Session A

Novel word learning: The impact of overt repetition and referent familiarity over tasks and individuals

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Novel word learning paradigms have become increasingly popular in recent times. This paper presents a series of experiments in which healthy young adults were asked to learn novel disyllabic spoken names in a single session with immediate assessment of acquisition. Across two experiments, the effect of overt repetition during learning upon acquisition of novel object names was evaluated. A significant advantage was observed for overtly repeated items in production tasks whether the referent was present (picture naming) or absent (immediate serial recall). Interestingly, there was also evidence of an advantage when production was not involved, again whether the referent was present (picture-name matching) or absent (serial order recognition). In a third experiment, learning of novel names paired with a novel or familiar object was compared. We found a clear advantage for familiar objects not just when the referent was present at test (picture naming), but importantly also when it was absent (immediate serial recall). Marked individual variation was apparent in the level of learning success achieved in the single training session, and associations between this variability and a variety of participant level variables were explored.

Is bedtime the best time for shared story book reading? Sleep improves word learning during shared reading with 3- and 4- year old children

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The benefit of shared story book reading for children's developing language skills is well known. But, does it matter when shared story book reading takes place? Recent work has shown that sleep aids consolidation of new word learning (Dumay & Gaskell, 2007) and that children can learn from spoken stories (Henderson et al., 2015; Williams & Horst, 2014) . We further investigated the impact of sleep on word learning in the first shared storybook reading experiment in a naturalistic home setting. Parents read a short story book with their 3- 4 year old children (N=38) either before bedtime or during the morning in a fully counterbalanced repeated measures design. Children were exposed to 5 instances of 2 x novel word-novel object pairings. Expressive vocabulary performance was low but increased over time, but with no evidence of sleep associated consolidation, possibly due to floor effects. However, receptive vocabulary knowledge for novel pairings did not differ immediately after learning but ~12 hours later the words learned at bedtime were recognised significantly more accurately (post sleep) than those learned in the morning. These results

replicate those seen in the lab and suggest that bedtime stories are advantageous for vocabulary learning.

Dumay, N., & Gaskell, M. G. (2007). Sleep-associated changes in the mental representation of spoken words. *Psychological Science, 18*(1), 35-39.

Henderson, L., Devine, K., Weighall, A., & Gaskell, G. (2015). When the daffodat flew to the intergalactic zoo: Off-line consolidation is critical for word learning from stories. *Developmental psychology, 51*(3), 406.

Williams, S. E., & Horst, J. S. (2014). Goodnight book: Sleep consolidation improves word learning via storybooks. *Frontiers in psychology, 5*(184), 1-12.

Why lexical diversity is more important than language exposure for optimal language learning and processing efficiency

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The amount of language to which the child is exposed and the diversity of vocabulary within that language both play a highly influential role in subsequent language performance and processing efficiency. Independent exposure and diversity manipulations are applied to an existing computational model that fits data on a language task across 6 studies involving children between the ages of 2 and 6 years. The model enables not only sublexical, lexical, and phrasal knowledge to be charted across development but also how processing efficiency changes over time based on three well-established measures of language and memory: nonword repetition, digit span, and sentence repetition. While vast exposure to language is important early in learning, hearing a diverse range of vocabulary is ultimately more crucial, enabling the model to outperform exposure manipulations on almost every linguistic knowledge measure and for all three language and memory tests. In turn, a diverse input allows the model to process language more efficiently than larger inputs with limited diversity. The predictions of the model are confirmed using mother-child dyads where maternal types rather than tokens are a better predictor of child vocabulary.

Effects of massed and spaced repetitions on word-meaning priming

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Listeners use sentence context and meaning frequency to interpret words with multiple possible meanings (e.g. ‘bark’ – *dog/tree*). Recent experience also influences

interpretation of these *ambiguous words*: listeners are more likely to disambiguate towards the meaning they have recently heard just once (word-meaning priming; [1]). Presumably, the word-meaning link is strengthened by the recent encounter, which makes the meaning subsequently more accessible. The present studies investigate whether *multiple* word-meaning encounters influence interpretation more than one encounter. In two experiments, participants heard words in the context of their subordinate meanings. Words were repeated either once or three times across different blocks (spaced; Experiment 1), or once or three times within a block (massed; Experiment 2). Participants completed a filler task (ensuring 30-minute prime-test delay), then responded to the ambiguous words in isolation with an associate, which indicated their interpretation of the word. Both experiments showed significant word-meaning priming following one encounter of the word-meaning. Three spaced repetitions significantly boosted the priming effect over that of one repetition (Experiment 1), although three massed repetitions provided no additional priming boost over one repetition (Experiment 2). It seems that repetitions must be spaced for them to act as separate instances in strengthening the word-meaning link.

Rodd, J.M., Lopez Cutrin, B., Kirsch, H., Millar, A. & Davis, M.H. (2013). Long-term priming of the meanings of ambiguous words. *Journal of Memory and Language, 68*, 180-198.

Comparing error-driven and associative accounts of word-meaning priming

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Recent experience plays a key role in listeners' ability to easily understand ambiguous words (e.g., BARK). Specifically, word-meaning priming experiments show that relatively low-frequency meanings (e.g. outer covering of a tree) become more readily available if the word was encountered in the subordinate-meaning context within the preceding 20 minutes (Rodd et al., 2013). These experiments explore the mechanism by which word-meaning priming occurs. An error-driven account assumes that representations are updated in order to reduce future misinterpretations and predicts that priming will be maximal when the disambiguating context occurs *after* the ambiguity (e.g., "the BARK came from her neighbour's tree") as listeners will often initially incorrectly select the more frequent meaning (e.g., noise of a dog). In contrast, if priming reflects a form of associative learning, then priming should be maximal when the disambiguating context occurs *before* the ambiguity (e.g., "her neighbour's tree was the source of the BARK"), because the appropriate word meaning becomes active soon after the word form is encountered. Using word association and speeded semantic decision tasks, we show that priming is significantly greater in the latter early-disambiguation condition, suggesting that co-activation of the subordinate meaning and ambiguous word underpins this retuning of lexical-semantic representations.

Rodd, J. M., Lopez Cutrin, B., Kirsch, H., Millar, A., & Davis, M. H. (2013). Long-term priming of the meanings of ambiguous words. *Journal of Memory and Language, 68*, 180-198.

Session B

Effects of native orthography on the perception of second language spoken words

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This study tested whether spelling affects speech perception in speakers of English as a Second Language (ESLers). In Italian, consonant digraphs represent a long consonant. In English, vowel digraphs generally represent a long vowel. Italian ESLers produce English sounds as longer if spelled with digraphs than singleton letters. We tested whether Italian ESLers perceive different sounds in English homophonic word pairs that are spelled with one or two consonant letters (*finish-Finnish*) or one or two vowel letters (*morning-mourning*).

Italian ESL speakers and English controls (both n = 30) performed a Word Similarity Judgment Task. Participants heard two homophonic words introduced by a picture (e.g., a Finnish flag picture, the spoken word *Finnish*, a race finish flag picture, the word *finish*). There were 18 homophone pairs each in the consonant and in the vowel version.

With consonant stimuli, ESLers showed lower accuracy and longer RTs with target than control pairs. With vowel stimuli, the orthographic effect on accuracy was larger for ESLers than English controls.

Italian ESLers appear to perceive different sounds in homophones spelled with digraphs or single letter. Orthographic effects were also found in both groups' vowel perception. We will discuss implications for L2 phonology and speech perception research.

Understanding the prediction-motion literature

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In a Prediction Motion (PM) experiment, people see a moving target disappear behind an occluder, and press when it reaches a mark. I have analysed the PM literature in terms of four theoretical dichotomies, and resolved each of them with new data. Dichotomy 1) Do people track the hidden object with spatial attention (tracking strategy), or estimate time-to-contact before occlusion, then withhold motor response for the estimated duration (clocking strategy)? Answer: Both are viable strategies. Dichotomy 2) Is PM mediated by the eye movement system, or by mental imagery? Answer: Neither. Dichotomy 3) People can do PM

tasks in feature space, as well as physical space. We must update mental representations at the right speed, and without sensory input. Do we have a *common rate controller* in the brain, which can be functionally coupled to dynamic state representations, or does each sensory map have its own local rate controller? Answer: common rate controller. Dichotomy 4) Do people run a rate controlled simulation of the occluded process, or do they use a clocking strategy? Answer: common rate controller. This synthesis is a review of the PM literature, but also offers a new way of thinking about cognitive and motor control.

Semantic congruency on natural scene viewing: what information is stored in memory?

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Recent research on information encoding has challenged more traditional accounts that assume that coherence improves memory. It has been shown that incongruency can trigger learning mechanisms that might lead to better encoding of the situations in which that incongruency was presented. Nevertheless, these studies lack of ecological validity due to the nature of both the stimuli and the tasks they use. In this line of research we test these new hypotheses with more ecological materials. We used a change detection task in which we manipulated the congruency between the target object and a background natural scene thus mimicking a more naturalistic environment. Our results consistently show that congruency, in spite of hurting the detection of objects during natural scene viewing, improves the encoding of said objects into episodic memory. Furthermore, we show that this result is still present when object identification is kept to a minimal. We discuss the implication of these results for theories of memory formation.

Perceptual-motor determinants of short-term memory: Evidence from the impact of order incongruence on verbal serial recall

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A perceptual-motor account of serial short-term memory is investigated by examining the way in which an irrelevant spoken sequence interferes with verbal serial recall. Even with visual-list presentation, verbal serial recall is particularly susceptible to disruption by irrelevant spoken stimuli that are identical to—but which are order-incongruent with—the to-be-remembered items. We hypothesized that such interference is due to the obligatory perceptual organization of the spoken stimuli yielding a sequence that competes with a subvocal motor-plan assembled to support the reproduction of the to-be-remembered list. Supporting the hypothesis, Experiment 1 showed that the interference is eliminated if the auditory stimuli are presented such as to demote their integration into a

single perceptual stream. Experiment 2 showed that the interference is also eliminated if subvocal motor sequence-planning is blocked via articulatory suppression. The results are in line with the view that performance-limits in verbal serial short-term memory reflect the limitations that arise from having to exploit general-purpose perceptual and motor processes for purposes for which they did not evolve, not the inherently limited capacity of structures or mechanisms dedicated to storage.

Can probabilistic cueing of visual attention occur implicitly?

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The deployment of visual attention is highly sensitive even to the most subtle statistical regularities in the environment. For instance, when searching for a hidden target among a number of distractors, we tend to prioritize regions where targets have appeared more frequently in the past. This learning is typically attributed to the operation of implicit or unconscious processes, as it seems to take place without participants becoming aware of the regularities that drive behavior. This conclusion is based on the fact that participants usually fail to identify explicitly the spatial regions in which the targets were more likely to be presented, even though they find the targets appearing in those regions significantly faster. In the present work we show that participants' failure to identify the 'rich' region in these experiments may not be due to a genuine lack of awareness, but to the use of testing procedures that are insensitive to explicit knowledge. We present meta-analytic evidence suggesting that across all the experiments conducted so far, participants in fact do possess some awareness of the regularities in the visual search task. A Bayesian analysis shows that, given the small sample sizes used in these experiments, none of them can provide strong evidence for the hypothesis that learning takes place unconsciously. Finally, a high-powered experiment using a sensitive awareness test shows that participants' performance in the visual search task correlates with their explicit knowledge of the spatial regularities.

Social interaction contexts bias the perceived expressions of interactants

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The present study sought to determine whether the visual information present within social interactions, viewed from third-person-perspectives, may exert contextual influence on observers' perception of the interactants' facial emotion. Observers judged whether the

expression of an ambiguous target face was happy or fearful, in the presence of a happy, aggressive or neutral interactant. In two experiments, the same ambiguous target expressions were judged to be happier when presented in the context of a happy interactant, than when interacting with a neutral or aggressive partner. Observers' perception of the target expression was not modulated by interaction context when the interactants were presented back-to-back, suggesting that the bias depends on the presence of an intact interaction arrangement. These results provide valuable insight into the neurocognitive mechanisms underlying the perception of social interactions and underscore how knowledge and experience shape our perception of facial emotion.

"Will I want these stickers tomorrow?" A test of the Bischof-Köhler hypothesis in preschoolers

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By the age of 4 children can plan for their own and others' future needs; however, they have great difficulty predicting future needs that conflict with current ones—ability described in the context of the Bischof-Köhler hypothesis. Importantly, this hypothesis has only been tested in the domain of physiological states (e.g., thirst). Therefore, it is still an open question whether in a different context preschoolers can disengage from their current needs to secure a different future one. In a Resource Allocation task, 4- and 5-year-olds had to distribute three types of rewards between themselves and another child for either "right now" or "tomorrow". Children's current needs were manipulated by providing them (or not) with their preferred reward at beginning of the task. Only 5-year-olds could predict future needs that conflict with their current ones and act accordingly. Younger children's performance is discussed in the context of temporal and social distance.

Session A

fMRI evidence against the automaticity of reading

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We investigated the word superiority effect (WSE) in tasks with varying attentional demands. In each experiment, native English speaking adults viewed 120 words and 60 pseudowords at different visibility levels. In Experiment 1, participants read items aloud. In Experiment 2, participants detected repeated items. In Experiment 3, participants detected a central fixation cross colour change. fMRI data were collected in Experiments 2 and 3. In Experiment 1, words were read aloud faster and more accurately than pseudowords, with lexicality effects on accuracy only observed at low visibility, demonstrating the WSE in this active task. In Experiments 2 and 3, there was no difference in neural activity between words and pseudowords, despite obtaining such differences when the same participants read aloud these items at full visibility. In Experiment 3, occipitotemporal activity was greater for more visible stimuli, reflecting greater engagement of orthographic representations. However, in Experiment 2, activity in these same regions was greater for less visible stimuli, reflecting greater orthographic processing effort (Taylor, Rastle, & Davis, 2013). These findings support emerging views that word reading requires attention (Robidoux & Besner, 2015). They further demonstrate that even passive tasks differ in the demands placed on brain regions involved in orthographic processing.

Robidoux, S., & Besner, D. (2015). Conflict resolved: On the role of spatial attention in reading and color naming tasks. *Psychonomic Bulletin & Review, 22*(6), 1709-1716. doi:10.3758/s13423-015-0830-7

Taylor, J. S. H., Rastle, K., & Davis, M. H. (2013). Can cognitive models explain brain activation during word and pseudoword reading? A meta-analysis of 36 neuroimaging studies. *Psychological Bulletin, 139*(4), 766-791. doi:10.1037/a0030266

Symposium

The quest of unveiling the orthographic code

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A large amount of reading research in the past years has been devoted to cracking the orthographic code (e.g., Grainger, 2008). Here we review recent experimentation on how the

brain codes letter identity/position using different languages, scripts, techniques, populations, and sensory modalities. We also examine how empirical evidence has challenged and refined computational models of visual word recognition. We conclude by hypothesizing on the future developments of orthographic code research, and how it might be integrated into a comprehensive view of the reading process.

Orthographic processing: the special case of letters

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Our visual system is highly sensitive to the internal structure of sequences of letters during visual word recognition while it allows a great degree of flexibility in letter position coding. This flexibility of the letter position coding can be accounted by a series of mechanisms that emerge during literacy acquisition or by a generic noisy perceptual mechanism that applies not only to letters but to other visual stimuli such as objects or symbols that would not be the direct consequence of literacy. Here we will describe empirical evidence (coming from behavioral and neuroimaging data) from illiterates, pre-readers and literates to shed light on the mechanisms underlying letter identity and position coding in reading and their origin.

The role of lexical precision in skilled reading: Insights from individual differences

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Understanding how written word forms are mapped to lexical knowledge is central to a complete understanding of reading. Recent efforts to 'crack the orthographic code' used in reading (Grainger, 2008) have generated a range of competing models of lexical retrieval of how skilled readers achieve this feat. Most of these models have been tested against average data for unselected samples of university students, reflecting an implicit assumption that all skilled readers read in the same way. I will review evidence demonstrating that the average data used to distinguish between these models can obscure systematic individual differences in early lexical retrieval that are captured by measures of reading comprehension, vocabulary and spelling ability. I will use converging evidence from masked priming studies of isolated word recognition and eye movement studies of sentence reading to illustrate how individual differences in written language proficiency can be used to investigate *why* orthographic precision is important for skilled reading and contribute to distinguishing between the theoretical nuances of current models of orthographic processing in skilled reading.

Is letter position coding universal? Insights from word processing in Korean and artificial

languages

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Successful reading requires not only identification of particular symbols but also analysis of their positions. Research on a variety of Indo-European languages reveals uncertainty in position coding; for example, stimuli with letter transpositions (e.g. *jugde*) are perceived as very similar to their base words (*judge*). However, similar effects are not observed in Hebrew, a dense orthography with many anagrams, suggesting that aspects of the writing system may influence position coding. In the first part of this talk, I report masked priming experiments from another dense orthography characterised by many anagrams, Korean Hangul. Like Hebrew, results of these experiments show no evidence that stimuli with letter transpositions facilitate recognition of their base words. In the second part of this talk, I report an experiment investigating letter position coding in artificial writing systems purposely designed to be sparse (i.e. few anagrams) or dense (i.e. many anagrams). Results from this experiment indicate that readers perceive stimuli with letter transpositions to be similar to their base words, but that these effects are significantly reduced in the dense orthography. These results suggest that the acquisition of orthographic representations is strongly influenced by properties of writing systems, and raise questions for recent approaches to modelling reading.

Frost, R. (2012). Towards a universal model of reading. *Behavioral and Brain Sciences, 35*, 263-279.

Grainger, J., Dufau, S., & Ziegler, JC (2016). A vision of reading. *Trends in Cognitive Sciences, 20*, 171-179.

How to evaluate computational models of orthographic processing

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One of the major topics in recent research in visual word recognition has been what Jonathan Grainger has referred to as "the quest to crack the orthographic code underlying reading". This quest has generated a wealth of empirical data and several theoretical models. Finally cracking the code will require careful evaluation - and probably modification - of these models. This in turn requires precise data and precise predictions. This talk will review our recent efforts towards these ends. The masked form priming project (Adelman et al., 2014) tested over 1000 participants in a single large, multicentre experiment, providing a rich empirical database for testing models. The *easynet* project aims to provide a simple, general-purpose software package for testing computational models of visual word recognition. We will demonstrate the use of this package, and consider the broader implications not only for

cracking the orthographic code but for other unsolved problems in cognitive science.

End of symposium

Session B

Perception of shape and local curvature

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A preference for shapes with smooth curvature has long been documented. Recently this preference has been confirmed using abstract shapes and comparing polygons (curvature discontinuities at the vertices) and a smoothed version of polygons (maxima of curvature instead of vertices) (Bertamini et al., 2015). We report a set of studies using controlled stimuli but focusing on simple and choice response time. Polygons have lower complexity and are defined by a small set of vertices, while smoothed shapes have a continuous curvature change along the contour. Angles can be an early signal of threat and danger and on that basis one may predict faster responses. Curved shapes are more typical of the natural environment in which the visual system has evolved. For simple response time we found no differences. We then tested two complex tasks: detection of symmetry and a comparison between shapes (detection of repetition). In both tasks in which the global shape was relevant we found an advantage for smoothed polygons. We conclude that smooth contours are superior in tasks that require access by the system to a global shape representation. This in turn has implications for understanding the preference for the smoothed shapes over the more angular shapes.

Bertamini, M. Palumbo, L., Gheorghes, T.N., & Galatsidas, M. (2015). Do observers like curvature or do they dislike angularity? *British Journal of Psychology.107*, 1, 154-178.

Preference for curvature: Effects of presentation time and backward masking

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A growing body of literature reveals a widespread tendency for people to prefer curved-contour objects (Bar & Neta, 2006), room (Vartanian et al., 2013), design elements (Westerman et al., 2012) and geometric figures (Bertamini, Palumbo, Gheorghes, & Galatsidas, 2015; Silvia & Barona, 2009) to equivalent sharp-angled alternatives. Nevertheless, such studies differ greatly in their methodological details; most notably in the time stimuli were presented to participants. Here we aim to clarify the effects of presentation time and backward masking on participants' preference for curvature, measured as the

proportion of curved choices in a 2AFC task. We recruited 300 participants and randomly assigned them to one of 8 groups, depending on presentation time (34, 48, 80, 144, 304 ms) and whether or not the target stimuli were backward masked. Our results suggest that preference for curvature arises when stimuli are shown for 48ms or more, and that backward masking markedly reduces this preference when stimuli are shown only briefly. Our results have implications for understanding the early perceptual processes involved in preference for curved contours, and suggest that this effect is quite robust to presentation time but not to competing visual processes, such as those exerted by masking.

