spatial simultaneity rather than linear sequencing of elements. This tendency towards spatial rather than temporal strategies might come into play when the constraints of serial recall are lifted.

With respect to real-world functions, immediate serial recall is a relatively artificial task that is stacked in favor of auditory processing. Therefore, the difference in immediate-serial-recall span might have little impact on the everyday lives of signers. However, as Boutla *et al.* point out, clinical evaluation and educational testing of deaf individuals commonly use a digit span task, which their results suggest might be inappropriate without normative adjustments. In this respect, the work of Boutla *et al.* represents an important step forward not only in theoretical understanding of the phenomenon but also in practical implications for the deaf population.

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Attention and awareness in synchrony

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Interactions between functional areas are often considered to account for subtle aspects of cognitive functions, although direct experimental evidence is scarce. A recent study by Gross *et al.* relates the strength of synchrony between human parietal, frontal and occipital regions to the availability of attentional resources. These results support the current view that attention and awareness emerge from dynamic interactions in distributed networks.

Attention increases the efficiency of information processing, leading to faster and better performance in many tasks. However, only a limited part of the incoming visual flux benefits from such resources. How and where the 'atten-attentional bottleneck' occurs is only beginning to be understood. The attentional blink (AB) paradigm has proved useful to probe attentional capacity limitations [1,2]. In this paradigm, subjects view a rapid sequence of visual stimuli and must identify targets embedded in this stream. If a second target falls within 500 ms of a first target, it often cannot be consciously reported (as if 'blinked'), although its processing can reach high-level stages such as semantic analysis [3]. The attentional bottleneck has been localized in the right intraparietal sulcus and the frontal cortex [4], but the neural mechanisms responsible for attentional limitation remain largely unknown. Recent findings [5] using the AB paradigm suggests that capacity limitations are related to neural communication within this network in humans. Gross and colleagues found that

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oscillatory synchrony in the beta range (around 15 Hz) between right parietal, frontal and occipital regions was stronger during the entire stream of stimuli when the second target can be consciously reported: a higher degree of synchrony correlates with a better use of attentional resources.

Oscillatory synchrony and collective neural behavior

Oscillatory synchrony is one of the likely mechanisms used to implement collective neural behavior. Activities organized along similar temporal patterns in distinct neural structures (neurons, columns or functional areas) would signal that these structures are working together on the same stimulus or task. It has been associated with a variety of cognitive functions, including feature binding and scene segmentation [6], short-term memory [7], and attention [8], the last being particularly relevant, of course, in the AB paradigm.

Synchrony could facilitate attentional selection in two ways. First, because temporally coincident spikes are more likely to elicit a response in a target structure than unsynchronized ones, synchrony could be used to amplify bottom-up driven target related signals at the next processing stages. Second, it could also facilitate attentional selection by pre-activating the assembly corresponding to the searched item via top-down mechanisms. Besides, although no experimental evidence is available yet, several authors have related recurrent patterns of activity (with which synchrony is very compatible) to awareness [9–11].

However, only little experimental evidence directly relate a decreased level of synchrony with reduced cognitive abilities [12,13]. Gross and colleagues show here a direct link between the amount of between-area beta synchrony and an efficient attentive state enabling the processing of two temporally close targets.

Methodological tricks

One of the difficulties in interpreting scalp EEG or MEG data in terms of between-area synchrony arises from volume conduction: a single neural source is likely to influence the signal in many recording channels. These channels can be spatially separated by several centimeters on the scalp surface, depending on the geometry of the piece of cortex involved. To overcome this problem, the authors reconstructed the sources of beta activities and then isolated those channels that were influenced mainly by a single source. Synchrony, defined as the amount of phase-coupling between MEG signals across trials, was then estimated between these channels, providing a time-varying index of functional connections between brain regions.

