

# WINTERCONFERENCE 2013 ★ EGMOND AAN ZEE

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DECEMBER 19 - 21

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## Organizing/Scientific Committee

Sara Bögels  
Lorenza Colzato  
Mariska Kret  
Diane Pecher  
Hedderik van Rijn  
Romke Rouw  
Steven Scholte (chair)  
René Zeelenberg

## PROGRAMME OVERVIEW

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### THURSDAY

14:30	Bus leaves from Alkmaar train station	
14:30 - 15:50	Registration*	NVP desk
15:50 - 16:00	Opening	Lamoraalzaal
16:00 - 17:00	Keynote lecture: <i>Jan Theeuwes</i>	Lamoraalzaal
17:10 - 18:30	Parallel sessions 1	Rooms 557, 558, 559, Lamoraalzaal
18:30 - 20:00	Poster session 1 + drinks	Lounge 1
19:00 - 20:00	Registration*	NVP desk
20:00	Dinner	Restaurant
22:00	NVP Pubquiz	Ritz

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### FRIDAY

08:00 - 09:20	Breakfast	Restaurant
09:00 - 10:30	Registration*	NVP desk
09:20 - 10:40	Parallel sessions 2	Rooms 557, 558, 559, Lamoraalzaal
10:40 - 11:00	Coffee/Tea	Lounge 1
11:05 - 12:25	Parallel sessions 3	Rooms 557, 558, 559, Lamoraalzaal
12:30 - 13:30	Lunch	Restaurant
13:00 - 14:00	Registration*	NVP desk
13:30 - 14:30	Keynote lecture: <i>Irene Pepperberg</i>	Lamoraalzaal
14:30 - 16:00	Poster session 2 + coffee/tea	Lounge 1
16:10 - 17:30	Parallel sessions 4	Rooms 557, 558, 559, Lamoraalzaal
17:30 - 17:55	Coffee/Tea	Lounge 1
18:00 - 18:45	NVP business meeting	Lamoraalzaal
18:00 - 19:00	Registration*	NVP desk
19:00	Dinner	Ritz
21:00	Bar open	The Pub

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### SATURDAY

08:00 - 09:20	Breakfast	Restaurant
09:00 - 10:00	Registration*	NVP Desk
09:20 - 10:40	Parallel sessions 5	Rooms 557, 558, 559, Lamoraalzaal
10:40 - 11:00	Coffee/Tea	Lounge 1
11:05 - 12:25	Parallel sessions 6	Rooms 557, 558, 559, Lamoraalzaal
12:30 - 13:30	Lunch	Restaurant
13:30 - 14:50	Parallel sessions 7	Rooms 557, 558, 559, Lamoraalzaal
14:50 - 15:05	Coffee/Tea	Lounge 1
15:05 - 15:15	NVP dissertation award	Lamoraalzaal
15:15 - 16:00	Lecture dissertation award winner	Lamoraalzaal
16:00	Closing	Lamoraalzaal
16:15	Bus leaves for Alkmaar train station	Central entrance hotel

Check-out at hotel desk before 10:30

\*Payments can only be made online, a computer is available at the NVP desk.

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## INSTRUCTIONS FOR AUTHORS

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### Oral presentations

All rooms in which oral sessions are held will be equipped with a Windows computer with powerpoint 2010. Make sure you have your presentation with you on a USB stick saved in this format and are present 15 minutes before the start of your session so the presentation can be copied on the presentation computer. We do not have the equipment that allows for the supply switching between laptops.

### Poster presentations

Poster boards have a size of 130 cm (width) \* 90 cm (height), which is big enough for an A0 landscape poster. Posters can be mounted after 15:00 on Thursday and between 8:00 and 14:30 on Friday. Poster should be removed at the end of the poster session.

## HOTEL ZUIDERDUIN

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### *Thursday 19 December*

Conference Registration: NVP desk opens at 14.30

Luggage storage in room 534

**Check-in Hotel Zuiderduin: after 15:00 (hotel desk)**

### *Friday 20 December*

Conference Registration: NVP desk opens at 9:00

Luggage storage in room 534

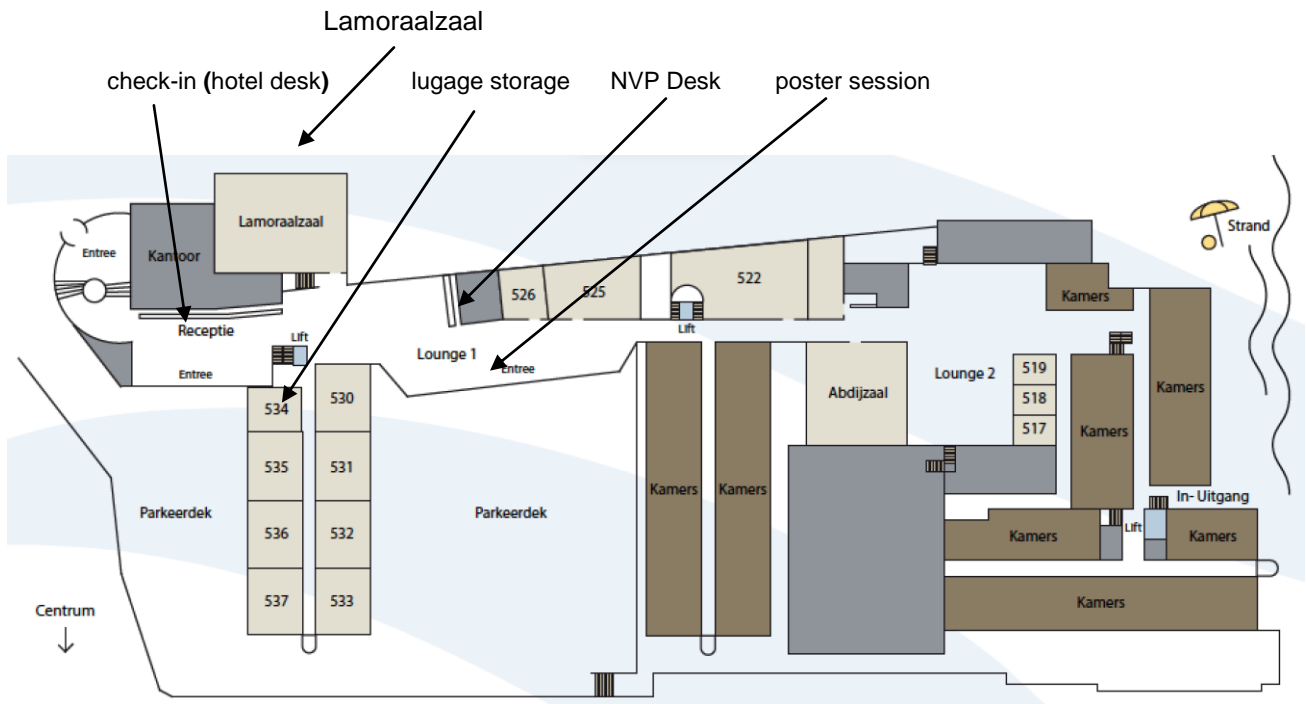
**Check-in Hotel Zuiderduin: after 15:00 (hotel desk)**

### *Saturday 21 December*

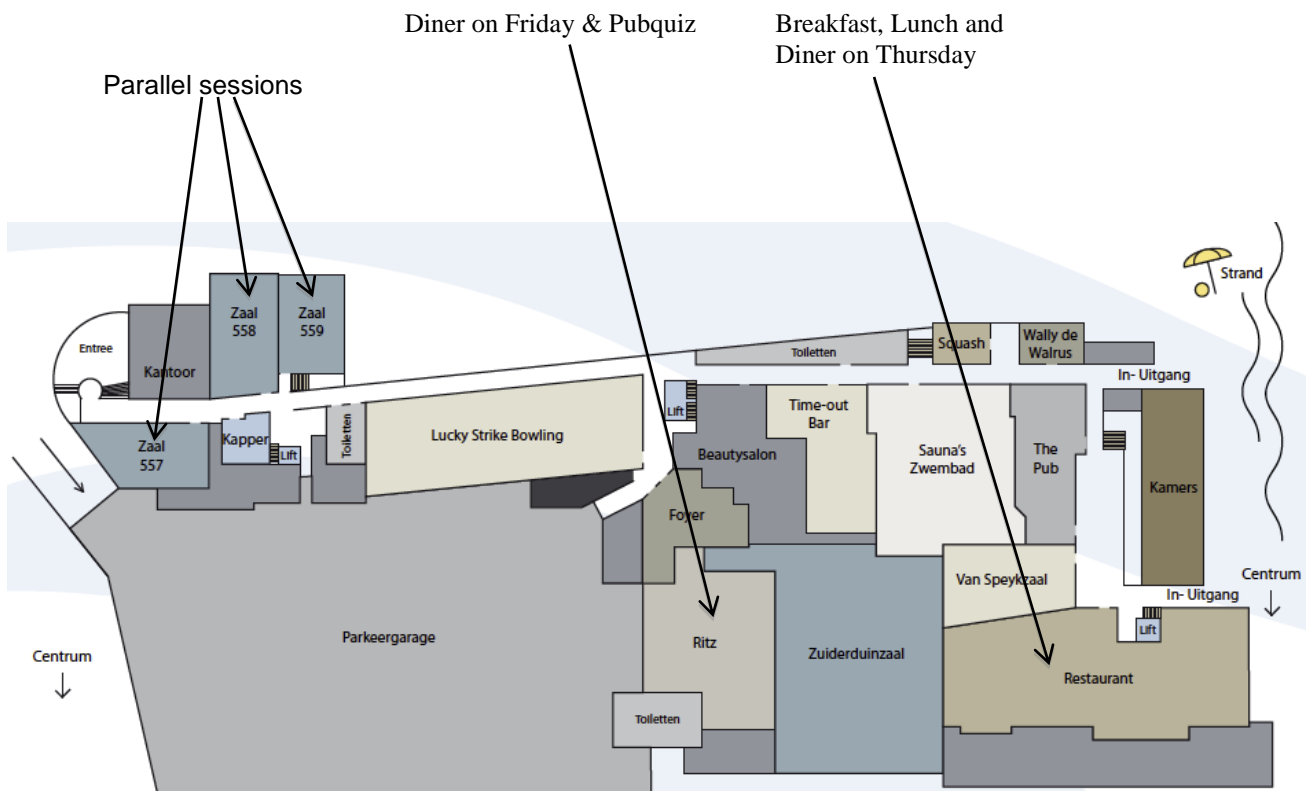
8:00 – 10:30 Check-out (hotel desk)

Luggage storage in room 534

**You must be checked-out of your room by 10:30!**



Map of the **first floor**: hotel desk (*check-in*), Lamoraalzaal (*keynote lectures, parallel sessions, business meeting, NVP dissertation award*), room 534 (*lugage storage*), Lounge 1 (*poster session, coffee/tea breaks and drinks*), and NVP desk.



Map of the **ground floor**: Vergaderzaal 557, 558, and 559 (*parallel sessions*), Ritz (*Pubquiz on Thursday and dinner on Friday*), The Pub (*Thursday and Friday Night Bar*) and Restaurant (*breakfast, lunches and dinner at Thursday*).

## CONDENSED SCHEDULE THURSDAY, 19<sup>TH</sup>

15:50	Opening		Lamoraalzaal		
16:00	Keynote Lecture: <i>Jan Theeuwes</i>		Lamoraalzaal		
Parallel Sessions					
Only first authors are mentioned					
Room	557	558	559	Lamoraalzaal	
Session	Illusions	Decision Making	Miscellaneous I	Body-Environment Interaction	
Chair	Kret	Nieuwenstein	Taatgen	Stins	
17:10	01 van Stralen	05 van Elk	09 Wiemers	13 Huis in 't Veld	
17:30	02 Kloosterman	06 Wokke	10 Buwalda	14 Hortensius	
17:50	03 de Brouwer	07 Nieuwenstein	11 Murphy	15 Stins	
18:10	04 Stuit	08 Warren	12 Taatgen	16 Anema	
18:30	Poster Session 1 + Drinks		Lounge 1		
20:00	Dinner		Restaurant		
22:00	NVP Pubquiz		Ritz		

## CONDENSED SCHEDULE FRIDAY, 20<sup>TH</sup>

8:00	Breakfast		Restaurant		
Parallel Sessions					
Only first authors are mentioned					
Room	557	558	559	Lamoraalzaal	
Session	Working Memory	Cognitive Control I	Salience & Selection	The Malleability of Visual Processing	
Chair	van der Lubbe	Tops	van der Stigchel	Jehee (Symposium)	
9:20	17 Gayet	21 Schel	25 Silvis	29 Brascamp	
9:40	18 van Moorselaar	22 Tops	26 Anderson	30 Donner	
10:00	19 Quak	23 Spronk	27 Wilschut	31 Jehee	
10:20	20 van der Lubbe	24 Brown	28 Siebold	32 Knapen	
10:40	Coffee/Tea		Lounge 1		

Parallel Sessions ( <i>Continued</i> )					
Only first authors are mentioned					
Room	557	558	559	Lamoraalzaal	
Session	Long-Term Memory	Cognitive Control II	Auditory Perception	Single-Trial Dynamics and Visual Representation	
Chair	Murre	Colzato	Van Gerven	Groen ( <i>Symposium</i> )	
11:05	33 de Jonge	37 Colzato	41 Bolders	45 Groen	
11:25	34 Murre	38 van Campen	42 van Gerven	46 van de Nieuwenhuijzen	
11:45	35 Vandeberg	39 Talsma	43 Bronkhorst	47 Jahfari	
12:05	36 Cox	40 Jongkees	44 Saija	48 Hogendoorn	
12:30	Lunch		Restaurant		
13:30	Keynote Lecture: <i>Irene Pepperberg</i>		Lamoraalzaal		
14:30	Poster Session 2 + Coffee/Tea		Lounge 1		
Session	Language I	Action	Perception I	Alpha Oscillations and Selective Attention	
Chair	Mitterer	Zaal	Los	Vissers ( <i>Symposium</i> )	
16:10	49 Mitterer	53 Verwey	57 Stapel	61 Bonnefond	
16:30	50 Vogelzang	54 Holten	58 Los	62 Mazaheri	
16:50	51 Viebahn	55 Bongers	59 Gunseli	63 Bergmann	
17:10	52 van Gaal	56 Zaal	60 Paffen	64 Slagter	
17:30	Coffee/Tea		Lounge 1		
18:00	NVP Business Meeting		Lamoraalzaal		
19:00	Dinner		Ritz		
21:00	Drinks		The Pub		

# CONDENSED SCHEDULE SATURDAY, 21<sup>ST</sup>

8:00	Breakfast		Restaurant	
Parallel Sessions				
Only first authors are mentioned				
Room	557	558	559	Lamoraalzaal
Session	Language II	Perception & Attention	Perception II	Social Acceptance and Rejection Feedback
Chair	Bögels	van Rijn	Meeter	van der Molen (Symposium)
9:20	65 Jongman	69 van Rijn	73 Meeter	77 van der Molen (Maurits)
9:40	66 Gerakaki	70 Mathôt	74 Erkelens	78 Dekkers
10:00	67 Bögels	71 Naber	75 Overvliet	79 van der Molen (Melle)
10:20	68 Nijhof	72 Akyurek	76 Fahrenfort	80 van der Veen
10:40	Coffee/Tea		Lounge 1	
Session	Mindwandering & Meditation	Perception / Action	Multi-Sensory Integration & Synesthesia	Psychological Science in Industrial R&D
Chair	van Vugt	Ondobaka	Rouw	Dijksterhuis (Symposium)
11:05	81 Mittner	85 Ondobaka	89 Rouw	93 Lemmens
11:25	82 Tucker	86 Schreven	90 Colizoli	94 Zandstra
11:45	83 Szapora	87 van der Linden	91 Vroomen	95 Veltkamp
12:05	84 van Vugt	88 Francken	92 van der Stoep	96 van Erp
12:30	Lunch		Restaurant	
Session	Social & Emotional Cognition	Miscellaneous II	Cortical Organization	Media Ergonomics
Chair	Mulckhuyse	Sellaro	Dumoulin	Nefs (Symposium)
13.30	97 Mulckhuyse	101 Spruit	105 Klein	109 Nefs
13.50	98 Kret	102 Kruijne	106 Albers	110 de Greef
14:10	99 Dijkstra	103 Hoppenbrouwers	107 Scholte	111 Kort
14.30	100 Steenbergen	104 Sellaro	108 Harvey	112 Roozendaal

14:50	<b>Coffee/Tea</b>	Lounge 1
15:05	<b>NVP Dissertation Award Announcement</b>	Lamoraalzaal
15:15	<b>Lecture Dissertation Award Winner</b>	Lamoraalzaal
16:00	<b>Closing</b>	Lamoraalzaal
16:15	<b>Bus leaves for Alkmaar train station</b>	Main Eentrance to Hotel

## Thursday, Oral Session 1 (17:10-18:30)

### Room 557 – Illusions

- 01      **Pleasant touch and the rubber hand illusion**  
H.E. van Stralen, M.J.E. van Stralen, L.M.G. Vischers, L.J. Kappelle, & H.C. Dijkerman
- 02      **Pupil dilation reflects specific perceptual alternations in a bistable visual illusion**  
Niels A. Kloosterman, Thomas Meindersma, Anouk M. van Loon & Tobias H. Donner
- 03      **The effects of the Müller-Lyer illusion on saccades and perceptual judgments decrease with longer presentation time**  
Anouk J. de Brouwer, Eli Brenner, W. Pieter Medendorp & Jeroen B.J. Smeets
- 04      **Eye- and image-based grouping during binocular rivalry**  
Sjoerd Stuit, Chris Paffen, Maarten van der Smagt & Frans Verstraten

### Room 558 – Decision Making

- 05      **Paranormal Believers are more prone to illusory agency detection than skeptics**  
Michiel van Elk
- 06      **You're sick! The neural signature of intuitive decision-making.**  
Martijn E. Wokke & K. Richard Ridderinkhof
- 07      **On making the right choice: A meta-analysis and large-scale replication study of the unconscious thought advantage**  
M.R. Nieuwenstein, H.T. Wierenga, R. Morey, J.M. Wicherts, T.N. Blom, E-J Wagenmakers & H van Rijn
- 08      **The Rodent Anterior Cingulate Cortex Exhibits a Reward-Related Local Field Potential Deflection that is Sensitive to Expectation**  
Christopher M. Warren, James M. Hyman, Jeremy K. Seamans & Clay B. Holroyd

### Room 559 – Miscellaneous I

- 09      **Spatial Interferences in Mental Arithmetic: Evidence from the Motion-Arithmetic Compatibility Effect**  
Michael Wiemers, Harold Bekkering & Oliver Lindemann
- 10      **Open your eyes: Uncovering the structure of thought using eye tracking.**  
Trudy A. Buwalda, Niels A. Taatgen & John R. Anderson
- 11      **Noradrenergic modulation of perceptual decision making in humans**  
Peter Murphy, Joachim Vandekerckhove, Eric-Jan Wagenmakers & Sander Nieuwenhuis
- 12      **Attentional Blink: Isn't it just a skill?**  
Niels Taatgen

### Lamoraalzaal – Body-Environment Interaction

- 13      **Muscle activations during the perception and expression of emotion: The Body Action Coding System**  
Elisabeth Huis in 't Veld, Geert van Boxtel & Beatrice de Gelder
- 14      **Empathy does not need company - the influence of group size and trait empathy on neural and behavioral patterns when witnessing an emergency**  
Ruud Hortensius, Beatrice de Gelder
- 15      **Biomechanical organization of gait initiation depends on the timing of affective processing**  
John F. Stins, Linda M.A. van Gelder, Laura M. Oudenhoven & Peter J. Beek
- 16      **Predicting bodily consequences of visual information**  
H.A. Anema, M. Mulckhuyse, R. Bron, D.S. Veldhuijzen H.C. Dijkerman

## Thursday, Poster Session 1 (18:30-20:00)

### Perception and Action 1

- p1001 **Relative proprioceptive distance is used for movements towards visual targets.**  
M.C.W. van der Graaff, E. Brenner & J.B.J. Smeets
- p1002 **Hotspots in the workspace: Investigating the Relation between Non-target Object Location and Avoidance Responses**  
Rudmer Menger, H. Chris Dijkerman & Stefan Van der Stigchel
- p1003 **Alpha oscillations affect the gating of downstream processing**  
Johanna M. Zumer, Rene Scheeringa & Ole Jensen
- p1004 **Target-distractor competition in the oculomotor system is spatiotopic**  
Artem Belopolskiy & Donatas Jonikaitis

### Attention & Control 1

- p1005 **Time for Control: An EEG Study to the Influence of Temporally Guided Expectations of Conflict on Cognitive Control**  
J.C.Swart, J. van Driel, T. Egner, K.R. Ridderinkhof & M.X Cohen
- p1006 **Interpersonal distance in antisocial and psychopathic forensic offenders**  
Johanna C. Glimmerveen, Inti A. Brazil, Ellen, R.A. de Bruijn & Berend H. Bulten
- p1007 **Neural Reactions to Positive and Negative Feedback Change Across Child and Adolescent Development**  
Sabine Peters, Barbara Braams, Maartje Rajmakers, Cédric Koolschijn, Eveline Crone
- p1008 **Pupil Dilation in the Simon Task as a Marker of Conflict Processing**  
Henk van Steenbergen & Guido P.H. Band
- p1009 **Effects of acute stress on oscillatory activity during feedback processing, in men and women. Modulations of theta and beta oscillatory power**  
H.M. Banis & M.M. Lorist
- p1010 **Activation and suppression during online and proactive cognitive control in autism**  
Anne G. Lever, K. Richard Ridderinkhof & Hilde M. Geurts

### Memory 1

- p1011 **Opportunity for verbalization does not improve visual change detection performance: A state-trace analysis**  
Florian Sense, Candice C. Morey, Richard D. Morey, Melissa Prince & Andrew Heathcote
- p1012 **Acquisition of an instrumental activity of daily living in patients with Korsakoff's syndrome**  
Erik Oudman, Tanja C.W. Nijboer, Albert Postma & Stefan Van der Stigchel
- p1013 **Do not fear: Beta-adrenergic blockade affects the neural network of extinction learning and prevents the return of fear in humans**  
Klodiana D Tona, Marijn CW Kroes, Hanneke EM den Ouden, Susanne Vogel, Guido A. van Wingen & Guillén Fernández
- p1014 **The presence of faces biases spatial working memory**  
Lisette Schmidt, Artem Belopolsky & Jan Theeuwes
- p1015 **Survival Processing Enhances Attentional Capture**  
Addie Johnson, Micha Keller & Edyta Sasin

### Decision Making 1

- p1016 **Neural correlates of evidence accumulation in intracranial EEG**  
Marijke Beulen & Marieke van Vugt
- p1017 **Development of the adaptive mind**  
Edita Poljac
- p1018 **Gambling for self, friends, and antagonists: Differential contributions of affective and social brain regions on adolescent reward processing**  
Barbara R. Braams, Sabine Peters, Jiska S. Peper, Berna Guroğlu & Eveline A. Crone
- p1019 **Friend or foe? Social decision-making in interactions with peers**  
Aafke Snelting, Eduard Klapwijk, Geert-Jan Will & Berna Guroglu
- p1020 **Neural correlates of the reproduction of temporal intervals as revealed by MEG and EEG.**  
Tadeusz W. Kononowicz, Tilmann H. Sander & Hedderik van Rijn
- p1021 **A covert perceptual decision modulates beta-band oscillations in visual cortex**  
Thomas Meindertsma, Niels A. Kloosterman, Guido Nolte, Andreas K. Engel & Tobias H. Donner

- p1022 **The interaction between novelty and emotion in enhancing visual perception**  
Judith Schomaker & Martijn Meeter
- p1023 **Look no further; this is disgusting!**  
Hannie van Hooff & Lu Draisma
- p1024 **The neural underpinnings of empathy for pain in adolescence**  
Sandy Overgaauw, Berna Güroğlu & Eveline A. Crone
- p1025 **The effects of oxytocin on self-other integration**  
Margit I. Ruissen & Ellen R.A. de Bruijn

**Perception 1**

- p1026 **Temporal but not spatial attentional orienting is sensitive to task and cue manipulations**  
Lieve Boshoff, Udo Boehm & Hedderik van Rijn
- p1027 **A common magnitude metric in perception: Interference between numbers and size during visual search**  
Florian Krause, Harold Bekkering, Jay Pratt & Oliver Lindemann
- p1028 **Disengagement of Attention from (un)Trustworthy-looking Faces and the Influence of Competitive and Cooperative Motivational States**  
Rozemarijn Mattiesing & Hannie van Hooff
- p1029 **Extending the watercolour illusion: differential effects of real colors versus afterimage colors**  
Simon Jan Hazenberg & Rob van Lier
- p1030 **Effects of baseline physiological arousal on responses to noise.**  
Kim White, Martijn Meeter & Adelbert Bronkhorst
- p1031 **Extending biologically-inspired Computer Vision: A Study on Applying Computer Graphics and Higher Order Statistics in HMAX**  
Robin Mills
-

## Friday, Oral Session 2 (9:20-10:40)

### Room 557 – Working Memory

- 17 **Information matching the content of visual working memory is prioritized for conscious access.**  
Surya Gayet, Chris L. E. Paffen & Stefan Van der Stigchel.
- 18 **In competition for the attentional template: Can multiple items within visual working memory guide attention?**  
Dirk van Moorselaar, Jan Theeuwes & Chris Olivers.
- 19 **The Influence of Context on Visual Working Memory: Effects on Visual Brain Areas**  
Michel Quak & Durk Talsma.
- 20 **EEG support for a close relation between visuospatial attention and visual working memory**  
Rob van der Lubbe, Carsten Bundt & Elger Abrahamse.

### Room 558 – Cognitive Control I

- 21 **Neural correlates of the development of intentional action and inhibition**  
Margot A. Schel, K. Richard Ridderinkhof & Eveline A. Crone
- 22 **Interactions between action control systems explain trial sequence effects in flanker tasks: a theory**  
Mattie Tops
- 23 **Acute effects of cannabis and cocaine on response inhibition- an ERP investigation**  
D.B. Spronk, E.R.A. De Bruijn, J.H.P. van Wel, J.R. Ramaekers & R.J. Verkes
- 24 **Effects of arousal on cognitive control: Empirical tests of the conflict-modulated Hebbian-learning hypothesis**  
S.B.R.E. Brown, H. van Steenbergen, T. Kedar & S. Nieuwenhuis

### Room 559 – Saliency & Selection

- 25 **How high and low level signals contribute to oculomotor selection; a novel approach to employ the global effect phenomenon**  
Jeroen Silvis, Katya Olmos Solis & Mieke Donk
- 26 **The early effects of saliency on eye movements in natural scenes**  
Nicola C Anderson, Eduard Ort, Mieke Donk & Martijn Meeter
- 27 **Spatial selection makes attention transient**  
Anna Wilschut, Jan Theeuwes & Christian N.L. Olivers
- 28 **Reinstating saliency effects over multiple eye movements**  
Alisha Siebold & Mieke Donk

### Lamoraalzaal – *Symposium* The Malleability of Visual Processing

- 29 **History Dependence Reveals Communalities Between Selection Among Attention Targets and Selection Among Perceptual Interpretations**  
Jan Brascamp
- 30 **Transient in Visual Cortex Consolidates Subsequent Perceptual Illusion**  
Tobias Donner
- 31 **Perceptual Learning Selectively Refines Orientation Representations in Early Visual Cortex**  
Janneke Jehee
- 32 **Instantaneous Influence of Reward on BOLD Responses In Visual Cortex**  
Tomas Knapen

## Friday Oral Session 3 (11:05-12:25)

### Room 557 – Long-Term Memory

- 33      **The Efficacy of Self-Paced Study in Multitrial Learning**  
Mario de Jonge, Huib K. Tabbers, Diane Pecher, Yoonhee Jang & René Zeelenberg
- 34      **S-shaped learning curves**  
Jaap Murre
- 35      **Explicit and implicit brand memory and evaluation in cross-media advertising**  
Lisa Vandeberg, Jaap Murre, Hilde Voorveld & Edith Smit
- 36      **Information processing during sleep**  
Roy Cox

### Room 558 – Cognitive Control II

- 37      **Eating to stop: Tyrosine supplementation enhances inhibitory control but not response execution**  
Lorenza S. Colzato, Bryant J. Jongkees, Wery P. M. van den Wildenberg & Bernhard Hommel
- 38      **Paired-pulse transcranial magnetic stimulation reveals probability-dependent changes in functional connectivity between right inferior frontal cortex and primary motor cortex during go/no-go performance**  
A. D. van Campen, F.X. Neubert, W.P.M. van den Wildenberg, K. R. Ridderinkhof & R.B. Mars
- 39      **Effects of multiple session tDCS on working memory**  
L. Talsma, Kroese, H. Slagter
- 40      **Working memory reloaded: Tyrosine repletes updating under challenging conditions**  
Bryant J. Jongkees, Roberta Sellaro, Bernhard Hommel & Lorenza S. Colzato

### Room 559 – Auditory Perception

- 41      **In the mood to hear**  
Anne Bolders, Guido P.H. Band, Pieter Jan Stallen & Susan Denham
- 42      **Making sense of age-related distractibility: The role of sensory modality**  
Pascal W. M. Van Gerven & Maria J. S. Guerreiro
- 43      **The Cocktail Problem revisited**  
Adelbert W Bronkhorst
- 44      **Temporal integration of consecutive tones into synthetic vowels demonstrates perceptual assembly in audition**  
Jefta D. Saija, Tjeerd C. Andringa, Deniz Başkent & Elkan G. Akyürek

### Lamoraalzaal – *Symposium* Exploiting Single-Trial Dynamics to Understand Visual Representation

- 45      **Two Stages in the Time-Course of Natural Scene Gist Perception**  
Iris I.A. Groen, Sennay Ghebreab, Victor A. F. Lamme & H. Steven Scholte
- 46      **MEG-Based Decoding of the Spatiotemporal Dynamics of Visual Category Perception**  
Marieke van de Nieuwenhuijzen, Alexander Backus, Ali Bahramisharif, Christian Doeller, Ole Jensen & Marcel van Gerven
- 47      **Prefrontal and Sensory Cortex Co-Direct the Basal Ganglia to Optimize Perceptual Action Selection**  
Sara Jahfari
- 48      **Multivariate Pattern Cross-Classification of Single-Trial EEG and fMRI Data: Comparing Neural Signatures in Illusory Visual Percepts**  
Hinze Hogendoorn & Frans A Verstraten

## Friday, Poster Session 2 (14:30-16:00)

### Language

- p2001 Birth language processing by adopted children**  
Wencui Zhou & Mirjam Broersma
- p2002 Classifying single-trial auditory ERPs in the discrimination of non-native speech categories: How Dutch learners process Mandarin lexical tone**  
Christian Hoffmann, Makiko Sadakata, Peter Desain & James M. McQueen
- p2003 An extended stimulus set containing words and pictures matched for visual and semantic similarity.**  
Floor de Groot, Falk Huettig, Christian N. L. Olivers
- p2004 Lexical specificity training enhances phonological awareness in L2-learners**  
Caressa Janssen, Eliane Segers, James M. McQueen & Ludo Verhoeven
- p2005 Bilingual education promotes the flexible mind: Adolescents being taught in L2 show smaller switching costs**  
Annelies M. de Haan, Ingrid K. Christoffels, L. Steenbergen, Wery P.M. van den Wildenberg & Lorenza S. Colzato

### Perception & Action 2

- p2006 Tactile body image when you're still growing**  
Alyanne de Haan, Anouk Keizer, Yolinde de Haan, Charlotte Maas & Chris Dijkerman
- p2007 Motor-Induced-Visual-Motion; Self-generated hand movements drive visual motion perception**  
M.N. Keetels & J.J. Stekelenburg
- p2008 Grasping Beer Mugs Revisited: Do Handles Facilitate Motor Responses?**  
Sander Roest, Diane Pecher & Rene Zeelenberg
- p2009 Proprioceptive position sense changes when skin stretch around the elbow is non-invasively manipulated**  
Irene Kuling, Eli Brenner, Jeroen Smeets
- p2010 Role of vestibular and visual depth cues in the perception of linear motion**  
Arjan C. ter Horst, Mathieu Koppen, Luc P.J. Selen & W. Pieter Medendorp

### Attention & Control 2

- p2011 Midfrontal conflict-related theta-band power reflects neural oscillations that predict behavior**  
Michael X Cohen & Tobias H Donner
- p2012 Post-error slowing as a consequence of disturbed low-frequency oscillatory phase entrainment**  
RL van den Brink, S Wynn & ST Nieuwenhuis
- p2013 Deconstructing complex action: statistical learning of hierarchical action**  
Roy de Kleijn, George Kachergis & Bernhard Hommel
- p2014 Concurrent multitasking: different tasks, different interference**  
Menno Nijboer, Jelmer Borst, Hedderik van Rijn & Niels Taatgen
- p2015 Game-based training of attention and flexibility: an EEG study**  
Kerwin J.F. Olfers & Guido P.H. Band
- p2016 Cognitive flexibility training in healthy seniors and recovery from stroke.**  
Jessica Buitenweg, Renate van de Ven, Jaap Murre, Ben Schmand & Richard Ridderinkhof
- p2017 Networks involved in conflict-related modulation of visual processing: a combined EEG-DTI study**  
Marlies E. Vissers, Heleen A. Slagter, Rudy L. van den Brink & Michael X Cohen