Bar, M., & Neta, M. (2006). Humans prefer curved visual objects. *Psychological Science, 17*(8), 645-648. doi:10.1111/j.1467-9280.2006.01759.x

Bertamini, M., Palumbo, L., Gheorghes, T. N., & Galatsidas, M. (2015). Do observers like curvature or do they dislike angularity? *British Journal of Psychology (London, England : 1953)*, 1-25. doi:10.1111/bjop.12132

Silvia, P. J., & Barona, C. M. (2009). Do People Prefer Curved Objects? Angularity, Expertise, and Aesthetic Preference. *Empirical Studies of the Arts, 27*(1), 25-42. doi:10.2190/EM.27.1.b

Vartanian, O., Navarrete, G., Chatterjee, A., Fich, L. B., Leder, H., Modrono, C., Skov, M. (2013). Impact of contour on aesthetic judgments and approach-avoidance decisions in architecture. *Proceedings of the National Academy of Sciences of the United States of America, 110*, 10446-10453. doi:10.1073/pnas.1301227110

Westerman, S., Gardner, P. H., Sutherland, E. J., White, T., Jordan, K., Watts, D., & Wells, S. (2012). Product design: Preference for rounded versus angular design elements. *Psychology & Marketing, 29*(August), 595-605.doi:1.1002/mar

Two signals for verticality

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The sense of straight up, *or verticality*, in the outside world depends on the integration between vestibular-gravitational inputs with visual and somatic signals. However, it remains unclear how verticality is perceived for stimuli applied to the body. To address this question, a psychophysical tactile vertical task has been combined with galvanic vestibular stimulation (GVS). Brief right-anodal and left-cathodal GVS or left-anodal and right-cathodal GVS were delivered at random to induce a pure vestibular sensation of left/right tilting. A sham stimulation condition was included. Participants judged the orientation of clockwise and counterclockwise lines drawn on their forehead. Surprisingly, pure artificial vestibular

signals did not alter tactile verticality. Conversely, verticality was reliably biased towards the neuraxis when participants were asked to physically tilt their head. Such bias was present also for stimuli not aligned with the body midline. Our results support two distinct representations of verticality: a vestibular representation, based on the direction of gravity, which is a reference for visual vertical, and a somatosensory representation, based on the neuroaxis, which is a reference for tactile vertical.

High cognitive load reduces tactile awareness

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The important link between attention and conscious perception is perhaps most strikingly demonstrated in the attentional blindness literature, which has shown that salient information can go unnoticed when attention is focused elsewhere (Simons & Chabris, 1999). In recent years, this phenomenon has also been reported in the auditory modality (e.g. Dalton & Fraenkel, 2012). Here, we present two experiments providing the first robust demonstrations of a tactile equivalent – inattentional numbness. In Experiment 1, we varied task difficulty in a tactile task consisting of sequences of tactile stimuli delivered to one hand. Our results showed that reported awareness of an unexpected tap delivered on the final trial to the unattended hand was lower in the hard task (vs. easy task) condition. In Experiment 2, we varied the level of perceptual load in a tactile target discrimination task delivered to the hands while we presented a brief tap to the forehead on half of the trials. Participants indicated on every trial whether or not they had detected the tap. We found reduced sensitivity in reporting the irrelevant tap under high (vs. low) perceptual load. Overall, our findings suggest that both general task difficulty and tactile perceptual load can modulate tactile awareness.

Dalton, P., & Fraenkel, N. (2012). Gorillas we have missed: Sustained inattentional deafness for dynamic events. *Cognition, 124*(3), 367-372.

Simons, D. J., & Chabris, C. F. (1999). Gorillas in our midst: Sustained inattentional blindness for dynamic events. *Perception, 28*(9), 1059-1074.

A sensitive period for tactile remapping

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When a stimulus touches the skin, the initial representation is a somatotopic map of

the skin surface, which is automatically remapped into an external reference frame by integrating information about posture. It has been suggested that visual input during development is crucial for the acquisition of this process, given that late, but not congenitally, blind people are impaired when skin-based and external spatial representations of touch conflict (e.g. when crossing the limbs). To test whether there is a sensitive period during which visual input is necessary for the acquisition of remapping, we tested fourteen children deprived of early visual experience by dense cataracts whose sight was restored during the first 4 months of age and a single case of a teenager (LM) whose cataracts were removed at age 7. We obtained a measure of tactile localization by studying the perceived temporal order of two touches, one on each hand, with crossed and uncrossed arms. Children showed a crossing effect indistinguishably from a matched control group. In contrast, LM showed no crossing effect at all. Together, these results demonstrate a clear sensitive period for the effects of visual exposure on tactile remapping which, critically, does not include early infancy.

Real-time uncertainty update in interactive and non-interactive social exchange

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Experiments on opinion aggregation show that when observers integrate information over independent advisors, response accuracy greatly improves. Nevertheless when people freely interact, phenomena of error cascades and escalation are often observed. Our hypothesis is that when agents are free to interact, independence of their private judgements breaks down and sources interdependencies lead to errors magnification.

Pairs of participants performed 2AFC tasks and expressed confidence in their answers. After private responses were entered, subjects received extra information from their partner and were allowed to adjust their initial confidence. Confidence changes were tracked continuously. Two conditions were compared differing in the extra information given to subjects. No-Interaction (NI): subjects were simply informed about their partner's initial private confidence. Interaction (I): subjects could see in real time their partner's current confidence, creating a situation where partners could react to each other's updates.

Results: (1) confidence update follows a Summing aggregation strategy. (2) updates show fast transitions but are mainly stable around an equilibrium; (3)NI and I conditions do not differ when private judgements start off confident, but (4)when private information is noisy (low confidence) then interacting with others leads to escalation, potentially harming accuracy. Results are consistent with the break of independence hypothesis.

Why are lineups better than showups? A direct test of the filler siphoning vs. enhanced discriminability accounts

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Presenting the police suspect with other similar-looking people (a lineup) results in more accurate eyewitness identifications than presenting the suspect alone (a showup). But why are lineups better than showups? The diagnostic-feature-detection hypothesis suggests that lineups enhance a witness's ability to discriminate between innocent and guilty suspects, because facial features can be compared across lineup members. Conversely, the "filler siphoning" account posits that the presence of other lineup members siphons some of the incorrect identifications that would otherwise land on the innocent suspect. To test these competing accounts, over 2000 subjects watched a mock-crime and were presented with either a simultaneous showup—a novel procedure—or a standard showup. Subjects in the simultaneous showup condition saw the suspect and five similar-looking faces, but, unlike a standard lineup, were prevented from identifying these other faces. In both conditions, the suspect was highlighted and subjects were asked whether this was the perpetrator. Presenting similar-looking faces alongside the suspect (simultaneous showup) enhanced subjects' discriminability compared to presenting the suspect alone (standard showup) as measured by the partial Area Under the Curve and by fitting a signal-detection process model. These results cannot be explained by filler siphoning, but rather, support the diagnostic-feature-detection hypothesis.

Session A

Contributions of fluency to the synchrony–liking relationship

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When behavioral elements synchronize, they may create a perceptual unit, a meaningful whole[1]. This kind of perceptual chunking has been shown to reduce cognitive load[2], increasing processing fluency and resource availability. We examined whether behavioral synchrony produces fluent processing, and whether this fluency contributes to social bonding. Participants were 3D motion-tracked[3] while bouncing in time with an auditory metronome and watching a video of a task partner bouncing synchronously or asynchronously, or not moving at all. Participants also reported orally whether letters presented concurrently in the periphery of the video screen were *p*s or *q*s. Participants demonstrated enhanced motor and perceptual fluency (as indexed by less variability in their bouncing movement and fewer probe-identification errors, respectively) in the synchronous-movement condition compared to the asynchronous-movement and baseline conditions. Synchrony also elicited more positive reactions to the task partner, and mediational analyses provided tentative support for fluency as a mediator of the synchrony–connectedness relationship. These results are compatible with the reasoning that synchrony leads to fluent processing of a task partner's movements by creating a single unitized motor representation that encompasses both one's own and one's partner's movements, and that this fluency contributes to the beneficial outcomes of synchrony.

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Temporal precision in short-term memory for spoken word sequences

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The capacity of auditory-verbal short-term memory (AVSTM) is typically measured as accuracy for item and order information. However this capacity can vary as a function of the sequence timing, and both temporal processing and memory for serial order have been linked to language development. To investigate the possibility that these abilities are coupled through a shared dependence on the same limited resources, we developed a new "rehearsal-probe" task. Participants listened to short sequences of spoken digits and silently 'rehearsed' (i.e. repeated using inner speech) the items and timing during an unfilled retention interval. After an unpredictable delay, a tone prompted report of the item being rehearsed at that moment. Experiment 1 showed cyclic distributions of item responses over time, with peaks preserving serial order and broad, overlapping tails. Using the spread of the response distributions as a measure of timing variability, we found that variability increased with additional memory load and correlated negatively with auditory digit span. Experiment 2 replicated the correlation and demonstrated its specificity to AVSTM by controlling for differences in visuo-spatial STM and nonverbal IQ. We interpret these results as converging evidence that a common resource underpins temporal precision and capacity for serial order in AVSTM.

Can bilinguals set themselves independently for production and comprehension?

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We asked bilinguals to alternate (in predictable 3-trial runs) the language in which they named visually presented numbers, whilst also categorising the meaning of intermittent auditory (in some experiments) or visual (in other experiments) word "probes" whose language alternated over blocks of ~50 trials. Categorisation performance was superior if the language of the probe matched that of the naming run, but no such "language match effect" was found for naming, which might be taken to suggest bilinguals are more practiced at controlling production than comprehension. However, when in a subsequent experiment we reversed the frequency of the two tasks (categorisation runs with intermittent number naming), there was a language match effect in naming but not categorisation. In the final experiment, number naming and visual word categorisation were equiprobable. To ensure more favourable conditions for the independent control of production and comprehension, the language for each task remained constant throughout relatively long blocks of 81 trials, changing only between blocks. Despite the predictability of the language to be used for each task, we found a clear match effect in both tasks. Thus, even in such stable conditions bilinguals do not seem able to set themselves independently for production and comprehension.

Bilingualism as an enhancer of cognitive reserve: evidence from inhibitory control

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There is evidence to suggest that using two languages enhances interference suppression, an aspect of inhibitory control. Many studies have shown that bilinguals perform more accurately and faster in tasks that require suppressing irrelevant competing information. The current study focused on how this cognitive advantage progresses with age, whilst controlling for the degree of bilingualism. One hundred participants took part in a Simon task, divided into three age categories (young adults, middle-aged and older adults) and into two language groups (Welsh-English bilinguals, English monolinguals). One additional condition was the level of difficulty of the Simon task, with a first block being a standard version of the Simon task, and a second block being a reverse of the initial association between response button and arrow. The Simon effect was evident in our results; in addition, the findings suggest a significant interaction between age and language. The fact that bilinguals seem to maintain their level of inhibitory control as they get older supports the rationale that bilingualism may be a very specific, weighted, form of enhancing cognitive reserve, shedding some light on how research can tap into cognitive reserve and how it can be affected by one's background language.

How to learn words in a foreign language: Semantic vs. lexical learning

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Fluent bilinguals have strong connections between meanings and words in their second language (L2). We aimed at creating a semantic learning method to foster these concept-L2 word connections present in highly proficient bilinguals. The semantic method consisted of L2 words-pictures pairs and a semantic categorization task in which learners decided whether L2 words were exemplars of semantic categories (e.g., animals, fruits, etc.). This semantic training was compared with a lexical method in which participants received L2 words paired with words in their first language (L1) and they indicated whether L1-L2 words contained the same grapheme (e.g., a, g, etc.). After training, participants decided if L1-L2 word pairs were translation equivalents. When the L2 word was not the L1 translation but it was semantically related, more interference was found in participants learning under the semantic method vs. the lexical method. This result suggests that semantic methods favor the acquisition of concepts-L2 words connections usually present in fluent bilinguals.

The cognate facilitation effect depends on stimulus list composition

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Research conducted by Poort, Warren, and Rodd (2016) suggests a key finding in bilingualism research, the *cognate facilitation effect*, may not be as robust as thought. Numerous studies have shown that cognates, which share their form and meaning across languages (e.g. "fruit" in English and Dutch), are often processed more quickly than single-language control words (e.g. "witch"). Two English lexical decision experiments with Dutch–English bilinguals investigated whether this effect depends on stimulus list composition. In Experiment 1, the 'classic' version, which included only identical cognates, English controls and regular non-words (e.g. "vasui"), showed significant cognate facilitation (32.6ms). In contrast, the 'alternative' version, which also included identical interlingual homographs (e.g. "angel", meaning "insect's sting" in Dutch), pseudohomophones (e.g. "mistaik", instead of regular non-words) and Dutch controls (e.g. "krijt"), showed non-significant inhibition (8.3ms). Experiment 2 further revealed that this reversal of the cognate effect was due to the presence of the Dutch controls. We suggest that when participants must respond 'no' to non-target language control words, competition arises between the 'yes' and 'no' responses associated with the two interpretations of a cognate, which can cancel out the facilitation that is a result of the cognate's shared form and meaning.

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Session B

A negative effect of trial spacing on learning in mice

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Conditioning is typically reduced when trials are separated by short intervals (trial massing) compared to when long intervals are used (trial spacing). We examined the effect of trial spacing using a within-subjects procedure in mice in which one stimulus was paired with food after a short inter-trial interval and a second stimulus after a long interval. Surprisingly, we found that a short interval led to greater learning than a long interval. In a second experiment we replicated this effect and found that it was abolished by GluA1 AMPAR subunit deletion, a putative manipulation of short-term memory. In contrast, when a between-subjects procedure was used in which mice received either massed or spaced training it was found that trial spacing facilitated learning compared to massed conditions, and this effect was not dependent on GluA1. The results of a third experiment suggest learning is increased on a trial if preceded by a recent presentation of a conditioned, but not unconditioned, stimulus. The results show that the typically found facilitatory effect of trial spacing is abolished if two cues are trained in the same context and that, under these circumstances, there is a beneficial short-term effect of a recent conditioning trial.

The role of outcome value in human Pavlovian-instrumental transfer

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Pavlovian-instrumental transfer (PIT) studies have demonstrated that reward-predictive stimuli can potentiate instrumental responses that predict a common outcome. Several experiments have shown that PIT is often immune to outcome devaluation manipulations. This is usually interpreted as evidence to suggest that PIT is mediated by a low-level, automatic mechanism rather than a high-level, inferential process. In a series of experiments, we tested the effects of a strong devaluation manipulation on PIT. Consistent with previous work, we found that the basic PIT effect was insensitive to outcome devaluation. When cue-elicited increases in outcome probability were equated, however, instrumental response choice became highly sensitive to outcome value. The results will be discussed with reference to the automatic and inferential accounts of PIT.

A Bayesian method for studying the effect of partial reinforcement on extinction

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It is traditionally assumed that learning consists of capturing the association between two stimuli such that, when the relationship changes, the association is updated accordingly. This view (single-state learning) is challenged by evidence that suggests that animals can learn multiple states simultaneously and quickly switch between expressing one or another. The latter proposal (multiple-state learning) is often understudied because it needs a different data-analysis approach. Here, we present a Bayesian model of the Partial Reinforcement Extinction Effect (PREE) that can test the predictions of the multiple-state view, by estimating the moment of change in the responses (from the acquisition to the extinction performance), both at the individual and at group levels. We used this model to analyze data from a PREE experiment with three levels of reinforcement during acquisition (100%, 75% and 50%), finding differences in the estimated moment of switch between states during extinction, so that the moment was delayed after lower partial reinforcement schedules. The results are compatible with the multiple-state view. It is the first time, to our knowledge, that the predictions from the multiple-state view are tested directly. We also aim to show the benefits that Bayesian methods can bring to the associative learning research field.

Monitoring of patterns of resource availability in a computerised foraging task in humans and baboons (Papio papio)

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Experimental psychology paradigms tapping the cognitive bases of foraging do not typically simulate foraging for ephemeral resources with predictable cyclical patterns of availability. Yet, it has been argued that foraging for such resources triggered primate brain expansion and eventually human cognitive sophistication. We present a set of experiments with humans and baboons using touch-screen based tasks affording the assessment of foraging efficiency for ephemeral, cyclical resources, and its memory components. Humans improved search efficiency by learning to avoid locations that never yield food items and locations already visited during a foraging bout and showed a tendency to use temporal patterns of resource availability to direct their searches to the most profitable locations at trials' outset. Baboons tested extensively with a simplified version of the tasks also showed the ability to improve foraging efficiency by identifying and avoiding locations never yielding food resources and by reducing revisits of locations explored in any given foraging bout. Evidence of the ability to exploit the cyclical availability of resources to direct searches to most profitable locations at the beginning of a foraging bout was less clear in baboons. Different scenarios are proposed for interpreting this pattern of similarities and differences between humans and baboons.

Launching awareness: Causal events enter awareness faster than non-causal events

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Philosophers have long argued that causality can not be directly observed, but that causality has to be inferred. Albert Michotte however developed numerous visual phenomena in which people seemed to perceive causality as a primary visual property (like color or motion), suggesting that the perception of causality did not require a conscious cognitive inference. Over the last seventy years, advocates of both sides have continued this debate and no consensus has been reached. Here we show that causal events enter awareness faster than non-causal events, providing evidence for Michotte's perceptual account of causality perception. We presented observes with 'causal' and 'non-causal' events, that participants were not immediately aware of (using Continuous Flash Suppression), and found consistent evidence across two experiments that participants would become aware of causal events more rapidly than they would become aware of non-causal events. Our results suggest that, whilst causality must be inferred from sensory evidence, this inference is computed at low levels of perceptual processing, and does not depend on a deliberative conscience inference. This work therefore supports Michotte's contention that, like color or motion, causality is an immediate property of our perception of the world.

The presence of side effects in a bogus treatment improves the accuracy of causal judgments

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Previous research has shown that people tend to use a bogus treatment frequently when it includes no side-effects, which prompts an illusory belief that the treatment and a possible healing are causally linked, despite the fact that the real contingency between those events is zero. On the other hand, when a bogus treatment has side-effects, it is used with less frequency, and people realize that it is not effective. The aim of this study is to investigate if this reduction of the causal illusion occurs even when the frequency of use of the treatment is controlled for. Fifty-four volunteers performed a contingency learning task, in which they observed records of fictitious patients who either took a fictitious drug or not and then felt better or not. For one group of participants the drug had side-effects, for the other one it did not. The contingency between the drug and the recovery was always zero. Once participants had observed all patients, they answered a causality judgment. Overall, participants who saw the medicine with side-effects perceived the medicine as less

effective. Therefore, the presence of side-effects increased accuracy in judging the causal connection between taking the medicine and the healing of the patients.

Session C

The role of contextual factors in written sarcasm comprehension

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Contemporary accounts of sarcasm comprehension make different predictions regarding whether contextual factors can influence the initial processing of a sarcastic comment. Specifically, modular accounts predict that contextual factors cannot influence initial processing, whereas interactive accounts predict that they can. Thus, in order to distinguish the predictions of these accounts, three eye-tracking studies were conducted. Each study required participants to read short stories that ended in either a literal or a sarcastic target remark. In Experiment 1, the context either did or did not create an "ironic environment" (Utsumi, 2000). In Experiment 2, an expectation for sarcasm was created by introducing a sarcastic character. In Experiment 3, the target remark was an echo of a contextual utterance (Sperber & Wilson, 1981). Results indicated that although the creation of an ironic environment did not aid sarcasm comprehension, introducing a sarcastic character did – when a character had previously uttered a sarcastic remark in the context, a sarcastic target remark was read faster than a literal one in the initial stages of processing. Echoing a contextual remark resulted in both literal and sarcastic target utterances being read faster than when no echo was present. Implications for theories of sarcasm comprehension will be discussed.

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Processing negated bounded and unbounded expressions during reading: An eye movement investigation

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The boundedness hypothesis suggests negated mental representations are sensitive to the semantic configuration of the negated entity. Bounded entities are categorical; only one state is possible so, when negated, a bounded entity must be interpreted as its antonym (not

dead=alive). Unbounded entities possess a scalar ontology, with many states in between the antonyms; when negated they are ambiguous and can refer to multiple states (not wide does not equal narrow). To investigate online interpretation of bounded and unbounded negations, participants read passages with two statements from different characters describing a bounded/unbounded entity (Experiment 1). The two accounts were either a repetition (not dead-not dead), contradiction (not dead–not alive) or were complementary (alive–not dead). The unbounded contradictory condition disrupted reading to a lesser degree than bounded equivalents. Furthermore, unbounded complementary passages were more difficult to interpret than bounded equivalents, evidenced by increased disruption to reading. In Experiment 2, we found the addition of congruent connectives facilitated the integration of unbounded negation to a higher degree than bounded negation. These results provide the first demonstration of boundedness effects on eye movements in reading, and suggest representations of bounded entities are categorically discrete, whilst representations of unbounded entities are continuous.

Adults with autism are less likely to bury the survivors: An eye movement study of anomalous text reading

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We investigated effects of context on the time course of local and global anomaly processing during reading in high functioning adults with Autism Spectrum Disorder (ASD). Short texts contained anomalous target words that could only be detected through computation of global context (Passage Level Anomalies), or, that could be detected via computation of a local thematic violation (Sentence Level Anomalies).

For sentence level anomalies the ASD group, in contrast to the TD group, showed early anomaly detection coupled with immediate attempts to resolve the anomaly, as shown by regressive eye movements from the critical target word upon fixation.

Conversely, for the passage anomaly condition the TD group showed early detection of the anomalies, followed by immediate attempts to resolve these, as indicated by increased regressive eye movements once the critical word had been fixated. In contrast the ASD group did not immediately regress in order to resolve the anomalies, with attempts to do that apparent only in the later processing measure of total fixation time.

