Virtual North Sea Meeting on Laterality

27th of August 2020,
hosted from Bergen, Norway

Abstract book

Foreword

This 1-day virtual event came about in an unexpected twist of fate: the COVID-19 coronavirus. In early 2020 no one of us fully understood how much the world was about to change. We did, however, realize that there was unfortunately no chance the eagerly anticipated North Sea Laterality Meeting 2020 could take place as planned. As we debated the options, we agreed that we could not fully replace the wonderful atmosphere and collegial debates which characterize these meetings in an online conference. Correspondingly, we have postponed the full meeting to 2021, and we hope it is not overly optimistic to expect welcoming the laterality community in Bergen in one year from now. We did however decide that the community deserves a virtual meeting place where the work from our early-career colleagues could be showcased. This was the origin of the Virtual North Sea Laterality Meeting 2020.

The resonance following the announcement of the virtual meeting was amazing, and we received more abstract submissions than a 1-day conference could accommodate. In the necessary selection of abstracts for presentation, we favoured students to give them the opportunity to boost their CVs also in difficult Corona times, and filled the remaining slots by random selection. To all of you whose name is not in the list of presenters, our sincerest apologies. Your chance to shine is coming next year at the full meeting in Bergen.

The abstracts in this book represent a slice of the multifaceted and fascinating laterality work which is ongoing in various labs around the globe. We are looking forward to exciting discussions, and seeing you all in the virtual meeting rooms.

Sincerely,

Karsten, Marco, René, and Kristiina

…

Is handedness associated with literacy and language difficulties? A meta-analysis of 11 novel datasets

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Session: A

Handedness is the most obvious lateralized trait in humans. Across populations approximately 90% of people prefer using the right hand for writing, with males ~20% more likely to prefer the left-hand. Dominance for language processing is also lateralised and typically resides in the left hemisphere, with this finding providing the basis for investigating a link between handedness, reading and language difficulties. Inconsistent findings on the relationship between handedness and language-related impairments continue to be reported, often due to small sample sizes, publication bias towards positive findings or inconsistent criteria definition.
In the present study, we assessed the frequency of non-right handedness with language and literacy abilities in eleven different datasets never analysed before (N>7,000, including both cases and controls). Most participants were recruited as part of the GenLang collaboration (http://genlang.org/) which aims to identify the genetic component of language-related conditions. The standardisation of the criteria to define typically developed and impaired individuals and the relatively large sample size provided a robust and unbiased approach to assess non-right handedness.
We used Chi-square test to compare for hand preference between the cases groups (language impaired; reading impaired and a more general case group including individuals with either language and/or reading impairment) and the controls. To evaluate sex effect, we performed each analysis for i) males only, ii) females only, iii) combined cohort with sex-matched controls. Results were meta-analysed under an inverse-variance random effect model.

Laterality and Personality in Western Rainbowfish

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Session: M2

Many vertebrates show a side preference for using one side of the body to perceive stimuli or perform actions. Recently, it is becoming increasingly clear that many vertebrates have individual personalities. Since different hemispheres handle different cognitive functions, such as predator recognition, sociality, exploration and perception, it is likely that these traits are linked. Importantly both traits are affected by early exposure to hormones. Therefore the development of personality and of lateralization may share a common mechanism. In order to study this more deeply, we are testing a new model for both laterality and personality in three tests. Firstly we tested laterality of eye use for looking at conspecifics and secondly we tested personality using an exploration test in Western Rainbowfish (Melanotaenia splendida australis) and checked for individual correlations between these two independent test. Thirdly, we performed a predator inspection test in which we analyzed behavior both in the context of personality and laterality to verify whether they are linked directly, and related this to the previous two

test. Our main aim is to assess individual laterality and personality in order to manipulate these traits by early hormone exposure. Based on our previous pilot test, we expect to find a significant relationship between personality traits and lateralization establishing this species as a proper model. Future experiments will entail exposing developing embryos to prenatal hormones and study the development of laterality and personality.

