

LNC - Laboratoire de neurosciences cognitives

Rapport Hcéres

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agence d'évaluation de la recherche
et de l'enseignement supérieur

Department for the evaluation of
research units

AERES report on unit:

Laboratoire de Neurosciences Cognitives
LNC

Under the supervision of
the following institutions
and research bodies:

Institut National de la Santé Et de la Recherche
Médicale

Ecole Normale Supérieure





agence d'évaluation de la recherche
et de l'enseignement supérieur

Research Units Department

President of AERES

Didier Houssin

Research Units Department

Department Head

Pierre Glaudes



Grading

Once the visits for the 2012-2013 evaluation campaign had been completed, the chairpersons of the expert committees, who met per disciplinary group, proceeded to attribute a score to the research units in their group (and, when necessary, for these units' in-house teams).

This score (A+, A, B, C) concerned each of the six criteria defined by the AERES.

NN (not-scored) attached to a criteria indicate that this one was not applicable to the particular case of this research unit or this team.

Criterion 1 - C1 : Scientific outputs and quality ;

Criterion 2 - C2 : Academic reputation and appeal ;

Criterion 3 - C3 : Interactions with the social, economic and cultural environment ;

Criterion 4 - C4 : Organisation and life of the institution (or of the team) ;

Criterion 5 - C5 : Involvement in training through research ;

Criterion 6 - C6 : Strategy and five-year plan.

With respect to this score, the research unit concerned by this report (and, when necessary, its in-house teams) received the following grades:

- Grading table of the unit: **Laboratoire de Neurosciences Cognitives**

C1	C2	C3	C4	C5	C6
A+	A+	A	A+	A	A+

- Grading table of the team: **Frontal lobe function**

C1	C2	C3	C4	C5	C6
A+	A+	A+	A+	A	A+

- Grading table of the team: **Social Cognition**

C1	C2	C3	C4	C5	C6
A	A	A	A	A	A

- Grading table of the team: **Visual Cognition**

C1	C2	C3	C4	C5	C6
A	A	A	A	A	A+



- Grading table of the team: **Economic Decision group**

C1	C2	C3	C4	C5	C6
A	A	A	A	A	A

- Grading table of the team: **Dynamical Neurotheory Group**

C1	C2	C3	C4	C5	C6
A+	A	NN	A	A	A+

- Grading table of the team: **Neural Inference Group**

C1	C2	C3	C4	C5	C6
A+	A+	NN	A	A	A+



Evaluation report

Unit name:	Laboratoire de Neurosciences Cognitives
Unit acronym:	LNC
Label requested:	INSERM, Ecole Normale Supérieure
Present no.:	INSERM U960
Name of Director (2012-2013):	Mr. Etienne KOEHLIN
Name of Project Leader (2014-2018):	Mr. Etienne KOEHLIN

Expert committee members

Chair:	Ms. Angela SIRIGU, CNRS Lyon
Experts:	Mr. Salvatore M. AGLIOTI, Sapienza University of Rome, Italy
	Mr. Julien BASTIN, INSERM Grenoble (<i>representative of INSERM CSS</i>)
	Mr. Klaus OBERMAYER, University of Berlin, Germany
	Mr. Guy ORBAN, University of Parma, Italy
	Mr. Marius PEELEN, University of Trento, Italy
	Mr. Gilles POURTOIS, University of Ghent, Belgium
	Mr. Rufin VAN RULLEN, CNRS Toulouse

Scientific delegate representing the AERES:

Mr. Laurent GROU

Representative(s) of the unit's supervising institutions and bodies:

Mr. Etienne HIRSCH (INSERM)

Mr. Yves LASZLO (ENS)



1 • Introduction

History and geographical location of the unit:

The LNC, is an Inserm-Ens research unit located at the Department of Cognitive Studies (Département d'Etudes Cognitives) of the Ecole Normale Supérieure in Paris. In the previous Aeres assessment (2008-2012) the unit counted a total of 4 groups (1. Executive functions; 2. Social communication; 3. Verbal communication; 4. Neural computation). In its new format the future LNC will be composed of six research teams distributed as follow: three are from the original lab (team 1: Frontal Lobe Function; team 2: Social Cognition group; team 4: Neural computation) with one team (Neural computation) split into two independent groups (Dynamical Neurotheory; Neural Inference group) and two have been newly created (Visual Cognition group; team 4: Economic Decision group). LNC's research space (around 400 square meters) is located on the second floor of ENS main building at the Rue d'Ulm. At the unit entrance an open space hosts students and post-docs working stations bordered by the offices of teams' leaders. The unit's space is pleasant and well organized. An additional space on the top floor has been recently granted by ENS where the Dynamical Neurotheory and Neural Inference teams are planning to settle. Despite the available space, because of an increasing number of students and postdocs the LNC still needs an additional room where members from different teams can do joint brainstorming to foster intergroup collaborations.

Management team:

The unit is directed by a prominent scientist, well known in the neuroscience domain who leads the *Frontal Lobe Function* team. Six consolidated researchers also well recognized in the field are part of the lab as team PI or co-PI. Five scientists hold the "Habilitation à Diriger les Recherches" (HDR). All graduate and post-graduate students are financially supported. One secretary and a research engineer (IR) constitute the only technical staff in support of the whole unit.

AERES nomenclature:

SVE1_LS5 Neurobiology

Unit workforce:

Unit workforce	Number as at 30/06/2012	Number as at 01/01/2014	2014-2018 Number of project producers
N1: Permanent professors and similar positions	4	4	4
N2: Permanent researchers from Institutions and similar positions	3	3	3
N3: Other permanent staff (without research duties)	0	0	0
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		1	1
N5: Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)	1	1	1
N6: Other contractual staff (without research duties)	2	4	4
TOTAL N1 to N6	10	13	13
Percentage of producers	100 %		



Unit workforce	Number as at 30/06/2012	Number as at 01/01/2014
Doctoral students	24	
Theses defended	9	
Postdoctoral students having spent at least 12 months in the unit*	17	
Number of Research Supervisor Qualifications (HDR) taken	4	
Qualified research supervisors (with an HDR) or similar positions	6	6