The findings, which show the opposite effect for the two groups, are in line with predictions derived from two converging cognitive theories of ASD, namely Weak Central Coherence and Disordered Complex Information Processing theory.

The use of world knowledge during reading in adults with autism spectrum disorder

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The aim of this experiment was to examine the on-line use of world knowledge during reading in adults with autism spectrum disorder (ASD). We recorded the eye movements of participants with and without ASD as they read sentences that were manipulated to include plausible (control condition), implausible (possible but highly unlikely) or anomalous (impossible) thematic relations. Our data indicate that the fixation patterns of the TD and ASD groups did not differ when reading plausible or anomalous sentences. Both the TD and ASD readers showed rapid detection of the anomalous violations, as evidenced by first fixation durations upon the target word, with disruption to reading continuing into post target processing. The TD readers also detected the implausibilites almost immediately, as evidenced by first fixation durations, and disruption as a result of implausibility was restricted to the target region. In contrast and critically, the ASD readers did not show any disruption as a result of the implausible manipulations during first pass processing of the sentences. These findings suggest that ASD readers are less likely to immediately evaluate implausible target words as violations of world knowledge during on-line interpretation in sentence reading.

Imagining counterfactual worlds in autism spectrum disorder

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Counterfactual reasoning is an important part of social communication. Specific impairments in this ability, as well as difficulty with imaginative thinking, are common in people with Autism Spectrum Disorders (ASD), however only a handful of published studies have empirically tested counterfactual thinking in this group. We present two eye-tracking experiments that explore how imaginability influences counterfactual reasoning in individuals with ASD and typically developing (TD) participants in an anomaly detection reading task. Experiment 1 depicted everyday events that incur a minimal change from reality (e.g. "If Joanne had remembered her umbrella, her hair would have been dry/wet…"). Experiment 2 described alternative versions of known historical events that require readers to suspend their knowledge of reality and imagine a novel version of the world (e.g. "If Spain were not a member of the European Union, they would pay for things using Pesetas/Euros…"). Factual contexts ("Because…") provided a baseline measure of contextual integration. Results revealed similar comprehension strategies for TD and ASD groups (faster counterfactual inconsistency detection in Experiment 2 than 1). However, autistic participants were more likely to regress back to aid comprehension of a counterfactual world, and were faster to detect the factual inconsistency in Experiment 1 than TD participants.

From the counterfactual to the future: The mediating role of normative inference

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Counterfactual thinking is the process of considering how things could have turned out differently for better or worse, usually taking the form of counterfactual conditionals, such as 'If I had studied more, I would have passed the exam'. This study examined the psychological mechanisms that transform counterfactuals into normative ('deontic') guidance rules for the future. We examined how counterfactual thinking translates into judgements about what an agent must, must not, should, should not, may and need not do by asking participants to infer these deontic conclusions from counterfactual premises. Participants were presented with a vignette and a counterfactual conditional, and assigned to either a control condition or a suppression condition in which they were presented with conflicting normative rules. In line with previous finding, the presence of conflicting norms reduced the likelihood of positive deontic conclusions being endorsed and increased the likelihood of negative deontic conclusions being endorsed. Participants in the suppression condition expressed lower degrees of counterfactual regret relative to the control condition, as well as lower degrees of intention to take the behaviour in the future. Hence, the same conditions that affect normative inference also affect counterfactual regret and counterfactual future planning, suggesting similar cognitive mechanisms underlie both.

Session A

Intolerance of uncertainty modulates the insensitivity to reinforcer devaluation found in an avoidance task

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The reinforcer devaluation paradigm has been regarded as a canoncial paradigm to detect habit-like behavior. Avoidance situations set a scenario where habit-like behavior may be of great experimental and clinical interest. On the other hand, proactive intolerance of uncertainty has been shown as a factor facilitating responses in uncertain situations. Thus, avoidance situations in which uncertainty is favoured, may be taken as a relevant paradigm to examine the role of intolerance of uncertainty as a facilitatory factor for habit-like behavior. We used a free-operant discriminative avoidance procedure to implement a devaluation paradigm. Participants learned to avoid an aversive noise presented either to the right or to the left ear. After the devaluation of one of the noises, they went through a test phase identical to the avoidance phase except that the noise was never administered. Sensitivity to reinforcer devaluation was examined by comparing the response rate to the cue associated to the devalued reinforcer with that to the cue associated to the still aversive reinforcer. The results showed that intolerance of uncertainty was positively associated to insensitivity to reinforcer devaluation. Finally, the theoretical and clinical implications of the habit-like behavior obtained in our avoidance procedure are discussed.

Associative interference and information processing: From learning about contexts to simply learning

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Interference is claimed as one of the main factors determining context-specificity of information retrieval. It is assumed that the conflict interference produces leads the organism to pay attention to the context, so that retrieval of either conflicting information, or all the information learned within an attended context, would become context-specific. The most striking support for this claim comes from the experiments showing that retrieval of consistent information learned after interference training becomes context specific, even when the new information is learned outside of the context where interference took place. Traditional views suggest that the effect of interference on attention is specifically attuned to the context. Alternatively, interference treatments may produce an unspecific increase on

attention that would lead to a general improvement in subsequent learning. The results of experimental series recently conducted in our laboratory within nonhuman and human animal associative learning seem to back up this latter alternative. Data are presented showing that an interference treatment may facilitate spatial learning in a water-maze, temporal conditioning of magazine training, and learning of complex discriminations in human predictive learning. Implications for the understanding of the role of interference in context processing are discussed.

Outcome responsiveness and time processing in contingency learning: Effects of depressed mood

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People judge outcomes as more contingent on actions when outcomes occur more frequently over time. However, depressed people are not similarly sensitive. Although this might be due, in part, to impaired context processing, depression's effects might be exacerbated by reward insensitivity. Average outcome rate or outcome density (OD) is a relative 'value' calculated over time (*f*reward/ time). Impairments in temporal processing would thus also influence OD effects on contingency judgements. We report experiments testing how properties of the outcome (rate, magnitude) affect contingency learning over time in depressed and non-depressed people. We used a 'constrained' free-operant contingency learning procedure, in which participants test the control of their actions over sound onset. They were required to leave periods of time in between responses to create 3, 9 or 15s time-bins (using "elephant counts"). In addition, OD and outcome magnitude were manipulated. For non-depressed but not depressed participants, OD effects were stronger with longer durations and greater outcome magnitude significantly increased contingency judgements overall. Depressed participants were less sensitive to OD and outcome magnitude, especially over longer periods of time. Findings are discussed in relation to associative learning theories and provide elucidate reward insensitivity in depression and the effect on contingency experience.

Reducing the illusion of causality by reducing processing fluency: The role of a hard-to-read font

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The illusion of causality arises when people believe that a causal relationship exists between two events that are causally unrelated. It arises mainly when the potential outcome, the potential cause, or both, occur frequently, thus increasing the number of coincidences.

Associative theories of learning readily explain these biases. They predict that the increase in the number of coincidences should increase the strength of the cause-effect association. However, they are silent with respect to the effect that manipulating other variables, such as the fluency with which the information is processed, should have. Reducing fluency by using a hard-to-read font has been shown to attenuate other cognitive biases. We tested whether it could reduce the illusion of causality as well. We used a standard causal learning procedure, which was presented either in an easy-to-read or a hard-to-read font. Participants in the easy-to-read font reproduced the causal illusion, which was significantly attenuated in the hard-to-read group. This suggests that a more automatic associative processing mode tends to occur by default in causal learning situations but can be replaced by a slower, effortful processing mode when conditions make the acquisition process less automatic.

Control of cue competition effects by associative history and instruction

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The anticipation of an impending outcome based on current environmental cues affects both decisions to act but also future learning about those cues and outcomes. The blocking effect is perhaps the clearest example of this to arise from associative learning research. Outcome expectancies can be learned through past experience with cue-outcome contingencies (associative history) or via explicit verbal knowledge passed on to the individual (instructions), and previous research suggests that both have a key role to play in conditioned responding, judgements of causation and selective attention. In a series of experiments, we investigated how expectancies based on a combination of associative history and instructions determine the course of new learning. The results suggest that expectancies from these sources are interactive but do not combine in a simple additive fashion to determine cue competition effects like blocking.

Previous predictive validity influences acquisition of biconditional discrimination

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The predictive validity of a stimulus influences subsequent associability; a previously informative stimulus will be attended to and learnt about more readily than a previously uninformative stimulus (Mackintosh, 1975). The implications of Mackintosh's model for configural learning are complex. For instance, while enhancing the associability of a stimulus should improve subsequent learning, enhancing the associability of only one of two co-occurring stimuli might be expected to interfere with subsequent configural discrimination (Holland & Haas, 1993). We tested the effect, in humans, of predictive validity training on the components of compound stimuli, prior to a biconditional discrimination. The two stages

involved different stimuli, of the same dimensions (e.g., different colours, or different shapes), ensuring effects cannot be attributed to associations acquired in training. Training stimulus dimensions to differ in predictive validity reduced the rate of biconditional discrimination compared to training both stimulus dimensions to be predictive or irrelevant. These effects were in same direction as observed when the physical salience of stimuli was manipulated directly. The implications of these findings for conditional and configural accounts of biconditional discrimination are discussed, in relation to Mackintosh's (1975) model. The findings have wider implications for contextual control of learning and memory.

How do signs affect the perception of information during sign-supported speech?

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The current study intends to determine the role of signs in transmitting information to deaf people by exploring the gaze behaviour when perceiving sign-supported speech (SSS), a method of communication that involves the simultaneous production of signs and speech,. Forty-nine deaf adolescents, wearing either cochlear implants or hearing aids, participated to this study. Fourteen participants were native Spanish sign language (LSE) users. The task consisted of watching a set of videos of subject-verb-object sentences using SSS. Sign and speech referring to the sentence's object were either consistent or inconsistent. Participants selected from four options displayed on a screen the image related to the object as communicated by speech. Crucially, in the inconsistent condition, results indicated that the image reflecting the information provided by speech was more likely to be selected, although native LSE users chose the competitor image related to the sign to a larger extent than non-native LSE users. With respect to eye movements data, we computed the log gaze probability between fixations from the onset of the ambiguity: not significant differences were detected between the consistent and the inconsistent condition. However native signers, as a whole, had different pattern gaze than non -native LSE users.

Session B

Free recall of early and late acquired pictures and words in pure vs mixed lists: Strategies in recall?

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Although the advantage of early over late acquired items in lexical/semantic tasks is well documented, contradictory evidence has been reported in free recall tasks where late items are better remembered than early items (Dewhurst, Hitch & Barry, 1998). Additionally, frequency and list type have been reported to influence recall where high frequency words are better recalled in pure lists; remarkably, this effect disappears when the same items are presented in mixed lists in English (Dewhurst, Brandt & Sharp, 2004). Previously, list type was also found to influence word naming in Turkish (Raman, Bauch & Besner, 2004). The objective was to partially replicate Dewhurst and colleagues' work in Turkish to shed light on what influences picture/word recall especially from an orthographic transparency perspective. Participants (N=80) were students recruited from Yeditepe University and were assigned to either a picture (N=40) or a word condition (N=40) in which stimuli were presented in either a mixed or a pure list. Following a distracter task, participants were asked to recall as many pictures or words as they could remember from the list they viewed. The findings lend partial support to findings in English and the implications are discussed within the context of theoretical frameworks.

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Dewhurst, S. A., Hitch, G. J., & Barry, C. (1998). Separate effects of word frequency and age of acquisition in recognition and recall. *Journal of Experimental Psychology: Learning, Memory and Cognition, 24*(2), 284-298.

Raman, I., Baluch, B., & Besner, D. (2004). On the control of visual word recognition: Changing routes versus changing deadlines. *Memory and Cognition, 32*(3), 489-500.

Prices are not special: Componential processing of price comparison

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Multi-symbolic quantities (two-digit numbers, negative numbers, measurement units, etc.) seem to be processed compositionally: the constituent symbols are analyzed separately in comparison tasks. However, there are only one study with price comparison and it suggests that prices are processed holistically (Cao, Li, Zhang, Wang, & Li, 2012). In two experiments, we explored the componential vs. holistic processing of prices. Participants judged the larger of two prices with simultaneous presentation (Experiment 1) and sequential presentation (Experiment 2). The prices to be compared were digit-monetary category compatible (e.g., 4 Euros - 3 Cents, where 4 > 3 and Euros > Cents) or incompatible (e.g., 3 Euros - 4 Cents, where 3 < 4 but Euros > Cents). In both experiments, price comparison was performed better in the compatible vs. compatible condition. These results confirm the componential processing of prices.

Cao, B., Li, F., Zhang, L., Wang, Y., & Li, H. (2012). The holistic processing of price comparison: Behavioral and electrophysiological evidences. Biological Psychology, 89, 63–70. doi: 10.1016/j.biopsycho.2011.09.005

Adjunctive behaviour and performance in a temporal bisection task

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Adjunctive behaviours are those that appear during intermittent reinforcement schedules when there is no explicit contingency between the occurrence of those behaviours and the delivery of the reinforcer and are characterized by its relative excessiveness. Recently it has been suggested that adjunctive behaviours are part of a behavioural pattern that fills inter-reinforcement times and is reinforced by the delivery of food at the end of the interval. Having the opportunity to engage in adjunctive behaviour, such as excessive drinking, can help organisms develop a more stable behavioural pattern which can result in a better performance on temporal tasks. The purpose of this study was to evaluate the effect of having the opportunity to engage in an adjunctive behaviour in a temporal bisection task (TBT). Male Wistar rats were divided in two groups (access/no access to water in the experimental chamber) and were exposed to a TBT: they learned to discriminate between a 10-s and a 40-s stimulus and then were tested with stimuli of different durations. Rats with access to water in the experimental chamber learned the behaviour faster than those without access, but there were no differences in the test.

Measuring intuition inhibition without math: Developing a verbal test of cognitive reflection ability

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The Cognitive Reflection Test (CRT) measures intuition inhibition – the cognitive ability to resist compelling but incorrect intuitions – in three simple mathematical problems. It rapidly became popular for its impressive power to predict how well people reason and make decisions. Despite the popularity of the CRT, three issues complicate its interpretation and threaten its continued use. (1) The numerical nature of the CRT confounds reflection ability with mathematical ability. (2) The statistical and psychometric properties of the CRT are imperfect. (3) An increasing proportion of participants are already familiar with the CRT. We have overcome these issues by developing a novel measure of cognitive reflection using verbal problems with low familiarity and with good statistical and psychometric properties: CRT-Verbal. First, we selected suitable items with relatively low familiarity and optimal difficulty as identified in two different populations (Studies 1 and 2) and with high content validity as judged by an expert panel (Study 3). Second, we demonstrated a good internal consistency and a test-retest reliability (Study 4) as well as criterion and construct validity of the test in different populations (Studies 5-7). We discuss the implications of these findings for research in thinking and reasoning, decision-making and moral cognition.

Do do do, the the the: Interactivity and articulatory suppression in mental arithmetic

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Doing long sums in the absence of complementary actions or artefacts is a multi-step procedure that quickly taxes working memory; congesting the phonological loop further handicaps performance. In the experiment reported here, participants completed long sums either with hands down—the low interactivity condition—or by moving numbered tokens—the high interactivity condition—while they repeated 'the' continuously, loading the phonological loop, or not. As expected articulatory suppression substantially affected performance, but more so in the low interactivity condition. Independent measures of basic arithmetic skill and mathematics anxiety moderated the impact of articulatory suppression on performance in the low but not in the high interactivity condition. These findings suggest that working memory resources are augmented with interactivity, underscoring the importance of characterizing the properties of the system as it is configured by the dynamic agent-environment coupling.

Predicting individual growth rates in mathematical achievement

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Research in understanding children's individual differences in mathematical achievement has been flourishing. Various abilities have been identified as being important predictors: children's IQ, Working Memory (WM), counting abilities, and their ability to compare and/or conduct simple arithmetic with nonsymbolic (i.e., abstract quantities) or symbolic (i.e, in their Arabic form) numbers. So far, focus was placed only on children's *average* general mathematical achievement. In reality, though, all individuals develop at their own rate. We addressed the question: Which cognitive predictors uniquely predict children's *individual growth rates*? We conducted a large-scale longitudinal study assessing children's general mathematical achievement in the beginning and end of grades 1 and 2. Latent growth modeling revealed that children's performance on all components of WM, their IQ, counting skills, nonsymbolic approximate comparison, symbolic approximate comparison and addition explained individual differences in children's initial status in mathematical achievement. Children's performance in the symbolic approximate addition task (i.e., in the form of "a+b" vs. c, which was larger?), however, was the only skill that uniquely predicted individual growth rates in mathematical achievement until the end of grade 2. This study highlights the importance of children's approximation skills and brings forth important implications for interventional designs and mathematics education.

Academic underachievement: who and why?

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Who and why do some underachieve academically relative to their potential (URP)? A multimodal theory was suggested (Krouse & Krouse, 1981), but is untested. The verbal and spatial reasoning tests for children (VESPARCH; Mellanby, McElwee & Badger, 2016) are accessible to all backgrounds and fairly identify URP.

In study 1, we tested 2,176 children from years 3 - 7 on VESPARCH. We identified 127 URP children. They were tested for phonological decoding, short-term memory and complex grammar. Time taken was also considered. In study 2, we tested 122 year 6 children on VESPARCH and the psychosocial Strengths and Difficulties Questionnaire (Goodman, Meltzer & Bailey, 1998) and identified 10 URP children.

In study 1, we found that 71% of URP children had one or more academic or cognitive difficulty, with 3% experiencing difficulties with all four factors. However, 29% showed unidentified difficulties. In study 2, URP children had a higher than average score for

hyperactivity and 60% experienced one or more psychosocial difficulty.

There are multiple academic, cognitive and psychosocial barriers to achieving potential. Future work should investigate whether one of the identified factors is more or less likely to cause URP than any other single or combination of factors.

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Krouse, J. H., & Krouse, H. J. (1981). Towards a multimodal theory of academic underachievement. *Educational Psychologist, 16,* 151-164

Mellanby, J., McElwee, S., & Badger, J. (2016). Verbal and spatial reasoning tests for children: VESPARCH. Cambridge: Cambridge Assessment.

Session C

Do people with autism spectrum conditions have a more rational decision making style?

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People with autism spectrum conditions (ASC) can show a reduced sensitivity to context (e.g., Shah & Frith 1993). We hypothesised that this characteristic of ASC might extend to decision making tasks, making people with ASC less susceptible to context-induced preference reversals. The attraction effect (Huber, Payne & Puto, 1982) is a contextual preference reversal where the addition of an obviously poor alternative to a choice set reverses preference between the original members. This effect demonstrates that people do not evaluate alternatives independently of one another as required by rational value-maximising models (e.g., Luce 1959). In a first experiment we tested for the attraction effect in decisions made by people with low and high levels of autistic traits. We found a significantly increased tendency to make consistent choices among people with high levels of autistic traits. In experiment two we tested for the attraction effect in people diagnosed with an ASC, and in matched neurotypical (NT) controls. The ASC group showed significantly greater consistency in their decisions than the NT group. These results suggest that decision making in ASC may follow a more effortful and rational style than in the NT population.

Huber, J., Payne, J. W., & Puto, C. (1982). Adding asymmetrically dominated alternatives: Violations of regularity and the similarity hypothesis. *Journal of Consumer Research, 9*(1), 90–98.

Luce, R.D., (1959). *Individual Choice: A Theoretical Analysis*. New York: Wiley

Shah, A., & Frith, U. (1993). Why do autistic individuals show superior performance on the block design task? *Journal of Child Psychology*

Local and global limits to orientation processing in autistic children

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A recent study showed increased integration of motion information in autistic children compared to typically developing children (Manning et al., 2015). Here, the paradigm was extended to investigate whether integration of orientation information is also atypical. An equivalent noise approach was used to quantify local and global limits to orientation processing in 26 autistic children aged 6 to 14 years and 27 age- and ability-matched typically developing children. Children were asked to determine the overall orientation of a

field of randomly positioned Gabor patterns, within the context of a child-friendly 'game'. Autistic children showed similar degrees of sensitivity to orientation information as typical children both when the Gabor patterns shared the same orientation, and when the Gabor patterns had variable orientations. Equivalent noise modelling revealed that autistic children had similar levels of internal noise and averaged over a comparable number of samples as typical children. The autistic children also had similar thresholds as typical children in an orientation coherence task. Orientation discrimination thresholds were not related to levels of autism symptomatology or parent-reported sensory processing. These results speak against theories of autistic perception proposing atypical local versus global processing, and altered levels of neural noise.

Manning, C., Tibber, M. S., Charman, T., Dakin, S. C., & Pellicano, E. (2015). Enhanced integration of motion information in children with autism. *The Journal of Neuroscience, 35(*18), 6979-6986.

Understanding perceptual judgement in autism using the drift diffusion model

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2AFC tasks are widely used to provide insight into perception / cognition in individuals with autism spectrum disorder (ASD). However, accuracy and response time data provide only limited information regarding the specific cognitive processes underlying decision making. The drift diffusion model (DDM, Ratcliff & McKoon, 2008) enables some of these processes to be identified. Here, for the first time, we have use the DDM to investigate perceptual decision making in ASD.