How acute stress modulates hemispheric asymmetries: Investigating the role of endocrinological and affective parameters

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Session: M1

For most people, stress is a part of everyday life. Social judgement and performance pressure lead to acute stress and the typical endocrine stress responses that include a release of epinephrine and norepinephrine and most prominently cortisol. Acute stress has been shown to influence the whole information processing stream. Recent evidence suggests that stress also affects functional hemispheric asymmetries (FHAs), differences between the left and right hemisphere in the processing of information and task performance. It has also been suggested that maternal and early life stress as well as chronic changes in the hypothalamus-pituitary-adrenocortical axis influence the development of aberrant asymmetry patterns that are associated with several neurodevelopmental and psychiatric disorders. In a series of experiments, our group investigated the impact of acute stress and heightened cortisol levels on FHAs on the behavioral and neurophysiological level. As of now, 60 and 51 participants were subjected to a stress induction and a placebo paradigm before completing a series of behavioral tasks and EEG recordings measuring FHAs, respectively. Stress-induced cortisol increases significantly predicted higher interhemispheric integration and stronger asymmetry in the behavioral tasks. Moreover, we found changes in frontal alpha asymmetry during and after acute stress induction in a resting state EEG measurement. Overall, this indicates that stress plays a significant role in the modulation of FHAs. To differentiate whether this influence is due to cortisol or emotional changes associated with stress, we plan on repeating the same experiments with a pharmacological intervention.

Hand preference in non-human primates: case study with hatinh langurs and grey-shanked douc langurs.

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Session: A

Handedness is one of the most commonly studied asymmetries in human motor behaviour. Genetic, behavioural, and environmental theories have been proposed to unravel this complex phenomenon. However, there is still no consensus about the most suitable hypothesis to explain handedness phylogenesis. The comparative approach in the study of manual laterality helps us to understand the processes that lead to the strong human left-hemisphere brain specialisation and language. We assessed for the first time hand preferences in a coordinated bimanual tube task in 36 captive Asian colobine monkeys from two leaf-eating Vietnamese endangered species: hatinh langurs (Trachypithecus hatinhensis) and grey-shanked douc langurs (Pygathrix cinerea). Our results showed that subjects presented strong individual-level hand preferences but did not follow any population-level tendency. There were no significant differences among sexes. Trachypithecus hatinhensis showed a higher strength of hand-preferences than Pygathrix cinerea manifesting a possible higher manual specialisation during the leaf-eating process. Additionally, the index finger was dominant on the task performance showing the specificity of this coordinated bimanual test. These findings help to broaden the scarce knowledge of manual laterality on Asian colobine monkeys and confirm that the coordinated bimanual tube task is a sensitive measure to assess manual laterality in non-human primates.

Keywords: bimanual; hand preference; langurs, colobines, tube task

Cerebral crowding doesn't affect reading, but asymmetry does: an fTCD study

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Session: M2

Reading is a complex skill which requires the concurrent use of verbal and nonverbal information processing. Whether the lateralisation of these processes impacts on reading performance has been under-explored. In this study, we questioned whether poor reading was associated with a 'crowded' neural configuration (i.e., verbal and nonverbal information processing dominant in the same hemisphere). This might be predicted due to competition for resources. In order to ensure a varied sample, 116 undergraduate university students were recruited by invitation due to poor reading (n = 21), left-handedness (n = 10), or through regular sign-ups for participants (n = 85). Functional transcranial Doppler ultrasound was used. Established Word Generation and Landmark tasks measured neural configurations of verbal and nonverbal processing. Oral reading fluency was also measured using behavioural tasks. The lateralisation of verbal information processing and oral reading fluency were significantly related but in the opposite direction than might be expected: more fluent reading was associated with greater right lateralisation. Average readers possessed typical and crowded neural configurations. Unexpectedly, those with bilateral and mixed configurations were above-average

readers. For example, those with mixed configurations outperformed those with typical configurations in tasks of accuracy and retrieval of vocabulary (Cohen's d = 0.75 and d = 0.6), while those with bilateral configurations excelled in phonemic decoding and sight-word reading tasks (d = 0.66 and d = 0.6). This evidence supports the view that both hemispheres of the brain play a role in optimal reading performance.

Left-right mirrored brain organization in right language dominance: rule or exception?

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Session: M2

In humans, it is commonly assumed that there exists a prototypical pattern of hemispheric functional segregation, with language and praxis lateralizing to the left hemisphere and spatial attention, face recognition, and emotional prosody being dominant in the right hemisphere. The present study used fMRI to determine hemisphere dominance for these five cognitive functions. Crucially, we screened 315 left-handers for atypical (right) language dominance with a visual half field task. Subsequent fMRI-scanning of selected participants confirmed language dominance and laterality of the other functions in 24 participants with right hemisphere language dominance (RLD) and a matched group of 39 participants with left hemisphere language dominance (LLD).