2 • Assessment of the unit

The LNC is enthusiastically animated by consolidated scientists who have already proven their scientific qualities and excellence in cognitive neuroscience and neurocomputation. During the site visit the members of the committee were impressed by the novelty of the scientific projects and everybody agreed that future results may have a strong impact for the national and international scientific community. The scientific productivity of the applicants is excellent in terms of quality and quantity. The committee has also perceived a strong involvement and excitement of students and post-docs in the scientific projects. The overall research goal of LNC is to assess human cognition (central executive functions, social cognition, economic decisions, neural simulation) using an array of functional imaging techniques (fMRI, EEG-MEG), neural computation methods and brain pathology. Two new teams have joined the unit for the future four years research plan. The first works in the domain of visual consciousness using MEG and the PI's past research is extensively quoted and recognized for the work on brain oscillations and the visual system. The second works on the neural basis of economic decisions. The PI, and coPI have associated their background in experimental economics and their expertise in brain imaging. The potential scientific interactions between these two new teams and the others is massive and if successful it may lead to important findings. Actually the committee has explicitly asked the PIs to commit themselves for collaborative studies across teams because the members feel that the mix of research ideas holds considerable promise. The unit outcome for the past four years is excellent with important publications in top (Science, Nature Neuroscience, Neuron, etc..) to excellent (J Neurosci, Cerebral Cortex) and good (NeuroImage, J Cogn Neurosci. Etc..) impact journals. A weak point of some teams concerns their rather large number of publication in journals such as "Frontiers" where papers are most of the time on invitation and acceptance rate too high comparing to others publication supports. Of course this is a minor point. In conclusion, on the whole, it was apparent that the overall strategy had the potential to be collaborative. During the visit, the committee felt a strong atmosphere of unity and mutual support. The research themes face crude competition from other groups worldwide but the LNC' teams show great potential to compete successfully, and to continue to publish in high impact journals.

All teams are financially "healthy" and the unit annual budget is significantly high. The PIs have been very successful in obtaining important grants from several national and international institutions. Among important grants there are two ERC, one "senior" obtained by the "Frontal group" and the other "starting" by the "Neuroinference group".

As it stands the unit technical support is poor. One secretary is the unique support for the lab administration and a research engineer for organizing data on the server and brain imaging analyses. Of course, the committee recognizes these technical needs but the members have advised the director to recruit two new technicians by using the Lab external funding. This may be an option while waiting for institutional permanent positions.

Strengths and opportunities:

High quality science performed by well know scientists from different fields in neuroscience. LNC's members have the competence to be the neuroscience "movers" and "shakers" in the local, national and international community.

Weaknesses and threats:

The LNC research report describes several potential collaborations between teams. This was the case also 4 years ago. Now the prospect of doing joint research in the future five years seems however more realistic. We therefore encourage the PIs to commit themselves on this important point.

Recommendations:

Our main recommendation is to exploit the scientific potential of each team to cross ideas in the context of multidisciplinary projects. The committee predicts outstanding results if this recommendation is followed. The experimental techniques used by the groups of the LNC are applied essentially to humans. It would be extremely interesting if their lines of research also converged towards non human primate investigations, perhaps by collaborating with monkeys neurophysiology labs established in Paris.



3 • Detailed assessments

Assessment of scientific quality and outputs:

The LNC scientific outcomes are very high. For instance the “executive model” proposed by the ‘Frontal group’ has been very influential in the community. It has been tested and confirmed by several authors across the world in neuroimaging studies with normal subjects and in psychophysical evaluations in brain damaged and psychiatric patients. Also, the models developed by the “Neuroinference” and by the “Dynamical theory” groups are well recognized and both teams are clearly among the internationally highly visible and well-reputed teams for Computational Neuroscience research. The “social cognition” group has contributed to new avenues of research by providing a conceptual link between the motor and the emotional systems and used this framework for the comprehension of autistic disorders. The “visual cognition” group proposes original ideas by bridging together the enteric system and the brain in order to determine how the two fluctuate. Finally, the neuroeconomic group has already contributed with seminal papers to the understanding of the complex relations between emotion and decision making and the neural bases of the subjective value or utility signals that guide economic choices. Recent projects from this group have led to interesting behavioural dissociations as a function of individuals’ economic decisions in private versus social settings. All teams have extensively published and contributed with outstanding papers in high impact journals. The committee members have no worries about the LNC scientific contribution for the next 5 years.

Assessment of the unit's academic reputation and appeal:

The unit attracts several students from France and abroad. Importantly, the LNC has a number of PhD students highly selected from the ENS. Because the LNC director and its members are well known in the neuroscience field, this certainly rank the lab among the best in the French community. The LNC is also part of the Institut d’Etude de la Cognition (IEC) created in 2011, one of the French “Laboratoires d’Excellence” (LabEx) (the French excellence research funding program).

Assessment of the unit's interaction with the social, economic and cultural environment:

The LNC involvement beyond scientific contexts is very good. The director receives invitations from influential institutions and the whole lab research has an obvious impact in various social and cultural contexts.

Assessment of the unit's organisation and life:

The committee perceived a wise competition among members coupled with an atmosphere of unity and mutual support. Furthermore, the committee wants to stress the excellent leadership of the director whose authority is unquestionable. Nowadays researchers have to cope with worldwide competition but the LNC’ teams show great potential to succeed. All teams are well-funded since the PIs have been very successful in obtaining important grants from several national and international institutions. As stressed above, the unit technical support is poor and it doesn’t match the growing technical need seniors and students have for their research projects. One secretary and one engineer constitute the unique technical support for the whole lab.

Assessment of the unit's involvement in training through research:

The training activity of the unit is simply excellent. The committee was impressed by the enthusiasm expressed by PhD students and postdocs concerning their research projects. Moreover all students were very positive about the quality of their training and the opportunities the LNC offers to them.

Assessment of the five-year plan and strategy:

The five-year research plan is outstanding. All the proposed projects will lead to important results that will certainly be published in good journals. All future projects are presented as between-teams collaborations and take the opportunity to exploit the expertise of the members of the unit as a whole. If collaborations are maintained great results can be expected.