Participants with and without ASD indicated whether a target grating was oriented clockwise or anticlockwise with respect to an obliquely orientated reference grating. Behavioural results showed that participants with ASD responded more slowly than controls, but the groups did not differ in accuracy. Modelling results indicated that: (i) participants with ASD were more likely to generate slow but accurate responses, (ii) processes that are not directly related to the perceptual decision such as encoding or response execution take longer in individuals with ASD and (iii) the quality of evidence extracted from the stimuli did not vary between groups. These data indicate that differences in non-perceptual components of the decision making process may underlie increased response time in participants with ASD rather than a perceptual or cognitive deficit per se.

Ratcliff, R., & McKoon, G. (2008). The diffusion decision model: theory and data for two-choice decision tasks. *Neural computation, 20*(4), 873-922.

Peer problems and low self-esteem mediate the schizotypy – reactive aggression relationship

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Very little prior research exists on aggressive behavior in children with schizotypal and paranoid features, and almost no research on factors that may help explain this relationship. This study assesses whether paranoid and non-paranoid features of schizotypy are associated with reactive forms of aggression, and if peer problems and low self-esteem mediate this relationship.

1,301 8- to 14-year-olds were assessed on the child Schizotypal Personality Questionnaire, Social Mistrust Scale, and the Reactive-Proactive Aggression Questionnaire. A serial multiple mediation model was conducted to test whether a causal flow from schizotypy / suspicious schizotypy to peer problems to low self-esteem led to increased aggression.

Increased paranoid and non-paranoid features of schizotypy were both associated with increased aggression, particularly the reactive form. Peer problems and self-esteem mediated the relationships between schizotypy and reactive, but not proactive aggression. Children with higher levels of schizotypy were more likely to have peer problems and lower self-esteem, which in turn was associated with reactive aggression.

Results provide an initial explanatory model of why children with paranoid and non-paranoid schizotypal features are more likely to be reactively aggressive. Therapeutic implications to enhance self-esteem in schizotypal adolescents may help reduce their co-morbid reactive aggressive behavior.

Cross-cultural theory of mind: Self/other differentiation in individualist versus collectivist cultures

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Theory of Mind (ToM) refers to the ability to compute and attribute mental states to both ourselves and other people. This research explored potential differences in engagement of ToM processes between two different cultures, Western (individualist) and Chinese (collectivist), using a sample of healthy adults. Individuals from different cultural backgrounds have previously been shown to differ on a variety of dimensions, from personality traits to visual perception and spatial reasoning. However, there is currently very limited research on cross-cultural ToM abilities. In this study, participants completed a computerized false-belief task, in which they attributed beliefs to either themselves or another person, in a matched design, allowing direct comparison between 'Self' and 'Other' oriented

conditions. Results revealed that both native-English speakers and native-Chinese individuals responded significantly faster to self-oriented than other-oriented questions. Interestingly, results also showed that when a trial required a 'perspective-shift', participants from both cultures were slower to shift from Self-to-Other than from Other-to-Self. Results indicate that culture does not influence task performance, with similar results found for both Western and non-Western participants, suggesting core and potentially universal similarities in the ToM mechanism across these two cultures.

Children with autism spectrum disorder do show self-processing biases: Evidence from an ownership paradigm

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Self-concept is reported to be atypical in Autism Spectrum Disorder (ASD) and may be anchored within some of the associated social and cognitive impairments (the absent-self hypothesis - Frith, 2003). However, there are discrepancies in the ASD literature with both intact and impaired self-processing being reported (Gillespie-Smith et al., 2014; Lee et al., 1994). The current study aimed to explore self-processing biases in children with ASD using a more developmentally appropriate ownership paradigm (Cunningham et al., 2014). The ASD group (n = 18) were individually matched to groups of typical children based on chronological age (n = 18) and verbal mental ability (n = 18). Pairs of children (aged 4-15 years) sorted 56 picture cards depicting a range of different toys into self- and other-owned sets. A surprise recognition task revealed a significant memory advantage for self-owned items regardless of participant group. This effect was related to levels of socio-communicative ability within the ASD group. These results highlight that, children with ASD do have an intact self-concept and can show the same self-processing biases as their typical counterparts. This self-processing however is linked to the level of socio-communicative ability across ASD and may help to elucidate the earlier reported discrepancies.

Cunningham, S. J., Brebner, J. L., Quinn, F., & Turk, D. J. (2014). The self-reference effect on memory in early childhood. *Child Development, 85*, 808-823. doi:10.1111/cdev.12144.

Frith, U. (2003). *Autism: Explaining the Enigma* (2nd Edition). Oxford: Blackwell.

Gillespie-Smith, K., Doherty-Sneddon, G., Hancock, P., & Riby, D. (2014). That Looks Familiar: Attention allocation to familiar and unfamiliar faces in children with Autism Spectrum Disorder. Manuscript in press in *Cognitive Neuropsychiatry*, doi: 10.1080/13546805.2014.943365.

Lee, A., Hobson, R. P., & Chiat, S. (1994). I, you, me and autism: An experimental study. *Journal of Autism and Developmental Disorders, 24* (2), 155–176.

The relative role of viewpoint and identity in the neural representation of faces in fusiform gyrus

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Models of face processing propose that the fusiform face area (FFA) plays an important role in processing invariant aspects of faces such as identity. Recent studies have shown that patterns of response in the FFA can successfully decode individual identities across different viewpoints. However, other studies have reported that patterns of response in the FFA can successfully decode different viewpoints across different identities. Thus, the relative role of identity and viewpoint on the pattern of neural activity in the FFA remain unclear. Here, we used fMRI and a correlation-based MVPA to explore how identity and viewpoint of faces is represented in the fusiform gyrus. A 3x3 design was used with faces from three different identities shown from three different viewpoints. The results showed that viewpoint explained significantly more variance than identity in the fusiform gyrus. Next, we asked whether low level visual properties could explain these patterns of neural response. A strong positive correlation between the neural patterns and the underlying low-level image properties was evident in the FFA. Our results suggest that the neural representation of faces in the fusiform gyrus is based on the statistical properties of the image rather than higher level attributes, such as identity.

Session A

Neurocomputational mechanisms of prosocial learning

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Prosocial behaviours are essential for social bonding and cohesion, but the mechanisms that underpin these behaviours are still poorly understood. Empathy, the ability to vicariously experience and understand the affect of others, is hypothesised to be a critical facilitator of prosocial behaviours, but the mechanistic link between empathy and prosocial behaviour is still unclear. Using computational modeling and neuroimaging, we show that people can learn to benefit others and that this learning is underpinned by reinforcement learning signals in the subgenual anterior cingulate cortex (sgACC). The ventral striatum, a key region previously implicated in reinforcement learning, responded when learning to benefit ourselves, another person or no one, suggesting a general rather than a specific response during reinforcement learning. However, we also observed substantial individual variability. More empathic people learnt faster and had more selective responses in the sgACC when benefitting others. Our results reveal a novel computational mechanism driving prosocial learning in humans and why empathy and prosocial behavior may be linked. This new framework could help to explain reduced empathy and prosocial behavior in people with disorders of social cognition.

Symposium

An early development of executive attention

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The development of executive attention serves the child with mechanisms that allow an increased voluntary regulation of thoughts and feelings. The first signs of control are shown over orientation of attention around the second half of the first year of life, as infants disengage attention from an object and move it to explore another object of interest, or anticipate gaze to a location where they expect something is about to appear. In this presentation, I will show data from a recent longitudinal study aimed at tracing the early development of executive attention. The study involved initial participation of 100 infants, whose attention skills were measured in four waves of data collection: 9-12 (W1), 16-18 (W2), 24-28 (W3), and 36-40 (W4) months of age. Results reveal important individual differences in the early development of attention, which predict later performance of hot and cool executive tasks. We also studied individual differences in the early development of

attention in relation to temperament and home environment variables. We will discuss the importance of designing cognitive and neural markers of executive attention that can be used for the early detection of risk of developmental disorders involving attention.

Attention, working memory and dynamic brain activity

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Poor working memory is highly predictive of educational underachievement and developmental disorder. We have been using the dynamic electrophysiological information captured using MEG to explore the neurophysiological mechanisms that vary in line with a child's working memory capacity, their overlap with attention, and the extent to which they can be altered with intensive training.

Despite the high level of interest in the application of cognitive training, especially in childhood, very little is known about the neurophysiological mechanisms by which training gains are achieved. I will present data from a double-blind randomised controlled training study, in which we explore the underlying neurophysiological changes following training. We used new methods to explore the spontaneous coordination of electrophysiological signals at rest. Improvements in working memory after training were significantly associated with changes in functional connectivity between areas in fronto-parietal cortex and inferior-temporal cortex. During task performance we also observed enhanced coupling between the upper alpha rhythm (at 16 Hz), recorded in superior frontal and parietal cortex, and high gamma activity (at ~ 90 Hz) in inferior temporal cortex. This is the first demonstration that this hierarchically organised neuronal coupling can be measured in childhood and is associated working memory changes following training.

The role of attention in explaining the overlap between ADHD and autism spectrum disorders

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In recent years evidence has accumulated to reveal considerable overlap between Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorders (ASD). Despite this, there has been very little research designed specifically to test the neural mechanisms underpinning the overlap between these two conditions. Although previous research has suggested a social cognition deficit in ASD and sustained/executive attention deficits in ADHD, few studies have measured attention at multiple different levels and compared these two populations directly. The evidence I present will suggest that while there are some areas of specificity to one condition or the other, many aspects of attention, social and non-social, are similarly impaired in ADHD and ASD and may explain the high rates of overlap between the clinical phenotypes. Moreover, previous studies have often ignored the dimensional nature of the overlap between ADHD and ASD symptoms, meaning that even when co-occurring diagnoses are excluded from research, the effects of symptoms that fall

below the threshold for diagnosis are not investigated but could potentially explain some of the pattern of effects in each disorder. I present evidence indicating that measuring the dimensionality of these symptoms can increase our understanding of overlap between ADHD and ASD.

Auditory and visual attention in infants with disorders of known genetic origin

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Starting with Scerif's seminal research on infant attention comparing Fragile X and Williams syndromes, I will stress how cross-syndrome studies and a focus on error patterns can reveal more subtle impairments than comparisons with neurotypical controls, even when similar behavioural scores are attained. Cross-syndrome studies also help to differentiate syndrome-specific from syndrome-general deficits. I will illustrate this from some of our more recent studies of auditory and visual attention in infants/toddlers with Fragile X, Williams and Down syndromes, and show how early attention difficulties impact across domains on subsequent phenotypic outcomes.

Executive control and academic achievement in primary school children

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In a first study we aimed at exploring the relationship between different working memory (WM) components, as measured by tasks that make differential recruitment from executive control, and several mathematical skills in a sample of 102 primary school children. We observed a positive relation between verbal WM and both complex word arithmetic problems and mathematical concepts, whereas spatial WM was associated with the subtest Series, a test that requires solving numerical sequences. In a second study we explored the contribution of an executive function-based intervention program for primary school children from disadvantaged areas of the Region of Murcia (Spain). Children were assigned to two groups, the intervention group and the control group. Children from the intervention group carried out a series of sustained attention and working memory tasks embedded in a video game during 30 minutes twice a week, from January to May, as part of their school activities. The tasks were programmed with increasing levels of difficulty to measure each participant's progress. Children in the intervention group outperformed controls in some cognitive tasks and academic achievement. Specifically, the intervention group showed a larger improvement in their fluid intelligence, math and reading skills, and increased abilities to control on-going responses.

End of Symposium

Session B

Alexithymia, loss-chasing and problem gambling

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This research examines the relationship between loss-chasing, the propensity to continue gambling to recover from losses, alexithymia, a personality trait associated poor emotional processing, and problem gambling.

Three experiments are reported. In experiment 1, two groups (low alexithymia, high alexithymia) completed the Cambridge Gambling Task (CGT). Loss-chasing behavior was investigated. In experiment 2, both alexithymia (low, high) and impulsivity (low, high) were examined also using the CGT. In experiment 3 participants low and high in alexithymia and adult gamblers at low and high risk of problem gambling complete the CGT.

Experiment 1 shows loss-chasing behavior in participants high in alexithymia but not those low in alexithymia. Experiment 2 shows loss-chasing behavior in participants both low and high in alexithymia but it was greater for participants high in alexithymia. Loss-chasing behavior was correlated with the emotional facets of alexithymia but not the cognitive facet. In Experiment 3 alexithymia was associated with loss-chasing but problem gambling was not.

The tendency to loss-chase depends on the need to recoup previous losses and failure to process the emotional consequences of those losses. This is the case for both low and high risk problem gamblers.

Does manipulating heartbeat perception cause changes in perception of affect?

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A number of studies have demonstrated that individual differences in interoceptive sensitivity (as measured by heartbeat perception tasks), are related to individual differences in affective processing. For example, individuals with more accurate heartbeat perception are found to give higher arousal ratings for affective images. This study explored the causal direction of this relationship by using a novel, state manipulation of heartbeat perception. A repeated-measures design was used, with two conditions: one in which in which sound-dampening ear-protectors were worn, and a baseline condition in which they were not worn. Order of conditions was counterbalanced. During each condition, participants firstly completed the Schandry heartbeat perception task and then rated the arousal and valence of both neutral and angry facial expressions. It was found that as anticipated, wearing ear protectors significantly enhanced heartbeat perception. Arousal ratings were also higher for affective versus neutral images. However, manipulation of interoceptive accuracy had no effect on arousal ratings of images. Findings are discussed in terms of the implications for

both the physical basis of heartbeat perception and also the relationship between interoception and affect.

Development of the disgust concept in adolescence: When does the "disgust face" become disgusted?

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Disgust is one of the basic emotions that have evolved facial expressions proposed to communicate a single specific emotion. However, children do not associate the disgust face with disgust though they do so for situations that elicit disgust and the label disgusted. It is possible that the association of disgust with the disgust face develops in adolescence. This study compared adolescents' free labelling responses to facial expressions and situations for disgust. Older adolescents (15-17 years) used disgusted for disgust faces significantly more than younger adolescents (11-14 years), whereas there was no age difference for situations. To explore the age difference in adolescents' labelling of disgust faces, we turned to their most frequent "incorrect" response to the disgust faces: angry (60% of non-disgust responses). Younger adolescents labelled the disgust face as angry significantly more often than did older adolescents. Younger adolescents also labelled the disgust face as angry significantly more often than they did the disgust situation. Thus, although younger children label disgust situations as disgusted, it is not until late adolescence that they do so for the disgust face.

The simultaneous extraction of emotion and social categories from unfamiliar faces

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There is abundant evidence that people can very rapidly recognise different emotional expressions from faces. Recent research also suggests that multiple social categories – including age, race and sex – can be extracted rapidly from faces in a seemingly simultaneous and automatic manner. In the current research we examined whether the ability to recognise different emotional expressions from faces is impacted by the social category to which a face belongs. Across three experiments we asked people to make speeded face categorisation judgements (i.e., Expt. 1: sex classifications; Expt. 2 race classifications; Expt. 3 emotion classifications). The results indicate that people's ability to make attended face categorisations is modulated by unattended aspects of the face, with performance of each attended classification impacted by each unattended category. Notably, in Expt. 3 people

were faster and more accurate at recognising happy expressions for female faces relative to male faces and for white faces relative to black faces. Conversely, people were faster and more accurate at recognising angry expressions for male faces relative to female faces and for black faces relative to white faces. We discuss these findings in the context of models of face processing, emotion processing, person perception and social cognition more generally.

Reduced sensorimotor responses to laughter in children with conduct problems and high callous-unemotional traits

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Listening to laughter activates motor/premotor cortical regions that are also involved in the production of emotional expressions. Such auditory-motor interactions are thought to facilitate the mirroring of others' emotions during social interactions, providing a mechanism for promoting affiliation. Youth with conduct problems and high levels of callous-unemotional traits (CP/HCU) are characterised by lack of lasting social bonds and reduced enjoyment of pro-social interactions. Using fMRI, we examined neural responses during passive listening of laughter in three groups of children: CP/HCU (n = 32), CP with low CU (CP/LCU; n = 30), and typically developing children (TD; n = 31). Compared with TD children, those with CP/HCU (but not CP/LCU) showed decreased neural responses in the supplementary motor area and anterior insula, areas that form part of the auditory-motor system previously shown to be involved in processing laughter in typical adults. In an off-line behavioural task, children with CP/HCU reported feeling less inclined to join in with others' laughter than TD children Group differences in anterior insula response to laughter partly explained group differences in experienced laughter contagiousness between CP/HCU and TD children. Atypical processing of laughter may be an early marker indexing social-affiliative deficits conferring risk for adult psychopathy.

The effects of discrete emotion categories on word processing and memory: disgust and fear

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Most of the research on emotional word processing and memory has been conducted from a dimensional theoretical perspective, according to which the emotional content of words can be described in terms of valence and arousal. An alternative theoretical approach assumes a limited number of discrete emotions. This approach has been supported mainly by research focused on facial expressions and images. In contrast, the use of words has been

very limited. In the present study we aimed to test whether discrete emotions affect word recognition and memory above and beyond valence and arousal. We selected a set of disgust-related words and a set of fear-related words that were matched on arousal and valence. In experiment 1, a lexical decision task (LDT) and a surprise free recall task were included. In Experiment 2, the LDT was followed by an unexpected recognition task. Results revealed that both disgust-related and fear-related words were responded slower than neutral words in the LDT. In contrast, only disgust-related words were better remembered and recognized than the other two sets. These results point out the role of discrete emotions in word processing and memory and the relevance of the task employed in the pattern of findings obtained.

'Offset analgesia' may reflect poor sensitivity to decreases in nociceptive heat

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Small decreases in nociceptive heat were thought to yield disproportionately strong relief from pain, a phenomenon called 'offset analgesia'. Previous studies used intensity ratings, which potentially confound perceptual sensitivity and post-perceptual bias. We measured offset analgesia using two-interval forced choice staircases to find perceptual thresholds for increases and decreases in nociceptive heat. We delivered either radiant heat (CO_2 laser) or contact heat (Peltier thermode) stimulation. In decrease detection staircases, participants reported which of two stimuli contained a temperature decrease. In decrease discrimination staircases, both stimuli contained a decrease, and participants reported which decrease was larger. Increase detection and discrimination thresholds followed the same procedures. In separate blocks, participants rated the intensity of similar stimuli on a 0-10 scale, allowing us to compare our findings to previous studies that used rating scales. We found higher detection and discrimination thresholds for decreases in nociceptive heat than for increases, regardless of whether radiant or contact heat was used. That is, decreases in nociceptive heat were difficult to perceive. Moreover, intensity ratings showed no evidence of offset analgesia. Thus, offset analgesia may reflect poor sensitivity to decreases in nociceptive heat, rather than an effect by which small decreases are perceived as large.

Session C

Measuring the approximate number system in ageing - the problem of visual confounds

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Some studies have indicated declined acuity of the Approximate Number System (ANS) in ageing, whereas others have found preserved ANS acuity in older age. The ANS is often measured with comparison tasks: participants decide which of two arrays of coloured dots is most numerous. In ensuring that numerical abilities are measured, visual features (dot size, cumulative area) are manipulated, whereby these features become confounds due to being negatively correlated with numerosity. During such trials the incongruent visual cue must be inhibited to make a numerosity judgement. Therefore, older adults may show declined ANS acuity on such tasks due to declined inhibition. However, convex hull (the perimeter around each array) may influence performance to a greater extent than other visual cues. Due to a decline in inhibitory control in older age, the impact of convex hull congruency (whether the more numerous array has the largest or the smallest convex hull) on ANS acuity in ageing was investigated. Although convex hull strongly predicted performance across participants, the influence of convex hull was found to be amplified in ageing. The findings indicate that prior conclusions regarding declined ANS acuity in ageing may have been unreliable due to the visual confounds present in ANS tasks.

Predicting survival, cognitive integrity and quality of life in old age

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Three analyses of 20 year longitudinal data examined how physical health, depression, lifestyle (number and kinds of daily activities and amount of exercise), scores on tests of intelligence, memory, speed and vocabulary jointly predict duration and quality of life. Demographic factors (Socio-economic advantage, Years of education, Sex, and city of residence) were also taken into account.

The strongest predictors of mortality were self-rated health and longitudinal decline in information processing speed. Lifestyle factors accounted for significant variance. A second analysis found that Health, Intelligence test scores and Sex were also strong predictors of depression. A third showed that when interpreting the effects of depression as

indexed by scores on instruments such as he Beck or Yesavage depression scales caution is necessary because different factors predict gradations of depression within high and low ranges of scores. We discuss implications for interventions to improve duration and quality of life in old age, and for the methodology of future longitudinal studies.