### Memory 2

- p2018 The Role of Depth of Encoding in Attentional Capture**  
Edyta Sasin & Addie Johnson
- p2019 Dissociating the effects of semantic grouping and rehearsal strategies on Event-Related Brain Potentials**  
Tamara Schleepen & Lisa Jonkman
- p2020 Optimizing Learning by Hierarchical Bayesian Estimation of Individuals' Learning Parameters**  
Florian Sense, Richard D. Morey & Hedderik van Rijn.
- p2021 Spatial working memory updating during object movement**  
Paul Boon, Jan Theeuwes & Artem Belopolsky
- p2022 From proactive to retroactive dual-task interference: The important role of task-2 probability**  
Mark R. Nieuwenstein & Nico Broers

## Decision Making 2

- p2023 Reward sensitivity in autism**  
Marieke de Vries & Hilde Geurts
- p2024 Development of equity preferences in boys and girls across adolescence**  
Rosa Meuwese, Eveline Crone, Mark de Rooij & Berna Güroğlu
- p2025 How reward induced motivation affects exogenous attention orienting**  
Berno Bucker & Jan Theeuwes
- p2026 Rejected: How childhood peer acceptance and rejection relate to neural responses to social exclusion during adolescence**  
Geert-Jan Will, Pol van Lier, Eveline A. Crone & Berna Güroğlu
- p2027 Pupil dilation in multitasking**  
Ioanna Katidioti, Jelmer Borst & Niels Taatgen
- p2028 A Meta-Analytic Informed Region of Interest Approach to the Structural Correlates of Inter-individual Differences in Perceptual Decision-making**  
Christa Müller-Axt, Roger Ratcliff, Andrew Heathcote & Birte U. Forstmann
- p2029 Reward-related modulation of oscillatory activity in human visual cortex**  
Filip Gesiarz, Niels A. Kloosterman, Tomas H. J. Knapen, Michael X. Cohen & Tobias H. Donner
- p2030 Model-Based Estimates of Response-Caution Predict Single-Trial EEG Data**  
Udo Boehm, Leendert van Maanen, Birte Forstmann & Hedderik van Rijn

## Miscellaneous

- p2031 The Development of Numerosity Estimation: Evidence for a Linear Number Representation Early in Life**  
Janny C. Stapel, Sabine Hunnius, Harold Bekkering & Oliver Lindemann
- p2032 Quantifying Inter-Individual Anatomical Variability in the Subcortex using 7T Structural MRI.**  
M.C. Keuken, P.-L. Bazin, L. Crown, J. Hootsmans, A. Laufer, C. Müller-Axt, R. Sier, E.J. van der Putten, A. Schäfer, R. Turner & B.U. Forstmann
- p2033 Interindividual differences in behavior and cognition predicted by local brain structure: A strictly confirmatory replication study**  
Wouter Boekel, Luam Belay, Eric-Jan Wagenmakers & Birte Forstmann

## Perception 2

- p2034 Visuo-tactile interactions are dependent on the predictive value of the visual stimulus**  
Manasa Kandula, Dennis Hofman & H. Chris Dijkerman
- p2035 Timing attention: How training attenuates the attentional blink**  
Charlotte Willems, Atser Damsma, Stefan Wierda, Niels Taatgen & Sander Martens
- p2036 Time course of lateralized categorical color perception**  
Sanne Brederoo & Mark Nieuwenstein
- p2037 Audiovisual integration is not affected by synesthetic association between the visual and auditory modalities**  
Jeroen Stekelenburg & Mirjam Keetels
- p2038 The shape-length illusion**  
Myrthe A. Plaisier & Marc O. Ernst
- p2039 Behavioral dynamics of cross-modal time perception: a psychometric modeling study**  
Joram van Driel, Tomas Knapen, Daan van Es, Roos Doeve, Richard B. Ivry & Michael X Cohen
- p2040 Pupil Dilation Tracks Perceptual Decisions and the Decision-Maker's Attitude**  
Jan Willem de Gee, Tomas Knapen & Tobias Donner
- p2041 Cyclopean perception with two eyes: binocular integration in early visual cortex**  
Martijn Barendregt, Bas Rokers & Serge O. Dumoulin
-

## Friday, Oral Session 4 (16:10-17:30)

### Room 557 – Language I

- 49      **Can we use a phoneme we do not know about?**  
Holger Mitterer
- 50      **Subject form influences resolution of object pronouns**  
Margreet Vogelzang, Hedderik van Rijn & Petra Hendriks
- 51      **Syntactic predictability can facilitate the recognition of words in connected speech**  
Malte Viebahn, Mirjam Ernestus & James McQueen
- 52      **Can the meaning of multiple words be integrated unconsciously?**  
Simon van Gaal, Lionel Naccache, Julia D. I. Meuwese, Anouk. M. van Loon, Alexa Leighton, Laurent Cohen & Stanislas Dehaene

### Room 558 – Action

- 53      **Distinct modes of executing movement sequences: Reacting, associating, and chunking**  
Willem B. Verwey & Elger L. Abrahamse
- 54      **Does illusory motion affect postural sway?**  
Vivian Holten, Maarten J. van der Smagt, Stella F. Donker & Frans A.J. Verstraten
- 55      **The influence of feedback on learning of joint angle coordination while learning to control a complex tool**  
Raoul M. Bongers & Sandra Suelzenbrueck
- 56      **Coupled digit movement in bimanual grasping**  
Frank T. J. M. Zaal & Raoul M. Bongers

### Room 559 – Perception I

- 57      **EEG responses to observation of self and others**  
Janny C. Stapel, Ilse van Wijk, Harold Bekkering & Sabine Hunnius
- 58      **Onsets capture attention regardless of attentional set**  
Sander Los, Mara Otten & Daniël Schreij
- 59      **The learning rate of a memory representation is independent of its function**  
Eren Gunseli, Chris Olivers & Martijn Meeter
- 60      **The perceived onset of visual events: smaller stimuli are perceived to occur earlier than larger ones**  
Chris Paffen, Edwin Dalmaijer & Ryota Kanai

### Lamoraalzaal – *Symposium* Alpha Oscillations and Selective Attention

- 61      **An Oscillatory Mechanism for Prioritizing Processing**  
Mathilde Bonnefond
- 62      **Region Specific Oscillatory Alpha Activity Serves to Suppress Distracting Input Across Visual and Auditory Modalities**  
Ali Mazaheri
- 63      **Transcranial Modulation of Alpha Oscillations and Visuospatial Attention**  
Til O. Bergmann
- 64      **Multiple Neural Mechanisms Underlying Attention-Based Inhibition and Facilitation of Sensory Processing**  
Heleen A. Slagter

## Saturday, Oral Session 5 (9:20-10:40)

### Room 557 – Language II

- 65      **Sustained Attention in Language Production: An Individual Differences Study**  
Suzanne Jongman, Ardi Roelofs & Antje Meyer
- 66      **The cost of planning speech while listening to speech**  
Svetlana Gerakaki, Matthias Sjerps & Antje Meyer
- 67      **EEG correlates of processes related to turn-taking in an interactive quiz paradigm**  
Sara Bögels, Lilla Magyari & Stephen C. Levinson
- 68      **Neural differences in mental simulation while listening to fiction**  
Annabel D. Nijhof & Roel M. Willems

### Room 558 – Perception & Attention

- 69      **The Preparatory Pupillary Response Predicts Trial-by-Trial Variation in Motor-Related Components of Response Time**  
Hedderik van Rijn, Udo Boehm & Leendert van Maanen
- 70      **The pupillary light response reveals pre-saccadic attentional shifts**  
Sebastiaan Mathôt, Lotje van der Linden, Jonathan Grainger & Françoise Vitu
- 71      **Pupil Frequency Tagging: an on-line measure of visual attention**  
Marnix Naber, George A. Alvarez & Ken Nakayama
- 72      **Spatial attention facilitates assembly of the briefest percepts: Electrophysiological evidence from color fusion**  
Elkan Akyurek & Manon van Asselt

### Room 559 – Perception II

- 73      **The truth about priming in visual search**  
Martijn Meeter
- 74      **Linear perspective explains slant, distortion and motion perceived in pictures**  
Casper Erkelens
- 75      **The effects of aging and Gestalt grouping on haptic search**  
Overvliet, K.E., Krampe, R.T. & Wagemans, J.
- 76      **Neuronal integration in visual cortex elevates face category tuning to conscious face perception**  
Johannes J. Fahrenfort, Tineke M. Snijders, Klaartje Heinen, Simon van Gaal, H. Steven Scholte & Victor A.F. Lamme

### Lamoraalzaal – *Symposium* Social Acceptance and Rejection Feedback

- 77      **The Hurt of Social Exclusion and Rejection**  
Maurits W. van der Molen
- 78      **The Heartbrake of Social Rejection: The Autonomous Nervous System Response to Social Feedback**  
Laura Dekkers
- 79      **Fear of Negative Social Evaluation: Biases in Information Processing**  
Melle J.W. van der Molen, & P. Michiel Westenberg
- 80      **The Role of Social Rejection and Acceptance in Psychopathology**  
Frederik M. van der Veen & Ingmar H.A. Franken

## Saturday, Oral Session 6 (11:05-12:25)

### Room 557 – Mind Wandering & Meditation

- 81      **Analyzing the multimodal signature of task-unrelated thoughts**  
Matthias Mittner, Wouter Boekel, Adrienne M. Tucker & Birte U. Forstmann
- 82      **Fatigue and Response Inhibition in the Stop Signal Task**  
Adrienne M. Tucker, Wouter Boekel, Matthias Mittner & Birte U. Forstmann
- 83      **More “Ohm”, more “A-ha”: the modulating effect of prior meditation practice on the strategy used in solving convergent thinking problems**  
Ayca Szapora, Lorenza S. Colzato & Bernhard Hommel
- 84      **Using cognitive models to understand meditation and mind wandering**  
Marieke van Vugt

### Room 558 – Perception & Action

- 85      **Hierarchical inference in action perception**  
Sasha Ondobaka, Marco Wittmann, Floris P. de Lange & Harold Bekkering
- 86      **Optimising smoothing parameters for a 3D motion analysis system**  
Sander Schreven, Peter J. Beek, Jeroen B.J. Smeets
- 87      **An optimal-viewing-position effect in object processing**  
Lotje van der Linden & Françoise Vitu
- 88      **The behavioral and neural effects of language on motion perception**  
Jolien C. Francken, Peter Kok, Peter Hagoort & Floris P. de Lange

### Room 559 – Mult-Sensory Integration & Synesthesia

- 89      **Neural basis of different types of synesthesia; To what extent are we all synesthetes?**  
Romke Rouw & H. Steven Scholte
- 90      **A taste for words and sounds: a case of lexical-gustatory and sound-gustatory synesthesia**  
Olympia Colizoli, Jaap M.J. Murre & Romke Rouw
- 91      **The Ventriloquist Illusion by Flashes and Averted Eye-gazes**  
Jean Vroomen & Jeroen Stekelenburg
- 92      **Exogenous attention decreases audiovisual integration of simple lights and sounds**  
Nathan Van der Stoep, Marieke A. Janssen, Stefan Van der Stigchel & Tanja C. W. Nijboer

### Lamoraalzaal – Symposium Psychological Science in Industrial R&D

- 93      **The Effect of Perceived Control on Treatment Efficacy of a Pain-Relief Device**  
Paul Lemmens
- 94      **Reducing Salt in a Consumer Friendly Way**  
Liesbeth Zandstra
- 95      **What is The Added Value of Using Implicit Over Explicit Psychological Measurements?**  
Martijn Veltkamp
- 96      **Convergence of Perception and Neurophysiological Research**  
Jan van Erp & Anne-Marie Brouwer

## Saturday, Oral Session 7 (13:30-14:50)

### Room 557 – Social & Emotional Cognition

- 97      **Capture of the eyes by threatening and non-threatening distractors**  
Manon Mulckhuyse, Edwin S. Dalmaijer & Leon Kenemans
- 98      **The social function of pupil-synchronization**  
Mariska E. Kret, Tetsuro Matsuzawa, Jolien van Breen, Agneta Fischer & Carsten de Dreu
- 99      **Emotional involvement in a video story aids emotional memory**  
Katinka Dijkstra & Jorg Huijding
- 100     **Tryptophan promotes interpersonal trust**  
Laura Steenbergen, Erik W. de Kwaadsteniet, Roberta Sellaro, Roman Liepelt, Bernhard Hommel & Lorenza S. Colzato

### Room 558 – Miscellaneous II

- 101     **The Benefits of Spacing Training for Surgical Motor Skills**  
Edward Spruit, Guido Band & Jaap Hamming
- 102     **The Long and Short of Intertrial Priming**  
Wouter Kruijne & Martijn Meeter
- 103     **The roles of bottom-up and top-down attention in psychopathy**  
Sylco S. Hoppenbrouwers, Jantine Slotboom, Yvonne Bouwman, Edwin Dalmaijer, Jan Theeuwes & Stefan van der Stigchel
- 104     **Does the joint Simon effect exist for non-spatial dimensions?**  
Roberta Sellaro, Lorenza S. Colzato, Thomas Dolk, Roman Liepelt & Bernhard Hommel

### Room 559 – Cortical Organization

- 105     **Local spatial attention distorts entire visual field representations in visual cortex**  
B. P. Klein, B.M. Harvey & S.O. Dumoulin
- 106     **Mental representations in the visual hierarchy**  
Anke Marit Albers, Brónagh McCoy, Ivan Toni & Floris P. de Lange
- 107     **Seeing the forest before the trees: the lateral occipital complex analyses the local correlation structure of scenes.**  
HS Scholte, IG Sligte, IIA Groen, VAF Lamme & S Ghebreab
- 108     **Topographic processing of numerosity in the human parietal cortex**  
Ben M Harvey, Barrie P Klein, Natalia Petridou & Serge O Dumoulin

### Lamoraalzaal – *Symposium* Media Ergonomics

- 109     **Spatial Connectedness**  
Harold T Nefs
- 110     **Information Connectedness**  
Tjerk de Greef
- 111     **Social Connectedness**  
Joke Kort
- 112     **Experience in Design Innovation for Healthcare**  
Marco Roozendaal

**Prior History Shapes Selection***Jan Theeuwes*

Vrije Universiteit Amsterdam

Classic models of attentional control assert a dichotomy between top-down and bottom-up control, with the former determined by current selection goals and the latter determined by physical salience. In the present presentation, I will argue that this theoretical dichotomy is inadequate to explain a number of cases in which neither current goals nor physical salience can account for strong selection biases. I will discuss feature-based attention (FBA), as the mechanism that enhances the representation of image characteristics throughout the visual field. FBA is explained in terms of the tuning of the responses of cortical neurons (increasing the gain of neurons) throughout the visual field. Even though it is suggested by previous studies, implicitly and explicitly, that this feature based tuning is under top-down (volitional) control, I will show that selection on the basis of feature characteristics (FBA) is not under top-down control but instead can be explained in terms of bottom-up (intertrial) priming. I will argue that the salience map that drives this selection is not only determined by raw physical salience of the objects in the environment but also by the way these objects are shaped by selection history. I will provide evidence that priming (both feature and reward priming) sharpens the cortical representation of these objects such that these objects appear to be more salient above and beyond their physical salience. I will demonstrate that this type of history effects are not under volitional control: it occurs even if observers try to volitionally prepare for something else. In other words, looking at red prepares our brain for things that are red even if we volitionally try to prepare for green.

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**K1****Number Competence in Grey Parrots:  
Similarities to, and Differences from, Young Children***Irene Pepperberg*

University of Arizona

**Abstract:** A Grey parrot (*Psittacus erithacus*) had previously been taught to use English count words ("one" through "six") to label sets of one to six individual items (Pepperberg, 1994). He had also been taught to use the same count words to label the Arabic numerals 1 through 6. Without training, he inferred the relationship between the Arabic numerals and the sets of objects (Pepperberg, 2006b). In the present study, he was then trained to label vocally the Arabic numerals 7 and 8 ("seven", "eight", respectively) and to order these Arabic numerals with respect to the numeral 6. He subsequently inferred the ordinality of 7 and 8 with respect to the smaller numerals and he inferred use of the appropriate label for the cardinal values of seven and eight items. These data suggest that he constructed the cardinal meanings of "seven" ("seven") and "eight" from his knowledge of the cardinal meanings of one through six, together with the place of "seven" ("seven") and "eight" in the ordered count list.

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**K2**

## The Malleability of Visual Processing

Organizers:

Janneke Jehee (Donders Institute, Radboud Univ. Nijmegen)  
Jan Brascamp (Helmholtz Institute, Univ. Utrecht & Psychology Dept., Univ. Amsterdam)

Plasticity is an essential quality of the brain. Whether we become better at recognizing people we know or improve in our ability to discriminate the finer details of an image, our day-to-day interactions with the environment require an adaptive neural architecture. Traditionally, plasticity of sensory areas was thought to be limited to a short period in early development known as the critical period. Recently, however, it has become clear that neural responses in all cortical areas, including the early sensory cortices, remain malleable throughout life. This symposium will focus on plasticity in the visual cortex. We will highlight different time scales of plasticity, ranging from seconds to months or even years. Our studies indicate powerful effects of priming, learning, and reward on neural activity and behavior, altering early-level cortical responses to improve visual perception, discrimination, and attention. This emphasizes the flexibility of visual function throughout our lifetime, and offers clues as to how this flexibility may arise in the brain.

029

### History Dependence Reveals Communalities Between Selection Among Attention Targets and Selection Among Perceptual Interpretations

Manje Brinkhuis & Jan Brascamp  
Helmholtz Institute, Univ. Utrecht & Psychology Dept., Univ. Amsterdam

Even into adulthood many brain functions retain an ability to be tuned and updated on the basis of changing requirements. Here we investigate two functions that possess this ability: both selective attention and the perception of ambiguous images are sensitive to what happened in the recent past. Although these two forms of history dependence are normally studied in separate fields and considered unrelated, we here provide evidence that they are closely linked, thereby shedding light on their underlying mechanisms.

During 'ambiguous trials' observers viewed a briefly-presented ambiguous Necker cube, which has two possible perceptual interpretations. On 'search trials' observers searched among disambiguated cubes that each represented either of these two interpretations, the target being defined as the only cube that represented a different interpretation than the rest. When presenting consecutive ambiguous trials, perception on a given trial often conformed to earlier perception, an established example of percept priming. Similarly established, responses on consecutive search trials became faster when target identity repeated than when it changed, demonstrating attention priming. In a novel finding, intermixing ambiguous trials and search trials revealed a mutual interaction: search responses were faster to targets representing the interpretation perceived on previous ambiguous trials, and perception during ambiguous trials tended to conform to the target on preceding search trials. Critically, this interaction depended on the presence of perceptual ambiguity: viewing a disambiguated cube only minimally affected subsequent search for that very same cube among distractors.

Our results point to a partial identity between attention priming and perception priming, thus bridging two hitherto unrelated fields of vision science. Beyond history dependencies, our results suggest that overlapping brain mechanisms are responsible for the selection of an attention target from among distractors and the selection of a perceptual interpretation from among viable alternatives.

030

### Transient in Visual Cortex Consolidates Subsequent Perceptual Illusion

Tobias Donner  
Psychology Dept., Univ. Amsterdam

Cortical networks continuously undergo changes in their internal state. Most of these state changes are slow and associated with changes in coarse behavioral state. But some are fast and precisely time-locked to specific cognitive acts, such as perceptual decisions. The functional consequences of the rapid, decision-related cortical state changes are unknown. I will present MEG results indicating that a decision-related state change in visual cortex can consolidate people's perceptual interpretation of an ambiguous stimulus. We found a transient modulation of beta-band (12-30 Hz) activity around subjects' report of their perceptual alternations in a bistable visual illusion. This transient was contingent on the alternations' behavioral relevance, and it encoded the specific type of perceptual report, but not the motor act of reporting. Critically, the amplitude of the transient predicted the stability (i.e., duration) of the subsequent perceptual illusion. Our results are consistent with a model, in which perceptual decisions trigger a transient state change in visual cortex by boosting the neural competition in visual cortex, which, in turn, consolidates the newly selected percept. Such mechanism may generally make people stick to their interpretation of ambiguous information.

031

### Perceptual Learning Selectively Refines Orientation Representations in Early Visual Cortex

Janneke Jehee  
Donders Institute, Radboud Univ. Nijmegen

Although practice is known to improve perceptual discrimination of basic visual features, such as small differences in the orientation of line patterns, the neural basis of this improvement is less well understood. Here, we used functional MRI in combination with signal detection measures to probe the neural concomitants of perceptual learning.

Twelve observers extensively practiced discriminating small differences in the orientation of a peripherally presented grating. Training occurred in daily 1-hour sessions across 20 days, during which subjects performed the task based on a single orientation at a single location in the visual field. BOLD activity was measured before and after training, while subjects performed the orientation discrimination task on the trained orientation and location, as well as three other orientations and a second isoeccentric location.

Training on average led to a twofold behavioral improvement in discrimination sensitivity, specific to the trained orientation at the trained location, with minimal improvement found for untrained orthogonal orientations or orientations presented in the untrained hemifield. We measured the strength of orientation-selective responses in individual voxels in early visual areas (V1-V4) using signal detection measures, both before and after learning. Although the overall amplitude of the BOLD response was no greater after training, training nonetheless specifically enhanced the neural representation of the trained orientation at the trained location. This training-specific enhancement of orientation-selective responses was observed in area V1 as well as higher extrastriate visual areas V2-V4, and moreover, reliably predicted individual differences in the behavioral effects of perceptual learning. These results demonstrate that extensive training can lead to targeted functional reorganization of the human visual cortex, refining the cortical representation of behaviorally relevant information.

032

**Instantaneous Influence of Reward on BOLD Responses In Visual Cortex**

Tomas Knapen  
Psychology Dept., Free Univ. Amsterdam

Motivational influences such as reward and punishment play a large role in the plasticity of our brains. However, the physiological mechanisms that mediate these influences are not well understood. We used reward administration and BOLD imaging of human retinotopic visual cortex to investigate these mechanisms.

Visual stimulation was paired to reward (administered as a reward- or a non-reward-tone) with 50% probability, making reward maximally unpredictable. Reward and non-reward tones could also occur during fixation trials, creating a full factorial reward vs. visual stimulation design. In this manner, we could dissociate responses to reward from visual responses of which the topography follows the retinotopic map.

We find that reward administration causes a temporary decrease in BOLD signal amplitude, and this decrease is independent of visual stimulation. We then investigated the properties of this negative reward response. The retinotopic profile of this reward-related BOLD decrease is a spatially global one, not confined to the stimulus region on the retinotopic map. To investigate the effect of this response on neural functioning we quantified trial-to-trial signal variability. During fixation trials, this variability changes as a function of retinotopic location. This retinotopic spatial profile corresponds to the activations caused by the visual stimulus in other trials.

Our results show that motivational stimuli can cause strong BOLD responses in visual cortex even when no visual stimuli are presented. The sign and spatial profile of these responses precludes an interpretation in terms of excitatory neural firing, meaning that they may be mediated by neuromodulatory systems that induce stimulus-related plasticity. Generally, our results indicate that when we measure BOLD responses, we are recording an undetermined mix of neural firing and other, unknown signals some of which may relate to motivational factors.

**Exploiting Single-Trial Dynamics to Understand Visual Representation**

Organizer: Iris I.A. Groen (University of Amsterdam)

Research into visual perception is largely aimed at understanding the notion of 'representation' in the brain. To understand visual representation, we ultimately need to know how individual stimuli are coded, rather than how average activity levels differ between aggregates of stimuli. Recently, cognitive neuroscience has seen an increase in the application of advanced statistical methods that allow for analysis of individual stimulus representations, i.e. at single-trial level. Single-trial analyses can be applied to many different kinds of neuroimaging data, for example by means of multivariate pattern classification or stimulus decoding. Importantly, it also allows for the evaluation of competing models of information processing against neural or behavioral data, based on how well these models can predict single-trial differences. This symposium will highlight how single-trial methods lead to novel insights in visual information processing, presenting data from several labs in the Netherlands where single-trial analysis has been applied to (a combination of) behavior, fMRI, MEG or EEG. Presenters will discuss how low-level visual information shapes the neural representation of real-world scenes (Groen), where and when information about stimulus category becomes available in visual processing (van de Nieuwenhuijzen), how action selection networks in the brain are dynamically adjusted based on the quality of visual information representation (Jahfari) and how not only real visual stimuli, but also visual illusions are represented at the neural level (Hogendoorn). Together, these studies demonstrate that exploiting single-trial dynamics in neuroimaging data allows for a better understanding of the nature of visual representation.

045

**Two Stages in the Time-Course of Natural Scene Gist Perception**

Iris I.A. Groen, Sennay Ghebreab, Victor A. F. Lamme, H. Steven Scholte  
Cognitive Neuroscience Group, Universiteit van Amsterdam

The ability of the visual system to perceive natural images at remarkable speed may be mediated by a global "gist" percept. It is unclear, however, how gist is computed and under what circumstances it is extracted. We addressed these questions using regression of single-trial EEG on scene statistics. Subjects categorized one type of gist, "naturalness", for a large set of images. Categorization performance was strongly correlated with statistics derived from early receptive field models. In addition, these statistics differentially modulated single-trial event-related potentials (sERPs) both early (100-150 ms) and late in time (up to 250 ms). In a second experiment, early sERP modulations persisted when an orthogonal task was performed, but late effects were present only during gist categorization. These results suggest that gist 1) can be derived from low-level image statistics and 2) is computed bottom-up but can be selectively 'read out' if relevant for the task at hand.

046

**MEG-Based Decoding of the Spatiotemporal Dynamics of Visual Category Perception**

Marieke van de Nieuwenhuijzen, Alexander Backus, Ali Bahramisharif, Christian Doeller, Ole Jensen, Marcel van Gerven  
Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen

Visual processing is a complex task which is best investigated using a method that can capture representation-specific brain activity over both time and space. We achieved this by applying a multivariate decoding algorithm to MEG data measured during a passive viewing task. In order to optimize localization, we used reconstructed source-space time courses as input to the algorithm. By using this method, we obtained high-accuracy single-trial classifications of image categories, with a focal localization in the occipital cortex. Moreover, when applying this algorithm to single time points, the temporal evolution of visual processing becomes apparent, with differences in visual category perception being detected as early as 85 milliseconds after stimulus onset. Finally, this temporal evolution can be focally localized at millisecond level by identifying the sources that underlie classification per single time point, revealing the spatiotemporal dynamics of visual processing.

### **Prefrontal and Sensory Cortex Co-Direct the Basal Ganglia to Optimize Perceptual Action Selection**

Sara Jahfari

Cognitive Science Center Amsterdam, Universiteit van Amsterdam

While most decisions in daily life rely on the assessment of available perceptual information, it remains unclear how sensory information is integrated into fronto-basal ganglia systems of decision-making. Using a model-based connectivity approach, we found that a sensory informed cortico-basal ganglia network best represented human-brain single-trial fMRI patterns during action-selection. When sensory information was less reliable, connection strengths from both prefrontal and sensory regions into the basal ganglia were adjusted dynamically to optimize response selection. Formal reaction-time analysis indicated these adjustments to reflect the ease of information accumulation, and response cautiousness. These results link the dynamics of information relay within the brain to strategic adjustments in behavior, and provide novel insights into how perceptual information modulates fronto-basal ganglia routes of action-selection. In addition, these results show decision-making within the basal ganglia to emerge through top-down adjustments from prefrontal-, and bottom-up evaluations from sensory cortex.

### **Multivariate Pattern Cross-Classification of Single-Trial EEG and fMRI Data: Comparing Neural Signatures in Illusory Visual Percepts**

Hinze Hogendoorn<sup>1</sup>, Frans A Verstraten<sup>2</sup>

<sup>1</sup>Department of Experimental Psychology, Universiteit Utrecht, Netherlands,

<sup>2</sup>School of Psychology, University of Sydney, Australia

We used multivariate pattern classification to compare the neural signatures of two visual illusions to the veridical stimuli that they resemble. First, we used fMRI to compare real motion to the illusory motion that can be observed during the motion after-effect. We show that a motion after-effect in a given direction in fact has a very dissimilar activation pattern to real motion in the same direction. Furthermore, the pattern of classification errors suggests a crucial role for motion area MT+ in generating the illusion.

In a second experiment, we classified EEG recordings of an illusion in which the perceived location of a stimulus is shifted away from its veridical location. This allows us to track the representation of visual position with high temporal resolution. We show that the illusion causes classification errors that correspond to the illusory percept, even in very early representations that we expected to be purely stimulus-driven.

## **Alpha Oscillations and Selective Attention**

Organizers:

Marlies Vissers & Dr. Heleen Slagter (University of Amsterdam)

Selective attention, the ability to attend to some things while ignoring others, plays a fundamental role in virtually everything we do, as it supports our momentary awareness and affects how we act on information in a rich and challenging environment. Not surprisingly, therefore, selective attention has been one of the most studied topics in cognitive neuroscience research over the past few decades. This research has shown that attention can prioritize early sensory processing of behaviorally relevant information by biasing sensory regions in advance to favor processing of relevant stimuli over irrelevant stimuli. Yet, our understanding of the mechanisms that limit and prioritize input in the brain is still incomplete. In this symposium, we will focus on alpha oscillations as an important mechanism for dynamically routing and gating information flow between brain regions. While historically thought to represent the activity of the visual cortex in an idle state, recent studies have shown reduced alpha activity in task-relevant cortical areas and increased alpha activity in task-irrelevant cortical areas, with alpha suppressive effects predicting better performance. These findings have led to the view that alpha oscillations play an active role in information processing and inhibit task-irrelevant brain regions. Yet, recent work suggests that the alpha rhythm does not simply serve an inhibitory purpose, but plays a crucial role in network coordination and communication: alpha oscillations may temporally shape the stream of perceptual experience. This symposium will present new empirical evidence and alternative theoretical views on the role of alpha oscillations in selective attention.

### **An Oscillatory Mechanism for Prioritizing Processing**

Mathilde Bonnefond

*Donders Institute for Brain, Cognition, and Behavior, Radboud University Nijmegen*

Alpha oscillations (8-13 Hz) are thought to underlie the filtering of irrelevant information through pulses of inhibition silencing a network node every ~100 ms. We recently showed that visual alpha power and phase are top-down adjusted so that the processing of a predictable distracter is optimally suppressed. Moreover, this alpha activity was coupled to low gamma (~40Hz) and high gamma (> 60Hz) power and the stronger the alpha power, the weaker the high gamma power specifically during alpha troughs. This indicates that stronger alpha power is associated with stronger pulses of inhibition. These results are in line with monkey results that we obtained showing a coupling between alpha phase in the deep layers and gamma amplitude in granular and superficial layers of V1. We propose a general theory about how alpha activity might act as a mechanism for limiting and prioritizing the input flow in order to prevent information overload.

### **Region Specific Oscillatory Alpha Activity Serves to Suppress Distracting Input Across Visual and Auditory Modalities**

Ali Mazaheri

*Department of Psychiatry, AMC, University of Amsterdam*

Recent theories suggest that oscillatory activity in the alpha range (10 Hz) plays a pivotal mechanistic role in attention by gating information flow to relevant sensory regions through the inhibition of irrelevant regions. Studies supporting this hypothesis have used shifts of attention (often spatial) within one modality (often visual or sensory motor). However, daily life very often dictates that our attention is coordinated across modalities which results in the facilitation of sensory processing in one modality and inhibition of input in other modalities. In this talk I will be present evidence that the modulation of alpha power serves a specific role in suppressing distracting information across the auditory and visual modalities. I will also discuss the direct relationship of alpha power in specific sensory cortices with attentional performance on a trial-by-trial and interindividual basis.

063

**Transcranial Modulation of Alpha Oscillations and Visuospatial Attention**

Til O. Bergmann

*Donders Institute for Brain, Cognition, and Behavior, Radboud University Nijmegen*

Visuospatial attention relies on the prioritized processing of task-relevant and the suppression of task-irrelevant locations in visual space. Neuronal oscillations in the alpha band (8-12 Hz) are supposedly mediating this function by rhythmically inhibiting cortical excitability. Indeed, alpha power in the visual system decreases contralateral and increases ipsilateral to the attended hemifield. The anticipatory modulation of alpha oscillations is presumably under top-down control of the dorsal fronto-parietal attention network. We study the impact of the frontal eye fields (FEF) on alpha oscillations and visuospatial attention by combining transcranial brain stimulation techniques with electrophysiology. I will present two complementary approaches: (i) Disrupting cued-driven FEF top-down signals by offline rTMS followed by a cued visuospatial attention task and MEG recordings. (ii) Mimicking cue-driven FEF top-down signals by online tDCS during an uncued visuospatial attention task and EEG recordings. Thereby, we aim to make a causal link between FEF activity and alpha oscillations.