4 • Team-by-team analysis

Team 1 : Frontal lobe function

Name of team leader: Mr. Etienne KOEHLIN

Workforce

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014	2014-2018 Number of project producers
N1: Permanent professors and similar positions	1	1	1
N2: Permanent EPST or EPIC researchers and similar positions			
N3: Other permanent staff (without research duties)			
N4: Other professors (PREM, ECC, etc.)			
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)	1	1	1
N6: Other contractual staff (without research duties)	2	2	2
TOTAL N1 to N6	4	4	4

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014
Doctoral students	6	
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit	5	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	1	1



• Detailed assessments

Assessment of scientific quality and outputs:

The frontal lobe function team joined the research unit (INSERM-ENS U960) in 2009 and is directed by Mr Etienne KOEHLIN (DR1 INSERM). The objective of the team is to understand the computational and neuronal mechanisms underlying executive control mediated by human frontal lobes. This is a very active, creative team that developed a model of the functional architecture of cognitive control (the cascade model). This model is internationally recognized as one of the prominent theory of prefrontal cortex functioning. Four axes have been developed to test and improve this model. These axes respectively address (1) dysexecutive syndromes mechanisms; (2) Motivational regulation of cognitive control; (3) Computational modelling of prefrontal executive function: controlling the creation, learning, storage retrieval and selection of tasks set driving actions; (4) The role of prefrontal executive function during perceptual inference. Between 2007 and 2012, using mostly fMRI recordings, the team modeled neuronal computations underlying anterior prefrontal functions, described motivational regulation of executive control, integrated learning, reasoning and exploration to their model and investigated information flows between visual and prefrontal areas during perceptual inference. Both the quantitative and qualitative quality of the team's publication is outstanding (18 original research articles: 2 Science; 3 Neuron; 1 Nature Neuroscience; 1 PlosBiology; 3 Journal of neuroscience; 1 Brain...). In June 2012, the team was composed of the group leader, 4 post-doc and 4 PhD students.

Assessment of the Team's academic reputation and appeal:

The team is highly attractive (as indicated by post-doc and PhD students coming from prestigious schools/universities around the world). The impact of the team and the PI is major in the field of frontal lobe function (their model was cited as one of the 10 most important discovery in cognitive neuroscience; the PI belongs to the top 1% cited scientists), and therefore their work is internationally recognized as being of excellent quality. The team has long-term collaborations with neurologists (Paris, St Anne Hospital) and psychiatrists (Lyon, CHU Le Vinatier) and the PI is regularly invited to international conferences (about 30 invited talks). The group leader is funded by European grants (One young investigator and one Advanced research Grant were obtained).

Assessment of the Team's interaction with the social, economic and cultural environment:

The PI gave several talks for a general public audience in Collège de France (2007), Institut Demos (2008, targeting company managers), Institut Henri Poincaré (2009, "La tour de Hanoi: un casse-tête mathématique d'Edouard Lucas"), Fondation pour la Recherche sur le Cerveau (2009, fund-raising events in Mairie du VIII arrondissement), Les Conférences de Bourg-La-Reine (2010, Cultural events in Hauts-de-Seine, "Les neurosciences aujourd'hui"), the Air and Space Academy (2011, international conference on "air transport pilots facing the unexpected" with proceedings targeting professionals in the Air and Space sector), Centre Sèvres (2012, Jesuit's Center in Paris for Philosophy and Theology, "Neurosciences et Liberté"), Fondation Hugot du Collège de France (2012, "Anticipation, Prediction, Temporalité"). In addition, the PI was a consultant for the "Agilis" agency for the development of a continuing education video program for Medical doctors (2011).

The PI acts as a scientific expert for the creation of a new public museum space dedicated to Brain & Cognition in the Cité des Sciences et de l'Industrie de la Villette, Paris (2012, public opening: 2014). Finally, the PI is often interviewed by scientific and generalist journalists writing for the general public (Pour la Science, Scientific American, BBC, National Public Radio, Le Monde de l'intelligence, Le Figaro, Le Figaro Magazine, TV-channels, etc.). The PI was also interviewed for making a short film produced by INSERM and Cargo Film in 2010 "Rêves de Recherche, Rêve de Chercheurs" aiming at promoting careers in research.

Assessment of the Team's organisation and life:

The PI specified that he supervises and coordinates the scientific work of post-doc and students according to well-established ethical and managerial guidelines (weekly meetings, journal clubs, one to one meetings...).

Therefore, both management and life of the team seems to be adequate to enable the best expressions of each team member quality during their stay in the team.



Assessment of the Team's involvement in training through research:

5 PhD were defended in June 2012. The group leader also teaches a full Master/PhD level Course entitled « Action, décision and Volition » (approximately 45 hours / year). Finally, the group leader acted as an external referee in 12 PhD thesis and 3 HDR committees. Altogether, the team is quite impressive in its capacity to train young researchers.

Assessment of the five-year plan and strategy:

The project aims at testing new predictions that emerged from the new computational model developed by the team (Collins and Koechlin, 2012 ; Plos Biology) by (1) using fMRI to perform a new functional parcellation of the prefrontal cortex. In addition the team plans to use sEEG, (2) to examine the temporal dynamics of executive control function, (3) A basal ganglia component will also be added to the computational model, (4-5) computational modeling, MEG and fMRI will be combined to examine the functional role of prefrontal-perceptual systems interactions. The project seems very exciting in the sense that it critically expands both the conceptual and empirical contributions of the team between 2007 and 2012. In particular, adding MEG and sEEG experiments will probably favor intense interactions with the team in the LNC, which has a strong expertise in MEG/sEEG analyses. Overall, projects are well developed and focused and address cutting-edge research questions of cognitive neuroscience.

Conclusion:

● Strengths and opportunities:

This is an excellent, productive team with a lot of creativity. The team leader is a world-class expert on this topic and we wish that his team continue to combine neuroimaging and neuro-computational model of prefrontal cortex functions to uncover new brain mechanisms mediating human decisions. The team makes significant conceptual advances in the field on a regular basis and has proposed an intriguing and very exciting new model that will be tested in the next years. They use advanced methodological tools that combine fMRI/computational models and effective connectivity analyses.

● Weaknesses and threats:

The time dynamics of executive control processes have not been addressed because of the technical limitations inherent to fMRI. The project addresses this weakness by proposing to combine fMRI, MEG and sEEG. A potential limitation inherent to sEEG will be the limited spatial coverage of the prefrontal cortex offered by such recordings simultaneously at single subject level. Therefore, links with groups studying prefrontal cortex in non human primates would be an extremely useful addition.

● Recommendations:

An interesting issue regarding the basal ganglia component (striatum) might be to directly record this structure using deep brain electrode local field potentials recordings (that are similar to cortical sEEG but are in the basal ganglia).

The team might have to develop new statistical between subjects methods of analysis in order to examine the functional connectivity between different prefrontal regions of interests (ROIs) across patients; because each ROI won't be recorded within single subject level of analysis. To conclude, this is a strong and mature team. Its visibility in neuroscience is very good. In light of the originality of the project, there is no doubt that the high level of publication will be maintained in the near future.



