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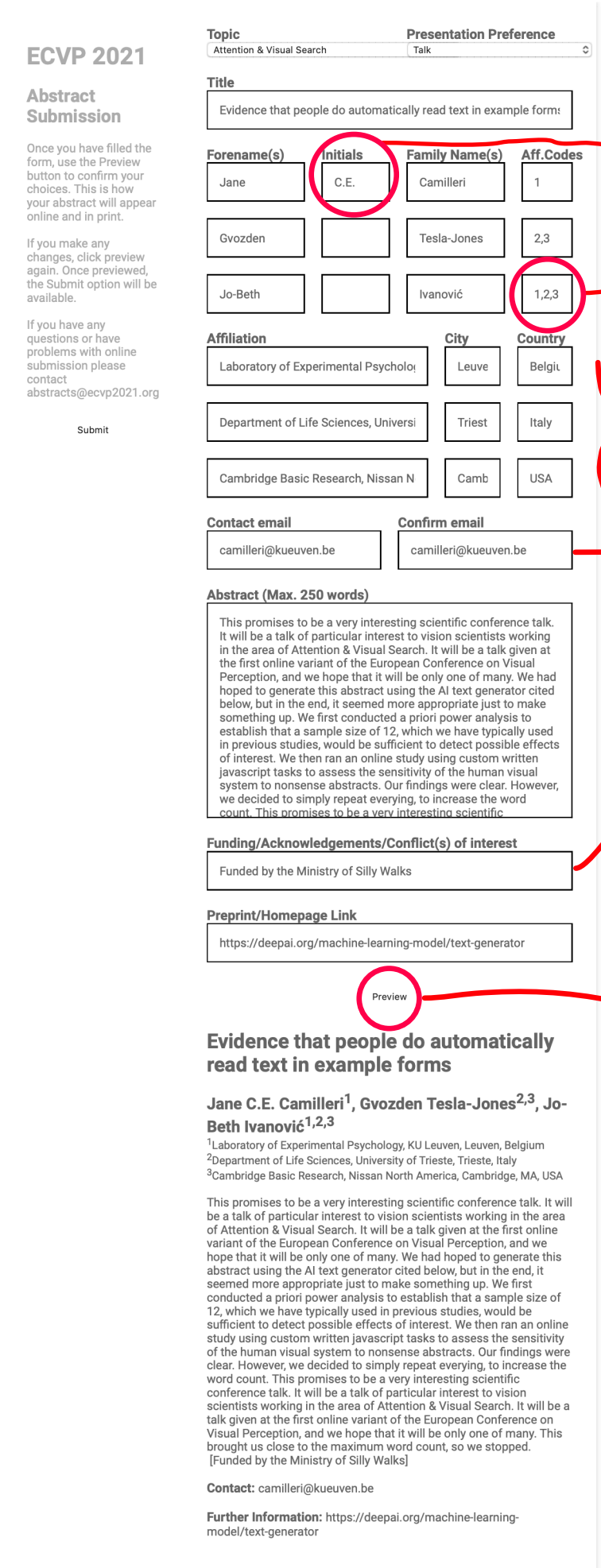

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Eye Movements in the Formally Blind

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Sensitive periods have been identified for several human visual system functions, such as global motion perception and face perception. This study investigated whether sensitive periods exist in the development of human oculomotor control. Goal-directed eye movements are crucial for efficient visual perception. Eye movements in individuals born with total bilateral cataracts were compared with sight-restored late blind individuals, individuals with pathological nystagmus, and controls with typical vision. Congenital cataract reversal individuals (CC) regained the ability to make systematic, purposeful gaze shifts, even after decades of blindness. The typical strong nystagmus of CC individuals caused distorted eye movement trajectories, but measures of latency and accuracy were as expected from their prevailing nystagmus, that is, not worse than in individuals with pathological nystagmus due to other reasons than a period of blindness. By contrast, saccade velocity was lower in CC individuals than in any of the control groups. This first study on basic characteristics of oculomotor control in CC individuals demonstrated a remarkable recovery of goal-directed gaze shifts despite some remaining impairments in oculomotor control. Thus, the severe higher visual function impairments observed in this group cannot be fully explained by the lack of basic goal directed eye movements.