064

**Multiple Neural Mechanisms Underlying Attention-Based Inhibition and Facilitation of Sensory Processing**

Heleen A. Slagter

*Department of Psychology and Cognitive Science Center Amsterdam, University of Amsterdam*

Alpha oscillations play a crucial role in biasing sensory areas in advance to favor certain stimuli over others. Specifically, alpha oscillations have been functionally linked to inhibition of irrelevant brain regions. Yet, through their phase, they have also been shown to create time windows for optimal information processing in regions representing behaviorally relevant information. Several studies have noted similarities between alpha oscillations and the early visual P1 event-related potential: both are functionally associated with inhibitory processes, and the frequency characteristic of the P1 lies in the alpha range. It has therefore been proposed that the P1 may be modulated or even generated by alpha oscillations. In this talk, I will discuss findings from an EEG study suggesting a functional dissociation between alpha oscillations and the P1. Implications for current cognitive neuroscience models of attention will also be discussed.

**The Processing of Social Acceptance and Rejection Feedback**

Organizer:

Maurits W. van der Molen (University of Amsterdam)

Social interaction and relationships are a hallmark of the human species. People are strongly motivated to gain social acceptance and are therefore typically highly sensitive to interpersonal rejection. Indeed, social rejection is conceptualized as a significant threat to survival. Recent studies examined the neural mechanisms underlying the processing of social exclusion and rejection as well as the bodily responses to the pain of social rejection. In this symposium Maurits van der Molen (UvA) will review recent studies examining neural and cardiac responses to cognitive and social feedback focusing on underlying mechanism. Laura Dekkers (UvA) will present the results of recent studies examining cardiac responses to social rejection feedback in both adults and children. Melle van der Molen and Michiel Westenberg (LU) will present results of a study examining the relation between anticipatory feedback processing and social anxiety. Finally, Freddy van der Veen and Ingmar Franken (Erasmus University) will examine the processing of social rejection in relation to psychopathology.

077

**The Hurt of Social Exclusion and Rejection**

Maurits W. van der Molen

University of Amsterdam

There is a considerable body of research focusing on the processing of negative performance feedback in cognitive tasks. The processing of negative performance feedback, including errors, results in remedial action on subsequent trials, and is indexed by negative brain potentials recorded at fronto-central scalp locations. More recently, research focused on the processing of negative information in the social domain. It has been shown that the processing of negative social information activates the anterior cingulate cortex and regions in the ventral prefrontal cortex. I will review a series of studies examining neural and cardiac responses to social rejection and exclusion. The results of these studies reveal that the processing of negative social information is associated with the activation of widespread neural circuitry overlapping with structures implicated in the processing of physical pain. These findings will be discussed within the context of central-autonomic network proposals.

078

**The Heartbreak of Social Rejection: The Autonomic Nervous System Response to Social Feedback**

Laura Dekkers

University of Amsterdam

The autonomic response to feedback has been extensively studied within the cognitive domain. These studies have shown heart rate slowing in anticipation to performance feedback that is prolonged when feedback is worse than expected. In this talk, I will extend these cardiac findings to feedback processing in the social domain. More specifically, I will introduce the 'Do you like me?' paradigm that we have used to study the processing of explicit social acceptance and rejection feedback. I will show that social feedback, like non-social feedback, has a pronounced influence on the autonomic nervous system in that heart rate slows in anticipation of social feedback in general but is prolonged when feedback signals unexpected social rejection. By discussing data from both adult and developmental samples, I will show that the autonomic sensitivity to unexpected social rejection feedback seems to emerge as a consequence of pubertal development.

### **Fear of Negative Social Evaluation: Biases in Information Processing**

Melle J.W. van der Molen, & P. Michiel Westenberg  
Leiden University

We investigated the processing of social rejection feedback in relation to individual differences in social anxiety by examining event-related brain potentials prior to (i.e., stimulus preceding negativity) and after the processing of social evaluative feedback (i.e., feedback-related negativity and P3). Results revealed a pronounced left lateralized parietal-occipital negativity (SPN) during the feedback anticipation period, which was larger for positive than for negative anticipations. Amplitude of the SPN, while awaiting social acceptance feedback, correlated positively with the level of fear of negative evaluation (FNE), a measure of social anxiety. These findings will be discussed in terms of current conceptions of information processing biases in social anxiety.

### **The Role of Social Rejection and Acceptance in Psychopathology**

Frederik M. van der Veen and Ingmar H.A. Franken  
Erasmus University

In a paradigm in which participants have to decide on the basis of pictures of virtual peers whether these peers like them or not, a distinct cardiac response to social rejection and a distinct cortical response to social acceptance can be measured. Physiological and behavioral measures in this paradigm show large individual differences and it has been suggested that these differences might be related to differences in personality. Moreover, these differences might be even bigger in different forms of psychopathology in which social feedback stimuli play an important role. In the present talk we will focus on changes in the perception of social rejection and acceptance in relation to depression, psychopathy and substance abuse.

## **Psychological Science in Industrial R&D**

Organizer and Session Chair  
Prof. Dr. Garnt Dijksterhuis  
Unilever R&D/University of Copenhagen

In this symposium we would like to present applications of psychological (cognitive, perceptual, behavioural, etc.) studies in an industrial context. It is increasingly recognized that the gap between academic research in psychology and applications thereof, is closing. The industry has a need for well trained researchers in psychological experimenting, and many students find jobs in an industrial context. In the Netherlands we have several large industrial R&D centres that employ psychological scientists in R&D functions.

### **The Effect of Perceived Control on Treatment Efficacy of a Pain-Relief Device**

Paul Lemmens  
*Philips Research, Brain, Body & Behavior*

Various psychological constructs like fear of pain, catastrophizing, self-efficacy, and control are relevant in pain perception. We carried out a study to investigate whether perceived control over a treatment can positively affect pain treatments. Pain patients came in for two sessions in which a research version of the Philips BlueTouch product (a pain-relief device exploiting photobiological effects induced by blue light) was used for pain relief. In one session, participants were given the opportunity to set up treatment parameters using sham-software. In the other session, this software supposedly crashed and the experimenter took control of programming the treatment parameters. In this way, in one session participants were given the idea of having control over their treatment and thus (perhaps) over their pain, whereas in the other session this control was completely taken away from them. However, unknown to the participants, the treatments in both sessions were identical. During and after the treatments, participants rated their perceived pain intensity on a visual-analogue scale (VAS) and after both sessions were completed they judged which of the two treatments they considered having given the most and the longest pain relief. We expected to find positive effects of having control on pain treatments. The results of the experiment highlighted that, subjectively, nearly all participants rated the having-control treatment as most efficacious. A mixed models regression on the VAS scores confirmed this benefit although self-efficacy was needed as a significant confounder in the regression. We conclude that perceived control is an important concept in pain relief that is expressed both in subjective preferences as well as objective pain relief. The strong preference for the having-control treatment indicates that it is relevant to users of the BlueTouch to have at least some control over the treatment parameters.

### **Reducing Salt in a Consumer Friendly Way**

Liesbeth Zandstra  
*Unilever R&D, Foods, Consumer Science*

We are all encouraged to eat less salt to reduce the risk of heart disease and stroke. Currently, average daily consumption of salt is 9–12g per day, whereas the World Health Organization guideline is 5g of salt a day. As part of its Sustainable Living Plan, Unilever set itself the challenging target of helping consumers to cut their salt intake to this recommended level of 5 grams a day. The challenge here is to create products which are lower in salt content while remaining appealing for consumers. Recent research showed that 'reduced-salt' labels alone can already have a negative effect on consumers' expectations and on taste perception. Now, a further study shows that this labeling may not just impact immediate taste perception but may drive compensatory salt use, even to the point of overcompensating. This is the focus of the presentation in which themes such as communication, taste perception, acquired preferences and salt usage will be addressed.

095

### What is The Added Value of Using Implicit Over Explicit Psychological Measurements?

Martijn Veltkamp  
FrieslandCampina R&D

Within industry, explicit methods to measure consumer preferences and behaviour are still very common. Scientific studies show that implicit measures can provide more predictive information regarding consumers' implicit affective reactions and behaviour. Thus, increasing the use of such methods within industry may help to be better able to predict consumer reactions to new products. However, most research on implicit methods took place under very controlled lab circumstances. In addition, there is little information available for food products where explicit and implicit methods are directly compared. A question I aim to answer in this presentation is therefore 1) how predictive implicit measures are for real-life behaviour, 2) how accurate and applicable implicit methods are in less controlled circumstances, with real consumers and real, complex products, and 3) what exactly the added value is as compared to explicit methods. These questions will be answered in three studies that directly compare various implicit and explicit methods with respect to predicting product choice, and changing consumption routines. The results support previous literature insofar that implicit measures have predictive power. However, no clear added value over more traditional explicit measures was found. Potential implications and future directions will be discussed.

096

### Convergence of Perception and Neurophysiological Research

Jan van Erp, Anne-Marie Brouwer  
TNO Soesterberg, The Netherlands

TNO has been engaged in applied perception research for many decades serving both government and industry in improving their services and products. TNO is an independent research organisation with the Netherlands' government as an important stakeholder. Over the years, we applied our knowledge for instance in advice on road design, camouflage, markings on emergence vehicles, and website design for local and national government agencies. Our approach has a strong foundation in psychophysics but we see a paradigm shift towards using neurophysiological indices of perception. We will present two examples of the convergence of perception and neurophysiology.

The first concerns visual search tasks. The P300 event-related potential (ERP) can be used to infer whether an observer is looking at a target or not. Common practice in P300 experiments and applications is that observers are asked to fixate their eyes while stimuli are presented. We investigated a target search task involving eye movements by using EEG epochs synchronized to fixation onset (fixation-related potentials: FRPs) instead of stimulus onset. We show that it is possible to classify single FRPs into target and non-target FRPs above chance. These results are the first step to practical applications such as covertly monitoring observers' interests and supporting search tasks.

The second concerns Brain-Computer Interfaces (BCIs) based on EEG responses to visual, auditory and/or tactile stimuli. So-called P300 BCIs are based on the modulating effect of attention on the amplitude of the P300 ERP. By randomly presenting different stimuli (coupled to different choices), a classifier comparing the P300 of the different stimuli can determine to which the user focused attention and execute the linked choice. BCIs based on tactile stimuli have the advantage of not taxing the visual or auditory system and of being potentially unnoticeable to other people. In a series of experiments we showed the feasibility of a tactile P300 BCI and effects of amongst others the number of options to choose from and the stimulus onset asynchrony (SOA) of the random presentation.

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## Media Ergonomics

Organizer:  
Harold T Nefs (Delft University)

The digital media industry is currently undergoing a profound change. Internet-based distribution is transforming traditional broadcasting towards higher levels of interactivity and integration with virtual, mixed and augmented reality, enabled by advanced web technologies and the proliferation of audio/video/tangible devices. Today's interactive broadcasting technology has the potential to enrich social connections, improve the feeling of being together and immersion in one shared space, and enhance collaboration. However, in order to achieve this potential, it is necessary that flexible, interactive media production and consumption platforms be designed in ways that the quality of the user experience is optimized in all its possible facets. It is therefore crucial to recognize the essential psychological factors that shape and affect quality of experience, and learn how to create ergonomic media experiences with these factors in mind. In this symposium we explore Quality of Experience in systems that are designed for professional collaboration and shared leisure activities. Three key domains are identified for improving quality of experience, namely: 1) Spatial Connectedness, 2) Social Connectedness, and 3) Information Connectedness. The concept of spatial connectivity is founded on the idea that one does not look at a video of a remote location, but rather, the remote location is embedded into a physical space. This is accomplished through for example virtual cameras. Through the design of contextualized communication support, social connectivity is experienced when communicating with each other in shared activities, as well as in ambient awareness and presence situations. Whilst safeguarding ethical values like privacy, information connectivity seeks to increase situation and activity awareness by ensuring that users can find relevant information for their context of collaboration, interests and/or goals. Relevant technologies are automatic information retrieval technologies, privacy preservation techniques, and automatic activity recognition. We conclude the symposium with a sketch of the design process for media ergonomics in design healthcare innovation at the Princess Maxima Center for Child Oncology.

### **Spatial Connectedness**

Harold T Nefs

*Delft University of Technology*

*Faculty of Electrical Engineering, Mathematics and Computer Science*

Joke Kort

*TNO ICT*

In shared mediated spaces, the individual experience of presence is negotiated as part of a process to establish trust and confirmation from the remote party/parties. An on-going construction of a sense of place is informed by a series of 'reality tests' carried out by participants, who seek fast, consistent and reliable confirmation that the mediated architectural extensions can be trusted –in which case they can temporarily agree to suspend their judgment in favour of a 'willing suspension of disbelief'. The experience of presence is closely linked to spatial connectedness. Ideally, we do not want to look at a video or a television screen, rather, we prefer the illusion that our real space is extended beyond the screen in ways that allow us to actively participate on a broadcasted stage, and to interact with others on e.g. a talk show. The concept of spatial connectedness and presence design research allows us to investigate 1) how video and audio streams that capture the face, body, and speech can be used more effectively to improve quality of media experiences through spatial presence, and 2) the spatial design considerations for embedding pictorial / mediated spaces in physical space.

In this talk I will address the possibilities to create spatial connectedness and will focus specifically on depth perception from motion parallax and stereopsis using cheap and simple webcams in the web browser. We will see how yoking the head to the perspective rendering, that is by creating so called virtual camera's can aid the perception of depth. A second related problem associated with classical camera's is the "mona lisa effect" (the fact that one does not seem to have proper eye contact over video connections). I will also show how virtual cameras can also overcome this problem.

### **Information Connectedness**

Tjerk de Greef

*Centrum Wiskunde & Informatica (CWI) – Department of Information Access*

Information Connectedness refers to the information that is required to 'feel' connected and to collaborate effectively while acting distributed, ad-hoc and a-synchronous. It is thus targeted towards increased awareness of activities and situations. In this talk I will A) discuss the relevance and importance of being connected from an information perspective and B) discuss important techniques that need to be integrated to work towards an information connectedness agent. The latter also embeds a discourse on the safeguarding of ethical values like privacy, data ownership and accountability.

Today's real-time mediated presence systems provide a rich image of the remote actor, potentially allowing understanding actions, states, and responses. However, these systems are typically limited to the timeframe of the call. Activities happening outside the timeframe may have an impact on the shared activity. The time between calls is, in today's work settings, quite large compared to the duration of a call, thereby limiting the opportunity to synchronize activities. Being aware of what has happened between the call is important for effective collaborations and proves valuable in dynamic settings, such as the Princess Maxima Centre for Child Oncology, as it allows validating assumptions and being aware on activities.

In this talk I will share the design and workings of the Information Connectedness Agent, which aims to put forward relevant information regarding the shared activity. Such information should put the information in the periphery of the process, allowing to browse this information at convenient times increasing the chance to observe interesting information regarding the shared activity with minimal interruption. The agent aids the human to observe what remote actors are doing adding valuable information about the context in which work is achieved. In particular, I will discuss:

- 1) In which way an intelligent software agent needs to be designed so that actors are increasingly aware of elements that affect the shared activity whilst safeguarding privacy, accountability and data-ownership.
- 2) What the effects of such a software agent would be on collaboration, resilience, and adaptation.
- 3) How information must be presented to the actors to allow them to interact naturally and to optimize situation awareness.

### **Social Connectedness**

Joke Kort

*TNO ICT*

Social Connectedness is the feeling of truly being connected to another person or group of persons both during but also before and after moments of interaction. Shared mediated spaces support social connectedness in many different ways such as through delivering a sense of presence, communication and interaction means such as audio/video communication or for mediated shared activities, or awareness means such as provided through chat or micro messaging services (status information and updates). In this talk I will address my design and evaluation framework for social connectedness used in the European FP7 project Together Anywhere, Together Anytime (TA2) and discuss the insights and results obtained in designing and evaluating different demonstrators for social connectedness through laboratory studies as well as real life experiments and with different qualitative and quantitative methodologies.

### **Experience in Design Innovation for Healthcare**

Marco Roozendaal

*Faculty of Industrial Design Engineering, Delft University of Technology*

How to design new products and services for healthcare by taking experience as a starting point? In this talk we will show some approaches on design for experience at Industrial Design Engineering - TU Delft, illustrated by student-work conducted for the new Princess Maxima Centre for Child oncology. A specific focus will be on how to generate and evaluate designs, considering specific qualities in experience.

## ORAL PRESENTATIONS - ABSTRACTS

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001

### **Pleasant touch and the rubber hand illusion.**

H.E. van Stralen, M.J.E. van Zandvoort, L. Visser, L.J. Kappelle & H.C. Dijkerman  
Utrecht University

Pleasant touch is mediated by a distinct neural pathway that consists of un-myelinated tactile afferents (CT-fibers) that respond to stroking with a slow velocity on the hairy skin. These fibers project to the posterior insula, an area that has also been implicated in the rubber hand illusion. We hypothesized that there would be an additional effect of pleasant touch on the rubber hand illusion (RHI) compared to touch that is regarded as less pleasant. We conducted two experiments with the rubber hand illusion. In the first experiment, we tested the effects of stroking velocity and stroking material on the RHI. We found an increased illusion for slow velocity, soft material stroking. In the second experiment, we tested whether these effects were specific for areas that contain CT fibers or whether this was a general effect of stroking speed. In line with our hypothesis, there was a higher proprioceptive drift after pleasant touch on the hairy skin compared to the glabrous skin, suggesting that CT-fibers were involved in conveying the stroking. Other outcome measures (temperature drop and the subjective illusion) showed effects of pleasant touch in the first experiment but not in the second, suggesting that these measures are less influenced by pleasant touch.

002

### **Pupil dilation reflects specific perceptual alternations in a bistable visual illusion**

Niels A. Kloosterman, Thomas Meindertsma, Anouk M. van Loon & Tobias H. Donner  
University of Amsterdam

Pupil dynamics at constant illumination have been proposed as an index of phasic neuromodulation during perceptual decision-making. Specifically, in bistable perceptual illusions, pupil size has been shown to modulate around behavioral reports of perceptual switches. It is unknown to which extent these pupil modulations reflect the content of perceptual switches and/or the motor act used to report them. Asymmetric bistable visual illusions like "motion-induced blindness" (MIB) provide an opportunity to address these questions. In MIB, a salient and physically constant "target" stimulus, surrounded by a rotating mask, spontaneously alternates in and out of visual awareness. Here, we linked pupil dynamics to the content of perceptual switches during MIB, under various manipulations of behavioral report. We asked 19 subjects to report perceptual switches both during MIB and intermittent physical target removal ("Replay"). In different experiments, subjects reported target disappearance as follows (complementary for re-appearance): 1) button press, 2) button release; 3) switch between two buttons; 4) Replay only: counting and reporting the total after each 3-minute run. In all conditions, the pupil constricted during an interval of ~1 s before report and dilated from ~0-1 s after report. The pre-report constriction was stronger during disappearance than re-appearance reports. This difference was also evident in the counting condition, in the absence of any overt behavioral report. We conclude that pupil constriction reflects the specific content of perceptual switches, independent of the specific motor regime used for report. We speculate that these pupil dynamics may be driven by decision-related, phasic neuromodulation.

003

### **The effects of the Müller-Lyer illusion on saccades and perceptual judgments decrease with longer presentation time**

Anouk J. de Brouwer, Eli Brenner, W. Pieter Medendorp & Jeroen B.J. Smeets  
VU University Amsterdam

The amplitude of saccadic eye movements is affected by size illusions such as the Müller-Lyer illusion, but this effect varies highly between studies. We examined the origin of this variability by testing the influence of three temporal factors on the effect of the Müller-Lyer illusion: presentation time, saccade latency, and response delay. Subjects performed reflexive saccades, deferred saccades, and memory-guided saccades along the shaft of the illusion. We compared the time course of the illusion effects on saccades to the results of a perceptual judgment task in which presentation time of the illusion was varied. We found that the illusion affected both saccade amplitude and perceptual judgments with a similar time course. In both cases, presentation time of the Müller-Lyer illusion, not saccade latency or response delay, was the most important factor in determining the size of the illusion effect. Longer presentation times resulted in smaller illusion effects, suggesting that our visual representation is dynamic and becomes more accurate when we look at an object for a longer time before we act on it.

004

### **Eye- and image-based grouping during binocular rivalry**

Sjoerd Stuit, Chris Paffen, Maarten van der Smagt & Frans Verstraten  
Universiteit Utrecht

Prolonged viewing of dichoptic images results in perceptual alternations known as binocular rivalry. A long-standing debate in rivalry research concerns the level of processing where rivalry originates; eye-based versus image-based competition. Here we used a new paradigm designed specifically to quantify eye- and image- components of rivalry by comparing the durations of different perceptual outcomes. Rivalry competition occurs at all locations of the competing images, however, certain combinations of dominant image-parts last longer than others. This is referred to as grouping during rivalry. What aspect of the competing images results in this difference in duration? In this study we focused on grouping of rivaling gratings as well as upright and inverted faces, with and without disparity. The processing of these images occurs at different stages in the visual stream. We found no differences based on the orientation of faces, for occluded or non-occluded images pairs, nor any change in image-based grouping between grating and face stimuli. Image content does play a role in grouping but appears to be limited to the image's basic components. The greatest contributor to grouping durations was the eye-of-origin of the dominant images. Our results suggest grouping occurs at a very early stage of visual processing.

### **Paranormal Believers are more prone to illusory agency detection than skeptics**

Michiel van Elk  
University of Amsterdam

It has been hypothesized that illusory agency detection is at the basis of belief in supernatural agents and paranormal beliefs. In the present study a biological motion perception task and a face-house categorization task were used to study illusory agency detection in a group of skeptics and a group of paranormal believers. Participants were required to detect the presence or absence of a human agent in a dynamic point-light display or in a picture representing faces or houses under different levels of visual noise. In the biological motion detection task paranormal believers had a lower perceptual sensitivity than skeptics, which was due to a response bias to 'yes' for stimuli in which no agent was present. In the face-house categorization task paranormal believers compared to skeptics showed a stronger response bias for detecting faces. The relation between paranormal beliefs and illusory agency detection held only for stimuli with low to intermediate ambiguity, but for stimuli with a high number of visual distractors responses of believers and skeptics were at the same level. Furthermore, it was found that illusory agency detection was unrelated to traditional religious belief and belief in witchcraft, whereas paranormal beliefs (i.e. Psi, spiritualism, precognition, superstition) were strongly related to illusory agency detection. These findings qualify the relation between illusory pattern perception and supernatural and paranormal beliefs and suggest that paranormal beliefs are strongly related to agency detection biases.

006

### **You're sick! The neural signature of intuitive decision-making.**

Martijn E. Wokke & K. Richard Ridderinkhof  
Universiteit van Amsterdam

In settings when a quick and complex decision is crucial to a successful outcome people often rely on pre-deliberate decisions. For instance, in crisis situations or in tennis ('a game of emergencies') a quick and intuitive response to a complex situation is critical for saving lives or, less dramatic, for winning a match. Through extensive training and experience intuitive decisions can often become highly sophisticated and adept. In this talk I will present data demonstrating how expertise modulates neural responses during decision-making. We recorded EEG signals while participants were asked to make a diagnosis after seeing a sample (a complex visual pattern) of fictive patient data. This sample could either belong to a sick or to a healthy patient. Participants gradually learned to distinguish sick from healthy patterns, while indicating on each occasion how they made their decision (i.e., guessing, intuitive or rational choice). Results demonstrate that the level of (conscious) knowledge about the decision is reflected in increased levels of fronto-central theta power during evidence accumulation and enhanced beta power during the actual choice. These findings indicate that expertise increases top-down control and boosts information integration in the brain during perceptual decision-making.

007

### **On making the right choice: A meta-analysis and large-scale replication study of the unconscious thought advantage**

Mark R. Nieuwenstein, Heertjen T. Wierenga, Richard Morey, Jelte M. Wicherts, Tesse N. Blom, Eric-Jan Wagenmakers  
University of Amsterdam  
Hedderik van Rijn  
University of Groningen

Are difficult decisions best made after a momentary diversion of thought? Research addressing this important question has yielded dozens of published experiments in which two groups of participants were first presented with a large amount of information about several choice options – e.g., cars – and then asked to select the best option either after conscious deliberation, or after performing an unrelated task. While half of these experiments showed that participants who had first performed the unrelated task were more likely to select the best option, the others found no evidence for this so-called unconscious thought advantage (UTA). The aim of the current study was to examine two accounts of this inconsistency in previous findings. According to the moderator account, the UTA is a real effect but it only occurs if certain conditions are met in the choice task. According to the reliability account, the UTA does not exist and previous reports of this effect concern nothing but spurious effects obtained with an unreliable paradigm. To test these accounts, we conducted a meta-analysis and large-scale replication study (N = 399) that met the conditions deemed optimal for replicating the UTA. Consistent with the reliability account, the large-scale replication study yielded strong support for the null hypothesis, and the meta-analysis showed that the UTA has only been found in studies that used a small sample size. Accordingly, we conclude that there exists no reliable support for the claim that a momentary diversion of thought would benefit making a difficult choice.

008

### **The Rodent Anterior Cingulate Cortex Exhibits a Reward-Related Local Field Potential Deflection that is Sensitive to Expectation**

Christopher M. Warren, James M. Hyman, Jeremy K. Seamans & Clay B. Holroyd  
Leiden University

The feedback-related negativity (FRN) refers to a difference in the event-related potentials (ERP) elicited by feedback indicating success versus failure: the difference appears negative when subtracting the success ERP from the failure ERP (Miltner, Braun, & Coles, 1997). Holroyd and Coles (2002) proposed that the FRN is a manifestation of anterior cingulate cortex (ACC) activity in response to dopaminergic signals from the midbrain dopamine system whereby the ACC uses the signals to adapt behaviour according to principles of reinforcement learning. Though source localization techniques (e.g. BESA) suggest that the source of the FRN is in the ACC, the inverse problems limits the certainty of this conclusion. We recorded local field potentials (LFPs) directly from the ACC in 6 rodents in a task based on the FRN paradigm. The animals were trained to poke their nose into a lighted port and received a feedback smell indicating whether or not a reward pellet would drop 1.5 s later. We observed a FRN-like effect time-locked to the feedback scent, where the LFP to feedback predicting no pellet was significantly more negative than the LFP to feedback predicting reward. This effect of feedback was sensitive to the expectation of reward, such that unexpected outcomes (e.g. feedback indicating reward at a port that yields rewards only 25% of the time) elicited larger differences in the LFPs than expected outcomes.

009

### **Spatial Interferences in Mental Arithmetic: Evidence from the Motion-Arithmetic Compatibility Effect**

Michael Wiemers, Harold Bekkering & Oliver Lindemann

Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen

Recent research on the spatial number representations suggest that the number space is not necessarily horizontally organized and might be also affected by acquired associations between magnitude and sensory experiences in vertical space. Evidence for this claim is however controversial. The present study now aims to compare vertical and horizontal spatial associations in mental arithmetic. In Experiment 1, participants solved addition and subtraction problems and indicated the result verbally while moving their outstretched right arm continuously either left-, right-, up- or downwards. The analysis of the problem solving performances revealed a motion-arithmetic compatibility effect for spatial actions along both the horizontal and vertical axes. Performances in additions were enhanced while making upwards compared to downwards movements as well as when moving right compared to left and vice versa in subtractions. In Experiment 2, instead of instructing to perform active body movements, participants calculated while the problems moved in one of the four relative directions on the screen. For visual motions, only the motion-arithmetic compatibility effect for the vertical dimension could be replicated. Taken together, our findings provide evidence for an impact of spatial processing on mental arithmetic. Moreover, the stronger effect of the vertical dimension supports the idea that cognitive calculations operate on representations of numerical magnitude that are grounded in a vertically organized mental number space.

010

### **Open your eyes: Uncovering the structure of thought using eye tracking**

Trudy A. Buwalda, Niels A. Taatgen & John R. Anderson

University of Groningen

Ordinary measures of performance generally only provide information on trials as a whole (are people faster in condition X or condition Y; is the prefrontal cortex more activated in condition X or in condition Y?). Previously, fMRI data and hidden markov models have been used to investigate the stages people go through during a trial (e.g. Anderson & Fincham, 2013). However, this method has several disadvantages: The temporal resolution low and therefore it is only suitable for relatively slow tasks, and fMRI can only be used in a theoretical setting because of the limitations of the scanner.

To get a more fine-grained perspective on the different stages people go through during a trial we have combined hidden markov models with eye tracking data to track what people are doing during a trial on a fixation by fixation basis. This yields a better temporal resolution and allows this method to be used in a more applied setting, such as a classroom. Here we will show that the eye tracking method is able to distinguish the separate stages in a mathematical problem solving process and that it can uncover short stages that were overlooked in the fMRI data

011

### **Noradrenergic modulation of perceptual decision making in humans**

Peter Murphy, Joachim Vandekerckhove, Eric-Jan Wagenmakers & Sander Nieuwenhuis

Leiden University

The brainstem locus coeruleus-noradrenergic (LC-NE) system is thought to exert powerful modulatory effects on the responsivity or 'gain' of neural networks, leading to the suggestion that this system may partly determine the efficiency and reliability with which we make decisions. However, what specific aspects of the decision process are affected by endogenous fluctuations in NE release is unclear. Our study sought to address this question via a combination of drift diffusion modelling and pupillometry, the latter providing a continuous indirect measure of LC-NE activity. Both traditional and Bayesian-hierarchical implementations of the diffusion model were employed to decompose participants' behaviour on the random dot motion task into latent parameters of the decision process. Both approaches converged to suggest that tonic pupil diameter was uniquely related to a model parameter representing variability in the rate at which decision evidence is accumulated. This finding is consistent with the notion that tonic NE-driven increases in neural gain enhance the influence of noise on the decision process, which manifests behaviourally in less accurate and more variable decisions.

012

### **Attentional Blink: Isn't it just a skill?**

Niels Taatgen

University of Groningen

There are many different models of the attentional blink, but all of them attribute the phenomenon to structural characteristics of cognition, either memory consolidation or executive control. Recent evidence by Choi et al. (2013) shows that the attentional blink disappears with appropriate training, thereby casting doubt on structural explanations. To understand the effects of learning it is necessary to see the attentional blink in the context of other tasks. Using the new PRIM architecture for studying transfer of skills (Taatgen, 2013), I will demonstrate that by first training a model on list-learning, the model will then exhibit an attentional blink in an RSVP task. However, when the model is first trained on the Choi training task, the model will not show an AB. List learning promotes a proactive strategy, which causes a blink, while the Choi task promotes a reactive strategy that does not produce a blink.

013

### **Muscle activations during the perception and expression of emotion: The Body Action Coding System**

Elisabeth Huis in 't Veld, Geert van Boxtel & Beatrice de Gelder

Tilburg University

When it comes to facial expressions, we know exactly what muscles are recruited and this knowledge has been used extensively in research. Body postures also provide clear signals about emotional expressions, but so far it is not clear what muscle patterns are associated with specific emotions. This study lays the groundwork for a Body Action Coding System (BACS) by investigating what combinations of muscles are used for emotional bodily expressions and to assess whether these muscles also automatically respond to the perception of emotional behavior. Surface EMG of muscles in the arms and shoulder were measured during both the active expression and passive viewing of fearful and angry bodily expressions. These muscles, especially in the arms, were recruited more strongly for the expression of anger and also respond automatically to the perception of anger. However, muscles in the neck showed automatic responses to the perception of fear and shoulder muscles responded to both emotional expressions. Additional results on the response patterns in the lower back, forearms and legs will be presented. In conclusion, this study provides more insight into the perception and expression of emotions in the body. A BACS can be used in a wide variety of research topics, such as empathy and emotional contagion, but can also benefit the development of virtual reality and other IT systems.

### **Empathy does not need company - the influence of group size and trait empathy on neural and behavioral patterns when witnessing an emergency**

Ruud Hortensius & Beatrice de Gelder  
Tilburg University

An emergency will trigger a cascade of automatic somatic and autonomic responses that have motor and emotional behavioral consequences. In the present studies we focus on automatic preparation for action as an initial measure of empathy (e.g., helping behavior) and study the negative effect of group size on this response. In the first study fMRI was used to clarify the neurofunctional basis of the influence of group size when witnessing an emergency. A decrease in activity with the increase in group size was observed in the left and right postcentral gyrus and left medial frontal gyrus. Next, a cued-reaction time task was used to map the effect of trait empathy on action preparation when one is confronted with an emergency. While both trait personal distress and sympathy predicted faster responding to an emergency, the increase in reaction time with the increase in group size was solely predicted by trait personal distress. The latter effect was also found in motor corticospinal excitability levels as measured by single-pulse TMS. Taken together, the results indicate that group size has a negative effect on preparation for action during an emergency especially for self-centered helping behavior (i.e., to remove discomfort in the observer).

