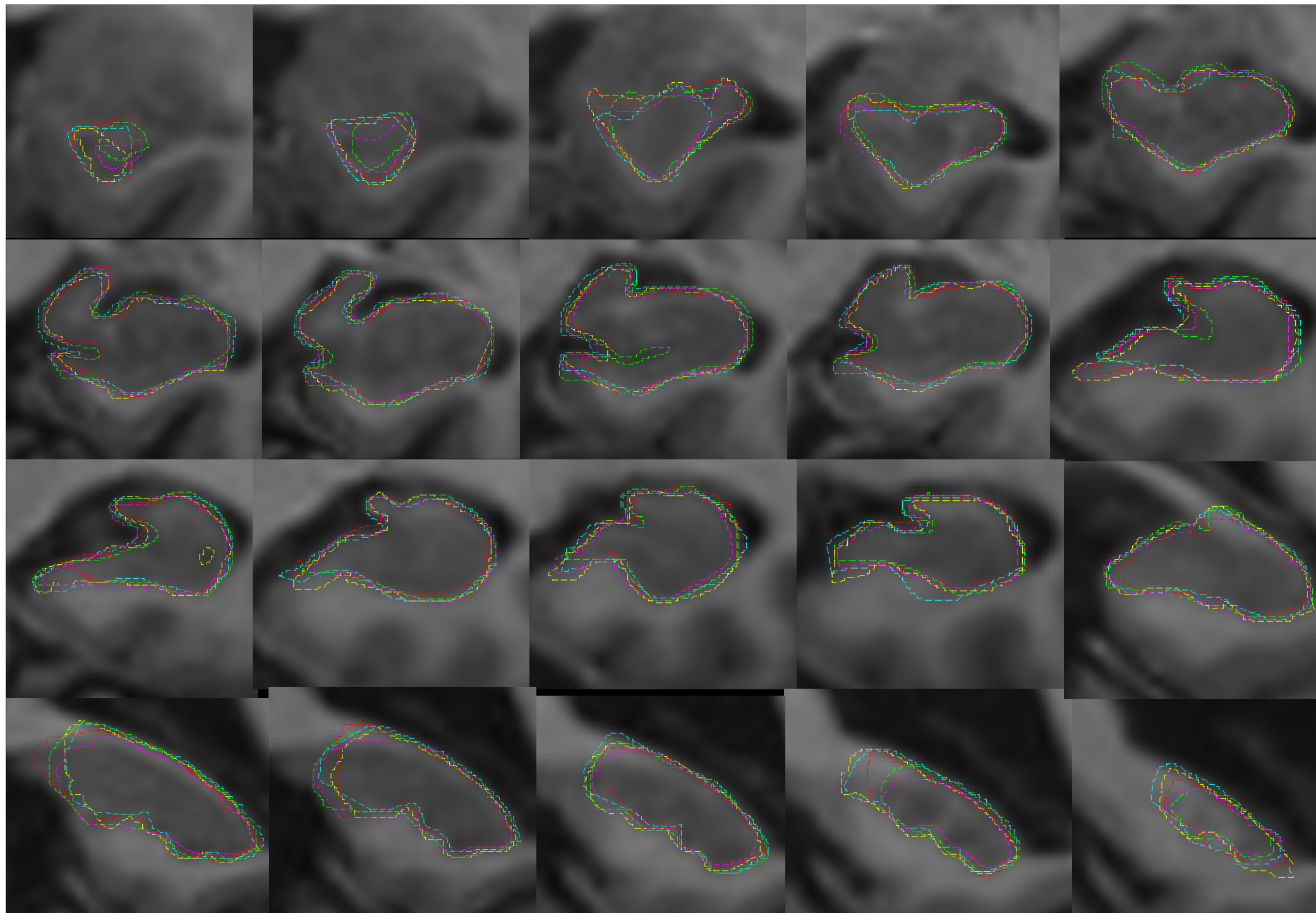
R. Ganzola
Quebec City



G. Preboske
Rochester



D. Wolf
Mainz



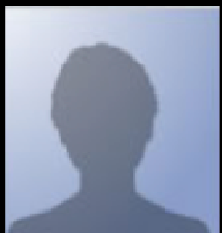
Benchmark Images Reliability

	Left Hippocampus	Right Hippocampus
Intra-rater 1.5T vs 3T (n=10)		
2 levels		
MB	0.982 (0.930-0.996)	0.994 (0.975-0.998)
RG	0.965 (0.867-0.991)	0.977 (0.909-0.994)
GP	0.976 (0.908-0.994)	0.987 (0.947-0.997)
LA	0.949 (0.757-0.988)	0.954 (0.791-0.989)
DW	0.982 (0.931-0.996)	0.988 (0.953-0.997)
Inter-rater (n=10)		
5 levels		
1.5T	0.974 (0.938-0.993)	0.983 (0.958-0.995)
Inter-rater (n=10)		
5 levels		
3T	0.949 (0.860-0.986)	0.965 (0.897-0.991)
Overlapping Value (among 5)		
	0.73	0.75