Learning Face Perception Without Vision: Rebound Learning Effect and Hemispheric Differences in Blind and Sighted

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To address the longstanding questions of whether the blind-from-birth have an innate face-schema, what plasticity mechanisms underlie nonvisual face learning, and whether there are interhemispheric face processing differences in the blind, we used a unique nonvisual drawing-based training in congenitally blind (CB), late-blind (LB), and blindfolded-sighted (BF) groups of adults. The 5-day 1-hour training taught participants to haptically explore, recognize, and memorize raised-line images and draw them from memory. FMRI (Siemens 3T) was run before and after training. Tactile-face perception activated the occipito-temporal cortex in all groups. However, the training led to a strong left-hemispheric reorganization in the blind, in contrast to right-hemispheric in BF. This is the first finding of interhemispheric differences in nonvisual face processing. Remarkably, this learning-based change was positive in CB and BF but negative in LB. The lateralization and inversed-sign learning effects were specific to faces but absent in nonface categories (small objects, houses). Importantly, a short training enabled good tactile-face perception and even face-empathy in CB, implies a preexisting face-schema. A rebound learning model and a neuro-Bayesian economy principle are proposed to explain multidimensional learning effects. The results provide new insights into the Nature-vs-Nurture interplay in rapid brain plasticity and neurorehabilitation.

Funding: This work was supported by NEI-ROIEY024056, NSF/L-CN-1640914.

Early Blindness Triggers an Imbalance Between Temporal and Occipital Regions Coding for Auditory Motion Directions

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A region in the middle occipito-temporal cortex (hMT+/V5), classically considered as purely visual, enhances its response tuning to moving sounds in case of congenital blindness. However, whether hMT+/V5 contains information about sound directions and whether the impact of this crossmodal reorganization of hMT+/V5 on the regions typically dedicated to auditory motion, like the Planum Temporale (PT), remains equivocal. We used functional magnetic resonance imaging to characterize the brain activity of sighted and congenital blind individuals listening to left, right, up, and down moving and static sounds. Whole-brain univariate analysis revealed preferential auditory motion response in both sighted and blind participants in a dorsal fronto-temporo-parietal network including PT, and in the most anterior portion of hMT+/V5. Blind participants showed additional auditory motion response in the more posterior region of hMT+/V5. Multivariate pattern analysis revealed auditory motion direction information in independently localized PT and hMT+/V5 in blind and sighted participants. However, decoding accuracies in the blind were higher in hMT+/V5 and lower in PT when compared with the sighted.

investigated the role of ambient scents with different crossmodal correspondences when visually evaluating various types of meaningful stimuli. Specifically, we looked at whether the perceived shape in terms of "roundness-angularity" of environmental scents would alter the perceived shape of other stimuli present in this environment. In a first study, 99 participants evaluated angular and rounded versions of products, while in a second study, 96 participants evaluated two-dimensional renderings of rounded and angular interior environments. Finally, during these studies and one additional study ($N = 111$), participants also evaluated the actual experimental room they were in. In all studies, participants were either in a situation with no added scent, a "round" or an "angular" ambient scent. Results suggest that environmental scents can indeed affect the perceived shape of other meaningful stimuli present, but also that this depends on both the type of stimulus and the specific task-induced mindset of observers.

Aesthetic Preferences in Visual Art: The Interplay With Mental Imagery and Face Perception

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Mental imagery can be depictive or propositional and it has been linked to aesthetic preferences in the literature and visual art, but little is known about their interaction with face perception. This study used a liking rating (Likert) scale to examine whether aesthetic preferences for a set of Picasso's paintings and photographs from assorted artists were modulated by mental imagery style or prosopagnosic traits. Half of the artwork depicted landscapes or objects and half depicted people and faces. In addition, the 186 participants completed the prosopagnosic traits index and the mental imagery and art expertise questionnaires. The findings showed that participants preferred paintings and photographs of landscapes/objects, but prosopagnosic traits were not significantly correlated with liking ratings. Conversely, object-based mental imagery and art expertise were positively correlated with each other and with aesthetic preferences, but only when people were present. These findings explained up to 8% of the variability in preference for photographs and up to 4% for paintings. The results suggest the aesthetic experience of neurotypical adults is not affected by prosopagnosic traits but is rather a function of the interaction between an object--based mental imagery style and the viewer's art expertise, supporting recent theoretical propositions which will be discussed.