### **Biomechanical organization of gait initiation depends on the timing of affective processing**

John F. Stins, Linda M.A. van Gelder, Laura M. Oudenhoven & Peter J. Beek  
Faculty of Human Movement Sciences, VU University Amsterdam

Gait initiation (GI) from a quiet bipedal posture has been shown to be influenced by the emotional state of the actor. The literature suggests that the biomechanical organization of forward GI is facilitated when pleasant pictures are shown, as compared to unpleasant pictures. However, there are inconsistencies in the literature, which could be due to the neural dynamics of affective processing. This study aimed to test this hypothesis, using a paradigm whereby participants initiated a step as soon as they saw an affective picture (i.e., onset), or as soon as the picture disappeared from the screen (i.e., offset). Pictures were a priori categorized as pleasant or unpleasant, and could also vary in their arousing properties. We analyzed center-of-pressure and center-of-gravity dynamics as a function of emotional content. We found that gait was initiated faster with pleasant images at onset, and faster with unpleasant images at offset. Also, with offset GI the peak velocity of the COG was reduced with unpleasant images relative to pleasant images. The results are discussed in terms of current knowledge regarding temporal processing of emotions (notably freeze and fight/flight tendencies), and its effects on GI.

### **Predicting bodily consequences of visual information**

H.A. Anema, M. Mulckhuyse, R. Bron, D.S. Veldhuijzen & H.C. Dijkerman  
Experimental Psychology, Faculty of Social Sciences, Utrecht University

Defending the body is considered to be a characteristic of Peripersonal Space, the area of space immediately surrounding the body. Recently it has been proposed that the extent of Peripersonal space is influenced by the anticipated somatosensory consequences of visual stimuli. That is, the more threatening a visual event is to the body, the larger the Peripersonal space will be and vice versa. Knowing what might potentially harm you (i.e. causes pain) can for instance be learned through recurrent visuotactile coupling of a visual and a pain stimulus (associative learning), particularly when these stimuli are presented in close proximity. Moreover, pain related learning is facilitated by attention as pain attracts attention automatically over competing demands. It has been argued that pain attracts more attention in chronic pain patients, which in turn might lead to facilitated learning of new visuo-pain relations. Using an additional singleton paradigm without hand pain, we found in healthy subjects that a visual distractor speeded up, instead of slowed down, search times of a target more when the visual stimulus was presented near a hand (same visual field) as compared to far away. Unexpectedly, facilitation of a distractor was found in all other conditions. In a second experiment we adapted the paradigm and investigated additionally whether aversive touch applied to the hand (condition 1) and a painful hand (condition 2), would affect the spatial proximity effect we observed in the first experiment. Results will be discussed within a theoretical framework of peripersonal space and the role of prediction, as well as within a clinical framework of chronic pain.

### **Information matching the content of visual working memory is prioritized for conscious access.**

Surya Gayet, Chris L. E. Paffen & Stefan Van der Stigchel  
Utrecht University

In a series of experiments we tested whether information that matches the content of visual working memory (VWM) is prioritized by the visual system, such that this information reaches visual awareness faster than non-matching information.

Trials in our experiments consisted of three phases: first, a colored patch (i.e. the cue) was shown, which participants were instructed to either remember (memory condition) or not (passive viewing). Next, a target was erased from awareness by interocular suppression: a target, either matching the color of the cue or not, gradually increased in intensity for one eye, while a high contrast dynamic pattern was presented to the other eye. Participants were instructed to press a button as soon as they detected the target. In the final phase of the color memory condition, three colored patches were presented. Participants indicated which of the targets matched the cue.

The results show that targets that matched the memorized color broke through interocular suppression faster than non-matching targets. In contrast, the passive viewing condition showed no such color congruency effect. Importantly, a control experiment revealed that when the target and the dynamic pattern were presented to the same eye no difference was observed between the color memory condition and the passive viewing condition. In another experiment, we ruled out the possibility that the congruency effect was caused by deeper initial processing of the memorized cue; two color stimuli were subsequently presented, followed by a postcue indicating which of the two stimuli should be retained. The color congruency effect was still observed under these conditions.

Together, these findings show that conscious access is prioritized for information matching the content of VWM. We suggest that VWM, a system that retains visual information for imminent goal-directed behavior, is recruited to funnel down the sensory input to that which requires conscious access.

018

**In competition for the attentional template: Can multiple items within visual working memory guide attention?**Dirk van Moorselaar, Jan Theeuwes & Chris Olivers  
Vrije Universiteit

Recent studies have revealed that the deployment of attention can be biased by the content of visual working memory (VWM), but that stored memories do not always interact with attention. This has led to a model which proposes a division within VWM between a single active template that interacts with perception and multiple accessory slots that do not. The present study was designed to study whether multiple memory representations are able to bias attention. Participants performed a visual search task while maintaining a variable number of colors in VWM. We observed increased attentional capture by memory-related distractors when VWM was filled with a single item. However, memory-related capture disappeared for memory loads beyond a single item. The absence of memory-related capture at higher VWM loads was independent of individual VWM capacity, nor was it attributable to weaker encoding, forgetting, or reduced precision of memory representations. When analyses were limited to those trials on which participants had a relatively precise memory, there was still no sign of attentional guidance at higher loads. However, when observers were cued towards a specific memory item after encoding, interference with search returned. These results are consistent with a distinction within VWM between representations that interact with perception and those that do not, and show that only a single VWM representation at a time can interact with visual attention.

019

**The Influence of Context on Visual Working Memory: Effects on Visual Brain Areas**Michel Quak & Durk Talsma  
Ghent University

We investigated how context influences the activation of visual brain areas during a visual working memory (WM) task. Using a delayed match-to-sample paradigm and simultaneous EEG recording, we examined the Contralateral Negative Slow Wave (CNSW), a neural correlate of visual WM capacity. Multiple random polygons were presented in each visual hemifield. While, low-level visual features were kept equal in all conditions, context was manipulated by prompting participants to remember either a single polygon, a single half of two polygons, or one quarter of four polygons, in one hemifield. In a second experiment participants were allowed to or prevented from using irrelevant information (i.e. parts of a polygon not required to be remembered). ERP and behavioral results show a decrease in WM performance with progressively increasing contextual complexity but only when participants were prevented from using irrelevant information. Since visual information was kept equal in all conditions, this increase in WM capacity seems to be due to the increase of relevant contextual information. These results suggest that activation in visual brain areas might also reflect processing of other forms of information besides purely visual information, in this case relevant contextual information.

020

**EEG support for a close relation between visuospatial attention and visual working memory**Rob van der Lubbe, Carsten Bundt & Elger Abrahamse  
University of Twente

According to several authors there is a close relation between visuospatial attention and the rehearsal and retrieval of information from visual working memory (VWM). Indirect support for this view is the observation that directing attention away from to-be-memorized items leads to impaired memory performance. In the current study we directly compared focusing attention and the retrieval of VWM by using several measures derived from the electroencephalogram (EEG): event-related lateralizations (ERLs), and lateralized power spectra (LPS; see Van der Lubbe & Utzerath, 2013). An experiment was carried out in which a colored frame indicated which stimulus, one out of four presented in separate quadrants, was the target. The frame occurred either before, simultaneously with, or after the stimuli (precue, simultaneous cue, or postcue). In the latter case, stimuli were masked, implying that they had to be retrieved from memory. ERLs revealed posterior contralateral negativities (PCN/N2pc) in the precue and the simultaneous cue conditions, but no such effect was observed in the postcue condition. However, LPS results for the upper theta band (6-8Hz) on the raw EEG showed a decrease in contralateral power above parietal sites for the postcue condition, but only when this analysis was carried out on the raw EEG, indicating that this activity should be considered as induced activity. The latter findings support the supposed relation between visuospatial attention and VWM.

021

**Neural correlates of the development of intentional action and inhibition**Margot A. Schel, K. Richard Ridderinkhof & Eveline A. Crone  
Leiden University

Currently, most research on the development of response inhibition has focused on externally driven inhibition. The development of intentional action and inhibition has remained largely unstudied, possibly because of a lack of valid paradigms to study intentional inhibition in a developmental sample. In the present study, 19 children (aged 10-12) and 24 adults (aged 18-26) performed the child-friendly marble paradigm as a measure of intentional action and inhibition while lying in the scanner. In the marble paradigm, a marble is rolling down a ramp and participants are instructed to freely decide between responding and inhibiting responding to the rolling marble. Both children and adults decided to intentionally inhibit responding to the marble on approximately 50 % of the intentional trials. The fronto-basal ganglia network (including inferior frontal gyrus, putamen, caudate, and globus pallidus) was activated for the contrast intentional inhibition vs. intentional action, and this effect was more pronounced for children compared to adults. Furthermore, the subthalamic nucleus was activated during both intentional action and intentional inhibition, independent of age group. These findings will be discussed vis-à-vis recent concepts of stimulus-driven and intentional action control.

### **Interactions between action control systems explain trial sequence effects in flanker tasks: a theory**

Mattie Tops  
VU University Amsterdam

Analyses of trial sequences in flanker tasks and some other conflict tasks have revealed cognitive adaptation, reflected in a reduced interference effect following incompatible trials. However, some recent studies suggest that the cognitive adaptation effect is driven by increased interference following compatible trials. I will present a theory of different action control systems in the brain that explains the trial sequence effects. Learning mechanisms enable guidance of action control by previous experience, through the formation of predictive internal models. Action control during the performance of a novel task progresses from tight feedback-guided control towards feedforward and predictive control. However, prediction errors, conflict or performance errors during feedforward or predictive control, induce a shift back to feedback-guided control. Dorsal anterior cingulate cortex areas implement feedforward control and are implicated in learning that shifts control from reactive feedback-guided control by areas including the right ventrolateral prefrontal cortex towards predictive control by areas including the posterior cingulate cortex and precuneus. I will discuss evidence that suggests that cognitive adaptation effects reflect the return to feedback-guided control by the right ventrolateral prefrontal cortex after the detection of errors or conflict.

### **Acute effects of cannabis and cocaine on response inhibition- an ERP investigation**

D.B. Spronk, E.R.A. De Bruijn, J.H.P. van Wel, J.R. Ramaekers & R.J. Verkes  
Department of Psychiatry, Donders Centre for Neuroscience, Radboud University Nijmegen Medical Centre

Abuse of illicit drugs has often been associated with impaired ability to withhold an intended motor action. Although impairments in response inhibition have previously been demonstrated after long-term use of many illicit drugs, studies on the acute effects are limited. Understanding response inhibition is of relevance as drug associated alterations may provide insights into side-effects and drug-associated motivational incentives. The current study investigated the acute effects of cannabis (inhalation) and of (oral) cocaine administration on response inhibition. A double-blind placebo-controlled randomized 3-way crossover design was used with matched double dummy placebos. The volunteers completed a Go/NoGo task after administration of the drugs. Cannabis administration increased omission and inhibition errors and slowed responding, whereas cocaine administration had opposite effects, i.e. it decreased omission and inhibition errors and fastened responding to Go stimuli. Furthermore, the ERP data revealed converging outcomes by showing a similar opposing pattern in the NoGo P300, a component thought to reflect response inhibition. I will relate this to individual differences in use history and trait impulsivity. The relevance of the findings will be discussed in light of possible implications for models of addiction.

### **Effects of arousal on cognitive control: Empirical tests of the conflict-modulated Hebbian-learning hypothesis**

S. B. R. E. Brown, H. van Steenbergen, T. Kedar & S. Nieuwenhuis  
Leiden University

The proportion congruency effect, the finding that interference effects (like the Stroop effect) decrease as the proportion of incongruent stimuli increases, has long been interpreted as a result of cognitive control. Recent evidence has shown that the proportion congruency effect is largely item-specific and hence must be due to associative learning. We are the first to empirically test a recent hypothesis about the neuromodulatory mechanism underlying such associative-learning effects, the conflict-modulated Hebbian-learning hypothesis, which proposes that the effect of conflict on associative learning is mediated by phasic noradrenergic arousal responses. In Experiment 1, we examined in detail the relationship between the item-specific proportion congruency effect and an autonomic measure of noradrenergic phasic arousal: task-evoked pupillary responses. In Experiment 2, we used a task-irrelevant phasic arousal manipulation and examined the effect on item-specific learning of incongruent stimulus-response associations. The results provide little evidence for the conflict-modulated Hebbian-learning hypothesis, which requires additional support to remain tenable.

### **How high and low level signals contribute to oculomotor selection; a novel approach to employ the global effect phenomenon**

Jeroen Silvis, Katya Olmos Solis & Mieke Donk  
VU Amsterdam

The current study was aimed to expose how high and low-level information independently contributes to oculomotor selection. By employing a two-eye-movement variation of a typical global-effect paradigm, and manipulating the onset of object identity and location, we were able to investigate the top-down modulation that is involved with target selection. The results demonstrate that when the objects' identity is revealed early in time, eye movements more precisely targeted the center of objects. However, when object-identity information is initially withheld for a short period of time, eye movements are far less specific and tend to land in between objects. These results are in line with the idea that visual objects compete for selection and that it takes time to resolve this competition. In addition, it appears that the presence of target information strongly facilitates this selection process.

### **The early effects of salience on eye movements in natural scenes**

Nicola C Anderson, Eduard Ort, Mieke Donk & Martijn Meeter  
Vrije Universiteit Amsterdam

Past work has shown that bottom-up visual salience can influence the locus of attention in a natural scene (Parkhurst, Law & Niebur, 2002). However, this conclusion has been hotly debated. Although researchers have come to agree that salience may play a role in natural scene viewing, it does so only within the first few fixations (e.g., Foulsham & Underwood, 2008) and appears to be completely overridden when the observer is given a simple search task (Einhauser, Rutishauser & Koch, 2008). However, in visual search tasks using more controlled displays, salience does play a significant role when saccadic latency is taken into account (e.g. van Zoest, Donk & Theeuwes, 2004). This suggests that salience may operate at a more fine-grained time scale than is typically measured in natural scene viewing studies. Employing a method similar to that of Einhauser and colleagues (2006, 2008), in the present series of experiments, we directly manipulated salience in natural scenes. The contrast across the image was selectively and gradually decreased or increased. We demonstrate that salience indeed plays a role in guiding eye movements in natural scenes when saccade latency is taken into account, even when it is counter-productive to the task at hand.

027

**Spatial selection makes attention transient**  
 Anna Wilschut, Jan Theeuwes & Christian N.L. Olivers  
 VU University

Salient visual signals draw attention rapidly, but only temporarily. This phenomenon is known as transient attention. In a series of experiments we investigated what makes performance transient as found in the spatial cueing paradigm. First, we showed that the presence of irrelevant distractors determines whether performance is transient or sustained after the rapid cued enhancement. This was true both when the target location changed from trial to trial, and when it was constant, suggesting that attentional selectivity underlies the transient attention, with no or little role for the spatial re-orienting component. We then investigated whether the type of competition, among which selection occurs shapes the attention time course. Competition by feature similarity between the target and distractors impaired performance throughout the cue-target intervals and did not interact with cueing. Also the response compatibility had an overall effect that did not vary as a function of time. In contrast, the effects of spatial competition became visible only at increasing cue-target intervals. Close distractors led to both reduced attentional enhancement and a more pronounced subsequent decline. The results thus suggest that spatial selection of targets from nearby competitors determines the transient time course of attention, as found in the spatial cueing literature.

028

**Reinstating salience effects over multiple eye movements**  
 Alisha Siebold & Mieke Donk  
 VU Amsterdam

Multiple studies have shown that people tend to preferentially fixate salient regions, in particular when salience is defined by dynamic changes. In static displays, salience seems to affect only initial saccades, while subsequent eye movements are directed in line with task requirements (Siebold, van Zoest, & Donk, 2011). The current study investigated how overt selection is affected beyond an initial eye movement when salience is derived from a sudden change in luminance contrast (Experiment 3) and luminance flicker (Experiment 2) as opposed to a static manipulation in orientation contrast (Experiment 1) between a target and distractor singleton in a simple line display. Observers were instructed to fixate one of two fixation dots and make a rapid eye movement to the target, either directly or preceded by an initial eye movement to the other fixation dot. Apart from Experiment 1, the orientation contrast between target and distractor was identical and the salience manipulation was presented either simultaneously with display onset or contingent upon the first saccade. In all three experiments, initial saccades were salience-driven, whereas second saccades were consistently goal-directed if the salience manipulation was present from display onset. However, if the manipulation occurred during the initial saccade, salience effects were reinstated, equally so for changes in luminance contrast and continuously flickering changes. This indicates that rather than the nature of the salience manipulation, the transient effect of salience can be reinstated if there is a change in pre-existing information, even when this occurs during an eye movement.

033

**The Efficacy of Self-Paced Study in Multitrial Learning**  
 Mario de Jonge, Huib K. Tabbers, Diane Pecher, Yoonhee Jang & René Zeelenberg  
 Erasmus University Rotterdam

In two experiments we investigated the efficacy of self-paced study in multitrial learning. In Experiment 1, native speakers of English studied lists of Dutch-English word pairs under one of four imposed fixed presentation rate conditions ( $24 \times 1$  s,  $12 \times 2$  s,  $6 \times 4$  s, or  $3 \times 8$  s) and a self-paced study condition. Total study time per list was equated for all conditions. We found that self-paced study resulted in better recall performance than most of the fixed presentation rates, with the exception of the  $12 \times 2$  s condition which did not differ from the self-paced condition. Additional correlational analyses suggested that the allocation of more study time to difficult pairs than to easy pairs might be a beneficial strategy for self-paced learning. Experiment 2 was designed to test this hypothesis. In one condition, participants studied word pairs in a self-paced fashion without any restrictions. In the other condition, participants studied word pairs in a self-paced fashion, but total study time per item was equated. The results showed that allowing self-paced learners to freely allocate study time over items resulted in better recall performance.

034

**S-shaped learning curves**  
 Jaap Murre  
 University of Amsterdam

The shape of learning is typically described as a negatively accelerated curve, like going up a small but steep hill. Going is tough at first but gets easier once you approach the top. This is probably wrong or least only half the story. We shall demonstrate that under specific circumstances, learning must follow an S-shape: first there seems to be little progress in the performance, then it increases rapidly, until it gets close to the its upper bound (e.g., 100% correct). We investigated the learning curve for foreign vocabulary words, distinguishing between a subject-specific learning rate and a material-specific parameter, which may be related to the complexity of the items such as number of syllables. We describe two experiments, one with Turkish words and one with Italian words. In both we observed S-shaped learning curves, most clearly if the subjects were not very familiar with the materials and if they were slow learners. With repeated relearning the S-shapes disappear. On the basis of a model of learning, we will argue why S-shaped curve are a logical consequence of non S-shaped curves and when they will occur. We shall also discuss why such learning curves may go unnoticed in many experiments.

035

**Explicit and implicit brand memory and evaluation in cross-media advertising**  
 Lisa Vandenberg, Jaap Murre, Hilde Voorveld & Edith Smit  
 University of Amsterdam

An important finding in communication research is that advertisements presented in different media have a greater impact on peoples' brand memory and evaluation than similar advertisements presented within a single medium. Which mechanisms are responsible for this advantage of cross-media advertising? We used early psychological findings to take a first step in answering this question. Current theories on cross-media advertising effects are mainly based on explicit psychological measures, such as self-reports. Such explicit measures may provide an incomplete view of the often implicit psychological processes that underlie consumer behavior. We used both explicit and implicit measures to assess whether exposure to advertisements (exposure/no-exposure) in different media combinations (single/cross-media) affects the cognitive and evaluative impact of advertising on consumers. We validated implicit measures that are able to tap into different memory processes and brand evaluations (bottom-up/top-down). The explicit measures measured memory in terms of recall and recognition, and evaluation in terms of attitude towards the advertised brand. The results show explicit but not implicit cross-media effects. The findings overall suggests that positive effects of cross-media exposure may depend on the explicit instruction to recollect exposure to the ad campaign.

**Information processing during sleep**  
Roy Cox, Joram van Driel, Marieke de Boer & Lucia M Talamini  
University of Amsterdam

During deep sleep, slow oscillations (SOs) dominate the human EEG. Intriguingly, they appear to have a role in memory processing. For one, boosting SO occurrence results in improved memory retention. Second, SOs organize the activity in faster frequency ranges, such as the sleep spindle band, which is itself of great importance for memory consolidation. Unexplored is the issue of whether SOs also influence functional network coupling. We assessed how the dynamics of brain-wide functional coupling depend on the SO phase. Interestingly, we found that phase coupling in the sleep spindle band was enhanced in the depolarizing phase of the SO, as were cross-frequency interactions between spindles and beta/gamma activity. Additionally, these effects were localized around the site used for SO detection, indicating that SOs exert their organizing influence in a local fashion. Thus, SOs affect numerous aspects of brain processing, including the extent to which networks communicate with each other. Currently, studies investigating the implications of these findings for memory (re)processing during sleep are underway.

**Eating to stop: Tyrosine supplementation enhances inhibitory control but not response execution**  
Lorenza S. Colzato, Bryant J. Jongkees, Wery P. M. van den Wildenberg & Bernhard Hommel  
Leiden University

Animal studies and research in humans have shown that the supplementation of tyrosine, or tyrosine-containing diets, increase the plasma tyrosine and enhance brain dopamine (DA). However, the strategy of administering tyrosine (and the role of DA therein) to enhance cognition is unclear and heavily debated. We studied, in a healthy population, whether tyrosine supplementation improves stopping overt responses, a core cognitive-control function. In a double-blind, placebo-controlled, within-subject design, one hour following the administration of tyrosine (corresponding to the beginning of the 1h-peak of the plasma concentration) or placebo, participants performed a stop-signal task—which taps into response inhibition and response execution speed. Participants in the tyrosine condition were more efficient in inhibiting unwanted action tendencies but not in reacting to go signals. This is the first demonstration that the supplementation of tyrosine selectively targets, and reliably improves the ability to stop overt responses.

**Paired-pulse transcranial magnetic stimulation reveals probability-dependent changes in functional connectivity between right inferior frontal cortex and primary motor cortex during go/no-go performance**  
A.D. van Campen, F.X. Neubert, W.P.M. van den Wildenberg, K. R. Ridderinkhof & R.B. Mars  
University of Amsterdam

The functional role of the right inferior frontal cortex (rIFC) in human behavior is the subject of ongoing debate. Activation of the rIFC has been associated with both response inhibition and with signaling action adaptation demands resulting from unpredicted events. The goal of this study is to investigate the role of rIFC by combining a go/no-go paradigm with paired-pulse transcranial magnetic stimulation (ppTMS) over rIFC and the primary motor cortex (M1) to probe the functional connectivity between these brain areas. Participants performed a go/no-go task with 20% or 80% of the trials requiring response inhibition in a classic and a reversed version of the task, respectively. Responses were slower to infrequent compared to frequent go trials, while commission errors were more prevalent to infrequent compared to frequent no-go trials. We hypothesized that if rIFC is involved primarily in response inhibition, then rIFC should exert an inhibitory influence over M1 on no-go (inhibition) trials regardless of no-go probability. If, by contrast, rIFC has a role on unexpected trials other than just response inhibition then rIFC should influence M1 on infrequent trials regardless of response demands. We observed that rIFC suppressed M1 excitability during frequent no-go trials, but not during infrequent no-go trials, suggesting that the role of rIFC in response inhibition is context dependent rather than generic. Importantly, rIFC was found to facilitate M1 excitability on all infrequent trials, irrespective of whether the infrequent event involved response inhibition, a finding more in line with a predictive coding framework of cognitive control.

**Effects of multiple session tDCS on working memory**  
L.J. Talsma, H. Kroese, H.A. Slagter  
University of Amsterdam

Transcranial Direct Current Stimulation (tDCS) is a relatively simple technique that can be used to non-invasively alter neuronal functioning in the working brain. Recently, several studies have shown that anodal tDCS (atDCS) to the left dorsolateral prefrontal cortex (DLPFC) can improve cognitive functions such as working memory (WM). Although promising, so far studies have looked only at the effects of one single stimulation session on WM, and it is unclear whether repeated tDCS stimulation may further and lastingly enhance WM. In the current study, healthy adult participants received three sessions (consecutive days) with either anodal (1 mA, 20 min.) or sham (1 mA, 1 min) stimulation over the DLPFC, while simultaneously performing a visual letter N-back task. By comparing groups on performance before, during and after stimulation at each day we explored the time effects of repeated atDCS on WM performance. Additionally, in separate sessions before and after the stimulation sessions we administered a spatial N-back task and an Operation Span task to examine transfer effects to other WM tasks. Replicating previous findings, atDCS was associated with improved WM performance in the first stimulation session. Yet, preliminary results show that performance returns to baseline the next day, did not increase more in the anodal vs. sham group during the subsequent two stimulation sessions. Also, stimulation benefits did not transfer to other WM tasks. Results of this study may shed light on the possibilities and limitations of using atDCS to enhance cognitive functioning in the healthy adult brain.

**Working memory reloaded: Tyrosine repletes updating under challenging conditions**  
Bryant J. Jongkees, Roberta Sellaro, Bernhard Hommel & Lorenza S. Colzato  
Leiden University

In this study we tested the idea that the food supplement L-Tyrosine (TYR) may reverse “ego-depletion” (i.e. reduced self-control after an exhausting cognitive task) only when substantial cognitive control is required. We investigated whether the “updating” (and monitoring of) working memory (WM) representations, a key cognitive-control function, can be promoted by administering TYR, the biochemical precursor of dopamine. Participants were compared with respect to the N-back task in which conditions (1-back and 2-back) differ in their amount of WM load and demands on executive control for the processing of information in WM. As expected, TYR promotes WM updating in the more demanding (the 2-back) but not in the easier condition (1-back). This result supports the idea that, first, TYR repletes the missing resources when more control is needed. Second, that the food we eat may act as a cognitive enhancer modulating the way we think and perceive the world.

041

**In the mood to hear**

Anne Bolders, Guido P.H. Band, Pieter Jan Stallen & Susan Denham  
Leiden University

Although both folk and real science indicate that the mood someone's in colors how we experience objective stimuli (a shadow turns into a monster, fear makes you hear every distant sound), there is hardly evidence for an effect of mood on low-level auditory perception. We investigated in two studies whether a randomly assigned mood induction causes participants to 1) have a more sensitive sound perception and 2) perceive ambiguous sounds in a mood-congruent manner. Arousal, but not pleasure, modulated the threshold for sound detection. Tone sequences that could be perceived both as increasing and as decreasing in pitch, depending on one's attentional focus, were judged more often as rising when participants were happy and more often as falling when participants were sad. The implications of these demonstrations of affective modulation of low-level auditory perception will be discussed.

042

**Making sense of age-related distractibility: The role of sensory modality**

Pascal W. M. Van Gerven & Maria J. S. Guerreiro  
Maastricht University

In daily life, selective attention is not confined to the visual modality. It involves multiple modalities, particularly also the auditory one. Moreover, it involves both "uni-modal" settings – that is, selective attention within one modality – and "cross-modal" settings – that is, attending to one modality while ignoring the other. Yet, the bulk of research into selective attention is aimed at visual selective attention with purely visual paradigms (e.g., variations of the Stroop task, the flanker task, and the reading-with-distraction task). Unsurprisingly, therefore, it appears that the pervasive idea that old age is accompanied by impaired selective attention is mostly based on unimodal visual, and – to a lesser extent – unimodal auditory selective attention studies. We have critically reviewed the literature on selective attention and aging by summarizing the results of studies aimed at each combination of visual or auditory target information and visual or auditory distractor information (laid out in a fully crossed, two-by-two matrix). The general pattern of results indicated that age differences in selective attention become apparent if (1) targets and distractors are presented through the same sensory modality rather than through different modalities and (2) distractors are visual rather than auditory [Guerreiro, M. J. S., Murphy, D. R., & Van Gerven, P. W. M. (2010). The role of sensory modality in age-related distraction: A critical review and a renewed view. *Psychological Bulletin*, 136, 975-1022]. However, until recently, this had never been studied in a fully crossed design with equivalent, or at least comparable, tasks across conditions. We have looked into this issue in four behavioral studies, two fMRI studies, and one EEG study. In my talk, I will give a brief overview of the results from these studies. In short, it appears that older adults especially show impaired performance in auditory selective attention tasks with visual distraction. This pattern of results was not seen in spatial selective attention tasks, however, where there were no age differences in performance. The fMRI studies moreover suggest that the ability to modulate – specifically, enhance, not suppress – the processing of stimuli from the auditory modality in the temporal voice area (TVA) is impaired in old age. Intriguingly, this result downplays inhibition as the usual suspect in age-related decline of selective attention.

043

**The Cocktail Problem revisited**

Adelbert W Bronkhorst  
VU

Six decades after Colin Cherry defined the "cocktail party problem", occurring when a listener attempts to understand one talker in the presence of interfering sounds, it is questionable whether we have come much closer to solving it. A complicating factor is that progress can only be made by integrating research on attention, auditory scene analysis, psycholinguistics and psychoacoustics. As a follow-up of my earlier review of psychoacoustic work [Bronkhorst A.W. (2000), *Acta Acustica* 86, 117-128], I now review and integrate research in all fields. I focus here on some key findings and on the presentation of a conceptual model of speech perception in noise. I will show that peripheral masking by noise can be adequately modeled but that results of recent work on informational (central) masking are more difficult to interpret. I will discuss evidence from mismatch negativity research that attention is not required for semantic processing of speech. I will demonstrate that spatial separation allows perfect grouping of speech sounds but that attention is unexpectedly sluggish when switching between talkers and locations in space. Finally, I will show that it is possible to integrate models of masking, auditory grouping and attention in a framework consistent with all reviewed research.

044

**Temporal integration of consecutive tones into synthetic vowels demonstrates perceptual assembly in audition**

Jefta D. Saija, Tjeerd C. Andringa, Deniz Başkent & Elkan G. Akyürek  
Department of Otorhinolaryngology / Head and Neck Surgery, University Medical Center Groningen, University of Groningen

Temporal integration is the perceptual process by which sensory stimulation is combined over time into longer percepts, which can span over ten times the duration of a minimally detectable stimulus. Particularly in the auditory domain, such "long-term" temporal integration has been characterized as a relatively simple function that acts chiefly to bridge brief input gaps, and which places integrated stimuli on temporal coordinates (i.e., preserving their temporal order information). These properties are not observed in visual temporal integration, suggesting they might be modality-specific. The present study challenges that view. Participants were presented with rapid series of successive tone stimuli, in which two separate, deviant target tones were to be identified. Critically, the target tone pair would be perceived as a single synthetic vowel if they were interpreted to be simultaneous. During the task, despite that the targets were always sequential and never actually overlapping, listeners frequently reported hearing just one sound, the synthetic vowel, rather than two successive tones. These results demonstrate that auditory temporal integration, like its visual counterpart, truly assembles a percept from sensory inputs across time, and does not just summate time-ordered (identical) inputs or fill gaps therein. This finding supports the idea that temporal integration is a universal function of the human perceptual system.

**Can we use a phoneme we do not know about?**

Holger Mitterer  
University of Malta

It is typically believed that we learn the phonemes of our language when we learn to read. In this talk, I will argue that Dutch speakers (and readers) use a phoneme in perception and production that they are completely unaware of, as it is not coded in the script: the glottal stop, found at the onset of "vowel-initial" words (such as *aap*, Engl. *ape*). German has, in contrast to Dutch, traditionally been analyzed as having a glottal stop in this context and hence no vowel-initial words. Perception and production experiments in Dutch and German show that the glottal stop plays a similar role in both languages: Full versus reduced production of the glottal stop patterns identically in a set of cognate phrases. In a word-monitoring task, the glottal stop seems to outweigh other lexical cues in word segmentation, arguing for a phonemic status. Preliminary results on Maltese (a language where the glottal stop is also written as *q*), show a similar pattern. This suggests that reading may only lead to an explicit phoneme awareness for those phonemes well coded in the script. Speech processing may rely on implicit phoneme-sized representations that are independent of learning to read.

**Subject form influences resolution of object pronouns**

Margreet Vogelzang, Hedderik van Rijn & Petra Hendriks  
University of Groningen

Pronouns are referential expressions that have to be processed and resolved. Contextual factors play an important role in the processing of subject as well as object pronouns. Although the interpretation of subject and object pronouns is typically studied in isolation, the sentential subject might contribute to the local context in which an object pronoun is interpreted. Therefore, the resolution of subject pronouns might influence the resolution of object pronouns, or vice versa.

We ran an eye-tracking experiment with 40 Dutch adults. The experiment used stories and questions to investigate the different resolution processes that occur when resolving a) a full noun phrase subject vs. a subject pronoun and b) a reflexive object vs. an object pronoun. Pupil dilation was measured as an indication of listeners' cognitive effort during sentence processing. The results showed that more effort was needed to solve both the subject and the object pronoun compared to the noun phrase and reflexive. Furthermore, an interaction between the subject and the object form indicates that when both the subject and the object are pronouns, pronoun resolution becomes increasingly effortful.

**Syntactic predictability can facilitate the recognition of words in connected speech**

Malte Viebahn, Mirjam Ernestus & James McQueen  
Max Planck Institute for Psycholinguistics

In the present study, we investigated whether the recognition of spoken words is influenced by how predictable they are given the syntactic structure of their carrier sentence. Moreover, we studied if listeners' sensitivity to syntactic predictability depends on how reliable the acoustic cues in the speech input are. In three eye-tracking experiments, listeners heard carefully and casually produced sentences while looking at a visual display containing four printed words and selected the word which was mentioned in the sentence. Syntactic predictability was manipulated by varying the word order of past participles and auxiliary verbs. In Dutch subclauses, past participles can either follow their associated auxiliary verbs (e.g. "Ik weet zeker dat hij heeft geleund op de houten tafel.") or they can precede them (e.g. "Ik weet zeker dat hij geleund heeft op de houten tafel."). In all experiments, participants recognized the past participle more quickly when it occurred after its associated auxiliary verb than when it preceded it. The reaction time data suggest that this effect is stronger for casually than for carefully produced sentences. These findings show that syntactic predictability can influence word recognition and suggest that listeners dynamically adapt to the different sources of linguistic information available to them.

