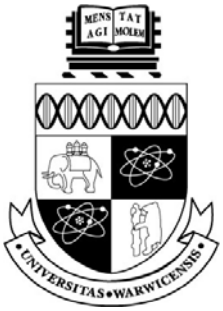
THE UNIVERSITY OF
WARWICK

Warwick Workshop on Motor Priming and Cognitive Control

Scarman House
17th – 19th August 2010



Tuesday, 17.08.

13:00	Lunch	Restaurant
14:30	Welcome	Lecture 7
15:00	Talks and Discussion: Session I	Lecture 7
19:00	Conference Dinner	Dining Room

Wednesday, 18.08

7:30-8:30	Breakfast	Restaurant
9:30	Talks and Discussion: Session II	Lecture 7
11:00	Poster Presentations	
13:00	Lunch	Restaurant
15:00	Talks and Discussion: Session III	Lecture 7
19:00	Dinner	Restaurant

Thursday, 18.08

7:30-8:30	Breakfast	Restaurant
13:00	Lunch	Restaurant

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Venue: Scarman House, University of Warwick, Coventry , UK

Access Routes: http://www2.warwick.ac.uk/conferences/howtofindus/
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Talks & Discussion, Session I:
(Tuesday afternoon)

Davelaar, E. J. *Birkbeck, University of London, UK*	Associative Learning as a Process Supporting Cognitive Control
Sumner, P. *Cardiff University, UK*	On the relationship between prime visibility and priming direction
Ansorge, U.[1], Khalid, S.[2], & Fuchs, S.[1] *[1]University of Vienna, Austria; [2]University of Osnabrück, Germany*	Consciousness and strategic control: Behavioural effects of visible and invisible words

Talks & Discussion, Session II:
(Wednesday morning)

Schlaghecken, F. *University of Warwick, UK*	Context and Control
Buckolz, E. & Fitzgeorge, L. *The University of Western Ontario, Canada*	Some Processing Properties Revealed Through Spatial Negative Priming (SNP) Tasks
Hermens, F. *Royal Holloway, University of London, UK*	Inhibition of masked primes: A comparison between response time and saccade curvature measures

Talks & Discussion, Session III:
(Wednesday afternoon)

Dittrich, K., & Klauer, K. C. *University of Freiburg, Germany*	Negative compatibility effects in arrow priming: An evaluation window account
Boy, F.[1], Evans, C. J.[1], Edden, R. A. E.[1,2,3], Singh, K. D.[1], Husain, M.[4] & Sumner, P.[1] *[1]Cardiff University, UK; [2]The Johns Hopkins University, USA; [3]Kennedy Krieger Institute, USA; [4]UCL, UK*	Individual differences in subconscious motor control predicted by GABA concentration in SMA

Associative Learning as a Process Supporting Cognitive Control

Eddy J. Davelaar
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In recent years, the dominant view of top-down control in conflict tasks has been challenged and extended (Blais, et al., 2008; Botvinick, et al., 2001; Davelaar & Stevens, 2009). I will review some of the main perspectives in the field and provide evidence for and against several interpretations. The bulk of the evidence comes from detailed behavioural studies that were designed to directly test computational accounts of top-down attentional control, which is supposed to underlie sequential effects in conflict tasks. I will focus on the flanker task in particular as this paradigm produces the most critical finding that fuels the debate on control: the finding that the Gratton effect is observed when response repeats across trials, but not when responses change (Mayr, et al., 2003). In several experiments, this pattern is replicated at both the group and individual level. I will present data from those experiments that suggest that a model using memory processes provide a better account of the data than a global-control model. Instead of doing away with conflict altogether, the experiments also suggest a reconceptualisation of the utility of response conflict, where conflict aids control though modulating memory and decision processes. The resulting computational framework is shown to account for all data points (eight in total) and their relative pairwise ordering (a further 28 patterns).

On the relationship between prime visibility and priming direction.