Team 2 : Social Cognition

Name of team leader: Ms. Julie GREZES

Workforce

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014	2014-2018 Number of project producers
N1: Permanent professors and similar positions	1	1	1
N2: Permanent EPST or EPIC researchers and similar positions			
N3: Other permanent staff (without research duties)			
N4: Other professors (PREM, ECC, etc.)			
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)			
N6: Other contractual staff (without research duties)	1	1	1
TOTAL N1 to N6	2	2	2

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014
Doctoral students	4	
Theses defended	2	
Postdoctoral students having spent at least 12 months in the unit	2	
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	1	1



• Detailed assessments

Assessment of scientific quality and outputs:

The Social Cognition group published a large number of papers (29) in the period 2007-2012 (e.g. Journal of Neuroscience, Cortex, Cerebral Cortex). The central theme of this work was to explore brain responses to dynamic displays of emotional bodies, particularly angry and fearful bodies, and test how these responses depend on attentional control, gender, and self-relevance.

This work followed up on earlier work on emotional body perception by the PI and other groups, and has led to several novel findings. The work is generally of good quality and has been published in mid- to high-impact neuroscience journals.

Assessment of the Team's academic reputation and appeal:

The team leader has a very good international reputation, based on highly influential and highly cited empirical and review papers on action observation. She is well known and respected in the growing field of social neuroscience.

Assessment of the Team's interaction with the social, economic and cultural environment:

This criteria does not apply to this team.

Assessment of the Team's organisation and life:

The team is quite limited in size and everything seems to proceed smoothly. There is thus nothing specific to report.

Assessment of the Team's involvement in training through research:

The team leader supervises 3 PhD students and co-organizes a Masters course on social cognition. Many PhD students and postdocs in the lab have published their work in international peer-reviewed journals, which provides an excellent start of their research careers.

Assessment of the five-year plan and strategy:

The proposed research is partly a continuation of existing research, but also contains novel research directions. One goal is to clarify the neural substrates of emotion perception, using various techniques, focusing on the role of self-relevance, premotor-limbic anatomical connections, types of emotion, and an individual's social behavior. In collaboration with other groups of the unit, the group also plans to explore neural mechanisms of emotional perceptual decision making, requiring the integration of visual social cues. Although somewhat explorative in nature, the proposed research will likely provide interesting results. A more specific goal is to test the hypothesis that autism-related social dysfunction is the result of abnormal anatomical connections between the limbic and the motor systems. This is a very interesting study with potentially important implications.

Conclusion:

• Strengths and opportunities:

Strengths and opportunities: This group has been very productive and is expected to continue to produce new results clarifying the neural basis of emotion perception and social cognition. The proposed research is novel, interesting, and contains important links to the other groups of the unit.



- Weaknesses and threats:

Some of the proposed research lines appear to be rather explorative, with the general aim to clarify the neural substrates of emotion perception. Hence, a possible downside is that obtained imaging results (e.g., modulation of activity in a particular brain region as a function of one of the proposed variables) are interpreted post-hoc, reducing the theoretical contribution of the work.

- Recommendations:

It would be beneficial to spell out a theory or framework that makes specific (falsifiable) predictions about brain responses to the various manipulations proposed.



Team 3 : Visual Cognition

Name of team leader: Ms. Catherine TALLON-BAUDRY

Workforce

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014	2014-2018 Number of project producers
N1: Permanent professors and similar positions			
N2: Permanent EPST or EPIC researchers and similar positions		1	1
N3: Other permanent staff (without research duties)			
N4: Other professors (PREM, ECC, etc.)			
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)			
N6: Other contractual staff (without research duties)			
TOTAL N1 to N6		1	1

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014
Doctoral students		
Theses defended		
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions		1

• **Detailed assessments**

Assessment of scientific quality and outputs:

The team leader of this new group published 15 peer-reviewed articles in the period 2008-2012 (e.g. J Neurosci., Neuroimage). These papers, which are generally of high quality, report novel findings on the relationship between visual attention and visual awareness, using behavioral and neuroimaging (EEG, MEG) measures. One of the major findings was a dissociation between the neural signatures of visual awareness and spatial attention, which were shown to affect different frequency bands in MEG.



Another important finding was that pre-stimulus neural activity in specific frequency bands influences visual awareness. Together, the 15 published papers in the evaluated period have already been cited >250 times, which is very good for such a short period.

Assessment of the Team's academic reputation and appeal:

The PI has an excellent academic reputation with outstanding expertise in MEG and, more generally, analysis of complex neurophysiological signals. She has done fundamental work on visual perception, attention and awareness, and is one of the top researchers worldwide studying the role of oscillatory neural activity in visual cognition.

Assessment of the Team's interaction with the social, economic and cultural environment:

The PI has contributed very substantially to the development of the MEG center at La Salpêtrière and she secured funding for a new MEG machine and the shielding.

Assessment of the Team's organisation and life:

N/A

Assessment of the Team's involvement in training through research:

The PI has supervised 3 Master students, 3 PhD students and 3 post-docs between 2007-2012. She has also been involved in the organization of conferences and training schools. Taken together, the PI has made substantial contributions to the training of young researchers.

Assessment of the five-year plan and strategy:

The PI made the choice to abandon the overseeing of the large MEG facility to concentrate on her research in a smaller group within the unit. The panel completely supports this move. The 5-year research plan consists of two parts. The first part is a logical continuation of previous work on attention and awareness, studied using various dependent measures including MEG. Considering the excellent track record of the PI in this field, this research is expected to lead to promising new results and papers. The second part addresses the role of bodily signals in visual consciousness. The goal is to find out whether and which bodily signals (e.g., heart rate, slow enteric waves) contribute to visual consciousness. This research line is very innovative but also somewhat speculative in the absence of existing data on this topic.

Conclusion:

- Strengths and opportunities:

The team leader has a very strong publication record and reputation, and is expected to continue to make important contributions to the field of visual cognition.

- Weaknesses and threats:

From the proposal, it is not clear exactly how the proposed research might benefit from the expertise of the other groups in the unit (e.g., neural theory, fMRI, social cognition). The proposed research on brain-body interactions is still a bit vague. Again the visual system of the non-human primate is extremely well known and an excellent model for the human one. The lack of knowledge and connections with groups studying the much more accessible non human primate visual system is a weakness that can easily be corrected.



- Recommendations:

It will be important to find a good balance between the two proposed research lines, with some exploration of novel topics but also a solid continuation of the highly successful research on visual cognition. More contact with groups with expertise in fMRI, e.g. developing techniques such as retinotopic mapping to define visual cortical areas, would be beneficial.