**Can the meaning of multiple words be integrated unconsciously?**

Simon van Gaal, Lionel Naccache, Julia D. I. Meuwese, Anouk M. van Loon, Alexa Leighton, Laurent Cohen & Stanislas Dehaene  
University of Amsterdam/Donders Institute Nijmegen

What are the limits of unconscious language processing? Can language circuits process simple grammatical constructions unconsciously, and integrate the meaning of several unseen words? Using behavioral priming and electroencephalography (EEG), we studied a specific rule-based linguistic operation traditionally thought to require conscious cognitive control: the negation of valence. In a masked priming paradigm, two masked words were successively or simultaneously presented, a modifier ("not"/"very") and an adjective (e.g., "good"/"bad"), followed by a visible target noun (e.g., "peace"/"murder"). Subjects indicated whether the target noun had a positive or negative valence. The combination of these words could either be contextually consistent (e.g., "very bad murder") or inconsistent (e.g., "not bad murder"). EEG recordings revealed that grammatical negations could unfold partly unconsciously, as reflected in similar occipito-parietal N400 potentials for conscious and unconscious three-word sequences forming inconsistent combinations. However, only conscious word sequences elicited centro-parietal P600 modulations. Overall, these results suggest that multiple unconscious words can be rapidly integrated and that an unconscious negation can automatically "flip the sign" of an unconscious adjective. These findings extend the limits of subliminal combinatorial language processes, but also highlight how consciousness modulates the grammatical integration of multiple words.

**Distinct modes of executing movement sequences: Reacting, associating, and chunking**

Willem B. Verwey & Elger L. Abrahamse  
Universiteit Twente

Responding to individual key-specific stimuli in entirely unfamiliar keying sequences is said to involve a reaction mode. With practice, short keying sequences can be executed in the chunking mode. This is indicated by the first stimulus sufficing for rapid execution of the entire sequence. The present study explored whether an associative mode develops also in participants who practice short keying sequences. This associative mode would involve priming by earlier events of responses to external stimuli, and is believed to be responsible for skill in the Serial Reaction Time task. In the present study participants practiced two discrete 6-key sequences. In the ensuing test phase, participants were prevented from using the chunking mode by including two deviant stimuli in most sequences. The results from the remaining – unchanged – familiar sequences confirmed that participants no longer used the chunking mode, but as predicted by associative learning these sequences were executed faster than unfamiliar sequences.

054

**Does illusory motion affect postural sway?**

Vivian Holten, Maarten J. van der Smagt, Stella F. Donker & Frans A.J. Verstraten  
Utrecht University

Visual stimuli simulating self-motion through the environment can induce potent postural adjustments in observers. This suggests a rather direct, stimulus-driven, mechanism subserving these visuo-vestibular interactions. Here we examine whether visual-motion induced sway can also be generated by an internal representation of visual motion, as apparent in the motion-aftereffect.

We presented a random-pixel-array ( $87^\circ \times 56^\circ$ ) translating at  $\sim 3$  deg/s leftwards or rightwards during adaptation. A static or dynamic version of the random-pixel-array or a black screen served as test pattern. In a second experiment, monocular adaptation to the RPA was followed by a static test pattern, either presented to the same eye (monocular) or the opposite eye (interocular transfer, IOT). Observers, standing on a force plate collecting posturographic data, initially received 40s adaptation, followed by 20s top-up adaptation epochs, interleaved by 14s test pattern epochs.

A static test pattern induced more sway and a longer motion-aftereffect than a black test pattern, indicating that the perceived motion of the motion-aftereffect induces sway. Furthermore, IOT resulted in a shorter MAE and less sway than the monocular condition. Hence, it seems that visuo-vestibular interactions involved in visual motion induced sway are influenced by the actual visual experience, rather than visual stimulation per se.

055

**The influence of feedback on learning of joint angle coordination while learning to control a complex tool**

Raoul M. Bongers & Sandra Suelzenbrueck  
University of Groningen

Tools change the mapping between movements of the hand holding the tool and the tool's tip. When this mapping is complex, as is the case when using a two-sided sliding lever, participants have to learn to coordinate joint angles in the arm to move the hand such that the tip of the lever reaches a target. We compared the lever's tip performance measures as well as joint angles over learning to reach with the tip of the lever to a target. We used two conditions, in one continuous visual feedback of the tip of the lever was provided, and in the other condition only terminal visual feedback in terms of the end position of the lever's tip after each movement was available. With continuous feedback the tip of the lever became straight over the course of learning, while hand trajectories were curved. With terminal visual feedback, curvature of hand movements was close to zero, while tip trajectories were curved. Because the straightness of the tip's trajectory is taken as an indication of the integration of the tool in the action, these findings show that the type of feedback affects the learning processes of integration of the complex tool into the action. Currently, joint angles are processed to analyze how they change over learning. This should allow us to get at a deeper understanding of how neuromotor learning processes result in the integration of a complex tool in a goal-directed action.

056

**Coupled digit movement in bimanual grasping**

Frank T. J. M. Zaal & Raoul M. Bongers  
Center for Human Movement Sciences, University of Groningen

The classic understanding of prehension is that of coordinated reaching and grasping. An alternative view is that in prehension individual digit movements are being controlled (Smeets & Brenner, 1999); that is to say, the opening and closing of the hand is not controlled per se but grasping emerges from the individually controlled digit movements. We tested this double-pointing account of prehension by perturbing the future end position of the individual digits involved in precision (two-digit) grasping. According to the double-pointing account, perturbation of the end position of one of the digits should not have an effect on the other digit. However, we did find perturbation effects on the non-perturbed digit in both unimanual (Van de Kamp & Zaal, 2007) and bimanual prehension. We conclude that in prehension digit movement is coupled into a grasping component.

057

**EEG responses to observation of self and others**

Janny C. Stapel, Ilse van Wijk, Harold Bekkering & Sabine Hunnius  
Donders Institute for Brain, Cognition & Behaviour, Nijmegen

Infants attain the developmental milestone of self-recognition around 18 months of age. At that age, half of the infants typically show signs of self-recognition in the classic mirror test. The current study is the first to examine neural correlates of self-recognition in infancy. Eighteen-month-old infants observed pictures of their own face, the face of an unfamiliar infant, the face of their caregiver, and the face of an unfamiliar caregiver, while their EEG was registered. The results show that infants show a stronger response to their own face compared to other faces. This was illustrated by a larger N290, an established face-selective ERP component, to observation of the own face compared to others' faces. In addition, the mirror test was administered. Half of the infants in our sample recognized themselves in the mirror. However, there were no differences in the ERP responses between the infants who did and did not recognize themselves in the mirror. This suggests that ERPs may be used as an independent indicator of emerging self-recognition.

058

**Onsets capture attention regardless of attentional set**

Sander Los, Mara Otten & Daniël Schreij  
VU University

Search for color is slowed down by the appearance of a sudden onset. This effect suggests that the onset captures attention in a stimulus-driven way. However, according to the contingent attentional capture theory, this effect cannot be attentional in nature, because onsets are not part of the participant's attentional set for color. Support for this view derives from the repeated finding that the effect of onset presence on manual reaction time (RT) is additive to the effect of the spatial validity of a color cue that precedes the search display. However, a recent eye movement study suggests that this additivity is not due to a functional independence of mechanisms influenced by onset presence and cue validity. Instead, it seems that an interaction fails to come to expression because of occasional additional saccades that people make in the invalid cue, onset present condition (from cue to onsets or vice versa). In the present eye movement study, we created a condition in which all display elements except for the color singleton were turned off after the first saccade, thereby discouraging these additional saccades. Now an interaction emerged between onset presence and cue-validity on manual RT, supporting the view that sudden onsets capture attention regardless of attentional set.

### **The learning rate of a memory representation is independent of its function**

Eren Gunseli, Chris Olivers & Martijn Meeter  
VU University Amsterdam

Prominent theories of attention claim that visual search is guided through attentional templates stored in working memory. Recently, the contralateral delay activity (CDA), an electrophysiological index of working memory storage, has been found to rapidly diminish when observers repeatedly search for the same target, suggesting that, with learning, the template moves out of working memory. However, this has only been found in pop-out search for distinct targets, for which a strong attentional guidance was not necessary. Using ERPs, we compared the rate of learning of attentional templates in pop-out and effortful search tasks. Furthermore, in separate experiments, we compared this rate of learning with the rate of learning of memory representations in simple memory recognition tasks in which no attentional guidance is required. Preliminary analysis suggests that the rate of learning of a representation is the same regardless of the task that the representation will be used for.

### **The perceived onset of visual events: smaller stimuli are perceived to occur earlier than larger ones**

Chris Paffen, Edwin Dalmajer & Ryota Kanai  
Utrecht University

When does a visual stimulus reach visual awareness? In the present study we addressed this question by manipulating the size of Gaussian blobs or Gabors of different spatial frequency presented left or right of fixation. In RT experiments, participants were instructed to indicate as fast as possible whether a target stimulus appeared left or right of fixation. In TOJ experiments, participants indicated which of two stimuli presented left and right of fixation appeared earlier.

The results for both sets of experiments were rather different. RTs were generally shorter for large stimuli, for both Gaussian blobs and Gabors of various spatial frequencies. On the other hand, the perceived timing of larger stimuli was delayed in TOJ experiments. Thus, when a large stimulus (e.g. 8 degrees in diameter) was presented simultaneously with a smaller stimulus (e.g. 1 degree in diameter), the larger stimulus was perceived to appear later. We suggest that the differential effects of stimulus size in both tasks reflects separate neural mechanisms being used. The effects on RT can be attributed to the increased signal of a larger stimulus. We suggest that the judgment of perceived timing in the TOJ experiments is made based on synchronized activity over a larger cortical surface. The perceived timing of larger stimuli will be delayed, since increasing stimulus size will increase the cortical surface over which activity needs to be synchronized.

### **Sustained Attention in Language Production: An Individual Differences Study**

Suzanne Jongman, Ardi Roelofs & Antje Meyer  
Max Planck Institute for Psycholinguistics, Nijmegen

Language production is a highly practiced skill that seems to happen effortlessly. In recent years however, evidence has been accumulating that some form of attention is required. Here we investigated the contribution of sustained attention, which refers to the ability to maintain alertness over time. First, sustained attention was measured with an auditory and a visual continuous performance task. Next, participants described pictures using simple noun phrases while their response times (RTs) and gaze durations were measured. In previous research, gaze durations have been suggested to reflect planning processes up to and including phonological encoding. Individual differences in sustained attention ability correlated with individual differences in the magnitude of the tail end of the RT distributions. In other words, individuals with relatively poor sustained attention had a higher proportion of slow responses when describing pictures. No such correlation was found for the gaze durations. These results suggest that sustained attention is involved in language production, especially after phonological encoding.

### **The cost of planning speech while listening to speech**

Svetlana Gerakaki, Matthias Sjerps & Antje Meyer  
Max Planck Institute for Psycholinguistics

In conversation interlocutors can switch from listener to speaker-role within 100 ms<sup>1</sup> (median), suggesting that speech planning and listening often overlap in time. But how well do we process what we hear while planning our utterances? We investigated this using a modified picture-word interference paradigm. Per trial participants either saw a shape that did not require a response or a picture they had to name. Simultaneously with each visual stimulus they heard a spoken word. In Experiment 1, no instructions were given about the words they heard; in Experiment 2 participants were asked to remember them. Each experiment involved 32 adult native speakers of Dutch. The instruction to divide attention between listening and speech planning led to a higher proportion of picture naming errors but better performance in a subsequent recognition memory test (a surprise test for participants of Experiment 1). Importantly, in both experiments recognition memory was more accurate for items from shape/no-response trials than for items from picture naming trials. Since the spoken word always ended before the onset of the participants' articulation, we conclude that planning while hearing speech is detrimental for both incidental and intentional encoding of heard words.

1 Stivers. (2009). PNAS, 106(26), 10587–92.

067

### EEG correlates of processes related to turn-taking in an interactive quiz paradigm

Sara Bögels, Lilla Magyari & Stephen C. Levinson  
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In psycholinguistic experiments on language processing, researchers have traditionally focused on either comprehension or production. However, real-life, communicative language use happens most often in an interactive setting, involving rapid turn-taking between interlocutors. In such a setting, listening to a turn probably overlaps with preparing an answer to this turn. In the current EEG experiment, participants answered quiz questions, asked by the experimenter. Unknowingly to participants, these questions were pre-recorded, while the experimenter gave live feedback on participants' answers. Questions appeared in two different conditions. Participants could confidently guess the answer to the question either halfway through the question (e.g., "Which character, also known as James Bond, appears in the famous movies?"), or only when they heard the last word(s) (e.g., "Which character, who appears in the famous movies, is also known as James Bond?"). ERP results showed a small N400 effect, followed by a large positivity at the moment within the question that the answer started to become apparent (the critical point). In the frequency domain, an alpha/mu desynchronization effect was found, starting within 500 milliseconds after the critical point. A follow-up control-experiment in which participants only listened to the questions and tried to remember them, showed a qualitatively similar pattern in the ERPs, but with a larger N400 and a smaller positivity. The alpha/mu desynchronization effect was absent or at least very much reduced. We tentatively interpret the alpha/mu desynchronization from the main experiment as a signal of response preparation, starting quickly after an appropriate response can be retrieved.

068

### Neural differences in mental simulation while listening to fiction

Annabel D. Nijhof & Roel M. Willems  
Donders Institute for Brain, Cognition and Behavior

Although fiction plays an important role in many people's lives, little work has been done on the neuro-cognitive processes underlying the comprehension of fiction. Here we used fMRI to investigate mental simulation during story comprehension. Several theories state that there are individual differences in the kind of simulation that people use. We focused on two kinds of simulation: simulation of characters' intentions and beliefs, related to Theory of Mind (ToM), and simulation of sensori-motor descriptions. Participants (N=18) in an MR scanner listened attentively to three story fragments presented over headphones. The fragments were coded for different kinds of descriptions, most importantly descriptions of characters' intentions and beliefs, and of motion events. As a control baseline, participants listened to the fragments played backwards. Lastly, participants carried out two localizer tasks to create regions of interest (ROIs). The first was a localizer of the ToM network (a 'false belief' task), the second of the action network (motor execution).

Results show large individual differences in mental simulation during listening to fiction. There was a negative correlation between 'character description' activation in ToM regions and 'motion description' activation in motor regions, indicating that some participants relied more on their mentalizing abilities while listening to the stories, whereas others relied more on sensori-motor simulation. Whole-brain analyses, contrasting the different kinds of descriptions in the stories against each other, show several additional activations at the group-level indicating mental simulation. This study shows the feasibility of measuring neural responses to comprehension of natural language, in particular fiction.

069

### The Preparatory Pupillary Response Predicts Trial-by-Trial Variation in Motor-Related Components of Response Time

Hedderik van Rijn, Udo Boehm & Leendert van Maanen  
University of Groningen

The preparatory pupillary response (PPR), measured before presentation of the stimulus, has been suggested to index motor preparation. For example, if more force is needed to give a motor response, the PPR is higher (Richer & Beatty, 1985); or when cues provide information about the preparation of motor features, cues that allow for more preparation evoke larger PPRs (Moresi et al, 2008). Although these studies seem to provide solid evidence for the view that the PPR indexes motor preparation, they do not exclude the alternative hypothesis that increased PPR shortens all stages of cognitive processing. To test this alternative hypothesis, we ran two random-dot kinematogram experiments, one with a speed-accuracy tradeoff manipulation (SAT) to manipulate preparatory set, and one manipulating task difficulty using different levels of coherence. Our results support the hypothesis that PPR only influences motor preparation: In the SAT experiment, PPR correlates with RT to a higher degree when motor preparation is more important. In the coherence experiment, the lack of interaction between PPR and coherence levels suggests that PPR does not affect the outcome of decisions to a higher degree when decision are harder. The fit of linear ballistic accumulator models support these results.

070

### The pupillary light response reveals pre-saccadic attentional shifts

Sebastiaan Mathôt, Lotje van der Linden, Jonathan Grainger & Françoise Vitu  
Aix-Marseille Université, CNRS, Laboratoire de Psychologie Cognitive

When the eyes are exposed to an increased influx of light, the pupils constrict. This pupillary response to light is traditionally believed to be purely reflexive and not susceptible to cognitive influences. Here we report that the pupillary light response is modulated by pre-saccadic attentional shifts. Participants fixated a central gray area and made a saccadic eye movement to a peripheral target presented on a bright or dark background. The overall brightness of the display was kept constant. As soon as the eyes set in motion the brightness of the target region changed from bright to dark or vice versa. This brightness switch allowed us to distinguish the anticipatory, pre-saccadic component of the pupillary light response from the normal response that results from directly fixating a bright or dark stimulus. Crucially, we observed a clear pre-saccadic pupillary light response: The pupil constricts when preparing a saccadic eye movement to a bright region and (relatively) dilates when preparing a saccade to a dark region. This finding illustrates that the pupillary light response is not merely a reflexive response to retinal illumination, but a dynamic movement that is tightly linked to visual attention and eye-movement preparation.

### **Pupil Frequency Tagging: an on-line measure of visual attention**

Marnix Naber, George A. Alvarez & Ken Nakayama  
Leiden University

The muscles that control the pupil are richly innervated by the autonomic nervous system. While there are central pathways which modulate pupil size in relation to arousal, there is no anatomical evidence that centers involved with higher order cognition innervate the pupil. In this study, we show that such connections must exist and that they reflect the operation of visual selective attention. In our first study observers gazed at a fixation point while they attended one of four separate objects. Each object had a distinct location and flicker frequency (1.50, 1.75, 2.00, and 2.25Hz). Results showed that the frequency of the attended object was selectively enhanced in the pupil response dynamics. In the second experiment, our aim was to show that we could predict behavioral performance from the frequency tagged response. Here we had subjects centrally fixate while tracking a slowly moving flickering disk (2Hz). A stream of changing letters was superimposed on the disk and observers were instructed to hit a button whenever the target letter "x" was shown. Improved detection of the "x" was correlated with increased amplitude of the pupillary response. These surprising results show that pupil responses closely follow the allocation and strength of focal visual attention. They provide a new opportunity to study visual attention and also invite investigation as to the pathways and mechanisms of this phenomenon.

### **Spatial attention facilitates assembly of the briefest percepts: Electrophysiological evidence from color fusion**

Elkan Akyurek & Manon van Asselt  
University of Groningen

When two different color stimuli are presented in rapid succession, the resulting percept is sometimes that of a mixture of both colors, due to a perceptual process called color fusion. Although color fusion appears to occur very early in the visual pathway, and although it only operates across the briefest of intervals (< 50 ms), the present study shows that the availability of spatial attention can alter the fusion process. In a series of experiments, spatial cues were presented that either validly indicated the onset of a pair of color stimuli in successive stimulus arrays, or that of equally luminant gray distractors in the other visual hemifield. Increased color fusion was observed for valid cues across a range of stimulus durations. By contrast, perception of single-color stimulus pairs did not change, suggesting that the enhancement was specific to fusion, not color discrimination per se. Electrophysiological measures showed that the N2pc component of the event-related potential, thought to index lateral attentional stimulus processing, was modulated during fusion of validly and invalidly cued color stimuli. Taken together, the results suggest that spatial attention causes a temporal slowdown, which enhances color fusion and decreases competition between stimuli.

### **The truth about priming in visual search**

Martijn Meeter  
VU

Searching for a target is faster when target features are repeated, than when they change from trial to trial. Such visual priming has been suggested to explain a substantial part of how our attention is guided, including findings that have previously been ascribed to top-down, voluntary steering of attention. Here, I will discuss new results that suggest that (1) priming results from attending – that is, attending to a stimulus, without any goal, is already enough to prime you to attend to similar stimuli later. And (2), priming results in a boost in perceptual signals – that is, when you are primed by a certain stimulus, similar stimuli enter the brain with increased strength, speed or both. These conclusions come from a series of visual search experiments in which observers either make a manual response, or make a saccade to the target.

### **Linear perspective explains slant, distortion and motion perceived in pictures**

Casper Erkelens  
Helmholtz Institute, Utrecht University

We, members of the Information Age, watch (moving) pictures during many hours a day. After having viewed pictures drawn on walls, paper and canvas for millennia, we devote much time now to pictures displayed on a screen (i.e. television, monitor, laptop, tablet and smartphone). Despite the fact that pictures are flat, viewing pictures can give us the impression of looking at 3D objects and scenes. Still, perception of depicted 3D objects differs from that of real 3D objects, in particular when the pictures are viewed from oblique directions. Since many centuries artists know that linear perspective creates powerful sensations of depth and slant. What is not known is how the brain measures linear perspective information from the retinal image. Here, an experimental technique and geometric computations are presented that enable the isolation of slant related to linear perspective from slant induced by all other cues. The results reveal the effective stimulus for slant perception and explain many past findings of both transformation and (apparent) compensation in pictorial viewing.

### **The effects of aging and Gestalt grouping on haptic search**

K.E. Overvliet, R.T. Krampe, R.T. & J.Wagemans  
KU Leuven

Recognizing objects or their 2D representations through haptic exploration requires extensive sensorimotor processing, intermediate integration of haptic features into a visual image and finally matching this image against stored object representations (Klatzky & Lederman, 1987). Compared with young adults older adults take more time or more frequently fail to recognize haptic 2D shapes. Working memory limitations constrain the integration of features into a coherent intermediate image during haptic processing which is generally slowed in older adults (Overvliet, Wagemans & Krampe, PandA, in press). In previous studies (Overvliet, Krampe, Wagemans, JEP:HPP, 2012) we showed that Gestalt grouping can make haptic perceptual processing more efficient. In the present study we had young and older participants perform haptic search tasks, in which certain conditions allowed Gestalt grouping of items. Older adults showed larger benefits of Gestalt grouping compared with young adults. We conclude that age-related performance declines due to central capacity limitations can be partly compensated for by making perceptual search processes more efficient through the usage of Gestalt grouping.

076

### **Neuronal integration in visual cortex elevates face category tuning to conscious face perception**

Johannes J. Fahrenfort, Tineke M. Snijders, Klaartje Heinen, Simon van Gaal, H. Steven Scholte & Victor A.F. Lamme  
Utrecht University

The human brain has the extraordinary capability to transform cluttered sensory input into distinct object representations. For example, it is able to rapidly and seemingly without effort detect object categories in complex natural scenes. Surprisingly, category tuning is not sufficient to achieve conscious recognition of objects. What neural process beyond category extraction might elevate neural representations to the level where objects are consciously perceived? Here we show that visible and invisible faces produce similar category-selective responses in the ventral visual cortex. The pattern of neural activity evoked by visible faces could be used to decode the presence of invisible faces and vice versa. However, only visible faces caused extensive response enhancements and changes in neural oscillatory synchronization, as well as increased functional connectivity between higher and lower visual areas. We conclude that conscious face perception is more tightly linked to neural processes of sustained information integration and binding than to processes accommodating face category tuning.

081

### **Analyzing the multimodal signature of task-unrelated thoughts**

Matthias Mittner, Wouter Boekel, Adrienne M. Tucker & Birte U. Forstmann  
Cognitive Science Center Amsterdam

Frequently, humans engage in task-unrelated processing, even under conditions of sustained attention (Smallwood, 2013). Estimates for the frequency of mind-wandering range from 40 to 50% of our waking time (Killingsworth & Gilbert, 2010). Obviously, such a high proportion of episodes of off-task cognition (task-unrelated thoughts, TUTs) poses a significant threat to the interpretation of many studies investigating cognitive functions. We acquire neuroimaging, pupil-diameter, and behavioural data in a Stop-Signal task (e.g., Forstmann et al., 2012) in which we randomly intersperse "thought-probes" (introspective questions about the content of the subject's current thoughts). In a machine-learning setup, we train a support-vector machine (SVM) on single-trial features derived from neuroimaging data and recordings of the pupil-diameter to predict subjects response to the thought-probes. A cross-validation procedure achieves a cross-subject classification performance of 75% using only brain-data and pupil-diameter as inputs. Based on predictions derived from this classifier regarding the state of mind during the remaining trials, we are able to apply the Stop-Signal Linear Ballistic Accumulator (SS-LBA; Forstmann et al., submitted) to the reaction time (RT) and accuracy data. Since this model can dissociate the RT distribution into underlying cognitive processes, we can derive conclusions about how processing differs in on-task vs. TUT-dominated trials.

082

### **Fatigue and Response Inhibition in the Stop Signal Task**

Adrienne M. Tucker, Wouter Boekel, Matthias Mittner & Birte U. Forstmann  
University of Amsterdam

Fatigue is implicated in 10-15% of severe car crashes, and fatigue-related accidents cause billions of economic damage yearly. Thus, an important question is whether sleep loss impacts the ability to stop a motor response. Fourteen healthy young adults with regular sleeping patterns completed a sleep deprivation study in the laboratory under continuous behavioral monitoring. Caffeine, alcohol, and smoking were prohibited, and light levels were fixed at <100 lux. The Stop Signal task was administered in an 3T fMRI scanner with eye-tracking twice: once sleep-rested and once sleep-deprived (order was counterbalanced). Participants indicated whether an arrow pointed left or right; on 33% of the trials a tone sounded signaling to stop the response. When sleep-rested, the classic stopping network was observed including right inferior frontal gyrus, parietal cortex, and pre-Supplementary Motor Area. We are currently applying a quantitative model of performance—the Linear Ballistic Accumulator—to the behavioral data<sup>1,2</sup>. This model-based approach allows for the isolation of different cognitive components such as the efficiency of stopping a response versus response caution. We will be able to pinpoint the neural activation associated with specific cognitive processes represented by model parameters, as well as how these change with fatigue to impact response inhibition.

1 Brown, S. D., & Heathcote, A. (2008). The simplest complete model of choice response time: Linear ballistic accumulation. *Cognitive psychology*, 57(3), 153-178.

2 Forstmann, B. U., Boekel, W., Wagenmakers, E.-J., Matzke, D., & Brown, S. D. (2013). Practice in a decision making task induces ultra-fast changes in structural white matter tracts. Manuscript submitted for publication."

083

### **More "Ohm", more "A-ha": the modulating effect of prior meditation practice on the strategy used in solving convergent thinking problems**

Ayca Szapora, Lorenza S. Colzato & Bernhard Hommel  
Leiden University

Scientific interest in meditation has significantly grown in the past years; however, so far, science has neglected the idea that different type of meditations may drive specific cognitive-control states. In our previous study we showed that focused attention (FA) and open monitoring (OM) meditation exert specific effect on creativity, by using creativity tasks tapping into convergent (Remote Associates Task) and divergent thinking (Alternate Uses Task). OM meditation induces a control state that promotes divergent thinking, a style of thinking that allows many new ideas to be generated; while FA meditation does not sustain convergent thinking, the process of generating one possible solution to a particular problem. In the present study, we investigated whether this effect was modulated by prior meditating experience, by comparing a group of practitioners (N=27) and a group of novices (N=25). The impact of OM meditation was found to be robust irrespective of prior experience. In contrast, while solving convergent thinking problems, practitioners used a holistic strategy, as opposed to an analytical approach, significantly more often than the novices.

### Using cognitive models to understand meditation and mind wandering

Marieke van Vugt  
University of Groningen

An increasing number of studies shows that meditation practice affects cognitive functions such as attention and working memory. At the same time, there is no detailed cognitive theory of what meditation is and how it exerts its salutary effects. In collaboration with both Buddhist scholars and cognitive modelers, I developed a model of meditation implemented in the ACT-R cognitive architecture. Implementing it in ACT-R, in which many different tasks have been implemented, and for which recently a theory of transfer was developed, allows for predictions of transfer from meditation to other cognitive tasks. The cognitive model of meditation is centered around the ideas of (1) becoming distracted through a failure of checking where attention is, and (2) returning to the object of attention through retrieving the intention to meditate from memory. Training these mechanisms should have specific consequences for performance on other tasks. I will use the model to fit data from a mind wandering task, and furthermore describe how this model could explain some effects of meditation on the attentional blink.

### Hierarchical inference in action perception

Sasha Ondobaka, Marco Wittmann, Floris P. de Lange & Harold Bekkering  
Donders Institute for Brain, Cognition and Behaviour

Predominant accounts of action perception propose that action outcomes are derived by direct mapping of observed movements onto a parieto-frontal circuit that is also involved in an observer's action control. From an alternative perspective, action recognition is cast in terms of a hierarchical inference that minimizes surprising sensations based on prior expectations. Here, we used functional neuroimaging to establish the hierarchical nature of surprise-dependent responses by manipulating high-level contextual surprise and low-level action surprise during recognition of observed grasping actions. Participants inferred whether (context-congruent or -incongruent) observed grasping actions were surprising or expected given the context that was either surprising or expected, independent of the action. Parietal and temporal association cortices (AC) showed greater activation for surprising than expected context. Fronto-insular cortex (FIC) was more active for surprising than for expected observed action given the context. Moreover, when the observed action was expected, FIC showed enhanced functional connectivity with the AC. Together, the findings provide support for a hierarchical inference account of action perception and suggest that the neural connectivity between fronto-insular cortex and classical association cortices underpins hierarchical processing of high-level contextual information and low-level action information.

### Optimising smoothing parameters for a 3D motion analysis system

Sander Schreven, Peter J. Beek & Jeroen B.J. Smeets  
Faculty of Human Movement Sciences, VU

In motion analysis it is common practice to use a low-pass filter in order to reduce measurement noise. However, the choice of cut-off frequency is rather arbitrary. Here, we propose to use the resulting precision of the 3D motion analysis system as criterion to find the optimal cut-off frequency. We tested this method in a situation in which measurement noise is a serious concern: the registration of the kinematics of swimming using a video-based motion analysis system. Filtering the data with a single cut-off frequency of 6 Hz reduced the standard deviation in reconstructed distances and angles by about 18% in comparison to using raw data. We found that the relationship between cut-off frequency and precision is dependent on body part and subject. If the optimal cut-off frequency was determined per subject and per segment, then the average standard deviations in reconstructed distances and reconstructed angles were reduced by about 28% compared to using raw data. We conclude that 3D motion analysis systems can be made more precise by optimising the cut-off frequency used in filtering the data.

### An optimal-viewing-position effect in object processing

Lotje van der Linden & Françoise Vitu  
Aix-Marseille Université, CNRS, Laboratoire de Psychologie Cognitive

Numerous studies have shown that a visually-presented word is processed most easily when participants initially fixate its center (for very short words) or slightly to the left of it (for other words). Fixating on this 'optimal viewing position' (OVP) results in shorter response times, a lower probability of making additional within-word refixations and longer initial-fixation durations, as compared to fixating at the beginning or the end of the word. In the current study we investigated whether such OVP effects also exist for isolated-object processing. And, if so, to what extent these effects differ from the ones typically observed for isolated-word processing. To this purpose, we carried out a picture-naming/ word-reading task in which we manipulated the position at which participants initially fixated the stimulus (i.e. a line drawing or the written name of an object). Our results show that not only words, but also objects have an optimal viewing position. However, in contrast to words, objects were processed most easily when participants initially fixated at the object's center, rather than slightly to the left of it. Therefore, we conclude that OVP effects in objects reflect visual-acuity limitations, but without additional language-related constraints that contribute to the OVP effect in words.

### The behavioral and neural effects of language on motion perception

Jolien C. Francken, Peter Kok, Peter Hagoort & Floris P. de Lange  
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Perception does not function as an isolated module but is tightly linked with other cognitive functions. Several studies have demonstrated an influence of language on perception, but it remains debated at which level of processing (perceptual or higher-order areas) this modulation takes place. We investigated whether language-perception interactions were specific to the language-dominant left hemisphere by comparing the effects of language on motion detection in the right and left visual fields. Subjects were faster and more accurate when the direction implied by a motion word was congruent with the direction of a visual motion stimulus, but only for motion stimuli that were presented in the right visual field. We observed a neural counterpart of this effect in the left middle temporal gyrus, an area involved in semantic processing of verbal material. Our results suggest that semantic information about motion retrieved in language regions may automatically modulate perceptual decisions about motion.

089

**Neural basis of different types of synesthesia; To what extent are we all synesthetes?**Romke Rouw & H. Steven Scholte  
University of Amsterdam

The condition synesthesia offers an extraordinary opportunity to study mechanisms involved in (hyper)-binding across different modalities. Currently, the majority of synesthesia research is aimed at a few types of synesthesia; colors evoked by written or spoken language and spatial arrangements evoked by sequential concepts. We do not yet know whether the processes involved in multisensory binding are similar or different across different types of synesthesia. In this project, brain structure measurements (connectivity and volume) were obtained from a large group of subjects (over 350 individuals). Furthermore, the subjects were presented with an extensive synesthesia questionnaire. In the subject group, different types of synesthetes were present; the inducers and concurrent ranged across perceptual modalities (e.g., visual, auditory, taste, tactile) but also involved non-sensory concepts (e.g. 'personality'). This allows studying which of the previously obtained white-matter and grey-matter differences in synesthesia are specific to that (i.e., linguistic-color) type of synesthesia, and which are related more generally to having synesthesia. Furthermore, it allows examining whether synesthetes are, as a group, categorically different from all non-synesthetic subjects. Alternatively, each synesthete is only different from a non-synesthete in the binding of his or her specific inducer to his or her specific concurrent.