Petroc Sumner
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There has been long-standing controversy over the role, if any, of prime visibility in reversed masked priming (the negative compatibility effect, NCE). I will present three recent studies from my group that address this issue from different directions. We have investigated 1) whether individuals who are better at prime discrimination have shifted reversed priming profiles compared with worse discriminators; 2) whether an invisible prime with a strong motor association behaves like a stronger (visible) prime with a weak motor association; 3) whether the asymmetry between foveally and peripherally presented masked priming is eliminated when prime discrimination is equated for these locations.

Consciousness and strategic control – Behavioural effects of visible and invisible words

Ulrich Ansorge[1], Shah Khalid[2] & Isabella Fuchs[1]
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Does strategic control depend on awareness? We studied this question with the help of congruence effects of invisible (masked) and visible (unmasked) prime words. Congruence effects were measured as faster responses in congruent (prime meaning = target meaning) than incongruent (prime meaning ≠ target meaning) conditions. In this context, stronger congruence effects in trial n after congruent than incongruent preceding trials n-1 reflect strategic control (cf. Gratton et al., 1992). In 2 experiments, we used primes of different degrees of visibility to test whether this strategic control depended on prime visibility. In agreement with a role of awareness for control, we found that perceived prime-target congruence in trial n-1 was responsible for the control effect. The results confirmed Kunde's (2003) conclusions and ruled out alternative explanations in terms of different degrees of negative compatibility effects under visible than invisible conditions (cf. Eimer & Schlaghecken, 1998)

References

Eimer, M., & Schlaghecken, F. (1998). Effects of masked stimuli on motor activation: Behavioral and electrophysiological evidence. *Journal of Experimental Psychology: Human Perception and Performance, 24*, 1737-1747.

Gratton, G., Coles, M. G. H., & Donchin, E. (1992). Optimizing the use of information – strategic control of activation of responses. *Journal of Experimental Psychology: General, 121*, 480-506.

Kunde, W. (2003). Sequential modulations of stimulus-response correspondence effects depend on awareness of response conflict. *Psychonomic Bulletin & Review, 10*, 198-205.

Context and Control

Friederike Schlaghecken
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Cognitive control refers to the ability to deal with current interfering information, and to adjust one's behaviour to better deal with upcoming interferences. In the cognitive literature, two main accounts have been put forward to explain such behavioural adjustments. Roughly, the associateive priming account assumes a bottom-up, passive mechanism, whereas the conflict monitoring account stipulates the existence of a top-down, active control system. Presenting data from various interference paradigms and a number of different analysis techniques, I will argue that neither of these approaches can fully account for the observed pattern of results. Instead, I propose that cognitive control is mediated by a mechanism of context adaptation, which adusts the excitability and response threhsolds of the visuo-motor system in an ongoing adaptation process. This mechanism is assumed to be general in the sense that it adjusts to both conflict and non-conflict, but selective in the sense that it operates on specific stimulus-response links.

Some Processing Properties Revealed Through Spatial Negative Priming (SNP) Tasks

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Responding to the location of a probe target stimulus takes longer when it appears at a spatial position previously occupied by a prime distractor event (i.e., ignored-repetition [IR] trial) than when it arises at a new prime location (i.e., control [CO] trial). This latency inequality defines the spatial negative priming (SNP) effect. The work reported here aimed to clarify the cause of the SNP effect. Emerging work indicates that the SNP effect results from prime distractor response processing. The conjecture here is that distractor response processing involves its automatic activation (A), inhibition (I), and then becoming execution resistant (ER), with ER being responsible for the inhibitory after-effects produced in SNP tasks. ER should manifest itself in a selection bias against the prime distractor response when it competes with a control response on a probe trial. We tested this possibility by using both forced-choice (1:1 location-response mappings) and free-choice (1:many mappings) trials in an SNP task, which included both non masked and masked prime distractor and target events (presented singly). Following distractor primes: (1) subjects exhibited a response bias against choosing the distractor-related response on free-choice (within-hand competitions) trials, revealing the existence of ER in location-based tasks, along with its impact of ER on response selection. *Recently inhibited responses resist future execution.* This ER selection impact was less evident on forced-choice, ignored-repetition trials where ER is opposed by probe target dictates, (2) when the prime distractor response was freely selected, its inhibitory after-effect equaled that produced on ignored-repetition trials, showing that re-using the prime distractor location on the probe had no role in SNP production (i.e., response-end SNP locus), and, (3) non masked and masked prime distracters produced comparable inhibitory after-effects, despite likely being processed by different neural circuitry. Invisible primes in a location-based task can influence later response selection to visible targets. Following target primes: (1) there was a selection bias 'for' the executed prime response on free choice trials, accompanied by a facilitation effect with non masked primes, and, (2) in contrast, masked target locations exhibited inhibitory after-effects comparable to those produced by masked distracters, supporting the 'self-inhibition' model of mask function (Schlaghecken & colleagues). Note – masked targets were rarely responded to on the prime (~3%), indicative to phenomenal invisibility. Time permitting, results will be discussed that indicate that *centrally presented events, often used in the production of the SNP effect, do not produce orientation inhibition* held to cause the inhibition-of-return (IOR) effect. This is consistent with the idea that the SNP effect has a response-end locus and the notion that IOR and SNP effects have distinct causes.