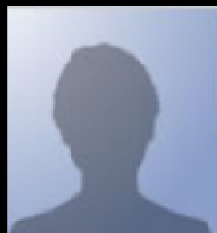
Naïve Tracers



C. Bauer



M. Blair



C. Boutet



E. Burton



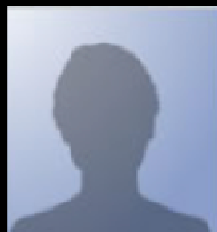
E. Cavedo



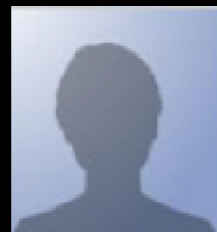
A. Christensen



KS. Frederiksen



M. Grothe



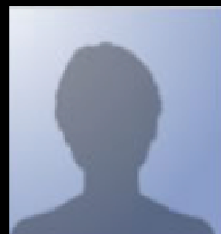
M. Lanfredi



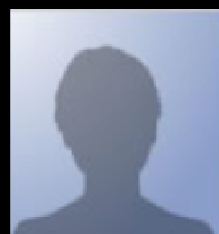
O. Martinez



M. Nishikawa



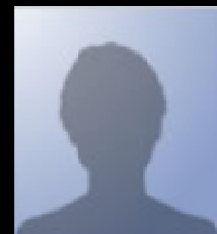
S. Pietrantonio



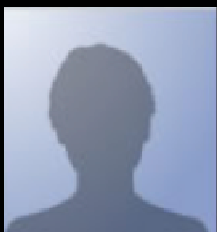
M. Portegies



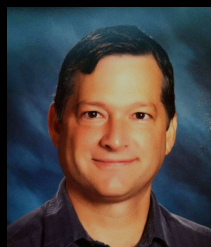
G. Preboske



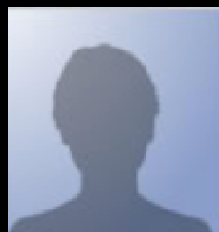
M. Pronk



T. Stoub



T. Swihart

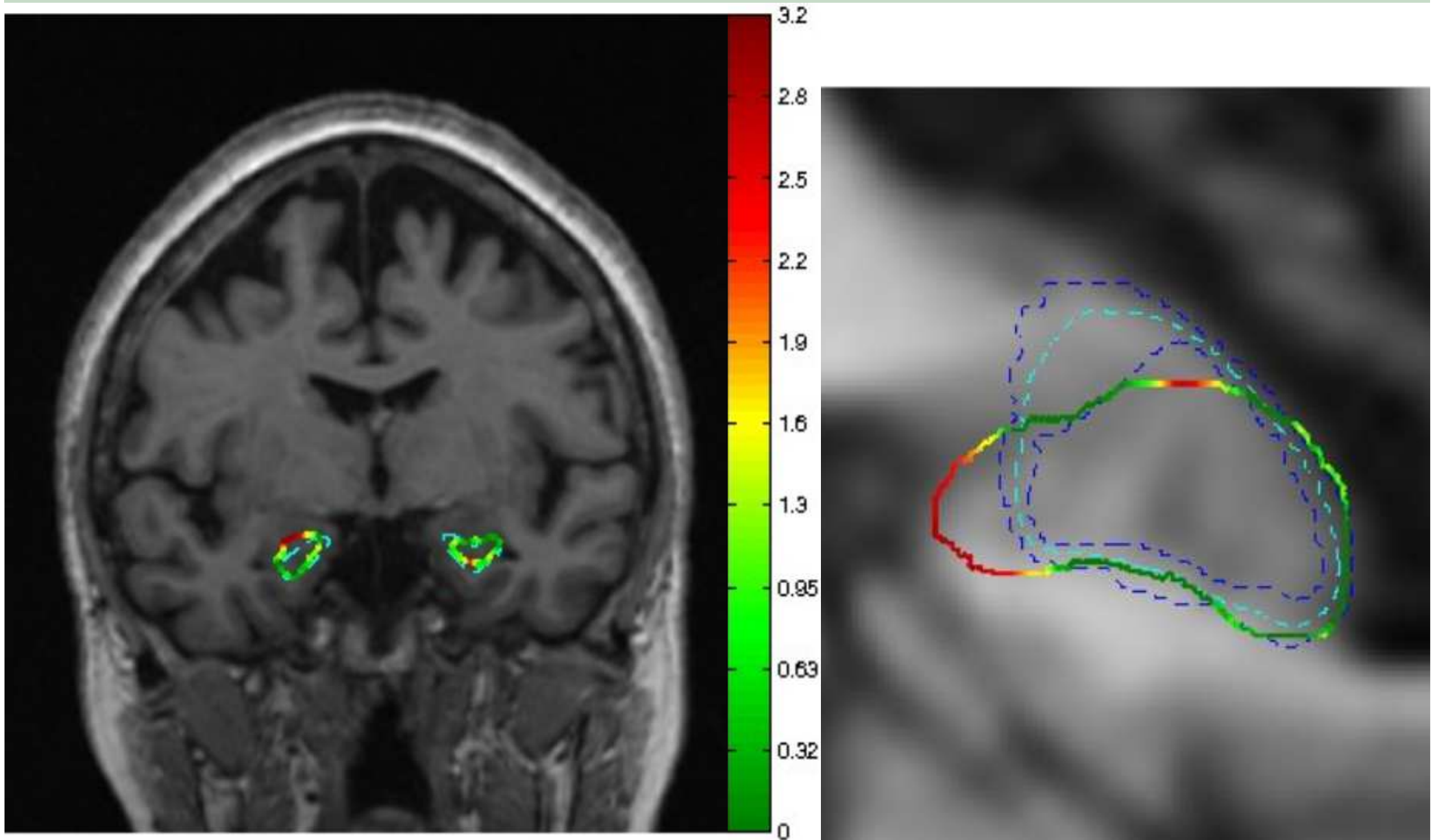


C. Ward



L. Yawu

Qualification Platform



Qualification Platform (first training step)

Tracer	Quantitative overlapping indices				Qualitative evaluation
	Dice		Jaccard		Would qualify this tracer?
	1.5T	3T	1.5T	3T	
Tracer 1	.89	.91	.81	.83	YES*
Tracer 2	.90	.90	.81	.81	YES*
Tracer 3	.87	.90	.77	.82	NO (* / §)
Tracer 4	.76	.90	.73	.82	NO §
Tracer 5	.88	.88	.79	.79	NO §
Tracer 6	.87	.89	.77	.79	NO §
Tracer 7	.82	.88	.70	.78	NO §§
Tracer 8	.85	.87	.74	.77	NO §
Tracer 9	.84	.86	.72	.76	NO §
Tracer 10	.82	.87	.70	.77	NO §§
Tracer 11	.79	.82	.65	.70	NO §§

www.hippocampal-protocol.net
hippocampal.protocol@gmail.com

Acknowledgements

Co-P.I.: **Clifford R Jack**