Contour Features Predict Valence and Threat Judgements in Scenes

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Quickly scanning an environment to determine relative threat or safety is an essential part of survival. Low-level visual features, extracted rapidly from the environment, may help people detect threat. In three experiments, we probe this link between low-level visual scene features and valence/threat decisions. In Experiment 1, we asked artists to trace the contours of all images from the International Affective Picture System image set. We computationally extracted the contour curvature, length, and orientation statistics of all images and explored whether these features predict emotional valence scores. We found that images containing angular contours were rated as more negative, and images containing long contours were rated as more positive. For Experiments 2 and 3, we composed new, content-free line drawings of contours with specific combinations of length, curvature, and orientation values; 67 participants and 97 participants were presented with these images on Amazon Mechanical Turk and had to categorize them as positive or negative, and safe or threatening, respectively. In both cases, we found that low curvature, long, horizontal contours predicted participants' positive/safe responses, while short, high curvature contours predicted participants' negative/threatening responses. Our work shows that low-level scene features help people make judgements about potential threat in the environment.

Revisiting the Positive Impact of Visual Exposure to Nature: A Case of Aesthetic Preference?

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Exposure to nature, even only as photographic images, impacts positively on physical and mental health. In line with this claim, we recently reported that walking towards images of urban as compared with nature scenes was more effortful, as indicated by a decrease in gait velocity and step length (Joyce and Leonards, ECVP 2017). Yet, what causes these gait changes: Differences in image statistics, semantic associations related to different image types, or scene

responses at 1.5 Hz (and harmonics), indexing generic face categorization located over right occipito-temporal regions, emerged at slightly lower contrast in L to H (7.4%) than their disappearance threshold in H to L (10.8%) sequences. Response saturation occurred at the same 15.6% contrast in both conditions. To summarize, the human brain requires nearly twice as much contrast for rapidly categorizing faces among objects than to merely detect visual stimuli. Yet the small offset between onset and saturation of the neural face-selective response suggests fast and efficient information accumulation for face categorization.

Integration of Spatial Frequency Information in Familiar Face Recognition in a Dynamic Visual Stream

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Here we investigated how visual information at different spatial frequencies (SFs) is integrated when recognizing familiar faces in a dynamic stream. Human participants observed 63-second sequences of unfamiliar face images presented at a fast rate of 6 Hz, with different images of different familiar faces embedded every sixth image (1 Hz). Each sequence comprised nine SF steps (from 3 to 40 cycles/image with low-pass Gaussian filter) in two orders: (a) from coarse to fine images and or (b) the reverse. We found different response patterns during two presentation orders. In the coarse-to-fine sequences, the neural responses emerged over the occipito-temporal cortex at around 11 cycles/image (cpi). Response increased and reached to plateau at around 15 cpi. In the fine-to-coarse order, we observed peak responses for faces filtered from 30 to 40 cpi. However, the recognition responses reduced strongly at 11 cpi, to an insignificance level. Our results provide neural threshold consistent with previous observations that a middle SF range (8–16 cpi) is important for face recognition. The lower recognition threshold found in the coarse to fine sequence, compared with the reverse order, supports visual perception theories that the visual system integrates visual input in a coarse-to-fine manner.

Does Holistic Processing Explain Ultra-Rapid Saccades Toward Face Stimuli?

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Previous studies have shown that face stimuli influence the programming of eye movements by eliciting extremely fast saccades toward them. This effect would be mediated by rapid processing of their low spatial frequencies. This study further examined whether these effects also reflected a holistic processing of faces. We used a saccadic choice task in which participants ($N = 24$) were presented simultaneously with two images and had to perform a saccade toward the target stimulus (face or vehicle). Stimuli were either upright or upside-down, the latter condition being used to disrupt holistic processing of stimuli. While stimuli inversion generally impaired performances (overall higher error rate and longer latencies of saccades toward the target when stimuli were upside-down than upright), saccades toward face targets were still faster and had lower error rates than saccades toward vehicle targets, irrespective of the inversion condition. Interestingly, Y-ending positions of saccades toward faces (but not vehicles) were flipped upside-down (relative to the center of images) according to the inversion condition suggesting that the same face features were targeted in both conditions. These results suggest that the bias for faces is not entirely explained by their holistic processing and rather relies on the detection of specific features.

Wild Lab—Characterizing Face-Selective ERPs Under More Natural Conditions

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Over more than two decades, neural mechanisms of face processing have been studied in the laboratory using highly constrained experimental conditions. Typical paradigms include passive fixation tasks, randomized image sequences, and adjusted low-level stimulus features. These controls help overcoming technical challenges in subsequent