Inhibition of masked primes: A comparison between response time and saccade curvature measures

Frouke Hermens
Royal Holloway, University of London, London, UK

In masked priming, responses are often speeded when primes are similar to targets ('positive compatibility effect'). However, sometimes similarity of prime and target impairs responses ('negative compatibility effect'). A similar distinction has been found for the curvature of saccade trajectories. Here, we test whether the same inhibition processes are involved in the two phenomena, by directly comparing response times and saccade curvature within the same masked priming paradigm. Interestingly, we found a dissociation between the directions of masked priming and saccade curvature, which could indicate that multiple types of inhibition are involved in the suppression of unwanted responses.

Reference

Hermens, F., Sumner, P., & Walker, R (2010). Inhibition of masked primes as revealed by saccade curvature. *Vision Research*, *50*, 46–56

Negative compatibility effects in arrow priming: An evaluation window account

Kerstin Dittrich, Karl Christoph Klauer
University of Freiburg, Germany

One of the most surprising results in category priming is the occurrence of negative compatibility effects (NCE), that is responses to targets are inhibited when prime and target share the same category. Perceptual processes and motor-response tendencies have been proposed to shape NCE in masked arrow priming (Eimer & Schlaghecken, 1998). We propose that a third class of processes may shape compatibility effects in arrow prime paradigm operating at a more central stage of categorizing stimuli into task-relevant categories. We explain these central processes with the evaluation window account (Klauer, Teige-Mocigemba, & Spuyt, 2009). Key principles of the account are that participants evaluate incoming evidence across a time window, and decisions about stimulus category are driven by changes in evidence weighted according to the Weber-Fechner law, leading to NCE for primes falling outside the time window and to positive compatibility effects for primes inside the time window. Within a series of experiments, we removed factors considered obligatory for NCE by current accounts of arrow priming. NCE remained intact as predicted by the valuation window account. Furthermore, NCE was also observed without a stimulus intervening between prime and target at intermediate prime-target SOA and when target onset comes as a surprise. As none of the current accounts can account for NCE without a stimulus intervening between prime and target, we propose that the evaluation indow account describes a hitherto overlook mechanism that contribute to NCE.

Individual differences in subconscious motor control predicted by GABA concentration in SMA

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Subliminal visual stimuli affect motor planning [1] but the size of such effects differ greatly between individuals [2, 3]. Here we investigated whether such variation may be related to neurochemical differences between people. Cortical responsiveness is expected to be lower under the influence of more of the main inhibitory neurotransmitter, GABA [4]. Thus we hypothesized that if an individual has more GABA in the supplementary motor area (SMA) – a region previously associated with automatic motor control [5] – this would result in smaller subliminal effects. We measured the reversed masked prime effect, and found that it correlated strongly with GABA concentration, measured with magnetic resonance spectroscopy. This occurred specifically in the SMA region and not in other regions from which spectroscopy measurements were taken. We replicated these results in an independent cohort: more GABA in the SMA region is reliably associated with smaller effect size. These findings suggest that, across individuals, the responsiveness of subconscious motor mechanisms is related to GABA concentration in the SMA.