Team 4 : Economic Decision group

Name of team leader: Mr. Giorgio CORICELLI

Workforce

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014	2014-2018 Number of project producers
N1: Permanent professors and similar positions			
N2: Permanent EPST or EPIC researchers and similar positions		1	1
N3: Other permanent staff (without research duties)			
N4: Other professors (PREM, ECC, etc.)		1	1
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)			
N6: Other contractual staff (without research duties)			
TOTAL N1 to N6		2	2

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014
Doctoral students		
Theses defended		
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions		1



- Detailed assessments

Assessment of scientific quality and outputs:

This group is a new team and will become officially one of the six groups of the research unit, starting from January 2014. There is 2 PIs, one at consolidator and the other at junior stage. The common objective of the PI's is to understand human decision-making processes by combining computational, psychological and neuroimaging data. The team leader is an expert in the field of game theory, experimental economics and neuroscience. His last discoveries concern the relationships between emotions and cognition in decision-making. Fourteen papers were written between 2007 and 2012 (9 out of 14 were signed in first or last position; all the other in second or equivalent position; 2007: 1 TICS; 2009: 1 PNAS; 2011: 1 PNAS). The other PI of the team is an expert in the field of brain mechanisms of decision-making. She examined brain activity underlying valuation vs. saliency signals. Between 2007 and 2012, she published 12 papers (3 as first author in good to very good journals (2007 and 2010: 2 J. Neurosci papers; 2008: 1 PNAS paper) and 2 articles as a second author J Neurosci in press and Cerebral cortex 2010). Therefore, the scientific quality and outputs can be considered excellent for both PIs.

Assessment of the Team's academic reputation and appeal:

The media coverage of the PI's previous research is impressive and speak in favor of a very good academic appeal.

Assessment of the Team's interaction with the social, economic and cultural environment:

The topic of this group may impact current theoretical approaches to the study of human social behavior. The co-PI is member of an inter-university team (IHU) of researchers in nutrition, microbiology, and epidemiology which received a large grant to fund the Institute for Cardio-Metabolism and Nutrition (ICAN). She is also a member of another IHU of researchers in neuroscience and social sciences which received a large grant to fund the Institut de Neurosciences Translationnelles de Paris for Research on Motivation: Understanding and managing disorders of motivation: a novel approach in the behavioral medical sciences.

Assessment of the Team's organization and life:

Not applicable because this is a new group (officially starting as such in January 2014).

Assessment of the Team's involvement in training through research:

The team leader supervised 4 Post-doctoral fellows; 10 PhD students and 4 Master students between 2007-2012. He also gives regular lectures at the level of Master/Phd on economic decision making.

Assessment of the five-year plan and strategy:

The group plans to perform research in the emerging field of economic decision making to which the two PIs has already contributed. The proposed projects have theoretical and application-related importance. Some of them are also potentially relevant for the health system. The translational implications are not much emphasized but they seem apparent even from the few general statements on this issue reported in the project.

Conclusion:

- Strengths and opportunities:

The two PIs have a very good publication record and high reputation in the field. The assistant professor is already very well integrated in the environment thanks to a long-standing collaboration with the frontal lobe group (headed by the Director of the research unit). The topic of this new group is well in keeping with the mission of the unit. The two PIs have demonstrated that they are active fund hunters/recipients being awarded national and



international grants. Particularly promising seems the access to health system-related large-scale grants although it is not clear whether it is perspective or actual money.

- Weaknesses and threats:

Need to manage carefully the transition towards the use of methodologies (e.g. MEG and iEEG) different from the one mainly used thus far (fMRI). Both MEG and iEEG require great expertise and technical investments. The environment may have most of what this new group needs for implementing successful collaborations to provide the expertise (other group within LNC). Two main research streams are presented. The first mainly deals with Individual decision making and expands on the important work of one of the PIs. In particular, the research will explore at both behavioral and neural levels how specific subjective value signals guide economic choices. Interestingly, one can see the attempt to link state-related decision to rather stable cognitive features of the individual involved in the choice. No specific reference to personality traits is reported but we believe the researchers are aware of the importance of the issue. The second main stream deals with social decision making and, in keeping with the work already carried out by the group leader, aims to develop dynamic contextual social settings for exploring a variety of phenomena of fundamental importance for (neuro)-economics (such as regret and its learning). We recommend the two PIs to consider in great detail the feasibility of the proposed projects. For example the first part of project 1 (out of three), the PI expects to publish 5 papers. At the rate of publication of the PI, this is by itself a five-year project. Additional potential funding for this project (that might speed-up this project thanks to post-docs) is not described. Hence, it is not clear whether the PI will successfully complete part 2 (3 expected papers) and part 3 of the project (2 expected papers) because these represent another 5-year project. The PIs may have been over-optimistic regarding their ability to do all what they claim they plan to do within five years. Therefore, we recommend them to focus on some of the projects and to collaborate with other groups (i.e., not being PIs anymore) for some of their depicted projects.

Two other details: since only the team leader seems to have the conditions to supervise PhD students (HDR), we are not sure that it will be (at least administratively speaking) possible to handle 6 PhD students in the next five years. Finally, some important details should be clarified, especially regarding what the PIs mean by "pharmacological modulation" in some parts of their projects: what exactly will be manipulated (dopamine, serotonin? other?) Will this be tested on patients? More details are needed here to fully understand this part of the project.

- Recommendations:

Interestingly, the two PIs seem to share the project on the emotional modulation of value signals. This indexes the group aims to achieve a high degree of integration. We strongly recommend they pursue such an aim.



4 • Team-by-team analysis

Team 5: Dynamical Neurotheory Group

Name of team leader: Mr. Boris GUTKIN

Workforce

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014	2014-2018 Number of project producers
N1: Permanent professors and similar positions	1		
N2: Permanent EPST or EPIC researchers and similar positions	3	2	2
N3: Other permanent staff (without research duties)			
N4: Other professors (PREM, ECC, etc.)			
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)			
N6: Other contractual staff (without research duties)			
TOTAL N1 to N6	4	2	2

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014
Doctoral students	6	
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit	4	
Number of Research Supervisor Qualifications (HDR) taken	3	
Qualified research supervisors (with an HDR) or similar positions	1	1



• Detailed assessments

Assessment of scientific quality and outputs:

Over the past years, the Neural Theory Group and collaborators established an excellent track record in research in Computational Neuroscience. There were 20 publications, most of them in leading international journals of the field (e.g. J. Neuroscience, Neural Comput., SIAM J. Appl. Dyn. Syst., PLoS Comput. Biol, etc.) as well as one publication in Neuron. Overall, the team leader and collaborators were very productive during the past funding period. Excellent results with a strong impact were, for example, achieved in the computational psychiatry and dendritic computation fields - for the latter specifically in the context of hippocampal dynamics. Innovative theoretical concepts were developed (e.g. with respect to the computational role of intrinsic oscillations in dendrites) and computational methods were introduced to new fields (e.g. computational psychiatry). In addition, there is an excellent (though more "mainstream") track record in understanding neural dynamics. There was an excellent mix between conceptual work and down-to-data projects, and there were a number of experiment-theory collaborations, which already led to joint publications, which is a big plus.