Brescia team: **Martina Bocchetta, Alberto Redolfi**

Alzheimer's Association

Lilly and Wyeth (part of the Pfizer group)

**ALL PARTICIPANTS,
and particularly, in the present phase:**

Statistical Working Group

Quebec City



Nicolas Robitaille



Fernando Valdivia

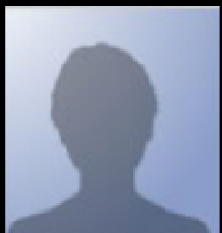


Simon Duchesne

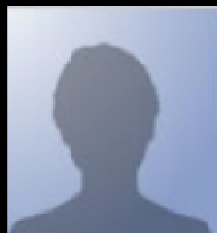
Naïve Tracers



C. Bauer



M. Blair



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E. Burton



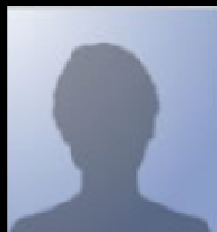
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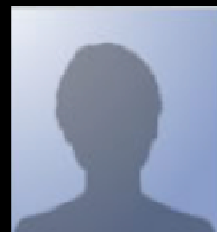
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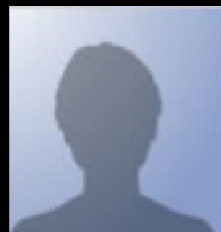
M. Lanfredi



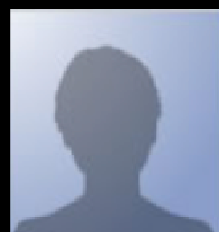
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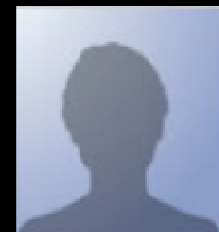
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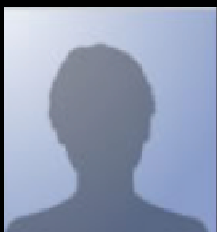
M. Portegies



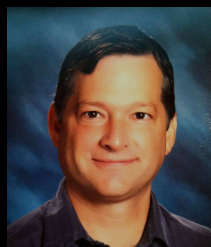
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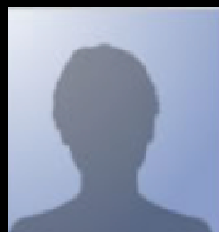
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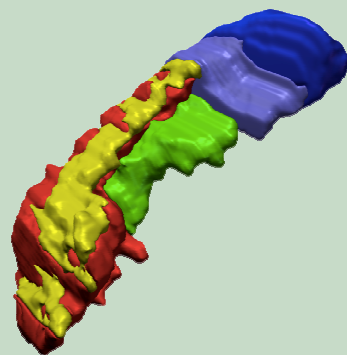
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www.hippocampal-protocol.net

hippocampal.protocol@gmail.com

alzheimer's  association®