090

**A taste for words and sounds: a case of lexical-gustatory and sound-gustatory synesthesia**Olympia Colizoli, Jaap M.J. Murre & Romke Rouw  
University of Amsterdam

We describe a case-study of a synesthete, code-named SC, who has a gustatory form of synesthesia involving the automatic and consistent experience of tastes that are triggered by non-taste related inducers. Most words and a subset of nonlinguistic sounds induce the experience of taste, smell and physical sensations for SC. SC's lexical-gustatory associations are highly consistent compared with a group of controls. We tested for effects of presentation modality (visual vs. auditory), taste-related congruency, and synesthetic inducer-concurrent direction using a priming task. SC's performance did not differ significantly from a trained control group. We used functional magnetic resonance imaging to investigate the neural correlates of SC's synesthetic experiences by comparing her brain activation to the literature on brain networks related to language, music and sound processing, in addition to synesthesia. Brain activation patterns showed evidence that two regions are implicated in SC's synesthetic experience of taste and smell: the left anterior insula and left superior parietal lobe. Anterior insula activation may reflect the synesthetic taste experience. The superior parietal lobe is proposed to be involved in binding sensory information across sub-types of synesthetes. We conclude that SC's synesthesia is genuine and reflected in her brain activation.

091

**The Ventriloquist Illusion by Flashes and Averted Eye-gazes**Jean Vroomen & Jeroen Stekelenburg  
Tilburg University

The brain combines auditory and visual information into a unitary event, but the processing level at which these multisensory interactions occur can vary. We demonstrate this with the ventriloquist illusion (a shift in the apparent location of a sound towards a visual distracter) as induced by peripheral flashes versus averted eye-gazes of a cartoon face. With standard psychophysical procedures that measure a direct ventriloquist effect and a ventriloquist aftereffect, we found that both types of stimuli induced an illusory shift of sound location. These standard methods, however, are likely contaminated by response strategies. We therefore developed a two-alternative forced choice (2AFC) procedure that allows measuring the strength of an intersensory illusion in a bias-free way. With this procedure we found that only flashes, but not averted eye-gazes, induced an illusory shift in sound location. This was validated in an EEG-study where again flashes, but not eye-gazes, illusory shifted the apparent location of a sound thereby evoking an auditory mismatch negativity (MMN) response. Our results are important because they highlight that commonly used measures of multisensory illusions are likely contaminated while there is an easy, yet stringent way to circumvent this.

092

**Exogenous attention decreases audiovisual integration of simple lights and sounds.**Nathan Van der Stoep, Marieke A. Janssen, Stefan Van der Stigchel & Tanja C. W. Nijboer  
Utrecht University

Both exogenous attention and multisensory integration are processes that can decrease detection times of simple lights and sounds. Endogenous attention has been shown to enhance multisensory integration. It is unclear, however whether there is a similar interaction between exogenous attention and audiovisual integration. In two experiments, we examined the influence of an exogenous auditory cue on the integration of lights and sounds in a detection task. In Experiment 1 we used the Posner cueing paradigm to present an auditory cue prior to the presentation of an auditory, visual, or audiovisual target. Auditory cues decreased response times compared to the no cue condition regardless of cue validity, but we only observed audiovisual integration in the no cue condition. In Experiment 2 we used the implicit cueing paradigm to obtain a validity effect and investigate whether valid and invalid cues influenced audiovisual integration differently. Again, there was an alerting effect of the cue decreasing the amount of audiovisual integration. Interestingly, audiovisual integration was present when the target location was unattended but not when it was attended. This indicates that exogenous attention enhances audiovisual target detection but decreases audiovisual integration, which implies that exogenous and endogenous attention interact differently with multisensory integration.

### **Capture of the eyes by threatening and non-threatening distractors**

Manon Mulckhuyse, Edwin S. Dalmaijer & Leon Kenemans  
Utrecht University

Emotional stimuli, such as threatening stimuli, are known to influence visual selection. However, how and when these stimuli modulate visual selection is not yet clear. One theory argues that threatening stimuli are processed very rapidly via a subcortical pathway, whereas another theory argues that threatening stimuli are not processed faster or differently than other salient visual stimuli. In the current study we measured eye movement behavior to index the time-course of emotional modulation on visual selection. Observers made a speeded saccade to a target stimulus while distractor stimuli were presented. In addition, by using a differential fear-conditioning procedure, we presented a visual salient onset distractor that could either be a threatening stimulus (CS+) or a non-threatening stimulus (CS-). The results showed that saccades were slowed in the presence of an onset distractor and that the distractor captured the eyes in a subset of trials. More importantly, correct and error saccades were modulated by threat. Latency distributions of the correct and error saccades showed that a threatening distractor stimulus affected the oculomotor system already early in time. The present findings reveal the modulation of threat on visual selection and are in line with the theory that threatening stimuli are processed faster and perhaps differently than other visual salient non-threatening stimuli.

### **The social function of pupil-synchronization**

Mariska E. Kret, Tetsuro Matsuzawa, Jolien van Breen, Agneta Fischer & Carsten de Dreu  
University of Amsterdam

Humans attend to other's gaze and pupil-size to gather information about the environment. Intriguingly, perceiver's pupil-size tends to synchronize with that of the observed. If such synchronization has adaptive value, e.g. to promote swift communication of arousal, shared understanding or trust, pupil-synchronization should emerge within but not across species. We first tested whether pupil-synchronization also exists in humans' closest relative, the chimpanzee (*P. troglodytes*). Chimpanzee and human subjects observed pictures of the eyes of both species with large and small pupils. We found that subjects' own pupils changed accordingly, especially when they observed their own species. The occurrence of synchronization of eye signals could only have become adaptive within groups where individuals trusted each other in that they would not misuse information derived from their eye-signals. To test the supposed relation between pupil synchronization and trust, we designed different pupillometry experiments in which participants played different economic games with virtual partners. Observing pupil dilation increased trust decisions (and reduced deception), because participants synchronized their own pupil-size with that of their protagonist. Overall, perceived pupil dilation is a strong and important cue that drives synchronization and subsequent pro-social choices behavior.

### **Emotional involvement in a video story aids emotional memory**

Katinka Dijkstra & Jorg Huijding  
Erasmus University Rotterdam

Why do we mimic the facial expression of someone who talks about an emotional experience? Is it just a way to show this person we empathize with him or her, or are there cognitive benefits as well? We think there are. In this presentation, two experiments are discussed that examined effects of facial expression manipulations on offline memory tasks. In Experiment 1, participants watched an emotional video after being assigned to a control, pen inhibition, emotion suppression, or emotional involvement condition. Afterwards, participants wrote down what they remembered from the video. Emotional involvement resulted in better free recall of positive segments from the video relative to condition in which a pen was held in the mouth. In experiment 2, participants watched the same video under emotion suppression or emotional involvement conditions and performed a factual and affective recognition task a week later. Emotional involvement yielded better recognition than emotion suppression but only for affective questions about the video. Being able to simulate emotions through facial mimicry seems to facilitate memory for the presented information. These results have implications for the social interactions we have with others, as well as our understanding of what factors may facilitate learning. Facial mimicry is a factor to take into consideration in situations that require retention of emotional information.

### **Tryptophan promotes interpersonal trust**

Laura Steenbergen, Erik W. de Kwaadsteniet, Roberta Sellaro, Roman Liepelt, Bernhard Hommel & Lorenza S. Colzato  
Leiden University

Interpersonal trust is an essential element of social life in general and an important determinant of cooperative behavior in particular. The link between serotonin and one of the most important determinants of cooperation, interpersonal trust, has remained largely uninvestigated. In the present study, we tested whether interpersonal trust can be promoted by administering the food supplement L-Tryptophan (TRP), the biochemical precursor of 5-HT. Participants were compared with respect to the Trust Game – an index of interpersonal trust that measures the extent to which a participant (the trustor) trusts the trustee in money units transferred from trustor to trustee. As expected, participants transferred significantly more money to the trustee in the TRP condition than in the placebo condition. This result supports the idea that the food we intake may act as a cognitive enhancer modulating the way we think and perceive the world and others.

### **The Benefits of Spacing Training for Surgical Motor Skills**

Edward Spruit, Guido Band & Jaap Hamming  
Leiden University

Reaching proficiency in performing laparoscopic surgery involves extensive training to acquire the required motor skills. Conventionally, training of such skills typically occurs during a full day training event utilizing surgical simulators that train specific motor skills pertinent to laparoscopic surgery. An important variable to consider is the optimal schedule for laparoscopic motor training. In this study, two groups of novice trainees were trained on different time schedules, one receiving three training sessions on a single day (massed condition) and the other receiving one training session a week for three consecutive weeks (spaced condition). Results indicated better performance at the end of training and at a two-week delayed retention session for the group that received training on a spaced schedule. This spacing effect was most pronounced for the more difficult laparoscopic training tasks.

### **The Long and Short of Intertrial Priming**

Wouter Kruijne & Martijn Meeter  
Vrije Universiteit Amsterdam

Attending and processing stimuli on one trial can facilitate processing of stimuli with the same features on the next trial, a phenomenon termed intertrial priming. Few accounts that explain priming mechanistically have been proposed yet, but one theory proposes that episodic retrieval of past trials has a crucial role. Using an established model of episodic LTM, we were indeed able to reproduce various findings from the priming literature. However, the general principles of learning embedded in the model yielded a counterintuitive prediction: a block with a surplus of trials in which the target has, for example, a certain color (a bias block), will result in long-term priming, speeding search for such targets for the remainder of the experiment. Testing this prediction, we found a remarkable dissociation between singleton- and conjunction search: No long-term learning effects were found for singleton search, but for conjunction search we found that bias blocks affected search in later unbiased blocks, without obvious forgetting. Furthermore, this long-term priming effect did not seem to result from an explicit strategy recruited by the participants and occurred on top of short-term intertrial priming. Based on these findings, and findings from neurophysiology, we propose to dissociate priming effects found in singleton and conjunction search, and illustrate how priming may fractionate in short- and long-term effects through to separate mechanisms.

### **The roles of bottom-up and top-down attention in psychopathy**

Sylco S. Hoppenbrouwers, Jantine Slotboom, Yvonne Bouwman, Edwin Dalmaijer, Jan Theeuwes & Stefan van der Stigchel  
Utrecht University & Forensic Psychiatric Centre Oldenkotte

When psychopaths initiate goal-directed behavior, they have difficulty modulating their initial response set based on peripheral (i.e., goal-irrelevant) information. In short, this is the idea that the response modulation theory conveys and it postulates that difficulties in response modulation relate to an early attention bottleneck (Newman et al. 2008). That is, when task-relevant information is identified, irrelevant stimuli appear blocked from further processing. Evidence also suggests that attention moderates callous-unemotional behavior in psychopaths (Newman et al. 2009). To scrutinize the attention bottleneck hypothesis, we employed two attention tasks that are at opposite sides of the spectrum, namely an attentional capture task and a visual search task. The first task is thought to tap into bottom-up, involuntary attention whereas the visual search task primarily measures top-down control of attention. Participants are violent patients in a forensic treatment facility. Preliminary analyses suggest that psychopaths did not differ in attentional capture compared to controls but appear unable to flexibly use goal-relevant information. In addition, performance on the visual search task correlates inversely with the extent to which individuals are psychopathic. Our pilot data appear to contrast earlier findings and suggest that psychopathic offenders primarily have deficits in the top-down allocation of attention.

### **Does the joint Simon effect exist for non-spatial dimensions?**

Roberta Sellaro, Lorenza S. Colzato, Thomas Dolk, Roman Liepelt & Bernhard Hommel  
Leiden University

The joint Simon effect (JSE) is considered as an index of action co-representation. However, this interpretation has been recently called into question by the results of other studies suggesting that the JSE is mainly a spatial phenomenon, being it triggered by any salient event that provides a reference for spatially coding one's own action.

The present study aimed at investigating whether the spatial dimension that characterized the Simon task is necessary for the JSE to occur. In two experiments, participants were asked to judge the geometrical shape (circle/triangle) of a central colored (red/green) stimulus by pressing a left or right button, while wearing colored (red/green) gloves. In both experiments, participants performed the task individually, either responding to both stimulus shapes (two-choice task; in Experiment 1) or responding to only one of the two shapes (individual Go/NoGo task; in Experiment 2), and co-acting with a partner (joint Go/NoGo task). S-R congruence effects were observed in the two-choice task and in the Go/NoGo joint tasks of both experiments but not in the individual Go/NoGo task.

The present results suggest that the spatial dimension is sufficient but not necessary for the JSE to occur. Indeed, social S-R congruence effects may also be elicited by other features, such as stimulus color, provided that these features allow discriminating between one's own and the co-actor's action.

### **Local spatial attention distorts entire visual field representations in visual cortex**

B. P. Klein, B.M. Harvey & S.O. Dumoulin  
Helmholtz Institute, Utrecht University

Voluntarily focusing visual spatial attention at a visual field location facilitates processing of information at that location and induces changes in neuronal response properties. Gaussian models that capture these response changes implicitly predict receptive field shifts towards the attention focus. To investigate this prediction in humans, we measured fMRI responses elicited by a visual stimulus while subjects performed an attention-demanding contrast discrimination either left or right of the visual stimulus. We estimated population receptive field (pRF) parameters and compared these between the two conditions. We found systematic shifts of pRFs towards the attention focus across the entire visual field in all recorded visual field maps. The sizes of the shifts differed between visual areas, but were strongly related to pRF sizes and very well captured by fitting attention field Gaussians at the attention positions. Interestingly, the size of the fitted attention field is nearly constant across several visual field maps, suggesting a near constant attention influence across several visual areas. This study highlights that localized spatial attention affects processing across the entire visual field, not just the attended location. Furthermore, spatial attention results in distorted visual field representations with more neural resources shifted towards the focus of attention.

### **Mental representations in the visual hierarchy**

Anke Marit Albers, Brónagh McCoy, Ivan Toni & Floris P. de Lange

Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Donders Centre for Cognitive Neuroimaging

Mental imagery is a perception-like experience in the absence of bottom-up, physical input. Although it has been found that early visual cortex contains stimulus representations during mental visual imagery of oriented gratings, early visual cortex may not be involved in all imagery tasks alike. Here we investigated whether the involvement of visual cortex during mental imagery depends on stimulus familiarity and task demands. Participants (N=16) imagined a familiar letter or novel pseudo-letter created out of small Gabor patches, while fMRI data was collected. After a 10 second imagery period they were required to compare the imagined stimulus with a physically presented probe. The comparison process could be on either the letter-shape dimension (shape imagery) or on the orientation of the Gabor patches (orientation imagery). We used multivariate analyses to investigate stimulus representations during the imagery period in both early (V1) and late (Visual Word Form Area VWFA) visual cortex, under the different task conditions. Initial results suggest that representational patterns can be modulated by both stimulus familiarity and task demands. Together, this provides insights into the nature of mental imagery and representational content during cognitive processes.

### **Seeing the forest before the trees: the lateral occipital complex analyses the local correlation structure of scenes.**

HS Scholte, IG Sligte, IIA Groen, VAF Lamme & S Ghebreab

University of Amsterdam

The gist of a visual scene is perceived in a split-second. Here, we show that the retinotopic part of lateral occipital complex (LO1/LO2) performs a crucial operation in deriving this gist; it estimates the spatial coherence (SC). SC organizes the scene space by the degree of fractionation, allowing it to predict the amount of clutter in a scene, the presence of objects against a coherent background or whether a scene is man-made or natural. The notion of SC has the potential to integrate studies dealing with rapid object detection with studies dealing with scene gist. Finally we show that SC can be approximated via divisive normalization using and easily computed using a predictive coding network. Together these results show how global image statistics can be used to rapidly identify gist like elements of scenes and how and where this is calculated.

### **Topographic processing of numerosity in the human parietal cortex**

Ben M Harvey, Barrie P Klein, Natalia Petridou & Serge O Dumoulin

Utrecht University

Numerosity, the set size of a group of visually-presented items, is processed by association cortex, but certain aspects mirror properties of primary senses (Dehaene, 1997; Burr and Ross, 2008). Sensory cortices contain topographic maps reflecting the structure of sensory organs such as the retina, cochlea or skin. Is the cortical representation and processing of numerosity organized topographically, even though no sensory organ has a numerical structure? Using high-field fMRI (7T) and custom-built model-based analysis that captures numerosity tuning (Dumoulin and Wandell, 2008), we describe neural populations tuned to small numerosities in human posterior parietal cortex. These neural populations are organized topographically, forming a numerosity map where preferred numerosity increases from medial to lateral cortex. This numerosity map is robust to changes in low-level stimulus features, although numerosity-tuning properties do vary with stimulus features. Furthermore, the cortical surface area devoted to specific numerosities (cortical magnification factor) decreases with increasing numerosity, and the tuning width increases with preferred numerosity. These organizational properties mirror key features of sensory and motor topographic maps. This extends topographic principles to representation of higher-order cognitive processing in association cortex, supports the analogy between numerosity and primary senses, and demonstrates that topographic structures can emerge within the brain.

## POSTER PRESENTATIONS - ABSTRACTS

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p1001

### **Relative proprioceptive distance is used for movements towards visual targets.**

M.C.W. van der Graaff, E. Brenner & J.B.J. Smeets  
VU University

When we move our hand repetitively towards visual targets without seeing our hand, movement endpoints slowly drift towards another location. Adding the other index finger under one of the target locations (without any feedback) should not influence the movements, as this unseen hand does not add new information; it only copies the visual information to proprioception. We tested this prediction by asking subjects to repeatedly move their right index finger between several visual targets on a table. We repeated the experiment after the subjects put their other index finger under one of the target locations. Subjects made considerable errors in positioning their invisible right finger. Adding this non-informative finger shifted the bias of the movement endpoints closer to the target (by about 20%); the rate at which the endpoint drifted away from its original point was smaller. When the invisible left hand was placed 10 cm to the right of the target, the rate at which the endpoints drifted away from its original point was also smaller than when there was no hand near the target. We interpreted this as evidence for the use of relative proprioceptive distance when localizing a visual target.

p1002

### **Hotspots in the workspace: Investigating the Relation between Non-target Object Location and Avoidance Responses**

Rudmer Menger, H. Chris Dijkerman & Stefan Van der Stigchel  
Experimental Psychology, Helmholtz Institute, Utrecht University

The presence of non-target objects influences kinematic parameters of reaches toward target objects. In previous studies, several different non-targets positions have been used. Taken together, these studies suggest that when distance in depth or width of non-target objects is decreased, avoidance responses are more pronounced. There have also been some observations that the response to non-target objects is asymmetrical across workspace, i.e. responses to ipsilateral and contralateral non-targets are different. However, these previous studies have provided us with only a coarse overall picture of the effect of non-target location. Therefore, the aim of this experiment was to systematically map the avoidance responses across the workspace in order to determine in detail the relation between non-target position and the avoidance response. Specifically, we were interested in the relation between horizontal and vertical position of the non-target and the spatial resolution of the non-target location representation. Participants were asked to perform reaches towards physical targets while physical non-targets were present in one of 24 different positions in the workspace. Our results imply that horizontal and vertical position of the non-target object on reaching behavior. We also found findings concerning stronger avoidances for non-targets position on the outside of the reaching limb than for non-targets on the inside. We have further provided a detailed overview of the interaction between these factors and demonstrated that there are 'hotspots' qua non-target positions that prompt the strongest behavioral responses. Lastly, there is evidence to support a fine-grained resolution of non-target position representation in the brain.

p1003

### **Alpha oscillations affect the gating of downstream processing**

Johanna M. Zumer, Rene Scheeringa & Ole Jensen  
Radboud University Nijmegen; Donders Institute for Brain, Cognition and Behaviour

Given the limited processing capabilities of the sensory system, it is essential that attended information is gated to downstream areas, whereas unattended information is blocked. Here we investigate how neuronal oscillations detected by EEG in occipital areas relate to sensory processing in downstream regions as measured fMRI by measuring both modalities simultaneously. The task allowed dissociation between attended and unattended streams of information, via a 2x2 factorial design, with the hemifield of spatial attention as one factor and the object category (faces or scenes) in the attended hemifield as the second factor. This task reliably modulates alpha EEG power in early visual cortices in a lateralized way. In line with previous studies alpha in the up-stream early visual regions was negatively correlated with the local BOLD signal in all four conditions in a trial-by-trial manner. However, for the object sensitive cortices (e.g. FFA or PPA) we found that the alpha power in the upstream attended region (e.g. occipital cortex contralateral to the attended hemifield) was negatively correlated with the BOLD activity in the downstream region of the attended object, but positively correlated with activity in the downstream region for the unattended object. Correspondingly, the alpha power in the upstream unattended region was negatively correlated with the BOLD activity in the downstream region of the unattended object, but positively correlated with activity in the downstream region for the attended object. This demonstrates that occipital alpha power plays a role in gating the flow of information from upstream to downstream visual cortices.

p1004

**Target-distractor competition in the oculomotor system is spatiotopic**Artem Belopolskiy & Donatas Jonkaitis  
Vrije Universiteit Amsterdam

In the present study we used saccade curvature to investigate whether oculomotor competition across eye movements is represented in retinotopic or spatiotopic coordinates. Participants performed a sequence of saccades, consisting of a horizontal and a vertical saccade. To induce oculomotor competition, a task-irrelevant distractor was presented briefly (50 ms) at different times during the saccade sequence. Our results show that despite the intervening saccade, the second saccade curves away from a spatial representation of the distractor that was presented before the first saccade. This finding was replicated in Experiment 2, in which we also manipulated the degree of competition by varying the salience of the distractor. The results showed that saccade curvature away increased with salience of distractor that was presented before the first saccade. Combined, the results show that not only the information about distractor's spatial location, but also the information about its relative salience was transferred across saccades. Spatiotopic representation of distractors is crucial for successful interaction with objects of interest despite the intervening eye movements.

p1005

**Time for Control: An EEG Study to the Influence of Temporally Guided Expectations of Conflict on Cognitive Control**J.C.Swart, J. van Driel, T. Egner, K.R. Ridderinkhof & M.X Cohen  
University of Amsterdam

In the current EEG study we investigated whether cognitive control improves when conflict is predictable based on temporal information, and whether this works through increasing proactive control. Contrary to the predictions, interference of conflict increased when conflict could be anticipated based on temporal information, compared to when non-conflict could be anticipated. This increased interference effect was associated with an increased interference effect in oscillatory activity in the theta frequency range (3 - 8 Hz) over mid-frontal sites. Furthermore, during anticipation of conflict, but before the actual conflict appeared, midfrontal theta oscillatory activity already increased. These findings suggest that temporally guided expectations of conflict heighten proactive control, but also lead to less efficiently applied cognitive control. The implications of these findings are discussed in light of the Cognitive Load Theory.

p1006

**Interpersonal distance in antisocial and psychopathic forensic offenders.**Johanna C. Glimmerveen, Inti A. Brazil, Ellen R.A. de Bruijn & Berend H. Bulten  
Donders Institute for Brain, Cognition and Behaviour

Interpersonal distance, which is the distance kept between two persons during social encounters, can be considered a measure of sensitivity for social norms. The amygdala plays a key role in the regulation of personal space and this structure has been shown to function abnormally in antisocial populations. More specifically, psychopathy, characterized by interpersonal and affective abnormalities in combination with an antisocial lifestyle, has been linked to reduced activity in the amygdala, suggesting a tendency to prefer shorter interpersonal distances. On the other hand, non-psychopathic antisociality has been related to hyperactivity of the amygdala, which could be reflected by a larger preferred interpersonal distance. However, the relationship between preferred distance during interactions, personality traits and clinical characteristics in offender samples has never been examined. Therefore, we conducted an explorative study to assess preferences for interpersonal distance and their relationship with personality traits in forensic patients with and without psychopathy. Preliminary analyses in the psychopathy group have revealed that the interpersonal-affective component of psychopathy and scores on empathic perspective taking are positively related to different measures of interpersonal distance. This suggests that psychopathic individuals use higher-order social cognition to infer others' preferences in maintaining personal space rather than following their own preferences. Importantly, these experimental approaches may offer new avenues for understanding social functioning in individuals showing aberrant social behavior.

p1007

**Neural Reactions to Positive and Negative Feedback Change Across Child and Adolescent Development**Sabine Peters, Barbara Braams, Maartje Rajmakers, Cédric Koolschijn & Eveline Crone  
Leiden University

Learning from feedback is a crucial component of adaptive behavior, which continues to develop across childhood and adolescence. Recently, developmental neuroscientists have started to investigate if feedback learning in adults and children relies on similar neural mechanisms. In one study (Van Duijvenvoorde et al., 2008), the dorsolateral prefrontal cortex (DLPFC) and parietal cortex were more active in adults after negative feedback, but in children after positive feedback. In this study, we further investigated these neurodevelopmental patterns in a larger sample of participants (n=268, 8-25 years old) in a more complex multiple-trial learning setting. Participants completed a task that was designed to compare feedback learning networks in children and adults, as well as possible valence differences across development, while ensuring that positive and negative feedback were similarly informative for learning. Behaviorally, adolescents and adults demonstrated faster learning than children. The neuroimaging data indicated that adolescents and adults recruited the fronto-parietal network and medial prefrontal cortex to a greater extent. Performance was correlated with neural activity during learning in areas within the feedback learning network, even after age-correction. Crucially, activity after negative feedback showed an increase with development, whereas activity after positive feedback remained constant. Children showed more activation in superior parietal cortex after positive feedback, whereas adults showed more activation in these areas after negative feedback. The results provide a detailed account of the neurocognitive development of learning from positive and negative feedback.

p1008

**Pupil Dilation in the Simon Task as a Marker of Conflict Processing**Henk van Steenbergen, Guido P.H. Band  
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Cognitive demands trigger negative affect and avoidance behavior in several tasks including response conflict paradigms. However, studies using physiological indices of emotional arousal, such as pupil diameter, have not consistently observed conflict-related increases in all response-conflict tasks. In contrast to earlier null-results, this study shows for the first time that conflict-related pupil dilation in a Simon task can be observed, provided that one uses a design that is sensitive to small changes (about 0.02 mm) in pupil diameter. Results show that response-conflict in Simon trials increases both behavioral costs measured in reaction time and pupil dilation. Moreover, sequential analyses revealed that pupil dilation mirrored the conflict-adaptation pattern observed in reaction time. Although single-trial regression analyses indicated that pupil dilation is likely to reflect more than one process at the same time, in general our findings imply that pupil dilation can be used as an indirect marker of conflict processing.

p1009

### **Effects of acute stress on oscillatory activity during feedback processing, in men and women. Modulations of theta and beta oscillatory power.**

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Background: Recent studies have revealed stress-induced alterations to decision making behavior. In addition, a number of studies have found that these stress effects are sex-dependent. Crucial to adaptive decision making is feedback processing. In the present EEG study, we examined whether acute stress alters feedback processing, and whether these stress effects are sex-dependent.

Methods: Participants performed a gambling task, in a control and a stress condition. Stress was induced by exposing participants to a noise stressor. Brain activity was analyzed measuring the feedback-related negativity (FRN) and feedback-locked changes in theta and beta oscillatory power. The FRN and theta power reflect action monitoring. Beta power has been shown to be sensitive to feedback valence, although its functional role is not yet well understood.

Results: The FRN was not affected by stress nor sex. Feedback-locked theta power increases were smaller in the stress relative to the control condition, in both sexes. Early lower beta-band power increases were larger for men than women, in the stress condition only. Furthermore, late lower beta-band power increases were larger for men than women, in both conditions.

Conclusion: Decision making is influenced by stress and sex. Acute stress impairs action monitoring in both sexes, as reflected in theta power changes. In addition, stress effects on feedback processing are in part sex-dependent, as reflected in early lower beta-band power changes. Furthermore, the neural mechanisms for feedback processing in general appear partly sex-dependent, as indicated by late lower beta-band power changes.

p1010

### **Activation and suppression during online and proactive cognitive control in autism**

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University of Amsterdam

So far, studies directed at interference control in autism, have only taken broad interference measures into account. However, a focus on specific processes, such as automatic response activation and its deliberate suppression, will give more information about underlying cognitive control mechanisms in autism. Therefore, we investigated the performance of 87 adults and elderly with autism (22-73 years) and 79 age and IQ matched neurotypical controls (20-73 years) on a Simon task, during both online (within-trial) and proactive (between-trial) control. We also examined the relationship with autism symptom severity. Although people with autism were overall slower in their reaction times (RTs), they were as accurate as controls. Distributional analysis (e.g. delta plots) revealed that stronger initial response activation led to more fast errors and that suppression was more efficient towards the slower end of the RT distribution. Incongruent trials caused more error-prone response activation after congruent trials and yielded more efficient suppression on subsequent trials. Groups did, however, not differ in any of these measures. Also, autism symptom severity was not associated with performance. These results seem to suggest that adults with autism were as proficient as controls in the ability to exert cognitive control during response conflicts.

p1011

### **Opportunity for verbalization does not improve visual change detection performance: A state-trace analysis**

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University of Groningen

Decades of memory research have shown that stimuli can be encoded in a different modality than they were presented in. There seems to be a tendency to verbalize visual stimuli whenever possible and this has been used to argue that there are multiple components in short-term memory (STM). When studying visual STM, it has become common practice to employ articulatory suppression (AS) to exclude the possibility that participants articulated the visual stimuli and thereby boosted their memory performance. In visual change detection paradigms, though, there is some indication that AS does not affect performance markedly. Whether AS is needed in such tasks is an on-going debate. Here, we present new data and results from a state-trace analysis (STA) that suggests that AS is not needed. Small effects of an influence of articulation are usually based on significant interaction terms from an ANOVA, which is methodologically problematic. STA avoids such problems and provides a straightforward way to assess the effect of AS and the dimensionality of STM.

p1012

### **Acquisition of an instrumental activity of daily living in patients with Korsakoff's syndrome**

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Patients with Korsakoff's syndrome (KS) show devastating anterograde amnesia and executive deficits. Consequently, the ability to perform instrumental activities such as making coffee is frequently diminished. Errorless learning (EL) is a teaching technique that uses feed-forward instructions, preventing mistakes during the learning process. Recent evidence suggests that EL may be beneficial for patients with severe explicit memory problems compared to trial-and-error learning (TEL). It is currently unknown whether EL is successfully applicable for (re)learning instrumental activities (e.g. making coffee, washing dishes) in KS. The aim of the present study was to examine whether EL is an effective method for (re)learning an instrumental activity in KS, namely using a washing machine to do the laundry. In the present experiment patients performed a laundry task by means of EL (n=8) or TEL (n=8). Both intervention techniques resulted in similar improvement over eight learning sessions. Performance in a different context also improved. Importantly, in follow-up sessions after four weeks without practice, performance was still elevated in the EL condition, but not in the TEL condition. This study demonstrates that (re)learning and maintenance of an instrumental activity is possible in patients with KS. EL was more effective for maintaining the instrumental task than TEL.

p1013

**Do not fear: Beta-adrenergic blockade affects the neural network of extinction learning and prevents the return of fear in humans**

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Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen

Administration of Beta adrenergic blockers in combination with psychotherapy has been advocated to treat traumatic memories by disrupting reactivated fear memories. However, studies have shown that beta-blockers can also impair consolidation of extinction memory, leading to increased fear. We tested these contradictory hypotheses and examined the role of noradrenaline blockage on the neural networks involved in the regulation of well-consolidated fear memories, and therefore the psychotherapeutic interventions and the ultimate fate of fear expression.

Fifty-four subjects participated in a double-blind, placebo-controlled, between-subject study, which took place over three consecutive days. On Day 1 participants were conditioned to two stimuli one of which was cutaneous electric shock reinforced (CS+). On Day 2 participants were exposed to a context-dependent extinction learning paradigm after administration of the 40mg  $\beta$ 1 $\beta$ 2-adrenergic receptor antagonist propranolol or placebo. On Day 3 extinction recall and reinstatement of fear was tested. BOLD fMRI data was collected on Day 2 and Day 3 and skin conductance responses were measured as an index of conditioned responses throughout the experiment.