Selective tuning of cognitive control during instructed novel task preparation

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Preparatory processes allow the optimization of behavior based on specific goals (Sakai & Passingham, 2006). Several studies suggest that the preparation and implementation of novel tasks, where a new set is created for each trial by means of rapid instructed task learning, differ from processes elicited by classic task-switching paradigms (Cole, Laurent, & Stocco, 2013). However, how novel tasks sets are established in the brain remains unclear. In this fMRI study, using verbal complex instructions, we observed a pattern of frontoparietal activations during the encoding, preparation and implementation of novel tasks, as well as the involvement of category specific regions during this later stage. Moreover, a multivariate pattern analysis decoding the content of instructions during preparation showed the involvement not only of frontoparietal areas but also of parts of the temporal lobe and parahippocampal regions. Additionally, we observed correlations between participants' behavior and the accuracy of the decoder in the parahippocampal cortex during preparation, and in the inferior frontal junction during task implementation. Altogether, our results suggest the behavioral relevance of the representations of stimulus contents in cognitive control and mnemonic associative brain areas during preparation and implementation of novel demanding tasks.

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Sakai, K., & Passingham, R. E. (2006). Prefrontal set activity predicts rule-specific neural processing during subsequent cognitive performance. *The Journal of neuroscience, 26*(4), 1211-1218

Can we prepare to attend to one of two voices?

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It is well known that we can selectively attend to one of two simultaneous speakers,

even when the voices do not differ in location. But can we tune our attention setting for a voice effectively before speech is heard? The question acquires additional interest in the light of recent evidence from task-cueing experiments with visual stimuli that the attentional component of task-set may be resistant to advance reconfiguration, so that the "stickiness" of attention contributes significantly to "residual" task-switch costs (see Monsell, 2015). Koch et al (2011) have claimed that pre-cueing attention to one of two voices by gender is completely ineffective in reducing the cost of switching between voices. In our experiments, participants heard two digit names spoken simultaneously, one by a male and one by a female voice. A cue preceding the stimulus told the participant which voice's digit to classify as odd or even. When the voices were those of the participants' parents, advance cueing reduced, by about half, the substantial RT cost of switching voices from trial to trial. A second experiment explored preparation for less familiar voices.

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The directionality of the exploration of graphic stories changes the temporal and numeric mental lines

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The standard view of the experiential origins of the numeric/temporal mental lines suggests that reading plays a key role. Two facts challenge this view: first, recent studies showed spatial biases revealing those analog representations in preliterate children; second, blind people show a dissociation between the number and time lines, suggesting that the number - but not the time - line originates in experiences of finger counting. The present study is aimed to test the causal efficacy of a kind of directional experience which might underlie preliterate children's spatial biases: the scanning of pictures in children's books. Moreover, we tested whether scanning directionality has similar effects on the number and time lines. Adult Spanish participants watched a silent comic book with frames presented one-by-one with left-to-right/right-to-left directionality. They then carried out two comparison tasks, one with single digits (smaller/greater than 5) and other with months (earlier/later than June). Results showed that 1) scanning directionality can change the spatial biases linked to the number/time lines; 2) the effect was analogous on both mental lines. This supports the picture scanning direction causal efficacy, suggesting that these experiences might produce preliterate biases. Moreover, they suggest a common experiential bases for both mental lines.

Automatic processing of number identity and place-value in multi-digit numbers

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The Arabic numerical system employs two dimensions to create multi-digit numbers: digits symbols and place-value. The present research explores in two numerical Stroop experiments to which extent number identity and number place-value processing is automatic in four-digit numbers. Whereas the automatic coding of place-value has been stated previously (see Kallai & Tzelgov, 2012), this has been studied in isolation using similar numbers (e.g., 0400-0040). Experiment 1 explored the access to numbers identity. Fifty-five volunteers were presented with pairs of four digit numbers that differed in one number (e.g., 0400-0600). They had to decide which number string was presented in bigger font size. Congruity between the physical size and the numerical value, distance between the numbers, and position of the discrepant numbers within the string, were manipulated. Results revealed congruity effects that were modulated by distance and position. Experiment 2 (N=90) jointly manipulated size congruity at the place-value (PV) and at the number identity (NI) dimensions (e.g., congruent NI & PV: 0100-5000; congruent NI & incongruent PV: 1000-0500; incongruent NI & congruent PV: 0500-1000; incongruent NI & incongruent PV: 5000-0100). Data analyses indicated an interaction between place-value and identity showing the automatic and simultaneous processing of both dimensions in four-digit numbers.

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Fighting phishing. Improving users' awareness about electronic fraud by discriminative training

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Phishing is a form of online identity theft that generates significant corporative and individual damages. In a typical scenario, users are lured to visit fraudulent websites carefully designed to resemble a legitimate site. Visual similarity between fake and legitimate websites is a key factor for the success of the scam; therefore, increasing sensitivity to physical differences may reduce human vulnerability at this level. An experiment was designed to assess the effectiveness of discriminative training as an anti-phishing strategy. Participants were asked to categorize website screenshots as coming from either a legitimate or a spoofed

website. One group was trained with the target discrimination (legitimate vs. very similar fake website) whereas another group was trained using and easy-to-hard procedure (i.e., presenting pairs of stimuli that were progressively more similar until the target discrimination is reached). Results showed better accuracy after training with progressively more difficult discriminations than when training involved only the highest level of difficulty (easy-to-hard effect). Implications for the design of strategies to prevent phishing are discussed.

An algorithm for stimuli selection in psycholinguistic studies with factorial designs

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Factorial designs are one of the most fertile methods of study in psycholinguistics. A factorial design in this field often involves the discretization of a continuous variable, and the experimental control of all those other variables that may covariate with the one of interest. However, with the increasing refinement of language processing models and the new discoveries about which variables can modulate these processes, stimuli selection for experiments with a factorial design is becoming a tough task. Consequently, nowadays this task can be very time consuming and error prone.

In order to assist experimenters in the stimuli selection task, we present an easy-to-follow method in the form of an algorithm with six well-defined steps. The method is based on K-means clustering as a way to detect small and tight clusters of words that match in the desired variables. Our proposal is halfway between a full manual selection, and a completely automated one, thus, it combines the best of both approaches. We have also developed an SPSS syntax that helps in choosing the correct size of the clustering.

Competition between cues in noun category learning

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Noun categorization or classification systems, like gender, are extremely common in natural languages. The class to which a given noun belongs in a language is often determined by what that noun means, but also the phonological features of the noun (e.g., what sound it ends in). Learners acquiring noun classification systems must therefore infer the particular set of (often probabilistic) cues which are relevant for their language. Previous work has shown that learners rely disproportionately on phonological cues (e.g., Karmiloff-Smith, 1981; Gagliardi & Lidz, 2014). Surprisingly, this occurs even when semantic cues are highly reliable predictors of class. In this paper, we investigate two possible explanations for this: first, that phonological cues are more salient to learners than semantic cues, and second that phonological cues are generally available earlier than semantic cues. We show that adult learners' treatment of conflicting cues to noun class in a miniature artificial language depends on *both* the saliency of the cues, and their early availability. Importantly, for equally salient cues, learners prioritize the earlier-learned cue. Our findings suggest a possible mechanism for children's over-reliance on phonology: children start building their classifications systems very early–when phonological information, but not word meanings are available.

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Gagliardi, A. and Lidz, J. (2014). Statistical insensitivity in the acquisition of Tsez noun classes. *Language*, 90(1):58–89.

Examining the influence of syntactic position on the attachment of ambiguous relative clauses in Spanish

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Since Cuetos & Mitchell's (1988) seminal paper, there have been many studies examining the attachment preferences of ambiguous relative clauses (RCs) in Spanish. The great majority of on-line studies had subjects read sentences with RCs that ambiguously modified the first or the second noun of the object noun phrase (NP). Only a few off-line studies have examined the attachment preferences when the complex NP occupies the subject position. The aim of the present study was to examine whether the attachment preferences vary as a function of the syntactic position (subject vs objet) of the complex NP. Eye-tracking measures were recorded while subjects read temporarily ambiguous RCs modifying the subject or the object NP. Half of the ambiguous RCs were disambiguated (by manipulating gender agreement) toward the first NP, while the other half toward the second NP. Perceptual and quasi-perceptual verbs were not used to avoid the pseudo-relative confound (Grillo & Costa, 2014). The results clearly show that the attachment preferences vary as a function of the position of the modified NP. When the RC modifies the subject NP there is a clear preference for attaching low, whereas when the RC modifies the object NP the preference is for attaching high.

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Grillo, N., & Costa, J. (2014). A novel argument for the Universality of Parsing principles. *Cognition*, *133*, 156–187. doi:10.1016/j.cognition.2014.05.019

Processing ambiguous words in Spanish: When both lexicographical criteria and subjective meanings matter

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Ambiguous words are usually classified as homonymous and polysemous words. In English there is ample evidence showing that, whereas homonymy seems to hinder word recognition, polysemy tends to facilitate it. In fact, Rodd, Gaskell, & Marslen-Wilson (2002) proposed that the critical distinction for the ambiguity advantage found with isolated words might be the one between meanings and senses rather than that between ambiguous and unambiguous words.

With the aim of testing the psychological reality of the homonymous-polysemous lexicographical distinction and its possible interaction with the dictionary (DNoS) and the participants' number of senses (PNoS), an experiment was conducted in which the 210 words included in the Spanish Ambiguous Words (SAW) database (Fraga, Padrón, Perea, & Comesaña, under review) were presented in a lexical decision task.

Results showed significant effects of the type of ambiguity and the PNoS. Even more, a significant interaction was obtained between the type of ambiguity and the PNoS in the analysis over participants, revealing that the fact of having few senses tends to hinder performance in homonymous words. Finally, regression analyses confirmed previous findings in that the PNoS, but not the DNoS, suitably predicts performance in word recognition.

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Rodd, J., Gaskell, G., & Marslen-Wilson, W. (2002). Making sense of semantic ambiguity: Semantic competition in lexical access. *Journal of Memory and Language, 46* (2), 245-266. doi: 10.1006/jmla.2001.2810

When should we call it a concreteness or an abstractness effect? Word recognition and free recall of concrete and abstract words

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Many studies in a variety of cognitive domains have demonstrated that concrete and abstract words are processed differently. Typically, concrete words show an advantage in processing and memory over abstract words. However, some recent studies have reported a reversed effect: an advantage in the processing of abstract words (i.e., an abstractness effect).

This abstractness effect has been observed after controlling for many variables affecting word processing and has been suggested to be produced by emotionality. In this study, we present a series of lexical decision (LDT) experiments to assess the role that imageability and contextual availability play in the abstractness effect, while controlling for emotionality. Additionally, and for the first time, we assess the abstractness effect in a free

recall task.

LDT results show that only when contextual availability is controlled, an abstractness effect is obtained. In contrast, when imageability is controlled, there is a trend towards the classical concreteness effect. Importantly, free recall data show a consistent concreteness effect.

Lexical neighbours and word misperception effects in older age: Evidence from eye movements

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Older readers (65+ years) are thought to compensate for the greater reading difficulty they experience by employing a more risky reading strategy in which they infer the identities of upcoming words more readily but also misperceive words more frequently (Rayner et al., 2006). Lexical neighbours are words that differ by one letter while word length and letter order is preserved (e.g., spice & space) and are an important source of word misperception effects. In particular, studies show readers are likely to misperceive words that have a neighbour with a higher frequency of written usage (Slattery, 2009). How this differs across age-groups is unknown, although older readers may be especially susceptible to such effects, especially when the neighbour is congruent with prior context. In the present research, young and older adults read sentences containing target words with and without a higher frequency neighbour, where the neighbour was congruent with prior context or not. Consistent with previous findings, eye movements were disrupted for words with higher frequency neighbours, especially when the neighbour fitted the context. But, crucially, there was no indication of an age difference in this word misperception effect. We discuss this finding in relation to age-related change in reading strategy.

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Slattery, T. J. (2009). Word misperception, the neighbor frequency effect, and the role of sentence context: Evidence from eye movements. *Journal of Experimental Psychology: Human, Perception and Performance, 35*, 1969-1975.

Does deviant-letter position affect cognate word processing?

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It has been shown that letter position influences reading processes. For example, the first letter of a given string is usually processed preferentially. However, this line of research has focused almost exclusively on monolingual word processing. Indeed, only one unpublished study (Font, 2001) explored how letter position affects word reading in bilinguals. In line with monolingual literature, the study showed that the recognition of cognate words (translation equivalents sharing form; e.g., tomato-tomate [English-Spanish]) is affected by the position of the deviant letter (the position of the letter that differs between translations, e.g., paper-papel). These results challenge the input-coding scheme of one of the most influential models of bilingual memory, the BIA+ (Dijkstra et al., 2010), since it does not assign a special role to any letter position. The present research was aimed to further examine this issue by employing a priming lexical decision task. Catalan-Spanish proficient bilinguals were presented with 240 Catalan-Spanish translation pairs, half of which cognates. Cognates were divided into five conditions regarding their deviant letter (from first position [e.g., xifra-cifra, "figure"] to last position [e.g., matriu-matriz, "matrix"]). Results showed no differences in priming across cognate conditions, giving support to the input-coding scheme of the BIA+.

Dijkstra, T., Miwa, K., Brummelhuis, B., Sappelli, M., & Baayen, H. (2010). How cross-language similarity and task demands affect cognate recognition. *Journal of Memory and Language, 62*, 284-301. doi:10.1016/j.jml.2009.12.003

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Evidence for a reduced perceptual span when reading dynamic horizontally scrolling text

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The dynamic horizontally scrolling text display format (as used e.g. for news 'tickers') requires the leftward tracking of text (in the direction of movement) concurrent with the normal pattern of rightward gaze shifts. Given the association of eye movements and attentional control (Sheliga, Riggio, & Rizzolatti, 1994), this unusual reading situation will produce a directional conflict that may reduce the attentional resources available to allocate to upcoming text. The allocation of attention during reading may be characterised as the *perceptual span:* the region around the point of fixation from which information is processed (Rayner, 1975). Our study investigated the perceptual span when reading scrolling text using the gaze-contingent moving window paradigm (McConkie & Rayner, 1975, 1976).

Participants (n=36) read scrolling and static sentences under conditions in which the amount of information available around the fixated position was manipulated. The findings showed that the allocation of attentional resources to the right of fixation was reduced to 8 characters with scrolling text, compared to 12 characters for static text. This demonstrates that the leftward tracking of moving text results in a reduction in the rightward extent of the perceptual span during reading, attributable to a directional conflict with rightward progressive saccades.

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Ageing and the optimal viewing position effect: The evidence from English

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Numerous studies show that where a reader initially fixates within a word influences the efficiency with which that word can be identified. In particular, word recognition is quickest and most accurate when a word is fixated at its *optimal viewing position* (OVP), which for English is a little to the left of the center of words. Studies to date have not examined effects of healthy ageing on this OVP effect, although age-related changes in visual abilities that occur naturally with older age are likely to affect the efficiency of word recognition by older readers. Accordingly, the present study compared OVP effects in English for young adult (18-25 years) and older adult (65+ years) readers. We examined lexical decisions for short (5-letter) and long (9-letter) words (and pseudo-words) that were presented briefly (150ms) at different offsets relative to a fixation point so that words were fixated at either beginning, middle or end letter locations, and an eye-tracker was used to ensure fixation accuracy. Standard OVP effects were obtained for both young and older adult readers, although the older adults were generally slower to recognise words. We discuss these findings in relation to the influence of age-related visual declines on word recognition.

How easily can we learn new meanings for known words from stories?

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We must often learn new meanings for known words, for example due to language evolving ('tweet'-Twitter message/bird call) or starting a new hobby ('boom'-sailing term/loud noise). These are normally acquired incidentally from context when reading/listening, rather than through intentional memorisation of definitions. This study compared incidental to intentional learning of new meanings, and examined incidental learning performance with varied amounts of exposure. In experiment 1, participants learned new meanings incidentally through stories, and intentionally through a repetitive task. Recall and recognition accuracy showed that while meanings learned from the intentional task were remembered better, there was good learning from both methods. Additionally, on some measures of learning, meanings learned from story contexts were less susceptible to forgetting after a 24-hour delay. In experiment 2, participants read stories with varied numbers of exposures (2, 4, 6, or 8) to words with their new meanings. Recall accuracy for meanings and meaning-to-word mappings was reasonably good after only 2 exposures, and increased linearly with increased exposure, with no decline after a 1-week delay. These findings show we are able to learn new meanings for known words from naturalistic contexts with relative ease and remember new meanings surprisingly well after only a few encounters.

Metaphor explanation enhances the left-hand use for co-speech gestures

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Experimental evidence suggests that both the left (LH) and the right hemisphere (RH) contribute to the comprehension of semantic relations. The RH seems to be differentially involved when processing linguistic units with alternate interpretations such as metaphor. Differential activation levels of the two hemispheres due to hemispheric specialization for different linguistic processes might determine hand choice for co-speech gestures.

We compared hand choices for gesturing in 44 young, healthy right-handed participants during explanation of metaphorical (motivated by idioms) versus concrete literal and abstract literal meanings. We hypothesised that metaphor explanation would enhance the RH contribution to speech production, leading to enhanced use of the left hand when gesturing.

Results showed that the right-hand over left-hand preference was significant when explaining literal meanings, both concrete and abstract. However, importantly, when explaining metaphorical meanings, the use of the left hand was significantly increased leading to no differences between the right and left hands in gesturing.

These findings suggest that the differential activation of the RH in the metaphor condition increased the RH generation of gestures, equalising the use of the right and left hands for gesturing, and strengthening existing evidence that the RH is differentially involved

in the processing of non-literal language.

Time course of meaning activation for pun comprehension: evidence from lexical ambiguity

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We investigated 'sense-relatedness' and 'meaning dominance' effects for pun comprehension at different stages of processing. In two lexical decision priming experiments, we used polysemes (e.g., *crown*) and equi-biased homonyms (e.g., *pupil*) to compare the time course of meaning activation for puns with semantically related meanings (e.g., *The prince with a bad tooth got a crown*.) and semantically unrelated meanings (e.g., *A cross-eyed teacher can't control his pupils*.). Visual targets, presented with prime-target inter-stimulus intervals of 0ms (Experiment 1) and 750ms (Experiment 2), were related to: (i) the dominant meanings of the ambiguous words, (ii) the subordinate meanings, or (iii) were unrelated. The results showed that, initially, puns with semantically related meanings were harder to process than puns with unrelated meanings. In the later stages, however, both pun types were processed similarly, only showing facilitation for their dominant meanings. We discuss the implications of our results with regard to models of figurative language processing (i.e., *the standard pragmatic approach*, Grice, 1975; *the direct access model*, Gibbs, 1994; *the graded salience hypothesis*, Giora, 2012; and *the conceptual blending theory*, Coulson, 2001). The results also have implications for on-line lexical ambiguity resolution and the asymmetrical mental representations of polysemes and homonyms.

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Revisiting the word/nonword dissociation in repetition priming: The role of explicit information about repetitions

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In a recent two-block lexical decision experiment, Perea, Marcet, Vergara-Martínez, and Gomez (2016, Frontiers in Psychology) reported that while repeated words were responded to faster than nonrepeated words, repeated nonwords were responded to more slowly than nonrepeated nonwords. This dissociation favoured familiarity/wordness models of the lexical decision task (e.g., the diffusion model), whereas it posed some problems for episodic accounts of repetition effects. To what extent this word/nonword dissociation could be modulated by participants' strategies? To shed some light on this question, we re-examined word/nonword repetition effects in lexical decision when participants were informed in advance that there were going to be repeated items in the second block of the experiment. Results showed a facilitative repetition effect for words and an inhibitory effect for nonwords, thus mimicking the findings obtained by Perea et al. (2016). Therefore, the present data demonstrate that participants do not use explicit knowledge about the nature experiment to adjust the core lexical components of the task (i.e., the evidence accumulation process).

Perea, M., Marcet, A., Vergara-Martínez, M., & Gomez, P. (2016). On the dissociation of word/nonword repetition effects in lexical decision: An evidence accumulation account. *Frontiers in Psychology.7*, 215. DOI: 10.3389/fpsyg.2016.00215

The role of morphology in reading and writing in Spanish children with dyslexia

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It is known that children with dyslexia have difficulties in learning the alphabetic code, but also in processing long words as a whole. Besides, it has also been reported that morphemes facilitate visual word recognition, leading to greater accuracy and fluency of morphologically complex words. Moreover, in children with dyslexia, the morphological structure could be useful to reduce difficulties caused by phonological deficits. The aim of this study was to determine whether Spanish children with dyslexia benefit from morphology when reading and writing. A total of 40 children, 20 with developmental dyslexia and 20 without reading difficulties, matched on chronological age and gender participated in this study. In the first task, the participants were asked to read isolated words and pseudowords; in the second task, participants had to write, in lowercase letters, the words and pseudowords that they had listened to. Stimuli were the same in both tasks: words and pseudowords in which morphological complexity was manipulated, half of them were morphologically simple and half morphologically complex. The results showed that both reading and writing from dyslexic children, were more affected by morphological structure of the stimuli than

those of controls.