Poster Session:
(Wednesday morning / afternoon)

Boulton, H., & Mitra, J. (*University of Warwick, UK)*	Postural effects of a concurrent Action Imagery task
Boy, F.,[1], Husain, M.[2], & Sumner, P. [1] *([1]Cardiff University, UK, [2]UCL, UK)*	Unconscious inhibition separates two forms of cognitive control
Boy, F. & Sumner, P. (*Cardiff University, UK)*	Tight Coupling Between Positive and Reversed Priming in the Masked Prime Paradigm
D'Ostilio, K. & Garraux, G. (*University of Liege, Belgium)*	Role of the medial frontal cortex in unconscious motor priming
Maylor, E. A., Birak, K. S., & Schlaghecken, F. (*University of Warwick, UK)*	Age-Related Deficits in Low-Level Inhibitory Motor Control
McBride, J.,[1], Sumner, P.[2], & Husain, M.[1]*([1] UCL, UK[2] Cardiff University, UK)*	Control of motor plans elicited by object affordances
Kwan, S., Loh, A., & Schlaghecken, F. *(University of Warwick, UK)*	Individual Differences in Cognitive Control: Gender, Culture, Languages
Refaat, M., Maylor, E. A., & Schlaghecken, F. *(University of Warwick, UK)*	Multiple Systems for Cognitive Control: Evidence from a Hybrid Prime-Simon Task
Seiss, E., Hope, C., Dean, P., & Sterr, A. (*University of Surrey, UK)*	An electrophysiological investigation of glucose administration effects in the Flanker task

An electrophysiological investigation of glucose administration effects in the Flanker task

Ellen Seiss, Christopher Hope, Phil Dean, Annette Sterr
Department of Psychology, University of Surrey

Behavioural studies have indicated that response times on complex reaction time tasks are faster if blood glucose concentrations are slightly elevated above normal (Donohoe & Benton, 2000). Such tasks involve several cognitive processing stages but it is not clear which of these stages are speeded after glucose administration. In order to investigate this problem we have used a double blind repeated measures design for the administration of glucose and placebo drinks. Participants performed a Flanker task while EEG was recorded as a physiological measure. More specifically, we used a Flanker task that required participants to respond to either left or right pointing central arrows by pressing a left or a right button, respectively. In addition on each trial there are extra arrows surrounding the central arrow which all either pointed in the same (congruent condition) or opposite (incongruent condition) direction as the central arrow or they were lines without an arrow head (neutral condition) All condition were presented equiprobably. No significant differences between the glucose and placebo condition were observed in mean reaction times and errors rates. However the ERP data showed that the N1 amplitude was significantly increased after glucose administration. This could indicate that stimulus identification is influenced by glucose administration, as previous researchers have found an increased N1 amplitude during discriminative feature processing compared to simple detection tasks (Hopf et al., 2002). In addition, mean reaction times and error rates were analysed separately for each of the 8 blocks. Differences between drink types were only found for the reaction times of the first block. Participants who had received glucose during their 1st session and placebo during the 2nd session, had longer reaction times after glucose administration compared to placebo. However this effect was not found for participants who received placebo before glucose drinks. These findings might be linked to task difficulty effects. Previous research has shown that high task difficulty is necessary to find glucose *enhancement* effects on the Hick task (sensorimotor function; Donohoe & Benton, 2000), working memory (Kennedy & Scholey, 2001) and episodic memory (Sünram-Lea et al., 2002). Our results conflict directly with Donohoe and Benton's (2000), potentially caused by methodological or task differences. It might be also possible that separate cognitive processes might be differently affected by glucose; which should be explored in future studies.

Age-Related Deficits in Low-Level Inhibitory Motor Control

Elizabeth A. Maylor, Kulbir Singh Birak, and Friederike Schlaghecken
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We investigated inhibitory control functions in old age using the 'masked prime' paradigm in which participants executed speeded manual choice responses to simple visual targets. These were preceded – either immediately or at some earlier time – by a backward-masked prime. Young adults produced positive compatibility effects (PCEs) – faster and more accurate responses for matching than for non-matching prime-target pairs – when prime and target immediately followed each other, and the reverse effect (negative compatibility effect, NCE) for targets that followed the prime after a short interval. Older adults produced similar PCEs to young adults, indicating intact low-level motor activation, but they failed to produce normal NCEs even with increased opportunity for prime processing, and prolonged learning. However, with longer prime-target intervals, there was some evidence that the NCE was significantly delayed in older adults, even more than expected on the basis of reduced processing speed.