Our results suggest that Beta-adrenergic blockade abolishes differentially conditioned responses during extinction learning, leads to loss of fear, and prevents the return of fear in the absence of drug the next day. These effects are attributable to changes in the fear neural network, where propranolol affects activity in the dorsal medial prefrontal cortex, midbrain, and hippocampus. These findings extend our current knowledge about the role of noradrenaline in fear and safety and provide support to clinical interventions employing beta-adrenergic antagonists in conjunction with extinction learning during psychotherapy to reduce symptomatology in anxiety disorders.

p1014

**The presence of faces biases spatial working memory**

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VU University

Human faces are considered to be a special class of stimuli, which are treated preferentially by our attentional system. The present study investigated whether such bias also occurs when faces are maintained in memory. Participants were presented with two pictures and had to memorize their locations, while ignoring their content. After the pictures disappeared, participants had to indicate with a mouse click the midpoint between the two pictures. In the experimental condition, the two pictures consisted of an object and a face. In the control conditions, either two objects or two faces were presented. The results showed that the spatial memory representation was affected by the occurrence of a face. Specifically, the location of the click was systematically shifted towards the face. This effect was present both when the two pictures appeared within the same hemifield and when they appeared in different hemifields. Such bias was not present in the control conditions. These findings demonstrate that storing faces in memory biases their representation in spatial working memory and are in line with an idea of a close link between attention and working memory.

p1015

**Survival Processing Enhances Attentional Capture**

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Over 30 articles have been published showing that processing items in a survival context leads to better memory. The purpose of our research was to determine if the survival processing advantage extends to attention. Words were rated one at a time for their relevance to a survival or a control scenario. Attentional capture was tested by presenting a picture corresponding to the rated word either before or after a to-be-detected digit target in a rapid serial visual presentation (RSVP) stream of pictures. Items processed for survival were expected to more strongly capture attention than were control items, and thus impair digit detection more when appearing before rather than after the digit target in the RSVP stream. Indeed, the impairment in digit identification accuracy (i.e., the attentional blink for the digit due to attentional capture by the picture) when the picture corresponding to the rated word was shown before, rather than after, the digit target was greater in the survival condition than in the control condition. This result is consistent with an adaptive attention account according to which we are tuned to attend to items processed for their fitness value.

p1016

**Neural correlates of evidence accumulation in intracranial EEG**

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University of Groningen

Decision making is well described by evidence accumulation. This class of mathematical models states that decisions are made by accumulating evidence for each available option until a threshold is reached, at which point the corresponding response is executed. The most well-known of these models is the Ratcliff Drift Diffusion Model, originally designed to account for behavior in recognition memory tasks.

Recent years have seen the first attempts to find neural correlates of this accumulation process. For example, we have found that oscillatory activity in the theta band (4-9Hz) shows characteristics consistent with the accumulation of evidence. So far, these studies have mostly focused on perceptual decision making tasks, ignoring the role of additional cognitive processes like memory retrieval in many real-world decisions. In addition, they used non-invasive neuroimaging/electrophysiology techniques that make it difficult to capture the accumulation process in real time while still being able to localize it with precision.

Here, we use intracranial EEG recordings of participants doing a memory task to remedy those deficits. The invasive iEEG technique offers a much greater spatial resolution than scalp EEG, while still benefitting from a high temporal resolution. Participants performed a recognition memory paradigm that requires the integration of evidence from memory as well as perceptual sources.

Results indicate that patterns of 4-9Hz theta power in stimulus-specific visual areas and frontal areas show the predicted dynamics of evidence accumulation. These patterns during memory-based decisions are similar to the previously-observed patterns during perceptual decisions.

p1017

**Development of the adaptive mind**

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Being able to adequately adapt one's own behaviour to dynamically changing environmental conditions is a skill that requires time to fully develop, usually across the first two decades of the human life. This study investigated the developmental trajectory of the adaptive mind across childhood and adolescence. To this aim, participants (8 to 19 years) chose between two cognitive tasks following a double registration voluntary procedure, in which they made two responses in each trial: the first to register that they have made a choice of task by pressing a spacebar, the second to respond to the subsequently presented stimulus. As such, this procedure disentangles task choice (intentions) from the actual task execution (actions). We know already that task switching execution differs across age, with younger children typically needing more time to switch between tasks. It is however still unclear how decision processes that precede their implementation in behaviour develop across age. The current study was designed to specify the development of the neurocognitive mechanisms behind the intentional component of the adaptive human cognition. Here I present preliminary behavioural findings, based on which the expectations regarding the developmental trajectory of the neural correlates of the adaptive mind will be addressed.

p1018

**Gambling for self, friends, and antagonists: Differential contributions of affective and social brain regions on adolescent reward processing**

Barbara R. Braams, Sabine Peters, Jiska S. Peper, Berna Güroğlu & Eveline A. Crone  
Leiden University

Typically, adolescence is associated with an increase in risk-taking behavior. This has been linked to a heightened adolescent reward-response. Adolescence is also associated with an increased sensitivity to social contexts. For instance, in adolescence peer relations become more important and peers may influence risk-taking behavior. Recent neuroscientific studies show that 'social brain' regions, such as the medial prefrontal cortex (mPFC), and the temporal parietal junction, are particularly responsive to social information. However, it is not clear whether neural networks related to reward processing during adolescence are also sensitive to the social context. The aim of this fMRI study was to shed light on the interaction between reward sensitivity and social context across adolescence. In this study, 249 participants aged 8-26, performed a gambling task in the scanner, in which they could win or lose money. Participants played for themselves, their best friend, and a disliked peer. Winning for self resulted in a mid- to late adolescent specific peak in neural activation in the ventral striatum, whereas winning for a disliked peer resulted in a mid- to late adolescent specific peak in the mPFC. Current findings reveal that ventral striatum hypersensitivity in adolescence is dependent on social context and that the mPFC displays a similar sensitivity to age and social context as the limbic regions. These results are important for a better understanding of the neural mechanisms underlying risk-taking behavior in adolescence.

p1019

**Friend or foe? Social decision-making in interactions with peers**

Aafke Snelting, Eduard Klapwijk, Geert-Jan Will & Berna Güroğlu  
Leiden University

Most of our daily social interactions are with people we know. However, the majority of studies on the neural mechanisms of social decision-making have focused on interactions with anonymous others. In the current fMRI study we investigated the neural activity associated with fairness-related decision-making in social interactions with personally familiar people. Participants (N=28, M age = 21) played three economic decision-making games where they could choose to distribute money in an equal or an unequal fashion between themselves and another player. They played these games with four different groups of interaction partners: liked classmates (i.e., friends), disliked classmates (i.e., antagonists), neutral classmates and unfamiliar peers. Behavioral results showed that participants more often chose to share equally with friends than with antagonists, even when they had to give up rewards to do so. Neuroimaging results showed higher activation of the temporoparietal junction (a region involved in mentalizing and perspective-taking) during interactions with friends than with other players. Making inequity offers towards friends was further associated with higher activation of the ventrolateral prefrontal cortex compared to inequity offers for antagonists. Taken together, these findings suggest that people engage in increased mentalizing when deciding how much money they want to share with friends and that behaving in an unfair way toward friends might require higher levels of emotion regulation compared to unfair treatment of antagonists.

p1020

**Neural correlates of the reproduction of temporal intervals as revealed by MEG and EEG.**

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When participants are asked to reproduce an earlier presented duration, EEG recordings typically show a slow potential that develops over the central regions of the brain. This contingent negative variation (CNV) has been linked to processes such as anticipation, motor preparation and interval timing (e.g., Walter et al. 1964; Elbert et al., 1991; Macar et al., 1999). However, a still open question is whether this electrophysiological component has a magnetic counterpart (CMV). To assess the robustness of the CMV, we have conducted a temporal reproduction study while co-recording EEG and MEG. Participants were presented intervals of 2, 3 or 4 seconds which had to be reproduced. The EEG data shows a CNV in the fronto-central areas which develops during the whole interval. The CNV amplitude was significantly bigger for the 2 seconds condition than for the 3 and 4 seconds conditions.

Magnetic field at centro-parietal locations is initiated by the onset of the interval but dissolves after 1 second resembling initial CNV. This wave is followed by a sustained magnetic variation resembling the CMV. Both magnetic waves showed a greater amplitude for the 2 second interval. Implications of the EEG/MEG slow changes are discussed in the context of interval timing theories.

p1021

**A covert perceptual decision modulates beta-band oscillations in visual cortex**

Thomas Meindertsma, Niels A. Kloosterman, Guido Nolte, Andreas K. Engel & Tobias H. Donner  
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Recent fMRI and MEG studies have discovered a novel top-down signal in human visual cortex that occurs during spontaneous (in a bistable illusion) or stimulus-driven perceptual changes (Donner et al., J Neurosci, 2008; Kloosterman et al., submitted). This signal entails a transient, retinotopically global modulation of beta-band (12-30 Hz) power around behavioral report of the perceptual change. It reflects the type of perceptual change and is contingent on the change's behavioral relevance. The signal has been interpreted as a feedback effect, which is triggered by the perceptual decision. However, beta-band oscillations have been associated with motor processing in many studies. Here, we tested whether the beta-band modulation in visual cortex is tied to the motor act used for reporting the perceptual change decision (button press) or also occurs when people make covert perceptual decisions without reporting them. We recorded MEG in 20 subjects monitoring (stimulus-driven) perceptual changes (unpredictable on- and offsets of a salient target). Subjects were asked to report these changes either overtly by button press, or by counting them (no motor act) and reporting the total after the 3-minute run in a 4-alternative forced choice question. During both conditions, we found a statistically significant beta-power modulation over visual cortex. When time-locked to the physical stimulus change, the modulation in both conditions occurred around the time of subjects' median response time (as measured in the overt condition). We conclude that this novel top-down signal in visual cortex reflects feedback triggered by internal perceptual decisions, irrespective of overt motor action.

p1022

**The interaction between novelty and emotion in enhancing visual perception**

Judith Schomaker & Martijn Meeter  
VU University

Emotional cues have been reliably shown to enhance visual perception by eliciting a transient attentional response. These effects are believed to be mediated by the amygdala. Recent findings suggest that amygdala activation depends strongly on novelty - amygdala engagement is reduced with repeated presentation of a stimulus. Also novel stimuli have been shown to increase perceptual sensitivity. The present study investigated the interaction between novelty and emotion in enhancing low-level visual perception. Participants performed a two-alternative forced-choice tilt detection task. The target was a Gabor patch was preceded by either a fearful or a neutral face. One face was presented repeatedly ('the familiar face') while other faces were presented only once ('novel faces'). The spatial resolution of the target was either high or low. Novel faces enhanced visual perception for targets with high spatial frequency, whereas the familiar fearful face enhanced perception of targets with low spatial frequency.

p1023

**Look no further; this is disgusting!**

Hannie van Hooff & Lu Draisma  
Vrije Universiteit

While stimuli signaling threat have been shown to have clear effects on perception and attention engagement, we argue that there is a difference between its components, specifically fear and disgust, in their ability to engage attention and to modulate subsequent target processing. In the current ERP study, participants were presented with pictures from the International Affective Picture System (IAPS) evoking fear, disgust, happiness, or no specific emotion (neutral). The participants' task was to identify a peripheral target that could appear at three different intervals following picture onset (200, 500 and 800 ms). In agreement with previous findings, reaction times were delayed only when targets quickly followed a disgust picture (200 ms condition). The frontal P2 component elicited by specifically these targets was also found to be smaller, which supports the interpretation that these targets received less processing resources, presumably as a consequence of increased attention engagement by the preceding disgust pictures. However, ERPs in response to the preceding pictures, showed larger N1 and P2 amplitudes for all three emotion cues (disgust, fear, happy), suggesting they all received more attention at early processing stages compared to the neutral ones. We speculate that the diminished processing of the targets following the disgust pictures may be the result of greater efforts directed to attention control and emotion regulation and not to the processing of the pictures themselves.

p1024

**The neural underpinnings of empathy for pain in adolescence**

Sandy Overgaauw, Berna Güroğlu & Eveline A. Crone  
Leiden University

Empathy is an important ability for understanding and sharing emotional states of others, which help us understand and predict others' intentions. This fMRI study examined neural responses to harmful events in relation to empathy in adolescence. Thirty-six participants aged between 12 and 19 years viewed pictures of social situations depicting intentional harm inflicting acts, harmed victims, and neutral scenarios. After observing each picture, participants allocated hypothetical points to the target (offender, victim or neutral) in a Dictator Game. Behaviorally, participants of all ages acted prosocially towards victims, fair towards neutral individuals and punishing towards offenders. Brain imaging analyses showed that harmful acts were associated with more activation in the intraparietal lobule (IPL) and the superior temporal sulcus (STS), whereas neutral acts were associated with more activation in the medial prefrontal cortex (mPFC), the temporal parietal junction (TPJ), and the posterior cingulate cortex (PCC). Subsequent analyses showed that mPFC, rTPJ and PCC correlated positively with age while observing neutral situations relative to harmful situations. These findings are consistent with prior studies showing that the development of these areas is associated with increased mentalizing abilities. Further analyses showed that brain activation in the STS was correlated negatively with individual levels of self-reported empathic support and understanding during observations of harm involving situations relative to neutral situations. This finding suggests that STS may have a regulatory role in empathic responses to observing harmful acts. Taken together, these findings highlight the involvement of the social brain network in assessment of social situations during adolescence.

p1025

**The effects of oxytocin on self-other integration**Margit I. Ruissen & Ellen R.A. de Bruijn  
Leiden University

Humans are social animals and appropriate social behavior is thus vital for human health and well-being. The nonapeptide oxytocin has recently received a lot of attention for its assumed role in facilitating pro-social behavior and social interactions. I will present data from a recent EEG study in which we investigated the effects of oxytocin administration in healthy volunteers on self-other integration. During joint task performance, people not only represent their own task, but also the task of their co-actor. The no-go P3 ERP component is thought to reflect the amount of this so-called self-other integration on trials that require a response inhibition. Previous studies have demonstrated that the amount of self-other integration greatly varies depending on individual differences and task demands. In this study, we aimed at investigating the modulatory effects of oxytocin administration on self-other integration and the amplitude of the no-go P3. Both behavioral and ERP outcomes will be presented and discussed in light of existing theories on self-other integration and oxytocin function.

p1026

**Temporal but not spatial attentional orienting is sensitive to task and cue manipulations**Lieze Boshoff, Udo Boehm & Hedderik van Rijn  
University of Groningen

Attentional orienting is the ability to direct attention to a point in space and/or time when a relevant event is expected in order to optimise behaviour. However, space and time are inherently different in nature, where time perception is noisy and subject to variability, and spatial perception is discrete and remains stable. We attempted to expose dissimilarities between temporal and spatial representations underlying attentional orienting by manipulating task demand and cue difficulty. These manipulations revealed that the behavioural benefit for spatial cueing was not affected by the manipulations. In contrast, the behavioural benefit for temporal cueing is negated by both a high demand task and an abstract cue condition. We hypothesise that these results show an inability to create and maintain accurate temporal representations in strenuous and ambiguous task conditions. Therefore, temporal orienting appears to be markedly more vulnerable to increased task demands whilst spatial orienting effects are more robust.

p1027

**A common magnitude metric in perception: Interference between numbers and size during visual search**Florian Krause, Harold Bekkering, Jay Pratt & Oliver Lindemann  
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The current study tests the involvement of a common magnitude metric in early visual processing. In a visual search task comprising single-digit numbers, participants had to identify a physically large (or small) target item amongst physically smaller (or larger) distractors. The relative numerical size of the digits was varied, such that the target item was either among the numerically largest or smallest numbers in the search display and the relation between numerical and physical size was either congruent or incongruent. Perceptual differences of the stimuli were controlled in a second experiment in which LCD-style numbers had to be searched. Our results revealed that identifying a physically large target item is significantly faster when the numerical size of the target item is large as well (congruent), compared to when it is small (incongruent). This finding suggests a convergence of physical and numerical size into a common representation of magnitude at an early perceptual processing stage.

p1028

**Disengagement of Attention from (un)Trustworthy-looking Faces and the Influence of Competitive and Cooperative Motivational States**Rozemarijn Mattiesing & Hannie van Hooff  
Vrije Universiteit Amsterdam

The aims of the present study were to explore the influence of the perceived (un)trustworthiness of faces on the disengagement of attention and, in addition, to examine the possibility that competitive and cooperative motivational states would enhance/induce such potential attention biases. Fifty-eight participants completed a Scrambled Sentence Task that induced either a competitive or cooperative mindset (except for people in the control condition). Then, disengagement of attention was measured by asking participants to identify a target presented around a central image-cue at varying cue-target intervals (100, 300, and 500 ms), which could be either a trustworthy, untrustworthy, or neutral face. Contrary to our expectations, we did not find evidence for delayed disengagement from untrustworthy-looking faces. Instead, results suggested impaired disengagement from trustworthy-looking faces in people with a cooperative mindset and facilitated disengagement from trustworthy-looking faces in people with a competitive mindset (in the 500 ms cue-target interval condition only). Findings are discussed within an evolutionary framework, while integrating theories of motivation and cognition, in particular within the domain of attention. Furthermore, we argue that the existing literature has been too one-sided by focusing primarily on threatening stimuli, while our study suggests there might also be something eye-catching about positive stimuli.

p1029

**Extending the watercolour illusion: differential effects of real colors versus afterimage colors**Simon Jan Hazenberg & Rob van Lier  
Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour

We investigated filling-in of coloured afterimages [Van Lier et al., 2009 Current Biology 19(8), R323–R324] and compared them with filling-in of real colours in the watercolour illusion [Pinna et al., 2001, Vision Research 41, 2669–2676]. We used shapes comprising two thin adjacent undulating outlines of which the inner or the outer outline was chromatic, while the other was achromatic. The outlines could be presented simultaneously, inducing the watercolour effect, or in an alternating fashion, inducing coloured afterimages of the chromatic outlines. In Experiment 1, using only alternating outlines, these afterimages triggered filling-in, revealing an 'afterimage watercolour' effect. Depending on whether the inner or the outer outline was chromatic, filling-in of a negative or a positive afterimage colour was perceived. In Experiment 2, simultaneous and alternating presentations were compared. During simultaneous presentation, filling-in induced by the inner chromatic outline was strongest. In contrast, during alternating presentation, the strength of filling-in induced by the outer chromatic contour appeared to be strongest. Comparisons with Experiment 1 showed that, while afterimage filling-in induced by the inner contour depended on the luminance contrast between the interior of the shape and that outline, afterimage filling-in induced by the outer contour appeared more robust.

### **Effects of baseline physiological arousal on responses to noise.**

Kim White, Martijn Meeter & Adelbert Bronkhorst  
Cognitieve Psychologie, Vrije Universiteit

Noise annoyance is known to be associated with cardiovascular risk, but previous studies are inconclusive about the effects of baseline arousal levels on noise annoyance and responses of the heart to noise. Here, we tested whether baseline physiological arousal levels can predict how people are affected by aircraft noise. This was addressed by subjecting participants to three conditions, with a duration of nine minutes, in which Heart Rate Variability (HRV) measures were obtained: Baseline (sitting with the eyes closed), Noise (performance of 3-back task with two A320 flyovers per minute, 75 ASEL) and Silence (performance of 3-back task in silence). Preliminary results showed that low baseline pre-ejection periods (PEP, indicator for autonomic activity) lead to little or no PEP responses to noise whereas high baseline PEP levels lead to reduced PEP levels during noise. Furthermore, little overall PEP variability coincided with higher annoyance levels during aircraft noise. These results indicate that autonomic responses can be used as a predictor of noise annoyance and bodily responses to noise.

### **Extending biologically-inspired Computer Vision: A Study on Applying Computer Graphics and Higher Order Statistics in HMAX**

Robin Mills  
RijksUniversiteit Groningen

Computer graphics (CG) and biologically-inspired computer vision have been two largely independent fields for the past decades. Arguably, the lack of communication has been due to a focus on natural image statistics: much of the processing of the brain is thought to be picking up on statistics occurring in natural scenes, which may be absent in CG. However, CG has made much progress in the past decade and therefore the role of CG in training computer vision systems is reexamined. Successful CG usage would yield many benefits, such as the generation of large scale databases and the fine control over image parameters, allowing the researcher to study more closely the characteristics of the vision model. In this project, I have generated CG databases and incorporated them in the training of HMAX, a biologically-inspired computer vision system. I have applied this database to study the characteristics of particular computations in the model. The results particularly suggest that the incorporation of higher-order summary statistics extend the functionality of HMAX. These results lay the fundamentals of the initiative of which this project is a part: to create a flexible biological vision framework, in which the user can choose and incorporate a set of computations to test neuroscientific hypotheses.

### **Birth language processing by adopted children**

Wencui Zhou<sup>1</sup> & Mirjam Broersma<sup>2</sup>

1) Max Planck Institute for Psycholinguistics, Nijmegen, Netherlands, 2) Radboud University Nijmegen, Netherlands

Previous studies with international adoptees report no evidence of any retention of the birth language by the time adoptees have reached adulthood [1, 2]. Adoptees do, however, perform better when relearning their birth language than novice learners [3]. Whereas previous studies tested adults, the present study provides insights into attrition of the birth language by investigating changes in birth language processing during childhood soon after adoption. It investigates perception and production of Chinese speech by Chinese adoptees in the Netherlands. Participants are Chinese adoptees between four and ten years old, whose birth language is either Mandarin or Cantonese, and an age-matched control group of native Dutch listeners with no prior experience with Chinese. They are tested on perception and production of Chinese affricates and tones before, during, and after extensive training. Tests and training consist of XAB discrimination tasks, presented in the form of animated video games. Results show that the Chinese adoptees outperformed their Dutch peers in speech perception after extensive training, and in speech production even before training. Thus, childhood language memory remains partially intact during the first years of non-exposure, and extensive training helps in retrieving such a memory.

[1] Pallier et al. (2003). *Cerebral Cortex*, 13, 155-161.

[2] Ventureyra et al. (2004). *Journal of Neurolinguistics*, 17, 79-91.

[3] Hyttenstam et al. (2009). *Bilingualism: Language and Cognition*, 12, 121-140.

### **Classifying single-trial auditory ERPs in the discrimination of non-native speech categories: How Dutch learners process Mandarin lexical tone**

Christian Hoffmann, Makiko Sadakata, Peter Desain & James M. McQueen  
Dept Artificial Intelligence/Braingain, Donders Centre for Cognition

Successful second language learning entails the acquisition of novel auditory categories relevant for lexical distinctions in the target language. Many studies have shown that successful acquisition of novel auditory categories is related to functional changes in electrophysiological signals, such as Mismatch Negativity (MMN) or P300 responses. Most studies, however, compare brain responses before and after specific perceptual learning tasks, and consider responses averaged over multiple trials. But the field of Brain-Computer Interfacing (BCI) offers advanced methods for single-trial analysis of neurophysiological signals. Yet the typical paradigms employed differ quantitatively and qualitatively from standard paradigms used to study auditory categorical perception. The current study explores a possible synthesis of the two fields by investigating the relationship between single-trial ERP classification and behavioral performance in auditory learning tasks. We acquired EEG signals of six native Dutch speakers during passive exposure, alternative-forced choice and direct response discrimination tasks to auditory stimuli from a Tone 1-Tone 4 Mandarin Chinese continuum. Results indicated that behavioral discrimination accuracy, N200/P300 amplitude, and single-trial classification performance were positively correlated. BCI techniques thus can be applied to auditory learning paradigms, offering the possibility to study the time-course of neurophysiological changes related to learning.

p2003

**An extended stimulus set containing words and pictures matched for visual and semantic similarity.**

Floor de Groot, Falk Huettig & Christian N. L. Olivers  
Vrije Universiteit

In different fields of cognitive psychology researchers are becoming interested in how language, and especially semantic information, interacts with vision. For this purpose researchers need a stimulus set that contains semantic and visual relationships between words and pictures, while controlling for several sensory and linguistic parameters. In addition, the number of stimuli has to be sufficiently large for researchers to reliably compare different conditions within participants without repetition. So far, such a stimulus set appears to have been lacking. We therefore introduce an extended stimulus set of 120 trials, each containing visual and semantic relationships between a word and four pictures. The stimuli have been normed on several visual and linguistic properties, such as luminance, contrast and naming agreement. We believe that researchers from different fields - for example psycholinguistics (e.g. visual world and picture-word interference paradigm), attention (e.g. visual search), developmental (e.g. preferential looking paradigm) and clinical (e.g. researchers working with visual agnosia or Alzheimer patients) – will benefit from such a stimulus set.

p2004

**Lexical specificity training enhances phonological awareness in L2-learners**

Caressa Janssen, Eliane Segers, James M. McQueen & Ludo Verhoeven  
Radboud University Nijmegen, Behavioural Science Institute,

Vocabulary knowledge is strongly connected to later success in school, however, second language learners often enter primary school with limited vocabulary in the target language. Speech decoding skill, phonological awareness and lexical specificity are phonological variables that have been shown to be related to children's vocabulary. Improvement of these variables may enhance vocabulary development of second language learners. Results of a first experimental training study show that lexical specificity training fosters phonological awareness in 4-year-old L1 and L2 learners of Dutch. L2 learners learned more words with phonological overlap of L1 and L2 than words without overlap. Overlap of L1 and L2 may thus have contributed most to the gain in phonological awareness for L2 learners, due to linguistic transfer.

p2005

**Bilingual education promotes the flexible mind: Adolescents being taught in L2 show smaller switching costs.**

Annelies M. de Haan, Ingrid K. Christoffels, L. Steenbergen, Wery P.M. van den Wildenberg & Lorenza S. Colzato  
Leiden University

The interest in the influence of bilingualism on our daily life is constantly growing. Speaking two languages (or more) requires people to develop a flexible mindset in order to rapidly switch back and forth between languages. This study investigated whether and to what extent participating in bilingual education generalizes to other cognitive control tasks. We tested two groups of Dutch high-school students who either followed regular classes or were being taught in English. They performed on a task switching paradigm that provides a relatively well-established diagnostic measure of cognitive flexibility. As predicted, bilingual educated participants showed smaller switching costs (i.e. greater cognitive flexibility) than not bilingual educated participants. Our findings support the idea that bilingual education promotes cognitive flexibility.

p2006

**Tactile body image when you're still growing**

Alyanne de Haan, Anouk Keizer, Yolinde de Haan, Charlotte Maas & Chris Dijkerman  
Utrecht University

Making perceptual judgements about your own body depends on a mental representation of the body. This body image is based on combined visual and somatosensory input and influenced by stored cognitive representations. It may however sometimes not be veridical. For instance the body image of phantom limb patients still includes the amputated arm or leg. When your body changes, your perceptual body image may be slow in updating. Throughout development, children's bodies change considerably. Therefore, the question is whether their body image can keep up with their growth.

To test this, we used the Tactile Estimation Task, in which children had to estimate the distance between two tactile stimuli on their forearm (50, 60 or 70 mm). 18 children (12-13 y.o.) participated in this experiment. Additionally, we used the data of 77 adult control participants who completed the same task. While adults estimated the tactile distances correctly, the children underestimated it by on average 8.7 mm. This suggests that the mental representation the children have of their arm is smaller than the arm actually is. Possibly, their body image is unable to keep up with the growth spurt they are currently in.

p2007

**Motor-Induced-Visual-Motion; Self-generated hand movements drive visual motion perception**

M.N. Keetels & J.J. Stekelenburg  
Tilburg University

Visual perception can be changed by co-occurring input from other sensory modalities (e.g. sounds can induce motion perception of a static visual stimulus; Sound-Induced-Visual-Motion or SIVM; Hidaka et al., 2009). Here we explored in three experiments whether self-generated hand movements (left-right or up-down key-presses) can induce visual motion perception. In Experiment 1, motion perception of a blinking bar was changed by hand motor movements in the same or opposite direction, indicative of 'Motor-Induced-Visual-Motion' (MIVM). In Experiment 2, moving and static blinking bars were combined with either moving or static motor actions. Results showed that the directional component in the hand movement was crucial for MIVM as static motor movements didn't evoke the effect. In Experiment 3, the role of response bias was excluded in a discrimination task. Taken together, all three experiments show that alternating key presses (either horizontally or vertically aligned) can induce illusory visual motion. This is the first demonstration of 'Motor-Induced-Visual-Motion' or 'MIVM'. In addition, Experiment 2 and 3 demonstrate that static motor-movements (without a vertical or horizontal direction) induce the opposite effect, namely a decline in visual motion (more static) perception.

p2008

**Grasping Beer Mugs Revisited: Do Handles Facilitate Motor Responses?**Sander Roest, Diane Pecher & Rene Zeelenberg  
Erasmus University Rotterdam

The left or right orientation of an objects' graspable part facilitates responses with the same side hand (congruent condition) compared to responses with the opposite hand (incongruent condition). The affordance account holds that passively viewing an object automatically activates specific motor programs in accordance with the viewed object. For example, the handle of a beer mug activates a grasp response in the hand towards which the handle is oriented. The Simon account however, holds that an object automatically activates abstract spatial codes due to heightened attention towards graspable parts of the object. We investigated if viewing a beer mug activates a specific grasp response or an abstract spatial code. Participants performed a reach and grasp action or a reach and button press action with their left or right hand in response to the color of beer mugs with handles oriented to the left or to the right. Movement initiation was faster for congruent than incongruent trials. This effect did not differ between grasp and press actions, which suggests that larger overlap between motor program and actual response in the grasp than press condition did not play a role. Our results therefore indicate that object orientation activates abstract spatial codes rather than specific motor programs.

p2009

**Proprioceptive position sense changes when skin stretch around the elbow is non-invasively manipulated**Irene Kuling, Eli Brenner & Jeroen Smeets  
VU University, Amsterdam

Proprioception is based on a combination of afferent information from cutaneous, muscle spindles and joint receptors and efferent information. So far, afferent information from cutaneous receptors might have been underestimated. In the present study we tested a non-invasive method with Cure Tape® (elastic tape) to manipulate skin stretch around the elbow joint in a (close-to-) daily life setting. Subject had to reach positions with their unseen hand relying on their proprioception. With the use of a force field, for which we previously showed that it did not influence the proprioceptive position sense at the end-points, and different ways of taping the arm, we tested whether the skin stretch induced by the elastic tape influenced proprioceptive localization.

We found a systematic shift of the individual errors in the reproduction of the end-points, irrespective of the force field. This result suggests that human proprioceptive position sense relies significantly on cutaneous information. Furthermore, taping with Cure Tape® (or equivalent tape) seems to be useful for non-invasive research of the contribution of cutaneous receptors in proprioception.

p2010

**Role of vestibular and visual depth cues in the perception of linear motion**Arjan C. ter Horst, Mathieu Koppen, Luc P.J. Selen & W. Pieter Medendorp  
Radboud University Nijmegen

Human self-motion perception is crucial for navigation and goal-directed action. In perceiving self-motion, the brain may combine information from various sensory modalities, including the vestibular and visual systems. To judge the amount of linear motion from optic flow, humans need to scale the egocentric distance of the observed visual objects. Scaling information can not only be provided by the vestibular system but also by visual disparity cues. In this study, we assessed whether inadequate scaling due to a lack of disparity also influences the perception of linear motion. Participants were seated on a linear sled embedded in a virtual reality environment. They were subjected to linear motion involving visual and vestibular cues. Participants performed a two-alternative forced-choice task, indicating which of two sequential displacements was larger. Preliminary results indicate that passive displacement with parallax cues but without disparity cues were overestimated with respect to the same movement with disparity cues. Our results suggest that depth scaling affects the perception of linear motion. Further experiments and analyses are currently underway to further validate this observation.

p2011

**Midfrontal conflict-related theta-band power reflects neural oscillations that predict behavior**Michael X Cohen & Tobias H Donner  
University of Amsterdam

Action monitoring and conflict resolution require the rapid and flexible coordination of activity in multiple brain regions. Oscillatory neural population activity may be a key physiological mechanism underlying such rapid and flexible network coordination. EEG power modulations of theta-band (4-8 Hz) activity over the human midfrontal cortex during response conflict have been proposed to reflect neural oscillations that support conflict detection and resolution processes. But it has remained unclear whether this frequency-band-specific activity reflects neural oscillations or non-oscillatory responses (i.e., event-related potentials; ERPs). Here we show that removing the phase-locked component of the EEG did not reduce the strength of the conflict-related modulation of the residual (i.e., non-phase-locked) theta power over mid-frontal cortex. Furthermore, within-subject regression analyses revealed that the non-phase-locked theta power was a significantly better predictor of the conflict condition than was the time-domain, phase-locked EEG component. Finally, non-phase-locked theta power showed robust and condition-specific (high vs. low-conflict) cross-trial correlations with reaction time, whereas the phase-locked component did not. Taken together, our results indicate that most of the conflict-related and behaviorally relevant mid-frontal EEG signal reflects a modulation of ongoing theta-band oscillations that occurs during the decision process but is not phase-locked to the stimulus or to the response.

p2012

**Post-error slowing as a consequence of disturbed low-frequency oscillatory phase entrainment**RL van den Brink, S Wynn & ST Nieuwenhuis  
Leiden University

One of the most ubiquitous findings in empirical studies employing reaction time (RT) measures is that RTs slow down on trials following errors. This phenomenon is known as post-error slowing (PES), and has been shown to occur across many different tasks and response modalities. Theories about the cognitive mechanisms that are responsible for PES exist, yet its underlying neural mechanisms are still poorly understood. It has been suggested that under circumstances of high temporal predictability, the timing of endogenous periodic processes is systematically aligned with the environmental rhythmicity. Such temporal alignment can be implemented by neural oscillations. In the present study, we tested the hypothesis that PES results from a disturbance of internally generated brain rhythmicity. To this end, we employed a modified version of the Eriksen flanker task, while measuring oscillatory dynamics with EEG. We predicted that errors would result in a disturbance of low-frequency EEG oscillatory phase entrainment, and consequently, would then lead to slowing on the subsequent trial. We replicate previous findings that show oscillations entrain to the stimulus presentation rhythm and extend them by showing entrainment is disrupted following errors, which results in slowing.

p2013

**Deconstructing complex action: statistical learning of hierarchical action**Roy de Kleijn, George Kachergis & Bernhard Hommel  
Leiden University

Decades of implicit learning research has looked at how people can learn complex skills (e.g., riding a bike) without much conscious effort or awareness. Implicit learning tasks such as the serial reaction time (SRT) task include not only simple stimulus-response mappings, but a temporally-extended sequence of stimuli (and responses) that repeats verbatim. However, implicitly learned skills in daily life are rarely completely unambiguous, and instead may have probabilistic dependencies that depend on the past stimuli and actions. We wanted to investigate how people learn sequences that have statistical uncertainty at different levels: the next action may be ambiguous given only the previous stimulus, but may be unambiguous conditioned on the previous two stimuli. Using a movement adaptation of the serial reaction time task (Nissen & Bullemer, 1987) in which we used spatial locations as both stimuli and response options, participants were trained on a continuous sequence of stimuli to which they had to move the cursor. Similar to statistical learning experiments investigating word segmentation (e.g., Saffran, Aslin, & Newport, 1996), unbeknownst to the subject the sequence was divided into subsequences of three elements forming consistent 'words'. However, neither the order of words nor the syllable-to-syllable transitions were completely predictable. Reaction time and trajectory deflection analyses show that subjects show within-word improvements relative to unpredictable between-word transitions, suggesting that participants learn to segment the sequence in accord with the statistics of the input.

p2014

**Concurrent multitasking: different tasks, different interference**Menno Nijboer, Jelmer Borst, Hedderik van Rijn & Niels Taatgen  
University of Groningen

Studies of dual-task interference have mostly been limited to the study of a single task type, single dual-task, or single bottleneck. We combined multiple single-tasks with varying cognitive resource requirements, observed how these tasks interacted, which tasks interfered, and why. We hypothesized that any resource can be a bottleneck: interference and its expression in behavior and neuroimaging is defined by the tasks that are combined. Consequently, overlap in resources should be a predictor of interference. Results showed that predicted cognitive resource overlap was indicative for observed performance decrements. Furthermore, the pattern of activity and performance depended strongly on the combined tasks. Dual-task regions were mostly the summation of single-tasks active regions, with a reduction in activity in sensory regions, and bilateral recruitment of regions. Finally, the similarity between single-task activation patterns seemed to be a predictor for performance reduction in dual-tasks.

p2015

**Game-based training of attention and flexibility: an EEG study.**Kerwin J.F. Olfers & Guido P.H. Band  
Leiden University

Recent studies suggest that playing video games has the potential to enhance cognitive functions. In a randomized intervention study with three groups we investigated if game-based training of attention or cognitive flexibility improved targeted functions beyond an active control group. Furthermore, using brain potentials, we explored the cognitive processes and neural mechanisms underlying such training effects. Cognitive performance was assessed using the attentional network task (ANT), a task switching task and a visual working memory task. Training consisted of four online adaptive brain-training games per group, targeting attention and working memory for the Attention group, task switching and cognitive flexibility for the Flexibility group, and math for the Control group. Participants played 20 daily sessions of 45-minutes each.