Evidence that valence affects reading in Spanish

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The influence of emotional content on language processing remains unclear. Research in English has obtained contradictory results regarding the effect of valence on word recognition. Whereas some studies claim valence has a monotonic effect on recognition times, with negative words being processed more slowly than positive ones, others have observed a non-monotonic effect of valence, with facilitation of responses to both positive and negative stimuli compared to neutral words. We analyzed the influence of valence on reaction time data from previous large-scale word naming and lexical decision studies in Spanish. We conducted linear mixed-effects models, including critical lexical and semantic measures as covariates, and examining linear and curvilinear effects. Our results support a continuous monotonic effect of valence. Negative words were recognized more slowly than positive words. This effect can be captured by a categorical valence term (positive vs. negative or emotional vs. neutral words) but to a lesser extent. There was no support for an additional arousal effect. A significant interaction showed the valence effect was stronger in lexical decision than word naming task, suggesting it can be located in the influence of lexico-semantic information on reading. Our results highlight the relevance of affective content to word recognition.

When the word shape matters: The role of letter features on the consonant bias effect

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Recent research with adults (e.g., New et al. 2008) and children (e.g., Soares et al. 2014) has shown an advantage of consonants over vowels in visual-word recognition. This effect is puzzling since it is not accounted by the number of consonants and vowels in a language, or its combinatorial distributions. Here we examined whether the consonant-bias is affected by consonant letter features. Although in lowercase all vowels are characterized by no distinctiveness features (e.g., a, u), consonants in contrast can be characterized either by the existence (e.g., b, g) or inexistence (e.g., c, m) of those features. Eighty flat words (e.g., *canino*[canine]) and 80 non-flat words (e.g., *palito*[toothpick]) were presented to adult skilled-readers in two masked-priming experiments. In Experiment 1 primes were presented in lowercase and targets in uppercase, and in Experiment 2 the reverse. Results revealed that

flat words were recognized faster than non-flat words in both experiments, and critically that the advantage of consonants over vowels was restricted to non-flat words in Experiment 1 and to flat words in Experiment 2. These findings showed that letter features play a role in the consonant bias and asks for amendments in the letter coding-schemes of current models of visual-word recognition.

New, B., Araújo, V., & Nazzi, T. (2008). Differential processing of consonants and vowels in lexical access through reading. *Psychological Science, 19*, 1223–1227.

Soares, A. P., Perea, M., & Comesaña, M. (2014). Tracking the emergence of the consonant bias in visual-word recognition: Evidence with developing readers. *PLoS ONE, 9*(2), e88580.

Is conditional sentence acquisition related to understanding the principles of scientific enquiry?

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Scientific investigation principles are often described using "if" sentences, which are hypothetical, sometimes also counter-factual. We explored whether the acquisition of such language is related to early vs. late understanding of scientific principles, specifically hypothesis testing (e.g. Sodian et al., 1991) and control variable strategy (e.g. Chen & Klahr, 1999).

98 children (47 girls) were tested individually in Year 3 on conditional sentence comprehension and repetition and scientific reasoning. Verbal and non-verbal intelligence were tested with groups of children. Children who failed the scientific reasoning tests were re-administered the test/s they failed and grammar tests in Year 5. Good understanding of counterfactual conditional sentences in Year 3 predicted showing understanding of hypothesis testing early (Year 3) versus late (Year 5), controlling for verbal and non-verbal intelligence (Model change $\chi 2$ =6.36, df=1, p=0.042). It also predicted passing or failing control variable strategy test by Year 5, independently of verbal and non-verbal intelligence (Model change $\chi 2$ =6.17, df=1, p=0.013). Conditional counterfactual sentence comprehension might be helping children in the formation of understanding of scientific principles.

Sodian, B., Zaitchik, D., & Carey, S. (1991). Young children's differentiation of hypothetical beliefs from evidence. *Child Development, 62*, 753–766.

Chen, Z., & Klahr, D. (1999). All other things being equal: acquisition and transfer of the control of variables strategy. *Child development, 70*(5), 1098–120

Individual differences in working memory capacity modulate semantic negative priming

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The main aim was to investigate whether semantic negative priming (SNP) from single prime words could critically depend on the availability of cognitive control resources. Participants with high vs. low working memory capacity (as assessed by their performance in working memory and attentional control tasks), were instructed to either attend to or ignore a briefly presented single prime word followed by either a semantically related or unrelated target word on which participants made a lexical decision. We manipulated the attentional instructions to elucidate whether a differential working memory capacity (WMC) may affect the relevant and irrelevant information processing. Results showed that individual differences in WMC mainly affected the processing of the ignored primes, but not the processing of the attended primes: While the latter produced reliable positive semantic priming for both high- and low-WMC participants, the former gave rise to reliable SNP only for high WMC participants, with low WMC participants showing positive priming. These data extend previous findings in demonstrating that (a) single negative priming can reliably generalize to semantic associates of the prime words, and (b) a differential availability of control cognitive resources can reliably modulate the negative priming effect at a semantic level of representation.

Expressive reading in Spanish children through school grades

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Expressive reading is considered to be one of the essential features of reading fluency. This expressiveness could be influenced by several variables, such as sentence length or type of sentence. The aim of this study was to stablish the role of these two variables in expressive reading in children from different school grades. Furthermore, we compared the children results with an adult sample results, used as a normative group, to determine when children acquire an adult-like reading prosody. A text including declarative, exclamatory and interrogative sentences, short and long, was created. Children (third and fifth school grade) and adults were recorded while reading it aloud. Recordings were analysed using Praat software in order to consider different parameters, such as sentence reading duration, last syllable of sentences lengthening, slope and F0 rise. Results showed that fifth grade children prosodic parameters were more similar to the adult's than those of third grade children. To sum up, we found differences between children from different grades in sentence length effect and also in general prosodic features in different types of sentences, since fifth grade children showed a more similar prosodic profile to that of the adult group.

Misconceptions about the brain in education: Prevalence among Spanish teachers and an exploration of cross-cultural variation

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Enthusiasm for research on the brain and its application to educational settings is growing among teachers. However, a lack of sufficient knowledge, poor communication between educators and scientists, and the effective marketing of dubious educational products, has led to the proliferation of numerous 'neuromyths'. The dissemination of these misconceptions about the brain involves not only economic costs for families and schools but also an opportunity cost for children who are deprived of effective, evidence-based interventions. The aim of this study was to explore the prevalence of these misconceptions among in-service teachers in Spain. As in previous studies, we observed that the belief in neuromyths was very high in this sample. Teachers who responded correctly to general knowledge questions about the brain were more likely to believe in neuromyths. Women were also more likely to believe in neuromyths than men. In addition, a meta-analytic synthesis of the present and previous studies revealed some consistencies across countries but also certain peculiarities in the type of neuromyths more widespread in each population. These results highlight the need for action to address the increasing presence of pseudoscientific practises in schools worldwide.

Discrimination of sign languages by monolingual and bilingual infants

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Language discrimination is a cornerstone in bilingual language acquisition. Although the language discrimination abilities of monolingual and bilingual infants in the auditory domain are similar, differences between groups arise in the visual domain, where bilingual infants outperform their monolingual peers. Here we explore if this advantage is restricted to speech stimuli or is extended to other linguistic domains.

We used a habituation procedure to test 8-month-old non-signer infants, in their ability to discriminate between Japanese and British sign languages. Twenty-four infants (12 bilingual, 12 monolingual) participated in the first study. The results revealed that only bilingual infants were able to discriminate between the two sign languages.

In a second study, we presented the same stimuli blurred, keeping the moving and

peripheral information of the videos but deleting the facial information. We tested 12 bilingual infants who did not show discrimination.

The bilingual advantage in visual languages discrimination is not restricted to speech and seems to be related to the perception of more general linguistic information. However, the relevant cues that bilinguals exploit for discrimination might be allocated in the face.

Working memory updating components and reading comprehension

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Working memory updating (WMU) has been related to deficits in Reading Comprehension (RC). Recently, WMU can been decomposed on different subcomponents: retrieval, transformation and substitution. The objective of this study was to investigate the contribution of each WMU component on RC. To this aim, these components were combined to make different versions of a WMU task, which was administered to two groups of poor and good comprehenders (9 years-old). Results showed the expected effect on accuracy and response times depending on the conditions. Most importantly, poor comprehenders, compared to good ones, showed lower accuracy when the version of the task involved the retrieval component. These results suggest that RC deficits are related to the retrieval of information in the focus of attention.

The word-length effect in verbal short-term memory does not depend on differences in neighborhood size

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The word-length effect, the observation that immediate serial recall is better for lists of short words than for lists of long words, has been a key finding in the development of verbal short-term memory models. Although different explanations have been proposed over the last decades, all they attributed the word-length effect to phonological factors: more numbers of syllables and phonemes, greater phonological complexity and/or slower subvocal rehearsal for long words. Against this view, it has recently proposed that the effect is actually due to the fact that short and long words differs in neighborhood size, with the greater neighborhood size of the short words leading to better immediate recall. In the present study, we tested this suggestion in four experiments that used four different sets of short and long words matched in number of phonological and orthographic neighbors. The four experiments consistently showed the standard word-length effect, which was mainly a consequence of better item recall (rather than order recall) for list of short words, and was greater with visual (rather that auditory) presentation of the stimuli. This finding strongly suggests that the word-length effect does not depend on differences in neighborhood size.

Forgetting negative pictures does not require more effort than remembering them in older people: Evidence from a visual detection task and electrophysiological correlates.

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The aim of this study was to analyze whether intentional forgetting requires more effort than intentional remembering, and the effects of emotional content and aging. Negative and neutral pictures were presented by the directed forgetting procedure (item-method). A visual detection task after memory instruction to measure the cognitive demand of instantiate an R (Remember) vs F (Forget) instruction was used. Event-related potentials associated to R vs F instructions were also analyzed. Sixteen younger and fourteen older adults participated in this study. The difference between F-instruction and R-instruction in the N2 component was larger in the young group than in the older group for neutral pictures. In the young group the P300 component was larger in R-instruction than in F-instruction for both types of pictures. However, in the older group, this was only found for negative pictures. Behavioral results showed longer Post-F probe RTs for negative and neutral pictures compared to Post-R probe RTs in the young group. However, older adults were slower to detect post-R probes. On the subsequent recognition test, a directed forgetting effect was observed in both groups. The results indicate that while young adults can inhibit F-pictures, older people have more difficulties regardless of its emotional content.

Changes in the precision of auditory short-term memory as a potential index of intrusion in tinnitus

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Tinnitus is the percept of ringing or buzzing in the absence of external sounds. The subjective nature of tinnitus makes it severity difficult to assess, and associations between audiometric estimates of the percept and the level of disruption during listening are generally low. Problem tinnitus has been associated with a bias to attend the internal percept, which is likely to divert resources away from external sounds during listening. One resource that may be particularly sensitive to competition is auditory short-term memory (ASTM). The purpose of his study was to investigate whether changes in the precision of ASTM provide a potential index of intrusion in tinnitus. To do this, we contrasted six listeners' response functions on a delayed pitch discrimination task in three conditions that manipulated attention in the presence and absence of simulated tinnitus: (i) No-Tinnitus (ii) Concurrent-Tinnitus (iii) Attend-Tinnitus. The data revealed a significant decrease in the precision of listeners' pitch discrimination functions in the Attend- compared to the No-Tinnitus condition. This result

suggests the precision of ASTM may be sensitive to competition between the internal percept and external sounds in tinnitus, and provide an objective measure of the level of intrusion experienced by individuals during listening.

Cognitive load in working memory produces opposite behavioral effects in a Stroop-priming task

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We demonstrated that a differential availability of working memory affected the capacity for expectation-based strategic actions. Participants performed a Stroop-priming task in which a prime word (GREEN or RED) was followed by a coloured target (red vs. green) that participants had to identify. The prime was incongruent or congruent with the target color on 80% and 20% of the trials, and participants were informed about the differential proportion of congruent vs. incongruent trials. This task was interleaved with a working memory task, such that the prime word was preceded by a sequence of either a same digit repeated five times (low load) or five different digits (high load), which should be retained by participants. After 2, 3, or 4 Stroop trials, they had to decide whether a probe digit was or not a part of the memory set. Responses to the probe digit were reliable longer under high than under low memory load. More important, there was a significant interaction between prime-target congruency and working memory load: Reversed (i.e., facilitatory) Stroop during low memory load, and Stroop interference during high working memory load. These findings demonstrate that the availability of working memory is crucial for implementing expectation-based strategic actions.

Differential outcomes training and delayed visual recognition memory: an ERP study

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It has been widely demonstrated that the Differential Outcomes Procedure (DOP) facilitates the learning of conditional symbolic relationships (for a review, see Mok, Estévez & Overmier, 2010). This procedure involves reinforcing each correct choice response to a specific stimulus-stimulus association with a unique outcome. Although extensive research has been conducted in relation to the applications of the DOP to different populations, little is known about the cognitive and neural mechanisms underlying the effect of using differential outcomes methodologies, particularly in humans. The present study thus attempts to advance

our understanding of the basic mechanisms underlying this effect. To do this, we examined modulations of the event-related brain potentials (ERPs) under two experimental conditions, differential vs. non differential outcomes, in a group of university students performing a delayed visual recognition memory task. The results obtained suggest that the DOP would activate neural circuits implied in prospective memory. Concretely, we found significant differences between both experimental conditions while recording ERP waves in parietal and central cortex regions. The implications of this finding for the theoretical accounts of the mechanisms involved in the DOP are discussed.

Differential outcomes training and delayed visual recognition memory in normal aging using masked reinforcers

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It has been widely demonstrated that the Differential Outcomes Procedure (DOP) facilitates both discriminiative learning and visuospatial recognition memory (for a review, see López-Crespo & Estévez, 2013; Mok, Estévez & Overmier, 2010). This procedure involves reinforcing each correct choice response to a specific stimulus-stimulus association with a particular reinforcer or outcome. In the present study we tested the usefulness of the DOP to improve the execution of a computerized visual recognition memory task involving the subliminal presentation of the outcomes in a group of healthy elders. The results showed that compared with the standard non-differential outcomes procedure (NOP), the DOP produced better visual working memory performance when a pattern mask was presented immediately after the outcomes. The implications of this finding for the theoretical accounts of the differential outcomes effect are discussed.

The emergence of backward semantic inhibition in toddlers

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The ability to suppress irrelevant information is essential to everyday cognitive functioning. Backward semantic inhibition has been demonstrated in adults: Switching attention from one semantic category to another results in the inhibition of the former semantic category, and that subsequent attention to the former semantic category is impaired (Fuentes, Vivas & Humphreys, 1999). This study examines the emergence of backward semantic inhibition in toddlers using an eye-tracking adaptation of the adult study. When do we develop the ability to inhibit words and meanings that are no longer relevant? Backward semantic inhibition was observed in 24-month-olds, but not in 18-

month-olds. Further analyses indicate that the effect of backward semantic inhibition is driven by participants' familiarity with the test words (regardless of age group): Participants who are more familiar with the test words show an inhibitory effect, while participants who are less familiar with the test words show a facilitatory effect. These results suggest that inhibitory links between lexical-semantic items emerge as a result of accumulated language experience during the second year.

Response bias in eyewitness recognition memory in young and older adults

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The increasing life expectancy makes necessary to investigate older witnesses and victims memory for crimes. In this study 168 young and older participants were presented with a realistic bank robbery video, completed a True/False recognition task about script-actions, specific actions and event details, and indicated their subjective experience of recollection by response confidence. Although older adults were as accurate as younger adults in recognition, they had more hits and false alarms than younger adults due to their tendency to accept as veridical true and false statements about the event. This response bias was especially relevant for specific-actions and details of the event. Confidence was higher for hits than for false-alarms in both age-groups, but older adults indicated similar confidence for hits and for false-alarms when recognizing event and actions details. Thus older adults accepted more false information with higher confidence than younger adults, showing that they believed in their false memories.

Estimate of the likely direction of gaze during object recognition from visual saliency map

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One of the central topics in vision research is to explain what factors determine the direction of saccades, which are the eye movements we make as we look a scene or visual image. The most accepted hypothesis is that there are two types of factors: exogenous, especially the visual salience (color, orientation, luminance...), which have to do with the image, and endogenous, which are independent factors of the image. Among the very last, we can find the spatial biases, which are preferences for certain saccadic directions, especially at the beginning of observation, regardless of the image. The effect of factors related to the image is usually assessed using the matching of fixation map (periods between saccades) with visual salience map. The spatial biases are generally detected by analyzing the angle or direction of saccades as a function of observation time. The aim of our study was to develop an index of gaze orientation for object recognition. A study of eye-tracking with object images confirms that this index shows a high correlation with the

variability of visual saliency. This result makes us think that our index could be used to better compare the relative contributions of the two types of above-mentioned factors to the oculomotor scanpath during observation of an image.

The effects of emotional arousal on memory-guided attention

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Our long-term memory guides spatial attention (Summerfield et al., 2006). The current study aims to investigate how emotional arousal affects memory-guided attention. Participants completed two sessions (1-day apart). In the first session, they were asked to learn the locations of a target embedded within natural scenes. In half of the trials, scenes included the target (valid-memory condition), whereas there was no target in the other half (neutral-memory condition). In the second session, participants were presented with a fear-conditioned (CS+) or a non-arousing tone (CS-), followed by a scene, and asked to indicate whether each scene included the target or not. In some trials, participants saw scenes from the valid-memory condition; in other trials, they saw scenes from the neutral-memory condition; and in the remaining trials, they saw new scenes that they did not see before. Results indicated that emotional arousal induced by CS+ slowed reaction times only when participants did not have a valid memory for the location of the target. Given that prior memory determines information's priority (Hutchinson & Turk-Browne, 2012), our results are consistent with the arousal-biased competition theory (Mather & Sutherland, 2011) and suggest that emotional arousal influences cognitive processing differently depending on information's priority.

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Proactive control of sequential biases in motor learning: A developmental study

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Action control in sequences of discrete responses might be initially affected by opposite response tendencies. Specifically, transitions between series of response repetitions

and response alternations, triggered by corresponding stimuli, require overcoming local sequential biases. In previous sequence learning experiments we have observed that these sequential effects were reduced after some training, but only for participants showing explicit knowledge of the sequence. Hence, previous findings suggest that the control of sequential biases depends on the possibility to prepare forthcoming responses in advance. Besides knowing the sequence, control over previous response tendencies would depend on the development of proactive control mechanisms. Confirming this hypothesis, present experiment showed that children between 8 and 9 years old were more affected by sequential effects than young adults. Importantly, groups did not differ in the amount of explicit knowledge. More detailed analyses showed that whereas all children had specific difficulties in the control of the alternation bias, adults showing explicit knowledge overcame it. Accordingly, results support control over sequential biases determined by both knowledge and development of proactive control.

Spatial memory and executive functions are modulated by practice of aerobic sports

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During the aging period cognitive skills are prone to decline. Hence, memory and executive functions show a tendency to decrease with age. Nevertheless, there are important individual differences and several factors could account for it. Practice of aerobic sports is known to benefit brain functioning and it is associated with a better aging.

In this study, sportsmen and sedentary participants were compared in memory and executive functions tasks. Two different ages were considered: 60-69 and 70-79 year-old. A virtual reality-based spatial memory task was used for measuring spatial orientation. The attention network task (ANT), k-bit, zoo test and FAS word fluency tests were used as well. Results showed that sportsmen outperformed sedentary in spatial memory at all ages. In addition, groups differed in the executive attention network, with sportsmen outperforming sedentary. Moreover, sportsmen performed better than sedentary in the zoo test, and FAS test some k-bit subtests which demanded frontal lobe functions.

Our study supports the beneficial effect of aerobic sports in memory functions and some frontal lobe-related functions, like executive functions and planning. Performance improves in all age groups. This study was supported by PSI2015-67442.

VSTM and comparisons of sameness and difference across same and different spatial locations

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Research has shown that it is harder to determine the presence of a *sameness* in features between two consecutively presented arrays than a *difference*. This asymmetry has been ascribed to the existence of an automatic comparison process which draws attention to mismatches between VSTM-held information and current input (Hyun et al., 2009). The reported study tests this interpretation. Observers were presented with four colour patches in two sequentially presented arrays interleaved by a blank ISI. Across the two arrays either all the given colours were the same or one, two, three, or all four colours were different. Observers performed either an *any-colour-difference* task (respond 'yes' when any different colour is present), or an *any-colour-sameness* task (respond 'yes' when any same colour is present). For both tasks accuracy increased monotonically with the number of critical events (i.e. respectively the number of different or same colours). However in all cases accuracy was higher for the difference task; importantly this advantage persisted even when the compared colours were in different locations. This finding suggests that an additional mechanism must underlie the difference advantage, possibly one which is sensitive to the change in the statistical properties of the display irrespective of their spatial position.

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The influence of visual crowding on the electrophysiological response to symmetry

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Electrophysiological research has identified a neural signature of symmetry processing known as the Sustained Posterior Negativity (SPN): ERP amplitude is lower for reflection than random around 200ms after stimulus onset (Bertamini & Makin, 2014). Previous ERP research has only examined the SPN to symmetry presented in isolation at central vision. However, symmetry detection can be compromised in peripheral vision when flanked by other objects (Roddy & Gurnsey, 2011). We investigated whether visual crowding modulates the SPN. Participants were briefly presented with reflection and random targets in the periphery (4.5°). These could be in isolation or flanked by a pair of random patterns positioned either above and below the target or on either side. Participants had to report if the target was reflection or random. Behaviourally, flanking reduced the recognition of symmetry. The SPN was found in an early time window (200-600ms after stimulus onset) in both the left and right hemisphere when the target was unflanked and when the flankers were positioned above and below. We conclude that crowding decreases the detectability of symmetry along with activity in symmetry-sensitive networks.