Control of motor plans elicited by object affordances

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Viewing objects results in automatic partial activation of motor plans associated with those objects ("object affordance"). An important question is how such automatically activated responses are controlled so that observers can respond flexibly. In two experiments, participants squeezed force transducers to make speeded responses to objects that afforded an action with the left or right hand. Experiment 1 produced the expected compatibility effect – responses were faster on trials where the object afforded an action with the same hand that was required to make the response (compatible trials) compared to the opposite hand (incompatible trials). Importantly, this compatibility effect was modulated by trial history – suggesting that current control settings might be modulated by previous experience of conflict between the action afforded by the object and the action required by the task (reminiscent of the "Gratton" effect reported in Eriksen flanker tasks). To investigate whether the usual positive compatibility effects could be reversed if inhibition is allowed to develop (as in masked priming paradigms) Experiment 2 extended the interval between viewing the object and programming the required response. Results are discussed in terms of the relationship of object affordance and motor priming to other stimulus-response mappings and their 'cognitive control'.

Tight Coupling Between Positive and Reversed Priming in the Masked Prime Paradigm

Frederic Boy and Petroc Sumner
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When associations between certain visual stimuli and particular actions are learned, those stimuli become capable of automatically and unconsciously activating their associated action plans. Such sensorimotor priming is assumed to be fundamental for efficient responses, and can be reliably measured in masked prime studies even when the primes are not consciously perceived. However, when the delay between prime and target is increased, reversed priming effects are often found instead (the negative compatibility effect, NCE). The main accounts of the NCE assume that it too is a sensorimotor phenomenon, predicting that it should occur only when the initial positive priming phase also occurs. Alternatively, reversed priming may reflect a perceptual process entirely independent from positive motor priming (which is simply evident at a different temporal delay), in which case no dependency is expected between the NCE and positive priming. We tested these predictions while new sensorimotor associations were learned, and when learned associations were suddenly reversed. We found a remarkable symmetry between positive and reversed priming during all such learning phases, supporting the idea that reversed priming represents a sensorimotor process that is contingent on, and automatically follows, the positive priming phase. We discuss also whether the NCE mechanism is subject to a trigger threshold.

Unconscious inhibition separates two forms of cognitive control

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In the human brain, cognitive-control processes are generally consid- ered distinct from the unconscious mechanisms elicited by subliminal priming. Here, we show that cognitive control engaged in situations of response conflict interacts with the negative (inhibitory) phase of subliminal priming. Thus, cognitive control may surprisingly share common processes with nonconscious brain mechanisms. In contrast, our findings reveal that subliminal inhibition does not, however, interact with control adaptation—the supposed modulation of cur- rent control settings by previous experience of conflict. Therefore, although influential models have grouped immediate cognitive control and control adaptation together as products of the same conflict detection and control network, their relationship to subliminal inhi- bition separates them. Overall, these results suggest that the impor- tant distinction lies not between cognitive or top-down processes on the one hand and non-conscious priming mechanisms on the other hand but between responsive (poststimulus) mechanisms that deal with sensorimotor activation after it has occurred and preparatory (prestimulus) mechanisms that are modulated before stimulus arrival.

Individual Differences in Cognitive Control: Gender, Culture, Languages

Serina Kwan, Adelene Loh, and Friederike Schlaghecken
Department of Psychology, University of Warwick, Coventry, UK

The ability to inhibit interfering neural activations in favour of pursuing goal-directed behaviour varies substantially between individuals. Reliable inter-individual differences are related to, for example, age (with children and the elderly being less able to protect themselves from interference), psychiatric disorders, and developmental disorders like ADHD. Biological gender, cultural background, and bilingualism have also been suggested as factors affecting inhibitory control, but here, the evidence is less clear. In the present study, we tested low-level and high-level inhibitory control in 72 young, healthy participants, 38 of which were female, 38 were Chinese, and 38 were bilingual. Using a hybrid motor priming-Simon task, we found that gender and culture, but not bilingualism, affect high-level interference and control processes in dealing with interference from irrelevant stimuli and stimulus locations. (i) Relative to men, women showed more effective inhibitory control of prime-induced interference. (ii) Relative to men and to Chinese participants, women and non-Chinese participants showed more interference from, but not less inhibitory control of, location-induced interference. Low-level inhibitory control of interference induced by masked (subliminal) primes was not affected by gender, culture, or bilingualism.