Behavioral results indicate decreased reaction times at similar or higher accuracy after training, for all tasks, but no significant interaction between session and training group on either RT or ACC. However, ERP measures of attentional processes were differently affected by training condition, as revealed by a 3-way interaction effect between session, training group and cue condition on P3b peak amplitude during the ANT. Our findings contribute fundamental insight regarding neural plasticity as well as practical directions for future cognitive training studies.

p2016

**Cognitive flexibility training in healthy seniors and recovery from stroke**Jessika Buitenweg, Renate van de Ven, Jaap Murre, Ben Schmand & Richard Ridderinkhof  
Universiteit van Amsterdam

Although functionally and structurally different, both healthy aging and sustaining a stroke are associated with cognitive decline, especially regarding executive functions. Based on recent brain training results in young adults, it seems reasonable to expect to find beneficial effects of cognitive training in the healthy elderly. Furthermore, cognitive training could help individuals recover better after suffering a stroke. The existing literature suggests, however, that the results of cognitive training studies in elderly are inconsistent and that transfer and sustained effects thus far appear limited. In a recent review (Buitenweg, Murre, & Ridderinkhof, 2012) we have argued for a series of elements that seem essential for successful brain training programs, such as including flexibility within training sessions and adaptability of games. In the current project, a number of these elements have been added to the training protocol. The current project investigates the effects of cognitive flexibility training on executive functions and daily functioning of elderly individuals (ages 60-80) and those recovering from stroke (ages 30-80). During 12 weeks, consisting of 60 half-hour sessions, participants play multiple games of memory, attention, and reasoning, and need to constantly switch between games and domains. Before and after the training, a large battery of tests and questionnaires is administered in order to test whether effects of training may transfer to different tasks or domains. At this moment (September) the project is ongoing. Based on earlier results we expect that participants' performance on a switch-task and several other tests of executive functioning will be higher after the flexibility training, compared to participants in a low-switch training condition and the control group. During my talk, I will discuss the preliminary results and implications.

p2017

**Networks involved in conflict-related modulation of visual processing: a combined EEG-DTI study**

Marlies E. Vissers, Heleen A. Slagter, Rudy L. van den Brink & Michael X Cohen  
University of Amsterdam

Selective attention to a visual feature such as color involves top-down modulation of visual processing. At present, it remains unclear whether similar modulations also occur in a situation that requires fast reactive control, for example in the case of response conflict. Therefore, we examined whether performance on a color-motion response conflict task involves top-down modulation of activity in visual areas using electroencephalography (EEG). In addition, we explored whether these modulations are predicted by anatomical brain connectivity using white matter diffusion tensor imaging (DTI). In the task, subjects responded to one visual feature (e.g., color) while ignoring the other stimulus feature (i.e., motion). Time-frequency analyses of the EEG-data showed a conflict-related increase in low theta power (3 – 6 Hz) over mediofrontal regions, as predicted from previous research. Moreover, conflict enhanced fronto-posterior functional connectivity in the upper theta band (6 – 8.5 Hz; measured through phase synchronization between mediofrontal and parietal electrodes). Using DTI, we investigated the relationship between this conflict-related functional connectivity and the strength of anatomical pathways related to color (V4) and motion (hMT+) processing (regions were defined via fMRI localizers). Cross-subject correlations showed that anatomical pathways connecting V4 and hMT+ to regions in the ventrolateral prefrontal cortex, and to regions within the ventral visual pathway, differentially predicted individual differences in conflict modulation of fronto-posterior connectivity. These findings provide novel insights into the role of the frontal cortex in conflict-related top-down control over visual processing, and reveal a functional role of individual differences in the underlying structural brain networks.

p2018

**The Role of Depth of Encoding in Attentional Capture**

Edyta Sasin & Addie Johnson  
University of Groningen

We examined whether depth of encoding influences attentional capture by recently attended items. Participants performed a digit identification task after judging whether words referred to living or non-living things (deep encoding condition) or were written in lower- or uppercase (shallow encoding condition). The digit to be identified was displayed midway in a rapid serial visual presentation stream of eight pictures. A picture corresponding to the processed word was presented either before or after the target digit. Evidence of attentional capture by the picture was found only in the deep encoding condition, such that digit-identification performance was worse when the critical picture was presented before the digit than when it was presented after the digit. These results suggest that deeply processed items reside longer in working memory than do shallowly processed items, and that they influence visual selection even when attention is shifted to another task.

p2019

**Dissociating the effects of semantic grouping and rehearsal strategies on Event-Related Brain Potentials**

Tamara Schleepen, Lisa Jonkman  
Maastricht University

Grouping items on similar semantic categories during encoding increases the likelihood that information can be successfully remembered. Previous studies showed that several ERP components, i.e. the P200, N400, late positive component (LPC) and late slow wave, are modulated when the semantic grouping strategy is used (Blanchet et al., 2007; Kiefer, 2001). Because in these studies subjects did not receive any instructions on how to remember the material, perhaps more simple strategies (e.g. rehearsal) were used in these conditions, which might (partly) account for the reported effects. To investigate this, in the current study subjects studied either four unrelated or related pictures that respectively had to be rehearsed or grouped on semantic category. Another goal of this study was to investigate if maintenance of semantically unrelated vs. related pictures elicited distinct ERP-slow waves. Behavioral benefits following semantic grouping were present for reaction times on half of the trials. The P200, N400 and late slow wave showed opposite effects as reported earlier, which were all increased in unrelated compared to related trials. The encoding-LPC and the maintenance-slow waves were modulated in the expected direction, showing increased amplitudes in related vs. unrelated trials. This indicates that the ERP components previously related to semantic grouping might be (partly) explained by rehearsal, and stresses the importance to carefully control which strategies are used in future studies.

p2020

**Optimizing Learning by Hierarchical Bayesian Estimation of Individuals' Learning Parameters**

Florian Sense, Richard D. Morey & Hedderik van Rijn  
University of Groningen

Computer-based learning has become a viable option for many classrooms. Ideally, such software will provide the optimal structure to acquire the desired skill. In optimal fact learning, the time between repetitions of an item should be maximized while ensuring that the student can still retrieve them from memory. Thus, the spacing and the testing effect need to be balanced. Taking individual differences into account, one would want to estimate a range of parameters based on students' input: the difficulty of an item, the activation of that item in a student's memory, and how fast each student tends to forget items. Mathematically, hierarchical Bayesian modeling provides the perfect framework for updating probability distributions of parameters in real-time and thus optimize the scheduling of study items. Using this approach, we can evaluate the benefits of this type of optimization by contrasting it to existing, simpler methods of parameter optimization in individualized learning support systems such as lists, flash cards, or systems that do not take individual difference into account.

p2021

**Spatial working memory updating during object movement**

Paul Boon, Jan Theeuwes & Artem Belopolsky  
VU University

In this study it was investigated how spatial information stored in working memory is updated during object movement. Participants had to remember a particular location on an object which, after a retention interval, started to move. The question was whether the memorized location was updated with the movement of the object or whether after object movement it remained represented in retinotopic coordinates. We used saccade trajectories to examine how memorized locations were represented. The results showed that immediately after the object stopped moving, there was both a retinotopic and object-centered representation. However, 200 ms later, the activity at the retinotopic location had decayed, making the memory representation fully object-centered. Our results suggest that memorized locations are updated from retinotopic to object-centered coordinates during, or shortly after object movement.

p2022

### **From proactive to retroactive dual-task interference: The important role of task-2 probability**

Mark R. Nieuwenstein & Nico Broers  
University of Groningen

When observers are asked to encode a first target in memory, response times to a trailing 2-alternative forced choice (2-AFC) task show a pronounced psychological refractory period (PRP) effect. On the basis of this finding, it is generally assumed that working memory consolidation imposes a slow and immutable central processing bottleneck. Recently, however, we found that the consolidation of a first target can in fact be disrupted by a trailing speeded 2-AFC task. The current study shows that the occurrence of this surprising retroactive interference effect depends critically on the expectancy of encountering a second task. Specifically, we found that if the second task is present on only 50% of the trials, the consolidation of information for the memory task is significantly disrupted by the 2-AFC task, whereas the 2-AFC task shows no evidence for a PRP effect, replicating earlier findings. In contrast, if the 2-AFC task is present on every trial, performance on the memory task is more accurate whereas performance on the 2-AFC shows a PRP effect, replicating the bottleneck scenario. To explain these findings, we propose that the consolidation of a first to-be-remembered stimulus is protected against interference by a suppression of attention for newly encountered targets, which are thus denied access to central processing mechanisms. When the second task is not always present, the probability of interference and the concomitant need for protection are reduced, which leaves the processing of the first target vulnerable to retroactive interference whereas it benefits the processing of the second target.

p2023

### **Reward sensitivity in autism**

Marieke de Vries & Hilde Geurts  
University of Amsterdam

**Objective:** Recently it has been postulated that children with Autism Spectrum Disorders (ASD) differ in reward sensitivity from typically developing (TD) children. However, the found effects of reward on performance of children with ASD might also be explained by deficits in self-monitoring, and might diminish by giving feedback. This study investigates the effect of a tangible reward compared to only feedback as a reinforcer. Moreover, the association of children's reward sensitivity as measured by an experimental task and as rated by their parents is investigated. **Method:** 50 TD children, and 121 children with ASD (age 8-12) performed a feedback only, and a money condition ('fake' money could be earned) of a Flanker task (Geurts, van Meel, & Luman, 2008). The BIS/BAS questionnaire (Colder & O'Connor, 2004) was administered to the parents of the children. **Results:** On the Flanker task all children performed faster in the money than in the neutral condition, but children with ASD increased significantly more in speed than TD children; and responded significantly faster in the money condition. Overall, accuracy was similarly accurate in the money and feedback condition, but children with ASD made more errors in both conditions. On the Reward Sensitivity scale of the BIS/BAS, children with ASD were rated as more reward sensitive than TD children, but there was no significant correlation between task performance and parent rating. **Conclusions:** Both in daily life, and in the research setting children with ASD seem to be more sensitive to rewards than children without ASD.

p2024

### **Development of equity preferences in boys and girls across adolescence**

Rosa Meuwese, Eveline Crone, Mark de Rooij & Berna Güroğlu  
Leiden University

In social decision-making, individuals prefer a sense of equity, resulting in avoidance of disadvantageous and advantageous inequity. Previous research shows that equity preferences increase from early to middle childhood. Adolescence is a developmental period known for changes in social decision-making, therefore in the current study we tested further development of equity preferences from 8 to 18 year-old ( $M = 14.09$  years,  $SD = 2.07$ ; 51.2% boys), for boys and girls separately. Participants played four allocation games assessing equity preferences. Using logistic regression analyses we tested different models with choices in the four games as dependent variable. Results show that equity preferences in general decrease with age, especially for boys. Furthermore, over the whole age range, girls are more likely to avoid disadvantageous inequity, but are also more likely to sacrifice resources for the benefit of the other player. This study is of value for understanding how views on social justice in adulthood are developed earlier in life. Future studies should focus on the role of impulse control in the development of equity preferences.

p2025

### **How reward induced motivation affects exogenous attention orienting.**

Berno Bucker & Jan Theeuwes  
VU university

Reward induced motivation influences perceptual and attentional processes to facilitate behavioral performance. In this study reward induced motivation was manipulated by exposing participants to high reward and low reward blocks of an exogenous cuing task with different cue-target stimulus onset asynchronies (SOA's), as first described by Posner and Cohen (1984). In this paradigm it is typically observed that the facilitating effect for detecting or discriminating a target at the validly cued location changes into an inhibition of return (IOR) effect that prevents reorienting towards the validly cued location, when the cue-target SOA exceeds around 200ms. Even though reward may sharpen attentional orienting it is unknown whether reward induced motivation affects the signature of IOR. In this study the typical IOR pattern (Klein, 2000) was observed, with faster and more accurate responses in the valid versus invalid cue conditions at the short delay and slower and less accurate responses in the valid versus invalid cue conditions at the long delay. Furthermore reward interacted with this IOR effect, showing more suppression of valid cued locations in the long delay. This resulted in faster responses for targets at the invalidly cued location in the high compared to the low reward condition.

p2026

**Rejected: How childhood peer acceptance and rejection relate to neural responses to social exclusion during adolescence**Geert-Jan Will, Pol van Lier, Eveline A. Crone & Berna Grolu  
Leiden University

The current fMRI study investigated emotional and neural responses to social exclusion in adolescents (age 12-15) who either experienced chronic acceptance ( $n = 27$ ) or rejection ( $n = 18$ ) by their peers during childhood. After being excluded in a virtual ball-tossing game (Cyberball) by two unknown peers, participants reported feeling distressed regardless of whether they had a history of chronic acceptance or rejection. Neuroimaging results showed that social exclusion was associated with increased activity in the anterior insula, ventral anterior cingulate cortex, medial prefrontal cortex and ventrolateral prefrontal cortex (vlPFC); regions associated with affect processing and emotion regulation. Chronically rejected adolescents showed increased activation in the pre-supplementary motor area/dorsal anterior cingulate cortex and anterior vlPFC when they did not receive the ball during the inclusion game and showed decreased activity in the anterior insula when they were excluded in comparison to chronically accepted adolescents. Taken together, our results suggest that social exclusion is highly distressing in adolescence and that chronic exposure to rejection during childhood might be associated with: 1) hypersensitivity to minimal cues of rejection and 2) a blunted emotional response to the continuous experience of social exclusion.

p2027

**Pupil dilation in multitasking**Ioanna Katidioti, Jelmer Borst & Niels Taatgen  
University of Groningen

The objective of this study was to gain physiological – in the form of pupil dilation – and behavioral information about what happens when people decide to switch between tasks. We conducted a multitasking experiment in which the main task was a memory game with equations and the secondary task a 2-back task. There were two manipulations in the experiment: either the participants were choosing themselves when to switch to the secondary task (Voluntary) or switches happened at unexpected moments (Forced). In addition, the secondary task either appeared immediately (NoDelay) or after a 3 second delay (Delay).

Behavioral data showed that participants preferred to switch after they had matched two cards in the memory game and thus their memory load was decreased. Eyetracking data showed an increase in pupil dilation before the switch to the secondary task. The difference was not significant between Delay/NoDelay conditions, suggesting that the increase in pupil dilation did not occur due to changing tasks or changes in the visual field. The difference was significant between Forced/Voluntary from 3 seconds before the switch, suggesting that participants prepared for voluntary task switches.

p2028

**A Meta-Analytic Informed Region of Interest Approach to the Structural Correlates of Inter-individual Differences in Perceptual Decision-making**Christa Mller-Axt, Roger Ratcliff, Andrew Heathcote & Birte U. Forstmann  
University Of Amsterdam

A major focus of the research field of perceptual decision-making is to explore the cognitive processes and associated neural mechanisms that underlie simple two-choice perceptual decision-making tasks (Ding & Gold, 2013). Here we employ a prominent mathematical model, the drift diffusion model (DDM; Ratcliff, 1978), to a simple motion and brightness discrimination task. The DDM takes both RT and accuracy distributions into account in order to decompose perceptual decisions into their underlying latent cognitive processes. One of these underlying cognitive processes is the accumulation of sensory evidence which is captured in a drift-rate parameter in the DDM. In this study, we use ultra-high resolution 7 Tesla diffusion weighted imaging (DWI) data in conjunction with a meta-analysis to investigate white matter structure underlying individual differences in drift-rate using a region of interest approach. In addition, we investigate whether a common structural correlate underlies inter-individual differences in drift-rate in both brightness and motion discrimination.

p2029

**Reward-related modulation of oscillatory activity in human visual cortex**Filip Gesiarz, Niels A. Kloosterman, Tomas H. J. Knapen, Michael X. Cohen & Tobias H. Donner  
Universiteit van Amsterdam

Recent fMRI measurements of monkey (Arsenault et al., Neuron 2013) and human (Knapen et al., SfN abstracts, 2012) visual cortex discovered a novel top-down signal, which is likely mediated by neuromodulation: a transient, retinotopically widespread decrease of the fMRI-signal time-locked to the delivery of rewards. This signal occurs during presence and absence of visual stimulation. The negative sign of the signal is inconsistent with a boost of attention or arousal by reward. To characterize the neurophysiological underpinnings of this top-down signal, we recorded the EEG of 21 participants using the same  $2 \times 2$  factorial design as the fMRI studies. Each trial entailed the presence or absence of (i) a visual stimulus (high-contrast, circular, contracting grating presented for 2s); and (ii) the delivery of a monetary reward (indicated by one of two sounds, counterbalanced across subjects). Stimulus presence and reward delivery were manipulated randomly and independently. On stimulus-present trials, the sounds occurred 800 ms after the visual stimulus onset. Rewards that were not preceded by a stimulus onset induced a decrease in alpha and beta band EEG-power in the electrodes overlying visual cortex that exhibited the strongest visual stimulus response. Thus, modulations of activity in visual cortex induced by monetary rewards are characterized by a spectral profile similar to the one of the stimulus response. Our results also indicate a positive correlation between alpha/beta power and fMRI, opposite to previous studies of stimulus-induced activity.

p2030

**Model-Based Estimates of Response-Caution Predict Single-Trial EEG Data**Udo Boehm, Leendert van Maanen, Birte Forstmann & Hedderik van Rijn  
University of Groningen

Recent theories of decision-making under time constraints assume that the pre-supplementary motor area (pre-SMA) can facilitate quick responding by decreasing the basal ganglia's tonic inhibition on evolving action plans on the cortex (Forstmann et al., 2008, 2010). EEG studies have linked the contingent negative variation (CNV), a well-studied slow potential, to the ease with which participants can trigger a response (Elbert, 1990) and have suggested the neural source of the CNV to be in close proximity to the pre-SMA (Leuthold & Jentzsch, 2001).

We conducted an EEG experiment in which participants performed a random dot motion task to test whether the CNV reflects adjustments of response caution implemented by the pre-SMA. At the onset of each trial, participants were cued to either focus on quick or on accurate responding. We used a version of the linear ballistic accumulation model (Brown & Heathcote, 2008) to obtain estimates of participants' response caution for every trial. Our results show the CNV amplitude to correlate with fluctuations in response caution under speed but not under accuracy instructions, implying that the CNV reflects the pre-SMA's mediation of action planning. Moreover, our data indicate that response caution is set before participants engage in a decision task.

p2031

### **The Development of Numerosity Estimation: Evidence for a Linear Number Representation Early in Life**

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Several studies investigating the development of approximate number representations used the number-to-position task and reported evidence for a shift from a logarithmic to linear in the representation of numerical magnitude with increasing age. However, this interpretation as well as the number-to-position method itself has been questioned recently. The current study tested 5- and 8-year-old children on a novel numerosity production task to examine potential developmental changes in number representations and to test the idea of a representational shift. Modeling of the children's numerical estimations revealed that responses of the 8-year-old children can be described best by a simple linear relation between estimated and actual numbers. Interestingly, however, the estimations of the 5-year-olds were best described by a bilinear model reflecting a rather accurate linear representation of small numbers and no apparent magnitude knowledge for large numbers. These findings suggest that the range of numbers which a child maps onto analogue magnitude codes expands during development. Numbers exceeding this range will not be distinguished and merely conceptualized as "many". Together, the current findings are not in line with the idea of a representational shift from log-to-linear, but rather suggest a linear magnitude coding for numbers that are familiar to the child.

p2032

### **Quantifying Inter-Individual Anatomical Variability in the Subcortex using 7T Structural MRI.**

M.C. Keuken, P.-L. Bazin, L. Crown, J. Hootsmans, A. Laufer, C. Müller-Axt, R. Sier, E.J. van der Putten, A. Schäfer, R. Turner & B.U. Forstmann  
UvA

Functional magnetic resonance imaging (MRI) data are usually registered into standard anatomical space. However, standard atlases, such as LPBA40, the Harvard-Oxford atlas, FreeSurfer, and the Jülich cytoarchitectonic maps all lack important detailed information about small subcortical structures like the Substantia nigra and Subthalamic nucleus. Here we introduce a new subcortical probabilistic atlas based on ultra-high resolution in-vivo anatomical imaging from 7 Tesla MRI. The atlas includes six important but elusive subcortical nuclei: the striatum, the globus pallidus internal and external segment (GPi/e), the subthalamic nucleus, the substantia nigra, and the red nucleus. With a sample of 30 young subjects and carefully cross-validated delineation protocols, our atlas is able to capture the anatomical variability within healthy populations for each of the included structures at an unprecedented level of detail. All the generated probabilistic atlases are registered to MNI standard space and are publicly available.

p2033

### **Interindividual differences in behavior and cognition predicted by local brain structure: A strictly confirmatory replication study**

Wouter Boekel, Luam Belay, Eric-Jan Wagenmakers & Birte Forstmann  
UvA

Replication in the field of cognitive neuroscience is uncommon. This is striking, given the large amount of research and academic debate on this topic (e.g., Ioannidis, 2012; Pashler and Wagenmakers, 2012). A recent study by Button et al. (2013), raised concerns about the low statistical power of studies within the neurosciences, and noted that this implies many findings within the field do not reflect true effects. We performed a purely confirmatory replication study of nine studies showing structural brain-behavior correlations. A methods and analysis document was published online prior to the analysis of any data. Results showed that most research findings were not successfully replicated. With these findings we emphasize the importance of replication in the field of cognitive neuroscience, and we hope to encourage other researchers to confirm their findings by means of replication.

p2034

### **Visuo-tactile interactions are dependent on the predictive value of the visual stimulus**

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The peripersonal space forms a safety zone around our bodies. The peripersonal space utilizes a set of dedicated brain regions to process stimuli originating from the space closely surrounding it. Our aim in this study was to explore the predictive link between the visual stimuli arising within the peripersonal space and tactile stimuli that follow them. More specifically, we tested if information derived from an approaching visual stimulus could be preprocessed to make more accurate judgments about the location and time of the impending tactile contact associated with that stimulus. In order to do this, we used moving hand stimuli that travelled either towards the face or slightly away from the subject's face followed by tactile stimulation on the left/right cheek. The time lag between the visual stimulus and tactile stimulation was also manipulated to simulate tactile contact at a time that was either consistent or inconsistent with the speed of the approaching hand. Reaction time information indicated that faster responses were produced when the arm moved towards the hemispace in which the tactile stimulation was consequently delivered and was insensitive to whether the arm was moving towards the cheek or slightly away from the cheek. Also, the response time was fastest when the tactile stimulation arrived at the moment that was consistent with the speed of the moving arm. With these results, we demonstrate the existence of a predictive mechanism that exploits the visual information derived from objects moving towards the body and makes judgments about the impending tactile contact.

p2035

### **Timing attention: How training attenuates the attentional blink**

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The attentional blink (AB) is the failure to identify the second of two targets (T1 and T2) in a stream of stimuli presented in close temporal succession. The effect has long been thought to reflect a robust cognitive limitation that is resilient to training. However, Choi et al. (2012) showed that the AB can be eliminated by a one-hour training session using a salient T2. Our aim was to study this training effect in more detail by measuring pupil dilation—associated with attentional processing—before and after the training session using a refined version of our recently developed pupil dilation deconvolution method.

Whereas T2 accuracy was indeed significantly higher after training, no latency change in T2-related pupil dilation patterns was observed. In contrast, we found that the attentional peak latency associated with the processing of T1 shifted to an earlier point in time when comparing pre- and post-training pupil dilation. Presumably, the training altered the timing of attention to T1 such that the chances of interference with the subsequent target (and thus the AB) were reduced. These findings provide further support for the idea that the AB is due to a problem to control attention rather than a capacity limitation.

p2036

**Time course of lateralized categorical color perception**Sanne Brederoo & Mark Nieuwenstein  
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A recent surge of studies suggests that visual stimuli, for example colors, are more easily discriminated if they have different linguistic labels. Although it is claimed that this is especially true for stimuli presented to the right visual field, (i.e. processed in the language-dominant left hemisphere), the evidence for this lateralization effect is mixed.

In analyzing the results of studies that produced inconsistent findings regarding the lateralization effect, we discovered that they show a difference in the mean overall response time. It appears as though the lateralization effect has only surfaced in tasks that yielded relatively fast responses. This finding leads to the hypothesis that the perceptual difference between differently labeled objects or colors is only larger in the right visual field shortly after stimulus onset.

Aside from reporting the results of our quantitative review of previous studies, we will present the results of a new experiment that examined this hypothesis by tracing the development of language-based biases across the visual field over time. In this experiment, a dual-oddball-experiment is used with saccade-latencies as dependent measure, providing more time-sensitive measurements than was the case for the studies reviewed in the quantitative analysis.

p2037

**Audiovisual integration is not affected by synesthetic association between the visual and auditory modalities**Jeroen Stekelenburg & Mirjam Keetels  
Tilburg University

It is well established that multisensory integration depends on low level stimulus factors such as spatial and temporal proximity of the unimodal signals. Here, we examined whether synesthetic congruency between the auditory and visual modalities modulates multisensory integration. In two experiments audiovisual stimuli varied in visual size and auditory frequency. Larger integration effects were expected for congruent size/pitch combinations. It was tested whether synesthetic congruency affected the ventriloquist effect (Exp. 1) and the Colavita visual dominance effect (Exp. 2). Participants in Experiment 1 judged the location of the auditory stimulus (left or right from the center) that was synchronized with a visual accessory stimulus that was presented either to the left or to the right. In Experiment 2 participants indicated the modality of the stimuli. The Colavita effect refers to the phenomenon that observers respond more to the visual than auditory component of the audiovisual stimulus. Synesthetic congruency had no effect on the magnitude of the ventriloquist effect and the Colavita effect. EEG recordings showed that synesthetic congruency was probably detected too late (450-500 ms) to influence multisensory integration.

p2038

**The shape-length illusion**Myrthe A. Plaisier & Marc O. Ernst  
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The size of an object can be perceived by pinching it between thumb and index finger. Here we show a new haptic illusion in which local curvature influences the perceived size of an object. Participants pinched ellipses between the thumb and the index finger and matched the size of the major axis to a set of rectangles that contain no curvature information. Ellipses with high local curvature at the contact areas were consistently rated to be larger than those with smaller curvature. In a second experiments participants had to compare the major and minor axes of ellipses to the diameter of a circular shape. Our results show that the length of objects with large local curvature is overestimated while small local curvature leads to underestimation. This is a surprising finding given that there is no direct relationship between object size and its local curvature.

p2039

**Behavioral dynamics of cross-modal time perception: a psychometric modeling study**Joram van Driel, Tomas Knapen, Daan van Es, Roos Doeve, Richard B. Ivry & Michael X Cohen  
University of Amsterdam

A feeling of a 'spacious present', as William James called it, reflects our ability to directly perceive the duration of ongoing stimuli. Time perception has been studied extensively for the different modalities (i.e. sound and vision), but to a lesser degree in cross-modal situations in which temporally (non-)aligned stimuli may either serve as a valid cue for integration across modalities, or elicit target-distractor interference. In a series of experiments, human subjects estimated at each trial whether a target (an auditory, visual, or audiovisual stimulus) was shorter or longer in duration than a preceding standard stimulus of 500 milliseconds. In two unimodal conditions, only the auditory or visual stimuli were used. In different bimodal conditions, subjects attended either to both modalities or to one modality while ignoring the other. In these latter conditions auditory and visual stimuli were presented simultaneously but differed in duration, introducing a stimulus-based interference between cues. Using a hierarchical Bayesian model that fits a Gumbel psychometric function to the data, we found that audition outperforms vision in precision as well as sensitivity. This auditory dominance was eliminated when adding sufficient noise to the auditory cues. In both interference conditions, the duration of the distractor stimulus determined the direction of the bias, indicating a 'ventriloquist-like' effect in judging elapsed time. Interestingly, ignoring sound while attending to vision seemed harder than the other way around, indicating that sound's natural dominance over vision in temporal judgments continues to assert itself in these interference tasks.

p2040

**Pupil Dilation Tracks Perceptual Decisions and the Decision-Maker's Attitude**Jan Willem de Gee, Tomas Knapen & Tobias Donner  
University of Amsterdam

A number of studies have shown that pupil size increases transiently during effortful decisions. Pupil dilation is also associated with the brain-wide release of modulatory neurotransmitters. It has been proposed that these pupil-linked neuromodulatory systems are activated by the final choice terminating a decision process and, therefore, affect only the post-decisional brain state. Here, we present pupil results that run contrary to this proposal, suggesting an important intra-decisional role. Using a well-controlled visual detection task and techniques from linear systems analysis, we found that the pupil was primarily driven by a sustained input that ramped up throughout the course of a protracted perceptual decision. This ramping component was five times larger than the transient components evident during the subject's final choice (indicated by button press). Also, the amplitude of the pupil dilation during decision formation differentiated between "yes" and "no" choices, irrespective of target presence or correctness. Most remarkably, the magnitude of the choice-dependent pupil dilation effect was strongest for conservative subjects choosing "yes" against their bias. We conclude that the central neuromodulatory systems controlling pupil size are continuously engaged during decision formation in a way that reveals the decision-maker's intrinsic bias. The associated changes in global brain state may help the decision-maker overcome his or her intrinsic bias.

**Cyclopean perception with two eyes: binocular integration in early visual cortex**

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We experience a single, cyclopean percept based on two horizontally offset retinal images of the world. We hypothesize that the retinal images converge into a single retinotopic organization. Using a combination of methods we identify where in visual cortex the transition occurs from two retinal representations to a unified cyclopean representation.

We measured fMRI responses elicited by a contrast defined bar moving through the visual field in multiple directions. The bar was presented at the same location in each eye (S1) or with a horizontal offset between the two eyes (S2, S3). In S2 and S3, the bars were presented either alternating between or simultaneously to both eyes respectively. S3 but not S2 elicited a cyclopean depth percept. First, we computed the average, normalized response to each of the three stimuli. We then computed a correlation coefficient between these responses. Second, we determined the population receptive field (pRF) properties from S1 and S2. We then compared whether more variance of the responses elicited by S3 is captured by predictions of the pRF responses by a unified cyclopean or two retinal representations.

We were able to identify systematic differences in the fMRI responses to the three different stimuli. We found these differences only when the stimuli moved horizontally, indicating that we are able to resolve a  $0.6^\circ$  disparity. The pRF analysis suggests that we can identify differences in the pRF properties for these representations. Thus, our methods are able to resolve the differences between two retinotopic representations and a unified representation.