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Conceptual distortions of hand structure are resistant to changes in stimulus information

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Hands are commonly held up as an exemplar of well-known, familiar objects. However, conceptual knowledge of the hand has been found to show highly stereotyped distortions. Specifically, people judge their knuckles as farther forward in the hand than they actually are. The cause of this distal bias remains unclear. In Experiment 1, we tested whether both visual and tactile information contribute to the distortion. Participants judged the location of their knuckles by pointing to the location on their palm directly opposite each knuckle with: 1) a metal baton (using vision and touch) 2) a metal baton while blindfolded (using touch), 3) a laser pointer (using vision). In Experiment 2, we investigated whether judgments are influenced by visual landmarks such as the creases at the base of each finger on the palm. Participants localized their knuckles on either a photograph or a silhouette of their hand. In both experiments, clear distortions were found across conditions, of generally similar magnitude. These results show that distal bias is resistant to changes in the stimulus information and does not rely on any specific stimulus cue or single sensory modality, suggesting that such mislocalisations reflect a conceptual misrepresentation of hand structure.

Mind the gap! Tactile distance aftereffect in passive touch

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Tactile distance perception has been widely used to investigate somatosensory processing. Distances are perceived as larger on relatively more sensitive skin surfaces, suggesting that encoding of distance preserves low-level asymmetries of primary somatosensory cortex. On the other hand, distance perception is also modulated by high-level manipulations of body representation, which suggest that the encoding of distance might occur at later stages of somatosensory processing. We inferred the stage of processing at which encoding of distance occurs using an adaptation aftereffect paradigm. Experiment 1 demonstrated the presence of a strong aftereffect induced by the simultaneous presentation of pairs of tactile stimuli: after adaptation to two different distances on each hand, participants systematically perceived as larger the subsequent stimulus delivered to the hand adapted to the smallest distance. We further demonstrated that aftereffects are orientation and skin-location specific (Experiments 2-3); occur when just one hand is adapted (Experiment 4); do not transfer either contralaterally or across palm and dorsum (Experiments 5-6); and are

defined in a skin-centred, rather than an external, reference frame (Experiment 7). These characteristics of tactile distance aftereffects are similar to those of low-level visual aftereffects, supporting the idea that distance perception arises at early stages of tactile processing.

Interactions between spatial proximity and texture similarity in touch: An electrophysiological study

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Previous research on perceptual grouping in the haptic modality showed that at least some grouping principles influence haptic perceptual organization. Moreover, grouping the elements of the haptic scene by spatial proximity seems to be faster and more accurate than grouping by texture similarity. However, it is unclear whether this differences in relative salience will result in an asymmetrical interaction pattern when both grouping principles act conjointly, both in a competitive or cooperative way, as occurs in visual modality. We aim to investigate this interaction pattern in the tactile modality using an adaptation of the repetition discrimination task designed for vision by Palmer and Beck (2007). The participants had to determine whether the repeated textures (similarity grouping) are smooth or rough. A 2 x 2 within-subjects factorial design was used, resulting in four different conditions: within-group, between-group and neutral close/far. Response times an error rates increase in between group condition relative to neutral conditions but not relative to whitin-group condition. Interestingly, neutral conditions differed, suggesting that non-targets proximity also affects grouping interaction irrespective of how targets are grouped. Nevertheless, brain oscillation data showed increased and long-lasting frontal and parietal alpha desynchronization in the between-group condition relative to the within-group condition.

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A gradient in tactile distance perception on the hairy skin of the arm

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In Weber's illusion, the distance between two touches is perceived as larger on skin surfaces with higher tactile spatial acuity. Moreover, numerous studies have documented a distally increasing gradient of tactile acuity on the arm. We investigated whether there is a similar gradient for tactile distance perception on the left 1) posterior forearm, 2) dorsal hand, and 3) volar hand. In five experiments, we asked participants to judge the distances between two simultaneous touches applied to four subregions of each skin surface. As expected,

distances felt larger on the hand (high tactile spatial acuity) than on the forearm (low tactile spatial acuity) consistent with Weber's illusion. A clear tactile distance gradient was observed on the hairy skin of both the hand and forearm. Critically, however, this gradient was for perceived distance to decrease at more distal skin regions, exactly opposite to what Weber's illusion would predict given the gradient in acuity. Perceived distance on the volar hand showed an inverted U-shape pattern, with distances perceived largest at the centre of the palm. Our results confirm the classic pattern of Weber's illusion between two different skin surfaces, but suggest that this pattern may break down within a single skin region.

Vision of the hand impairs tactile finger identification

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Patients with lesions of the left posterior parietal cortex commonly fail in identifying their fingers, a condition known as finger agnosia, yet are relatively unimpaired in skilled action. Several studies have shown that non-informative vision of the body enhances performance in numerous tactile tasks. However, it is unknown whether body structural representations are also affected by vision, given that finger agnosia is typically assessed while patients are blindfolded. Here, we investigated whether structural body representations are modulated by non-informative vision of the body. We tested healthy participants in a classic task used to assess finger agnosia, the "in-between" test, to determine whether tactile fingers identification vary when seeing the stimulated hand (non-informative vision). Across blocks, we used three different visual conditions: (1) viewing the stimulated hand, (2) viewing an object, and (3) viewing the other hand. Participants judged the numbers of unstimulated fingers "in between" the two touched fingers and responded vocally as quickly and accurately as possible. Critically, numerosity estimates were less accurate when they were seeing the stimulated hand compared to when an object or the unstimulated hand was visible. Our results demonstrate that vision of the body modulates body structural representations impairing tactile fingers identification.

The effects of scripts on memory prediction and recall of daily activities

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We examined the effects of script knowledge on memory predictions versus memory performance for daily activities. To this end, a normative study was conducted to determine students' scripts for typical daily activities. Participants studied 20 high-typicality and 20 low-typicality daily activities. Half of the activities were generic and half specific. During encoding, participants had to asses via judgements of learning their subjective feeling that they would remember each activity in a later memory task. These predictions were contrasted

with the real performance in a free recall task. For typical actions there were no differences between memory predictions and memory performance, while for low-typical activities participants expected better recall than it happened. Memory predictions were higher for generic than for specific daily activities, but there were no differences between generic and specific activities in recall. Results are discussed in terms of the impact of previous knowledge in memory predictions and performance.

Economic decision-making in morning/evening-type people as a function of time of day

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Decision-making is affected by psychological factors like emotional state or cognitive control, which may vary with circadian rhythmicity. Here we tested the influence of circadian chronotype (32 Morning-type vs. 32 Evening-type) and time of day (9 am vs. 5 pm) on interpersonal decision-making as measured by the Ultimatum Game. Participants had to accept or reject different economic offers proposed by a virtual participant (e.g., 1/9: 1 € for the participant and 9 € for the proposer). Acceptance involved distribution of gains as proposed, whereas rejection involved no gain for any participant. Results in the game showed a deviation from rational performance, as participants usually rejected the clearly unfair offers. This behaviour was similar for both chronotype groups, and in both times of day. However, Morning-types invested more time than Evening-types to respond to high-uncertainty offers (which were not clearly fair or unfair). This more cautious decision-making style of Morning-types fits with our finding of higher proactive control as compared to Evening-types when performing the AX-Continuous Performance Task. In line with personality traits literature, Morning-types behave with more conscientiousness and less risk-taking than Evening-type individuals.

Categorization vs. individuation processes in social learning

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We examine whether individuals use categorical or individual information when learning about the cooperative behavior of others. In order to explore how categorization vs. individuation processes take place in social learning, we adapted the Trust Game paradigm by incorporating the general procedure used by Cañadas, Rodríguez-Bailón, Milliken, & Lupiáñez (2013), who showed that categorization seems to prevail over individuation when social information is used as a context for the allocation of attentional control. In our adaptation of the Trust Game, we manipulated trustees' reciprocation rate along with their

social group, either gender (Experiment 1) or ethnicity (Experiments 1, 2 and 3). Particularly, within each social group, 3 out of 4 members (consistent individuals) were associated to the same reciprocation rate (i.e., high vs. low reciprocation rate) whereas a fourth member displayed the opposite pattern of reciprocation (inconsistent individuals). Despite the individualistic nature of the task, for black trustees we found a tendency to categorization reflected in a poorer capacity of discrimination between high and low cooperating inconsistent trustees, especially when the experimenter belonged to the outgroup. Taken altogether, our data suggest that even in a context of high individuation, categorical information and social biases may impair learning.

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Strategic, unequal, distribution of attention to multiple moving objects

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In standard multiple object tracking (MOT) tasks the relative importance of the objects being tracked is typically held constant. This is not typical of the real world in which one object (e.g. car) may be more important to attend to than another (e.g. pedestrian). In this situation an observer may need to strategically distribute attention unequally. Research has shown that observers can unequally allocate attention based on stimulus demands such as target proximity (Iordanescu, Grabowecky & Suzuki, 2009) and speed (Chen, Howe & Holcombe, 2013). However, the ability of observers to strategically split attention unequally is unknown. A series of experiments investigated this using modified MOT tasks in which the relative importance of targets was manipulated. Participants preferentially allocated attention, as indexed by faster and more accurate tracked/untracked judgements to a 'supertarget' whilst maintaining a good level of accuracy for all targets. Participants also demonstrated higher accuracy on direction of travel estimates for targets which had a higher likelihood of being questioned at the end of a trial. These results suggest that observers can strategically distribute attention unequally in lab-based MOT tasks.

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Discriminating affective valence and emotion content in emotional film clips: Evaluative and psychophysiological results

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Affective ratings and self-report measures showed a differential structure of a new collection of positive and negative emotion films (Experiment 1). In Experiment 2 high arousal positive and negative films produced larger skin conductance responses. Facial electromyography (EMG) measures showed a more complex pattern. Happy and relaxing films had opposed effects, with happy films increasing and relax films decreasing activity over the zygomaticus muscle region. Only negative films eliciting disgust produced a differentiated pattern of EMG activity, with larger corrugator and zygomatic responses. In Experiment 3, the analysis of EEG activity revealed a consistent pattern characterized by early and faster components (500-800ms and 900-1700ms latency ranges) and a later and slower component in the 2000-4000ms range. All components showed polarity reversal at anterior/posterior regions of interest and enhanced amplitudes in the presence of negative, compared to positive and neutral clips. This is a first demonstration that modulation of ERP components by affective valence can be obtained with complex dynamic stimuli. These results have implications for the differentiation of emotional states in terms of general dimensions and discrete emotion categories and reveal the adequacy of film stimuli to study the relationship between subjective and psychophysiological measures of affect.

The influence of cognitive reappraisal and expressive suppression on memory of an amusing emotional event

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The aim of the two conducted experiments was to investigate the influence of emotion regulation (ER) on memory. Participants watched an amusing video and regulated emotions via cognitive reappraisal or expressive suppression. Shortly after, they took part in an unexpected verbal memory test.

In the first experiment watching the film significantly increased participants' amusement and the change was the biggest for the control group. The declared level of expressed emotions in the suppressing group was significantly lower compared to the control condition. Emotion regulation had no influence on memory performance.

In the second experiment participants were more amused while watching the film compared to the starting point. Both cognitive reappraisal and expressive suppression

resulted in lower levels of emotion expression known from participants' self-reports and FaceReader analyses. The influence of emotion regulation on memory was nearly significant: only expressive suppression but not cognitive reappraisal impaired memory for the emotional event compared to the control group.

The results are consistent with previous findings and show that expressive suppression may have a potential to impair memory for an emotional event also when positive emotions are regulated. Cultural differences and study design may, however, play a role in studies on ER.

The role of sensorimotor cortical oscillations in skilled action anticipation

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The human mirror neuron system (hMNS) is believed to play a crucial role in facilitating skilled athlete's ability to anticipate the actions of an opponent. Here we used EEG to examine sensorimotor oscillatory activity in the mu (8-13Hz) and beta (15-25Hz) frequency bands, both EEG indices of hMNS activity. Skilled (N = 18) and unskilled (N = 21) tennis players observed videos of an expert player hitting groundstrokes, occluded 40ms before racket-ball contact. Following occlusion, participants anticipated ball direction. It was hypothesised that during the observation period prior to anticipation, skilled players would engage their own motor representations, represented by earlier and greater event related desynchronisation (ERD) in both frequency bands compared to unskilled participants, who lack the necessary motor representations. Behavioural results indicated only the skilled group performed significantly above chance and were more accurate than the unskilled group. In both frequency bands, the skilled group showed significantly earlier and greater ERD compared to the unskilled group. Specifically, only the skilled group showed ERD in the high mu (11-13Hz) band, whilst the unskilled group showed no ERD. These results suggest skilled players activate specific motor representations when observing an opponent, which may aid in their superior ability to anticipate.

Improving adherence to treatment in Alzheimer's disease through differential outcomes

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In the last decades several studies have explored the potential usefulness of the DOP to improve both discriminative learning and memory in children and adults (for a review see

López-Crespo & Estévez, 2013; Mok, Estévez, & Overmier, 2010). This procedure involves reinforcing each correct choice response to a specific stimulus/stimulus association with a particular outcome. The main aim of the present study was to test whether the DOP may improve adherence to treatment in Alzheimer's disease patients by increasing the learning of the association between two pills and two different times of the day. To assess the long-term effects of the DOP, participants were also tested 1 h and 1 week after completion of the learning phase. The results showed better discriminative performance and retention of the learned associations when participants were trained with differential outcomes. This finding suggests that the DOP can be used in intervention programs targeted to increase adherence to medical recommendations mainly in people with memory deficits (e.g., patients with dementia).

López-Crespo, G., & Estévez, A.F. (2013). Working memory improvement by the differential outcomes procedure. En S.H. Clair-Thompson (Ed.), *Working memory: Developmental differences, component processes, and improvement mechanism* (pp. 145-157). New-York: Nova Publishers.

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The differential outcomes procedure improves emotional facial recognition in children with autism spectrum disorder

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One of the main core symptoms of people diagnosed with autism spectrum disorder (ASD) is a deficit in social recognition. This deficit could explain the problems that this population has with the recognition of emotional facial expressions. Recent studies have shown the effectiveness of the differential outcomes procedure (DOP) when tasks involving the recognition of neutral or emotional faces are used. The DOP involves associating each stimulus to-be-remembered with an specific outcomes. The aim of the present study was to assess whether this procedure would improve the performance of a group of children with ASD in an emotional facial recognition task. In order to do this, we compared them with a control group of children who did not show a deficit in the recognition of emotional facial expression. The results demonstrated (i) an improvement in the performance of the ASD group when differential outcomes were arranged, and, (ii) a worse overall performance of this group as compared to the control group indicating that control children found the task very easy to perform. These findings suggest the potential of the DOP as a useful tool for the training of populations with deficits in the recognition of emotional facial expressions.

A lifespan examination of audio-visual stimulus and response interference

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Interference, aka distraction, often occurs across the senses and may occur at multiple levels of processing. In this study we aimed to compare unimodal (visual) with audio-visual interference across the lifespan and disentangle the level at which interference occurs: Does irrelevant information impede efficient perceptual encoding; stimulus interference (SI), prime competing motor responses; response interference (RI), or both? 33 young adults (aged 18-25 years), 39 older adults (age 60-84 years) and 49 children (aged 6-11 years) completed an adapted visual and audio-visual Stroop task designed to separate SI and RI. Both SI and RI appeared to play a significant role in slowing RT and reducing accuracy across age groups under unimodal and audio-visual conditions. However, older adults reaction times were slowed to a greater extent under visual conditions than children and young adults. Furthermore, audio-visual interference only reduced accuracy in children. We consider these findings within the framework of modality dominance shifts across the lifespan.

Colour preference and colour naming in red-green dichromats

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Colour preference has been widely studied in people with normal color vision but this is the first study (Álvaro et al., 2015, PNAS, 112, 9316-9321) investigating color preference in red-green dichromats. Thirty two common observers (males, N=15; females, N=17) and thirty two red-green dichromat males (protanopes, N=15; deuteranopes, N=17) took part in the study. They named (using one of the 11 Spanish basic color terms) and rated their preference (0-10) for 35 stimuli. Common observers showed the same pattern found in previous research: preference maxima in blue, preference minima in yellow-green. Especially protanopes but also deuteranopes had preference maxima at yellow and a much weaker preference for blue than common observers. Contrasting with previous research, response times (RT) were significantly lower for primary categories (red, green, yellow, blue, black, white) than for derived categories (orange, pink, purple, brown, grey) in the four groups of observers (unpaired *t*-tests; all $P < 0.001$). Moreover there were significant correlations between color preferences and RT for the three male groups (male = -0.68; protanope = -0.74; deuteranope = -0.68; all $P < 0.01$), but not for females (-0.20, $P > 0.05$). We discuss the implications of these results and the concept of fluency.

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Effects of emotion and interoceptive sensitivity in time perception

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Presentation of angry faces has been found to lengthen time-interval-estimates. Given that individuals with better heartbeat perception (HP) have been found to report more intense emotional responses than individuals with poorer HP it was predicted that individuals with better HP might show a greater time-lengthening effect for angry faces. Participants were shown angry and neutral faces at four different time intervals (1, 2, 4, and 8 seconds). For each participant estimates of the duration of each stimulus were recorded, as well as judgements of the arousal of each stimulus. HP was measured using a heartbeat-counting paradigm. Angry faces were judged to be more arousing and last longer than neutral faces. Better HP individuals also reported angry faces as relatively more arousing than neutral faces compared to poorer HP participants. However, better HP participants did not show a greater lengthening of time duration estimates for angry relative to neutral faces compared with poorer HP individuals. These results support the previously observed role of interoceptive sensitivity in emotion perception. However, these results do not suggest that this enhanced arousal contributes to affect-related cognition, at least in terms of differentially altered time-perception.

Investigating the pacemaker of the internal clock in humans

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A series of experiments investigated the pacemaker component of the internal clock and manipulations of its speed. Auditory click-trains are known to increase pacemaker speed as measured by relative overestimations of duration (e.g. Penton-Voak et al., 1996). Experiment 1 found that a regular click rhythm is unnecessary, and that random inter-click intervals are sufficient. Click-trains can also increase information processing speed (Jones et al., 2011). Experiment 2 investigated whether pacemaker speed (as measured by temporal difference thresholds; TDTs) and information processing speed were related in the absence of click-trains, but found little evidence of correlations between them. Experiment 3 tested whether this was because TDTs are not accurate indicators of pacemaker speed. Under the assumption that TDTs do measure pacemaker speed, TDT trials were preceded by click-trains. It was predicted that this would lead to smaller TDTs, but no significant differences were found. Finally, Experiment 4 tested this assumption by computer modelling the effect of

increased pacemaker speed on TDT performance (according to Scalar Expectancy Theory; Gibbon, 1977), finding no significant differences; depending on the assumptions made about the model. These findings suggest that the mathematical operation of the pacemaker-accumulator clocks may need to be reconsidered.

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Examining the persistence of affective expectations

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Perceptually based research has provided evidence to suggest that under certain conditions, a strongly held belief or expectation can bias how we view particular stimuli. We are interested in whether these same principles influence judgements about the affective value of stimuli, and whether these effects persist over time.

Since multiple studies have illustrated that humans show a preference for curved objects, we attempted to address these questions using a series of smooth and angular abstract shapes. The study employed a mixed design; all participants were exposed to the same stimuli, with half being given predictive information about the type of shape that would appear next. Affective responses were collected across two sessions separated by one week, and smooth and angular shapes became increasingly similar over the two sessions. Both groups (those with predictive information, and those without) preferred the smoother shapes in session 1, but this effect only persisted for the group with predictive information in session 2.

This finding suggests that, if we are provided with categorical information relating to a particular item, and if the affective value of that item broadly adheres to that which is expected, minor deviations from the expected value will be ignored.

Fearful faces as action feedback produce an enhanced temporal recalibration effect

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Temporal recalibration refers to a phenomenon by which the brain adapts itself to temporal asynchronies. Specifically, repeated delayed action feedback during an adaptation phase accelerates processing of the feedback following an action in a testing phase, as measured with a temporal order judgement task. We examined whether the effect of adaptation to delayed feedback using a neutral stimulus (grey oval) would be differentially transferred between emotional face stimuli and the same neutral stimulus in the testing phase. Experiment 1 confirmed the existence of a temporal recalibration effect (TRE) using a neutral stimulus as delayed feedback and test stimuli. In Experiment 2, following adaptation to delayed feedback using the oval stimulus, fearful faces were judged as appearing significantly earlier than the oval stimulus. This accelerated processing of fearful faces was not associated with autonomic arousal, as measured using skin conductance responses. In experiment 3, we confirmed that the fearful expression of the faces were affecting the degree of temporal recalibration, as they were judged as appearing significantly earlier than neutral faces. Thus, we suggest increased attention to fearful faces produces an acceleration effect, due to their biological significance for communicating threat.