Postural effects of a concurrent Action Imagery task

Hayley Boulton
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Everyday posture and gait control are known to interact in complex ways with concurrent cognitive tasks. Research on this type of dual-tasking has focused on the effects of task load and the difference between spatial and non-spatial tasks, and considered the possibility of shared information-processing resources. However, the ubiquitous pairing of imagined actions and ongoing posture or gait control has received less attention. Planning of imagined and actual actions appears to be a similar process, obeying many of the same constraints, so there is strong potential of conflict between imagined actions and ongoing body coordination. In the present study, participants made imaginary arm movements to targets at various distances in the mediolateral and anteroposterior direction, while standing either in the easier feet-closed or harder semi tandem-Romberg stance. Reported imaginary movement times grew linearly with target distance and participants' mediolateral sway increased as stance stability decreased in the tandem-Romberg stance. This sway increase was greater when imagining arm movements in the mediolateral as compared to anteroposterior direction. These preliminary results suggest potentially strong interaction between posture coordination and action imagery. Further work will contrast effects of current and imagined postural context.

Role of the medial frontal cortex in unconscious motor priming

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Medial frontal cortex is known to play a great role in motor and cognitive control. However, its involvement in unconscious processes is still debated. To investigate this issue, we conducted a fast event-related fMRI experiment during which participants were performing a subliminal visuo-motor priming task (see Eimer and Schlaghecken, 2003) with responded (<< << or >> >>) and non-responded (0 0) trials. We focused on two specific brain regions: the anterior cingulate cortex (ACC) and the supplementary motor area (SMA) which are known to be respectively implicated in conflict processing and motor selection/preparation. We observed longer reaction time and stronger ACC activity in incompatible trials in comparison to compatible and neutral trials. Conflict magnitude, did not correlate with this differential activity but rather showed a positive relationship with the level of functional coupling between the ACC and the prefrontal cortex during conflict processing. Imaging analysis of the non-responded trials showed that activation was mainly restricted to posterior brain areas when using a subliminal stimulus that has not been previously associated with a motor response. However, when the subliminal stimulus has been strongly associated with a motor response, this activation extended to rostral brain regions classically involved in motor preparation as the SMA. These findings provide first robust evidence supporting a role of the ACC and prefrontal cortex in processing unconscious response conflicts. Second, the role of the SMA in automatic and unconscious motor activation calls into question the relation between conscious intention and task-specific cerebral activity in response to external demand.

Multiple Systems for Cognitive Control: Evidence from a Hybrid Prime-Simon Task

Malik Refaat, Elizabeth A. Maylor, and Friederike Schlaghecken
Department of Psychology, University of Warwick, Coventry, UK

Cognitive control resolves conflicts between appropriate and inappropriate response tendencies. Is this achieved by a unitary all-purpose conflict control system, or do independent sub-systems deal with different aspects of conflicting information? In a fully factorial hybrid prime-Simon task, participants responded to the identity of targets displayed at different nominally irrelevant screen locations, preceded by nominally irrelevant, consciously or non-consciously perceived primes. The response required by the target's identity could match or mismatch a) the target's location, and b) the prime's identity, resulting in potential conflict a) across and b) within stimulus domains. Conflict effects were investigated within and across trials. Results suggest that (i) non-nonsciously perceived information elicits within-trial control, but – unlike consciously perceived information – no across-trial behavioral modulation; (ii) separate subsystems deal with conflicts arising from different stimulus domains; and (iii) occasional apparent interactions between domains reflect a particular difficulty in reactivating a just-discarded response (reactivation aversion effect, RAE).