Assessment of the Team's academic reputation and appeal:

The team leader has an excellent scientific track record with 20 (16 as a first or last author) publications in peer-reviewed international journals over the past 6 years. Although the track record is still dominated by theory and math publications, strong impact in the neuroscience area has clearly been made (e.g., through his recent publication in Neuron). Although the team leader and his group is primarily concerned with basic research, the successful collaboration with the US based company Targacept Inc. already demonstrates important implications for health and clinical research. The team leader was very active within the scientific community with the organisation of workshops and summer schools, with editorial work, and as a member of review panels. He has a very good funding track record with a total of almost 800 kEUR. The other researcher will strengthen the group in the area of neural dynamics and has an excellent theoretical track record in this area. The group clearly has established itself as one of the internationally visible and well-reputed places for Computational Neuroscience research.

Assessment of the Team's interaction with the social, economic and cultural environment:

N/A

Assessment of the Team's organisation and life:

The team is quite limited in size and everything seems to proceed smoothly. There is thus nothing specific to report.

Assessment of the Team's involvement in training through research:

The team leader has supervised 4 PhD students, one of whom has already defended the PhD successfully, with a publication in a leading applied math journal (SIAM J Appl Dyn Syst). In addition, there was the supervision of several Master students. The team leader had been on the faculty of two highly reputed international summer schools and was organizing a third one. He is coordinator of the French node of the Russian-EU postgraduate network (BION), and he is on the faculty of (and teaching within) three graduate/doctoral schools in Paris. In summary, there exists a well-structured integration of students in the scientific activities of the team, from master to PhD.

Assessment of the five-year plan and strategy:

The group's research agenda picks up three highly relevant "hot topics" in current Computational Neuroscience: Dendritic computation, oscillations and effortful cognition, and circuit models of reward-based learning. These efforts are complemented by research activities in the more mainstream (though still important) research area of network dynamics. The attempt to bridge multiple scales is also very laudable. Most of the proposed subprojects build on highly successful previous work, so the committee expects the group to continue being very productive in the future, too. Given that the research topics are timely and of high relevance, the group's results will have a strong impact in the neuroscience field.



The experimental teams within the LNC unit are strongly focussed on non-invasive methods and human neuroscience, while a larger part of the scientific agenda of the DNG team is focussed on computational models addressing "invasive" phenomena (membrane potentials, spikes, rates) and smaller scales (neurons & networks). It is appreciated, that a key mission of the theory groups is to understand the neural implementations of (human) cognitive function, which requires investigations at the "lower levels". In order to exploit the synergies within LNC, however, validation of computational hypotheses against (mostly non-invasive) human data should be one important point on the group's future research agenda. A new principal scientist was recruited in order to specifically work in this area, which is a big plus.

One key feature of the research agenda of the original Neural Theory Group was the combination of top-down, functional approaches (using concepts from AI and machine learning) with bottom-up approaches using concepts from dynamical systems and neural network modelling. This combination of expertise is - on the one hand - essential, if one wants to understand how brain systems implement cognitive functions. On the other hand, there is the danger that the palette of subprojects becomes too diverse. Given this fact, the split into two complementary (but collaborating) new research groups is very reasonable.

Conclusion:

- Strengths and opportunities:

There is a wide range of expertise in theory and computational modelling for addressing the dynamics of neural systems, which is an excellent starting point for understanding mechanisms and implementations underlying cognitive functions. The group has a large number of contacts and collaborations with experimental researchers working on different levels, which can be exploited in the new funding period. There is also an excellent mix between conceptual and down-to-data projects. The group clearly has established itself as one of the internationally visible and well reputed places for Computational Neuroscience research.

- Weaknesses and threats:

The research agenda has a broad scope and there is the danger that the projected resources in personnel may not be fully sufficient - in particular given uncertainties about recruiting possibilities in the French system specifically for collaborative research. The office space is really small and may be a limit. There is, for example, no space for guest researchers, and there is no space for having small meetings and discussion groups.

- Recommendations:

Synergies within LNC could be strengthened further with a still stronger focus on strategies for the validation of computational hypotheses against human (specifically non-invasive) data.



Team 6: Neural Inference Group

Name of team leader: Ms Sophie DENEVE

Workforce

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014	2014-2018 Number of project producers
N1: Permanent professors and similar positions	1	1	1
N2: Permanent EPST or EPIC researchers and similar positions			
N3: Other permanent staff (without research duties)			
N4: Other professors (PREM, ECC, etc.)			
N5: Other EPST or EPIC researchers (DREM, Postdoctoral students, visitors, etc.)			
N6: Other contractual staff (without research duties)	1	1	1
TOTAL N1 to N6	2	2	2

Team workforce	Number as at 30/06/2012	Number as at 01/01/2014
Doctoral students	2	
Theses defended	1	
Postdoctoral students having spent at least 12 months in the unit	2	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	1	1



- Detailed assessments

Assessment of scientific quality and outputs:

Over the past years, the Neural Theory Group established an excellent track record in research in Computational Neuroscience. There were 13 publications, most of them in leading international journals of the field (e.g. J. Neuroscience, Neural Comput., PLoS Comput. Biol, etc.) as well as three publications in Nature Neuroscience and Proc. Natl. Acad. Sci. USA. Overall, the team leader and her collaborators were very productive during the past funding period. The team leader developed an innovative framework for probabilistic inference with spiking neurons. This and her other work on optimal inference led to excellent results with strong impact in the field. Although subprojects are seemingly diverse (ranging from control of eye-movements to sensory integration for perceptual decision making), they were linked by the common theoretical concept of Bayesian inference. There was an excellent mix between conceptual work and down-to-data projects, and there were already some experiment-theory collaborations, which led to joint publications, which is a big plus. The high relevance of the theoretical concepts to neuroscience is well documented by the large number of publications in several experimental neuroscience journals. The group clearly has established itself as one of the internationally visible and well-reputed places for Computational Neuroscience research.