Malleable self-concepts trigger cooperation: An exploration through enfacement

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Cooperation is a cornerstone of human existence, yet is a challenging activity because individual and collective interests are often in conflict. While arising in many everyday contexts (e.g., task completion, negotiation, problem-solving), it is interesting to note that cooperation also emerges in laboratory tasks — such as the one-shot Prisoner's Dilemma (PD) game — where no obvious motivational forces are operating and defecting is always more rewarding than cooperating. It has therefore been suggested that the cooperation observed in such settings must derive from an implicit property of social interaction. But what exactly is this property? One interesting possibility is that synchronous body movements promote pro-sociality (i.e., cooperation) through increased self-other similarity. To investigate this prediction, synchronous (vs. asynchronous) multisensory stimulation was applied to participants to generate the illusory experience that a model's face was assimilated with their own (i.e., enfacement), after which they played a single-shot PD game with the model. The results revealed that, following enfacement, cooperation and physical/psychological self-other similarity with the model increased. In addition, further analysis showed that self-other similarity mediated the enfacement effect on cooperation. What this suggests is that modification of the self-concept may underpin human pro-sociality.

Body temperature as a neuroergonomic marker of cognitive demands in multitasking

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Body heat loss, measured by the temperature gradient between proximal (infraclavicular) and distal (wrist) skin sites, can predict somnolence and sleep onset latency. Recent studies relate high proximal temperature and gradient to lower vigilance (i.e., slower responses in simple reaction time tasks). We tested whether this association could be extended to performance of complex cognitive tasks, and whether the temporal profile of skin temperatures is selectively dependent on task demands. We measured the time course of distal, proximal and the distal-proximal gradient (DPG) during a task demanding sustained executive control to inhibit inappropriate responses (Sustained Attention to Response Task, SART) under single and dual-task conditions. Preliminary results suggested that the ability to maintain successful response inhibition decreased over time on task (vigilance decrement), and it was impaired by dual-task demands. Importantly, the proximal temperature followed an earlier temperature rising in the single-task relative to the dual-task condition, while the DPG followed the opposite trend. Our findings suggest that both DPG and proximal temperature profiles are sensitive to different task demands and might be used in the future to monitor operator performance in prolonged cognitive tasks.

Mental rotation training and its effect on cognitive performance in college students

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This study reports the changes in Working Memory (WM) and Intelligence measures after a short training program in visual exercises of Mental Rotation (MR). MR has been proposed as a key process of the general cognitive performance (Johnson & Bouchard, 2005). The training program considered a Differential Outcome Procedure (DOP; Trapold, 1970) that improve discriminative learning and memory performance through paring a unique reward with a specific stimulus. A within-subjects design of four equidistant MR training sessions during a week was conducted. Pre and post MR parallel form measures of WM (Dot-Matrix, Computation-Span) and Intelligence (DAT-SR, DAT-AR) were also collected. A total of 20 college students participated in this study voluntarily. A linear increase of MR correct answers (and a decrease of response time) was found ($F_{correct}$ (1, 19) = 9.84, $p < .001$, $\eta_p^2 = .34$; F_{time} (1, 19) = 1.89, $p < .001$, $\eta_p^2 = .36$; Post-hoc power of a linear effect was 0.88). Repeated measures tests also showed a general increase of WM and DAT-SR; $t_{Dot}(19)$ = -

2.64, p = .020, d =.59; $t_{Span}(19)$ = -2.72, p = .010, d =.61; $t_{DAT\text{-}SR}(19)$ = -2.53, p = .020, d =.57. No significant improvement between DAT-AR measures was found.

Trapold, M. A. (1970). Are expectancies based upon different positive reinforcing events discriminably different? *Learning and Motivation, 1*, 129-140.

Johnson, W. & Bouchard, T. J., Jr. (2005). The structure of human intelligence: It's verbal, perceptual, and image rotation (VPR), not fluid and crystallized. *Intelligence, 33*, 393- 416.

‘Four’ and 4: Cross-format number integration and its relationship to math performance

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In this study we systematically investigated the integration between auditory number words (e.g. ‘four’) and visual Arabic digits (e.g. 4), and whether the efficiency of this integration is related to math ability in adults.

Participants completed a single-digit audiovisual same-different task and a standardized math test. In the same-different task, auditory and visual stimuli were displayed with various stimulus onset asynchronies (SOAs: -500ms to +500ms). Participants had to indicate whether the spoken number word (e.g. ‘six’) and the Arabic digit (e.g. 6 or 4) were the same or different in quantity.

There was a significant cross-format distance effect: the closer the Arabic digit and the number word numerically the larger the response times. This effect was strongest for simultaneous stimulus presentation (0 ms SOA), and decreased with increasing SOAs. A significant negative correlation was found between individuals’ response times in the same-different task and their performance in the math test indicating that better math performance is associated with more efficient cross-format integration.

Our results support the idea that a semantic quantity representation of auditory and visual symbols is activated when participants perform a same-different task and that the efficiency of cross-format number integration is related to math competence in adults.

Classification videos reveal the information used to respond to an opponent’s tennis stroke

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Experts are able to predict the outcome of their opponent’s next action (e.g. a tennis stroke) based on kinematic cues “read” from preparatory body movements. Here, we used classification-image techniques to find out how participants discriminate sporting scenarios as they unfold.

We filmed tennis players serving and hitting forehands, each with two possible directions. These videos were presented to novices and club-level amateurs, running from 800ms before to 200ms after racquet-ball contact. During practice, participants reported shot direction under a time limit targeting 90% accuracy. Participants then viewed videos through Gaussian windows ("Bubbles") placed at random in the temporal (E1), spatial (E2) or spatiotemporal (E3) domains. Comparing Bubbles from correct and incorrect trials revealed the contribution of information from different regions toward a correct response.

Temporally, two regions supported accurate responding (from ~50 ms before ball contact to 100+ ms afterwards, and, for forehands, from around the time of swing initiation, ~300 ms before ball contact). Spatially, information was accrued from the ball trajectory and from the opponent's head. Spatiotemporal bubbles again highlighted ball trajectory information, but seemed susceptible to an attentional cuing artefact. Overall, there is potential to help players improve by showing them from when/where they read information.

Self-attribution of positive and negative autobiographical experiences

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In this study we examined subjective causal attribution for positive and negative autobiographical experiences. Normative data were first obtained to standardise autobiographical experience type and to ensure representative experiences for the participants of the experiment. Participants worked with 40 emotional autobiographical experiences, half positive and half negative. They rated the emotional level of the autobiographical experiences and had to attribute the origin of the experiences to them, to others or to a combination of the participants and other people. Participants recalled more positive than negative experiences. There was a tendency to attribute negative events to others whereas positive experiences are shared more often. In addition, a negative attributional style correlated with the recall of negative autobiographical experiences. These ideas illustrate the role of self in the organization of autobiographical memories and coincide with the sin of egocentric bias that makes us feel good.

Evaluation of EEG-based information transfer between two different vigilance tasks

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A major topic in driving security research is the prediction of performance declines in order to avoid accidents, for example by evaluating the attentional state of the subject before the driving task through electroencephalography (EEG) frequency analysis. However, it is unclear whether the attentional state indexed by this measure could be extrapolated to the

driving task.

We measured reaction time (RT) and EEG frequency power during the performance of the Psychomotor Vigilance Task (PVT) to measure the attentional state of the subjects, and then used it as a predictor of the performance in a simulated driving task.

Preliminary results showed that RT performance in the PVT was correlated to performance in the driving task. Also, individual differences may render the use of EEG frequency power measured with the PVT unsuitable as a reliable predictor of alertness during simulated driving for some subjects.

Effects of light upon vigilance and simulated driving tasks in adverse times of day

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Vigilance maintenance during prolonged tasks (e.g., driving) deteriorates under adverse circadian conditions, such as when evening-type individuals have to drive early in the morning. Exposure to blue-enriched bright light might prevent this vigilance decrement, as it has been shown to boost alertness in the nervous system. However, its impact on cognitive performance remains unclear.

Our study tested the effects of blue-enriched polychromatic white light (versus a control condition of dim light) over performance on both 60-min simulated driving and 10-min Psychomotor Vigilance Task (PVT), in a group of evening-type participants at their suboptimal time of day (8 am). We expected light exposure to enhance performance by preventing vigilance decrements along the time on task.

Preliminary results suggest an increment in the distal-proximal temperature gradient along the driving task, reflecting a vigilance decrement in both conditions. However, exposure to blue-enriched bright light led to better performance in the PVT but not in the driving task.

These data suggest that light exposure can improve performance in simple vigilance tasks (PVT) under certain adverse conditions, while the benefit on more complex cognitive tasks (driving) is not robust. Our preliminary analyses also point to a dissociation between the physiologic and cognitive responses to light.

The necessity of conflict and cues in triggering backward inhibition

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Backward inhibition (BI; Mayr & Keele, 2000) – the mechanism proposed to account for the N-2 repetition cost, whereby performance is poorer for switching back to a recently

completed task, ABA, than for switching to an alternative task, CBA (Mayr & Keele, 2000) – has been suggested to be triggered by a conflict-monitoring mechanism (Koch, Gade, Schuch, & Philipp, 2010).

We asked whether participants might instead employ BI as a consequence of being encouraged to think in terms of three alternative "tasks". Univalent stimuli and responses were identical between groups. The Tasks group were instructed to perform one of three tasks on each trial, a task cue (e.g. "COLOUR") preceding all targets; the Mappings group were told to respond to each image with the appropriate response and received no task cues. A significant N-2 repetition benefit in the Mappings group was abolished in the Tasks group, consistent with BI counteracting underlying facilitation. When task cues were removed, an N-2 repetition benefit was present in both groups.

These findings suggest that the triggering of BI does not require task-conflict, replicating Costa and Friedrich (2012), but that instead, as previous work suggests (Mayr & Keele, 2000), it may be driven by pre-target task-preparation.

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The effects of distractor placement in animal perceptual learning

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Research in perceptual learning shows that the way stimuli are presented leads to different outcomes. The intermixed/blocked (I/B) effect is one of these outcomes and different mechanisms have been proposed to explain it. In human research it seems that comparison between stimuli is important, and the placement of a distractor between the preexposed stimuli interferes with the effect. Results from animal research indicate that such comparison process does not seem to be responsible for obtaining the I/B effect, because the type of procedure normally used in animal perceptual learning does not favor comparison. In our experiments we explore the possibility that a distractor, placed between the to-be-discriminated stimuli, may interfere with the perceptual learning process. The stimuli are presented in a short time lapse to favor comparison and either the distractor or water is presented in between. This short time lapse presentation could lead to more generalization

than the usual intermixed design. To prevent this, we used test procedures to minimize generalization due to direct association between the unique elements. Results are discussed in terms of the current theories of perceptual learning.

Reversal training facilitates context conditioning, but not new learning in rats' appetitive conditioning

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According to Attentional Theory of Context Processing (ATCP) ambiguity of the information boosts subjects' attention to the context, so that retrieval of all the information learned becomes context specific. Recent research from our laboratory shows that the ambiguity produced by reversal learning may also facilitate new learning that occurs afterwards. Two groups of rats were trained in an appetitive conditioning task with either a simple discrimination or with a discrimination reversal. Additionally, a new cue was followed by food during discrimination reversal or simple discrimination, depending on the group. No differences between groups were found with respect to the acquisition of the new learning. However, context conditioning was higher in group Reversal than in group Simple discrimination suggesting that the context was processed during reversal training, as ATCP suggests, and that there are some boundaries on facilitation of new learning after reversal training.

Costs of switching between "tasks" with univalent stimuli and responses

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The cost of switching between tasks is usually studied with stimuli and responses which map to more than one task, making a switch between stimulus-response mapping rules necessary when the task changes. But switch costs also arise with 1:1 (univalent) stimulus-response mappings, where a single task-set could presumably avoid the need for any task-switching. We hypothesised that the encouragement to use separate task-sets might inflate the switch cost in such designs. Univalent stimuli and responses were identical between groups. The Tasks group were instructed to perform one of two tasks on each trial, a task cue (e.g. "COLOUR") preceding all targets; the Mappings group were told to respond to each stimulus with the appropriate response and received no task cues. The switch cost was significantly higher for the Tasks group than the Mappings group, supporting our hypothesis. In subsequent experiments, however, we did not find a significant effect of either initial task instructions or task-cueing when manipulated alone; nor did we replicate the original between-groups effect within a 3-tasks design. We did consistently find a significant cost of switching between colour and shape, despite there being no ostensible need to switch

between distinct stimulus-response mapping rules.

When does retrieval interfere with learning of new information?

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It is well established that retrieval facilitates retention of new memories (i.e. the "testing effect"). However, recent research suggests that retrieval can interfere with future learning. Finn and Roediger (2013) taught participants names of 20 unfamiliar people. Some participants then restudied the names once more, while others were tested on the names. Next, participants learned a new piece of information about each person (i.e. their profession). Those who had been tested on the names learned fewer professions than those who restudied the names, suggesting that retrieval interfered with acquisition of new information. We hypothesised that this may be because the names had not been allowed to consolidate before adding new information. In Experiment 1 we replicated this study, with the exception that we allowed the name information to consolidate overnight before introducing the professions. This did not influence the retrieval interference effect, however. In Experiment 2 we used famous people as stimuli to ensure that the names were even more highly consolidated before introducing new information. The retrieval interference effect was now abolished. We suggest that strongly represented, highly consolidated memories can be updated with new information following retrieval, while weak, poorly consolidated memories suffer from retrieval-induced interference.

Finn, B., & Roediger, H. L. (2013). Interfering effects of retrieval in learning new information. *Journal of Experimental Psychology: Learning, Memory & Cognition, 39*, 1665-1681.

The time course of false memories: Mouse trajectories in the DRM paradigm

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The Deese-Roediger-McDermott paradigm (DRM) is a widely used method of eliciting false memory in which *Critical* lures (words related to a studied set of words) are recalled and/or recognised at rates similar to *Studied* words. However, use of just choice and reaction time data limits our ability to map the full time course of decision making in the DRM paradigm and therefore develop a full account of the processes involved. Within the DRM task strategic criterion shifts can occur across the time course when using signal-to-respond methods to investigate the time course of responding (Heit, Brockdorff, & Lamberts, 2004). In the present study, we utilised mouse trajectory information while participants

completed a recognition task within the DRM paradigm. By recording participants' mouse movements when deciding whether an item is New or Old minimises the participant's expectations about strategic criterion placement, compared with signal-to-respond methods, allowing a more natural examination of the temporal dynamics of choice in the DRM paradigm. Our results show that "Old" response trajectories for *Critical* items were most similar to "Old" responses to *studied* items. Even when participants correctly recognised *Critical* words as New there was a distinct bias towards the "Old" response in the mouse trajectory.

Heit, E., Brockdorff, N., Lamberts, K. (2004). Strategic processes in false recognition memory. *Psychonomic Bulletin & Review, 11*, 380-386.

Mouse trajectories reflect processing speed in target detection

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Participants are slower and less accurate at locating a target when it is displayed amongst an array of similar stimuli. In the few studies looking at the full time course of responding, a respond-to-signal methodology has been used (e.g. Carrasco & McElree, 2001). This methodology is unnatural and requires much practice; even with practice there can be a loss of data and a secondary task load. One possible alternative methodology is to track participants' computer mouse movements and analyse the trajectories while they make speeded responses. This methodology is more natural for participants, requires little training, and does not require much more additional cognitive resources. In a partial replication of Carrasco and McElree (2001), participants had to identify whether a target was orientated towards the left or right hand side by clicking on either the top left or top right of the computer screen. A target was presented with a valid cue, neutral cue or indiscriminate cue (all locations were cued). The mouse trajectories reflected the speed accuracy trade-off found in Carrasco and McElree (2001). In addition, a hemifield advantage was found for targets presented bilaterally. The implications for studies of response dynamics using mouse trajectories are considered.

Carrasco, M., & McElree, B. (2001). Covert attention accelerates the rate of visual information processing. *Proceedings of the National Academy of Sciences, 98*(9), 5363-5367.

The face size illusion: orienting stimulus and viewer

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An inverted face is perceived as larger than a physically identical upright face. Here, we separately investigated the impact of stimulus and viewer orientation on the face size illusion. In Experiment 1 on each trial, the same greyscale face stimulus was presented on either side of fixation; one face was always upright while its identical counterpart was presented in one of 7 different orientations in the picture plane. Participants had to decide which face stimulus ('left' or 'right') was larger. The size illusion was only present when the face was fully inverted (180) and no illusion was present when the face was only partially rotated. In a second experiment, participants performed the face size task while standing up or lying down to investigate potentially independent effects of egocentric and environmental reference frames on the illusion. These findings offer insights into visual processing and face perception.

Attention related to driving and hazard discrimination from the driving environment

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Hazard Prediction (HP) could be related to other measures such as proneness to distraction. ARDES (*Attention Related to Driving Errors Scale*) is a self-reported questionnaire that assesses individual differences in the proneness to perform attentional errors while driving (Roca et al. 2013). The participants carried out the Spanish HP Test (Ventsislavova et al. 2016). In addition, the ARDES scale was administered to the 101 participants. A bi-factorial ANOVA was performed to test the differences between levels of experience (novice and experienced drivers) and offender-status groups as independent variables and ARDES scores as dependent variable. The results indicated a significant effect of experience of offender-status and of the interaction between experience and offender-status Offender novice drivers showed the highest scores (2.27) while non-offender experienced drivers showed the lowest scores (1.56). Moreover, we used a bi-factorial ANOVA where independent variables were experience and ARDES group with d-prime average score as the dependent variable of the HP Test. Results indicated a main effect of experience group, novice drivers obtained worse d-prime results (0.49) than experienced drivers (1.43) and a marginal main effect of the ARDES group the group of ARDES-Low (1.19) obtaining better d' scores than ARDES-High (0.73).

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DOI:10.1016/j.aap.2016.02.013 ISSN:0001-4575 Q1

Tool choice based on rigidity property in children: A developmental and comparative study

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It has been found that non-human primates are able to select new tools according to their rigidity, a non-visual functional property. They can do it by manipulating them for first time or by just observing a short demonstration (e.g., Marín-Manrique, Gross, & Call, 2010). The main goal of this study was to explore how and when children show this capacity. To achieve this objective, we investigated whether 58 children aged between 25 and 55 months would select new stick-like tools based on this physical and functional property. Participants faced an out-of-reach reward inside a box and a choice of three unfamiliar tools differing in color, diameter, material, and rigidity. In order to retrieve the reward, they needed to select only the rigid tool exemplar.

Participants gathered information regarding tools' pliability either by (1) manipulating the tools themselves for a short time (2) observing a human demonstrator repeatedly bending (or not) the tools, or (3) seeing the tools placed without any manipulation taking place The results showed that children selected the rigid tool above chance levels but only above certain age in both the manipulation and observation conditions, but not in the visual static condition.

Developmental and comparative consequences will be discussed.

Marín-Manrique, H., Gross, A.N.M. and Call, J. (2010). Great Apes Select Tools on the Basis of Their Rigidity. *Journal of Experimental Psychology: Animal Behavior Processes,*36, 409–422.

Is executive function related to the extend kids are able to adopt others' perspective, think about them, and their attitudes towards minority groups?

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Previous research with children indicated that Executive Function (EF) considerably develops between the age of 4 and 7 years, and promotes the development of Theory of Mind (ToM) and Perspective taking (PT) skills. Moreover, a link between PT and prejudice has been found. Along the 6-7/8 age range, the expression of prejudice reaches a peak, which decreases in late childhood. However, to our knowledge there is not research testing the

relationship between measures of EF, ToM, PT and prejudice in children. This was the goal of the current study. Building on previous research, we expect a positive relation between EF and social cognition skills (ToM and TP), and a negative relation between EF and prejudice. We also predict a negative relation between social cognition and prejudice. Eighty-five children, divided into two age groups (5-6 years old, *N*=42; 8-9 years old, *N*=43), participated in the study. We measured EF, ToM, intelligence, TP and prejudice of children. Results showed that flexibility (executive attention) was positively related with social cognition skills, and was the best predictor of prejudice. No differences of group age were found. The role of EF for the development of social cognition as well as prejudice processes is discussed.

The impact of Least-Square Separate pattern estimators on event-related fMRI designs: A multivariate approach

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In the last few years, there has been an increase in the use of multivoxel pattern analysis (MVPA) in functional magnetic resonance imaging (fMRI) studies. Most of these studies use estimates extracted from a General Linear Model (GLM) as the inputs of the classification algorithms. The most straightforward approach models each trial/condition per run as a separate regressor, which can become unstable due to correlation between the trial-specific regressors [1]. Employing several different task designs, we found that running a separate GLM for each trial (the so-called Least Squares – Separate [2]) in an event related design makes the estimates less prone to scan noise and collinearity of regressors. We used a 4-voxel radius Searchlight [3] approach across the whole brain implemented with The Decoding Toolbox (TDT; [4]) and custom Matlab code. A linear kernel version of Support Vector Machine (SVM) was used as the classification function, setting a cost parameter value C=1 and using a leave-one-run-out cross validation technique [5] to assess the generalizability of the results. Our analyses suggest that this method improves the results obtained when using traditional averages of runs, and also offers the possibility of obtaining trial-by-trial estimates of brain activity.

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