The second difficulty was to identify those connections that were involved in target processing. Indeed, in the AB paradigm, stimuli are presented in rapid succession, generating responses that overlap in time. The authors used an elegant trick: they postulated that connections involved in *any* stimulus processing would be modulated at stimulus presentation rate (stimulus onset asynchrony 146 ms), whereas those mainly related to *target* processing would be modulated at a lower frequency (two targets were separated by one distractor, leading to a stimulus onset asynchrony of 292 ms). Having identified those connections involved in target processing, they analyzed the global amount of beta synchrony within this network in the two conditions of interest: second target seen or ‘blinked’. The main result is that synchrony is higher during the entire stream of stimuli when the processing of the first target left enough resources available for the second target to be consciously reported.

Enhanced availability of attentional resources

The level of synchrony at the very beginning of the stream of stimuli, before the occurrence of a target, correlates with the presence or absence of the attentional blink occurring several hundreds of ms later. It thus seems that the level of ongoing synchrony is predictive of the absence or presence of the attentional blink.

Ongoing or ‘stimulus-independent’ activity has indeed received growing attention during the last decade. Fluctuations in spontaneous brain activity have been offered as an explanation for the trial-to-trial variability of brain responses [14]. More specifically, the precise temporal pattern of ongoing activity like the phase of alpha [15] and gamma [16] rhythms at stimulus onset influences the latency and amplitude of early sensory responses. Attention can modulate the temporal structure of neural activity preceding stimulus onset, when the subject ‘prepares to attend’: spontaneous within-area synchrony in the gamma range (30–100 Hz) is enhanced by attention in monkey area V4 [8] and human LO [17]. The results of Gross *et al.* suggest that in the AB paradigm beta synchrony at the beginning of a trial creates a state of enhanced availability of attentional resources.

A recent model [18] suggests that the temporal structure of ongoing activity is indeed fundamental to account for the AB. When spontaneous activity is in phase with stimulus presentation, the stimulus-driven bottom-up wave of activity is amplified and triggers a self-sustained recurrent activity synchronized in different areas, enabling subsequent conscious report. The ignition of synchrony is an all-or-none phenomenon in the model. The bifurcation in the global state of the system predicted by the model fits well with the early onset of a difference in synchrony for seen and blinked trials in the experimental data. However, the Gross *et al.* study suggests that the strength of synchrony, rather than its phase-locking to the stimulus, is relevant.

It is also possible that to be consciously perceived an incoming stimulus requires a certain amount of recurrent activity in the occipito–parieto–frontal network. When background synchrony is set at a high level, the number of iterations requested is lower. The first target processing time is then shorter, and resources are available for the second target to be perceived. Two equally plausible predictions can be derived from this interpretation: the larger the synchrony before target onset, the shorter the blink, or the higher the frequency of synchrony, the shorter the blink.

Another possibility in interpreting the data is to consider that beta synchrony contributes to a better temporal segmentation of the information flow. Indeed, predicting time intervals to re-allocate attention at each incoming stimulus might be a crucial factor in the AB paradigm. Beta synchrony could act as an internal self-generated clock facilitating the re-orientation of attention to the second target. The prevalent role of posterior parietal cortex in the Gross *et al.* study fits well with this interpretation: this structure is involved in time estimation [19] as well as in directing attention in time [20].

Attention or awareness

There are two fundamental dimensions in the attentional blink. The first one is the capacity-limited process required to identify the first target, usually considered to be attention. Indeed the conscious identification of the first target does not seem necessary for the attentional blink to occur [21]. The second one is access awareness that is present (the second target is seen) or absent (the second target is blinked). Is it likely that the same mechanism – long-range beta synchrony – accounts for both phenomena? Attention and awareness are tightly linked. Attention is most often considered as a prerequisite for awareness (only attended objects can enter awareness), although this view has recently been challenged [10,22]. Does synchrony facilitate attentional selection or does it give the selected item access to awareness? This difficult question will probably require a large number of experiments to be answered. The Gross *et al.* study might nevertheless give us a hint; indeed, the first target can be identified in both high- and low-synchrony states. This raises an intriguing question: is the quality of the perception of the first target different depending on the background level of synchrony?

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