Assessment of the Team's academic reputation and appeal:

The team leader has an excellent track record with 13 (10 as a first or last author) publications in peer-reviewed international journals over the past 6 years. Within the international Computational Neuroscience community she is well known and well respected for her work on probabilistic inference in spiking networks, which she has pioneered, as well as her work on Bayesian inference and neural coding. The high experimental relevance of her work is well documented by publications in leading Neuroscience journals like J. Neurosci. The team leader was very active within the scientific community with the organisation of workshops and summer schools, with editorial work, and as a member of review panels. She has an impressive funding track record in the past 5 years (including a recently acquired ERC young investigator grant). This is quite unusual for a still junior research group.

Assessment of the Team's interaction with the social, economic and cultural environment:

N/A

Assessment of the Team's organisation and life:

The team is quite limited in size and everything seem to proceed smoothly. There is thus nothing specific to report.

Assessment of the Team's involvement in training through research:

The team leader has supervised 5 PhD students. 3 PhD students defended their PhD successfully, all of them with one publication in leading international journals (J. Neurosci., PLoS Computational Biology). In addition, there was the supervision of several Master students. The team leader has been on the faculty of two international CNS summer schools, including the highly reputed Okinawa Computational Neuroscience Course. She is on the faculty of (and teaching within) three graduate/doctoral schools in Paris. In summary, there exists a well-structured integration of students in the scientific activities of the team, from master to PhD.

Assessment of the five-year plan and strategy:

The research program of the group is focussed around the vision of the team leader that spiking neural dynamics in many systems can be understood as probabilistic inference at work. This implies that the dynamics of spiking networks can be interpreted as state estimation (of body/environment), that individual spikes are informative and form the elementary unit of the neural code, and that prediction errors are linked to basic biophysical quantities (e.g., the membrane potential) describing a neurons' state. These hypotheses are intriguing, provide a fresh view on neural processing orthogonal to the more standard rate interpretations, and provide innovative new interpretations of older data (e.g. for contextual effects in vision).



However, as stated by the PI herself, experimental validation is still in the beginning. This makes at least part of the research program "high risk, but high reward" in terms of the potential future impact on neuroscience research.

Experimental validations, however, will be an important part of the upcoming funding period. Several pertinent experimental collaborators are named. As stated by the team leader, experimental validations will be a major part of the work funded by the ERC grant. This is very positive, as experimental validations should be one major focus of the group's future work.

Judging from the proposal, most of the planned experiment-theory work will test for consistency between model predictions (derived from the functional concepts) and the data. A much more strict test would be to interfere with neural processing (through current injections, optically, etc.) and to then test whether the functional / behavioural consequences match the predictions. This is very hard to do, but - still - it may be worthwhile to think along those lines when designing the validation work.

One key feature of the research agenda of the original Neural Theory Team was the combination of top-down, functional approaches (using concepts from AI and machine learning) with bottom-up approaches using concepts from dynamical systems and neural network modelling. This combination of expertise is - on the one hand - essential, if one wants to understand how brain systems implement cognitive functions. On the other hand, there is the danger that the palette of subprojects becomes too diverse. Given this fact, the split into two complementary (but collaborating) new research groups is very reasonable.

Conclusion:

- Strengths and opportunities:

The work program is centered around a conceptual framework, which is intriguing, provides a fresh view on neural processing, and provides innovative new interpretations of experimental data. There is the potential that results may change our view on neural processing and will, therefore, have a very strong impact. Also, the concept of Bayesian inference applies to different levels of neural processing, including high-level cognitive processing, which allows the NIG to interact with the other teams of LNC as well as experimental research groups within the Paris research environment. The group is well connected and already collaborates with experimental researchers working on different levels. These contacts can be exploited in the new funding period. In summary, the group clearly has established itself as one of the internationally visible and well-reputed places for Computational Neuroscience research.

- Weaknesses and threats:

Several of the experimental validation paradigms still have to be developed, and there is the risk that the proposed framework may not turn out to be as general as one currently hopes. This makes part of the group's research agenda "high risk, but high reward". The group may suffer from uncertainties about recruiting possibilities in the French system specifically for collaborative research. Office space is too limited. There is, for example, no space for guest researchers, and there is no space for having small meetings and discussion groups.

- Recommendations:

Experimental validations and close-to-data projects should form an important component of the research agenda (as it is planned). Specific care should be given to the fact, that computations implemented by different areas in the brain hierarchy may implement different constraints - hence alternative computational hypotheses should also be considered and evaluated. It would be worthwhile to think of experimental paradigms which test for causality rather than correlation, although these paradigms may be technically very challenging to implement. Finally, given the powerful theoretical approach of this group, strong collaborations within the unit itself should be highly desired.



5 • Conduct of the visit

Visit date:

Start: February 8th, 2013; 8.45 am.

End: February 8th, 2013; 17.30 pm.

Visit site:

LNC, Ecole Normale Supérieure

Institution:

Ecole Normale Supérieure

Address:

rue d'Ulm, Paris

Conduct or programme of visit:

08 H 30 - 9 H 00: Welcoming Coffee

09 H 00 - 9 H 30: Meeting of the AERES committee

09 H 30 - 9 H 45: Introduction to the LNC, Etienne KOEHLIN, Head of the LNC

09 H 45 - 10 H 05: Social Cognition Group, Julie GRÉZES, team leader

10 H 05 - 10 H 25: Neuroscience of Economic Decisions, Giorgio CORICELLI, team leader

10 H 25 - 10 H 45: Visual Cognition Group, Catherine TALLON-BAUDRY, team leader

11 H 15- 11 H 35: Dynamical Neurotheory Group, Boris Gutkin, team leader

11 H 35 - 11 H 55: Neural Interference Group, Sophie Deneve, team leader

11 H 55 - 12 H 15: Frontal Lobe Function Group, Etienne Koechlin, team leader

12 H 15 - 12 H 30: General Discussion

12 H 30 - 14 H 00: Lunch

14 H 00 - 15 H 00: Visit of the lab LNC + Meeting with support staff

15 H 00 - 15 H 30: Meeting with ENS and INSERM representatives

15 H 30 - 16 H 00: Meeting with post-docs and PhD students

16 H 00 - 16 H 30: Meeting with director

16 H 30 - 17 H 45: Meeting of the AERES committee



6 • Statistics by field: SVE on 10/06/2013

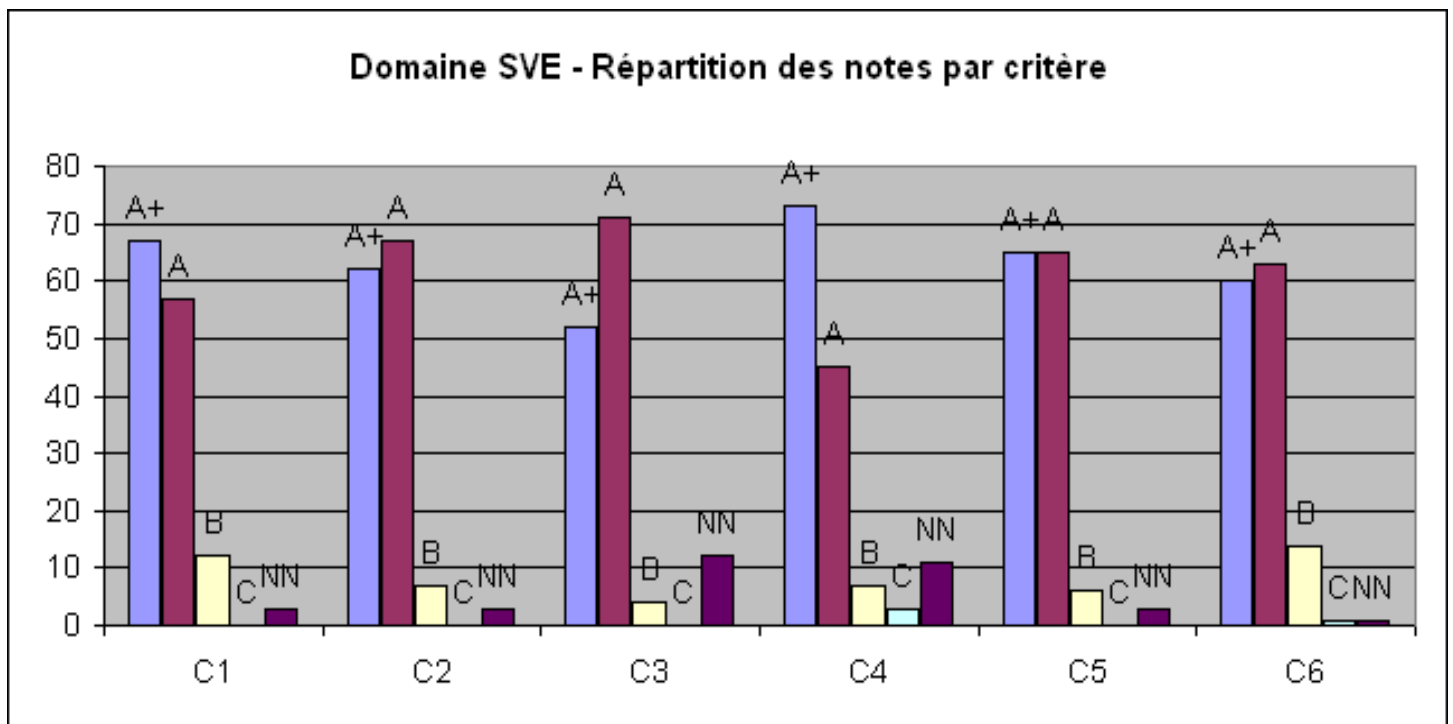
Grades

Critères	C1 Qualité scientifique et production	C2 Rayonnement et attractivité académiques	C3 Relations avec l'environnement social, économique et culturel	C4 Organisation et vie de l'entité	C5 Implication dans la formation par la recherche	C6 Stratégie et projet à cinq ans
A+	67	62	52	73	65	60
A	57	67	71	45	65	63
B	12	7	4	7	6	14
C	0	0	0	3	0	1
Non Noté	3	3	12	11	3	1

Percentages

Critères	C1 Qualité scientifique et production	C2 Rayonnement et attractivité académiques	C3 Relations avec l'environnement social, économique et culturel	C4 Organisation et vie de l'entité	C5 Implication dans la formation par la recherche	C6 Stratégie et projet à cinq ans
A+	48%	45%	37%	53%	47%	43%
A	41%	48%	51%	32%	47%	45%
B	9%	5%	3%	5%	4%	10%
C	0%	0%	0%	2%	0%	1%
Non Noté	2%	2%	9%	8%	2%	1%

Histogram





7 • Supervising bodies' general comments

Laboratoire de Neurosciences Cognitives
Unité INSERM-ENS U960
Head : Prof. Etienne Koechlin

RE : AERES Evaluation Report 2013
D2014-EV-0753455Y-S2PUR140005345-001965-RT_Koechlin

Paris, 4th April 2013

To whom it may concern

Comments from Unit's Director about the AERES Evaluation Report

I wish to thank the AERES committee for its report, which I think provides an overall faithful evaluation of scientific production, activity, organization and human resources of our research unit. However, I have a few comments regarding two specific points:

- The item "Assessment of the Team's interaction with the social, economic and cultural environment" was apparently misunderstood by external referees. Thus, for Teams 2 and 5, this item was considered as non-applicable, whereas both teams have substantial interactions outside academics, as indicated in the unit report transmitted to the AERES. For team 2, the principal investigator gave several talks for a general public audience in Collège de France (2007, 2008), Institut Demos (2008, targeting company managers), Cité des Sciences et de l'industrie (2010, France Culture), and for the Semaine internationale du cerveau (2011, Genève). Also, in 2008, the PI was vice-president of a think tank labelled "France 2025 – le renouvellement du Vivre Ensemble" for more than 8 months at the Centre d'Analyse stratégique. The PI is now collaborating with Yann Algan, Professor in Economics (Science Politique, Paris) to evaluate socio-political actions. For team 5, the PI has secured an industrial contract with Targacept, Inc. USA.
- I also note a strong discrepancy between, on the one hand, the *Assessments of scientific quality and outputs* as well as the *academic reputation and appeal* of Team 2 and, on the other, *The conclusion (Weaknesses and threats and Recommendations)* regarding this team. The conclusion includes statements of a nature more fitted to a scientific debate than to an evaluative report.

I prompt the reader to consider these comments in reading the evaluation report to get a better insight of our research unit.



Etienne Koechlin
Head of research unit