Our results reveal that most participants with LLD display the prototypical pattern of functional hemispheric segregation (44%) or deviate from this pattern in only one function (35%). Similarly, the vast majority of RLD participants demonstrate a completely mirrored brain organization (50%) or a reversal for all but one cognitive function (32%). While these results suggest there exists a population bias to maintain typical hemispheric functional segregation, the observation that half of the participants deviate from this pattern in one or, less commonly, two functions, implies that this bias is not obligatory, but subject to at least some variation. We moreover find that participants who deviate by more than one function from the standard segregation pattern demonstrate poorer cognitive performance, in line with a presumed biological advantage of hemispheric functional segregation.

Cheeky Art: The Left Cheek Bias in Historical Portraiture

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Session: M1

Most portraits in art show a left-cheek bias, depicted individuals will usually have their left cheek forward. There is a tendency in self-portraits to instead show a right cheek bias and the left cheek bias is more pronounced in depictions of women. In a first study, for 267 portraits by Rembrandt and Holbein, it was tested how showing the left or the right cheek was related to gender of the depicted person and the painting being a self vs non-self-portrait. Holbein lacked a significant gender-based cheek bias, showing a weak overall cheek bias (52.94%), and only had one self-portrait (left-cheek position). Rembrandt's female portraits had a pronounced left-cheek bias (72.72 %) compared to males (29%) and had most self-portraits (94.4%) showing the right-cheek forward. For a second study, 104 participants

assessed a subset of 18 portraits and rated the depicted individuals on 1-6 bipolar Likert scales of powerful vs weak, trustworthy vs untrustworthy, emotional vs rational, open vs conservative, active vs passive and attractive vs unattractive. Depicted gender and prominent cheek influenced participant perception of emotionality, so that females with the left cheek being prominent had significantly lower ratings of rationality then men with the left cheek forward. A left cheek position was associated with higher emotionality and furthermore was associated with perceptions of higher openness, lower power (a novel finding) and higher passivity, no effects were found for trust and attractiveness and no other interactions were found. Overall, findings supported the laterality-based explanation of the cheek bias.

The effect of music: Brain lateralization, music and ratings of visual stimuli

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Session: M1

Past research shows that music can induce real emotions; happy and sad music produce different physiological reactions. Music has been found to affect the judgement of emotional pictures. When background music is concurrent, the emotional valence of congruent pictures is enhanced. When music and pictures are emotionally contrasting, the ratings of the affective pictures are influenced dependent on the emotional valence of the background music. This study aimed to investigate whether one hemisphere of the brain is more effected emotionally than the other by means of the dichotic listening test. The right hemisphere is predominantly the dominant emotional hemisphere, and it was theorized that playing music to the right hemisphere would have a stronger effect on ratings of emotional faces compared to music played to the left hemisphere. Happy and sad music was played to the participants' left or right ear (with white noise played to the other ear) while they rated the emotionality of happy, sad and neutral faces that were shown at the same time. The results found that happy music resulted in similar ratings for happy faces when played to the left and right hemisphere. However, sad faces were rated happier when happy music was played to the right hemisphere, which is in line with the right hemisphere hypotheses of emotion. Furthermore, all emotions were rated as sadder when the sad music was played to either the left or the right hemispheres, suggesting an overall negativity bias.

The influence of non-genetic factors in the ontogenesis of laterality: Consequences of the intrauterine asymmetries

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Session: A

Atypical laterality patterns are frequently found among individuals suffering from learning, neurodevelopmental and psychiatric disorders (Berretz, Wolf, Güntürkün & Ocklenburg, 2020). This leads us to question a possible existence of a common mechanisms at the origin of these disorders. Besides the genetic contribution, in-utero perceptual and motor asymmetries may influence higher cognitive functions, which in turn impact children's cognitive and motor development (Bishop, 2013). In line with this hypothesis, a relationship has been suggested between hemispheric asymmetries,

handedness, and the foetal positioning (Previc, 1991; Segond, 2015). However, to our knowledge, no study on humans has been conducted to test this assumption.
For this purpose, we adopted a cross sequential approach to observe the developmental trends of children from three to eight years of age. This study's aim is to assess the consequences of the foetal positioning (Breech vs. Cephalic) on the manual lateralization, the hemispherical specialization of spatial and linguistic information processing, and the children psychomotor development. We expect that an uncommon foetal positioning at the end of gestation (i.e. Breech position) would later leads to an atypical lateralization.
Combining different areas of expertise in developmental psychology, neuropsychology, and obstetric medicine, this research project has a double theoretical and clinical interests. Our aim is firstly to better understand the ontogenesis of laterality by investigating its atypical development, and secondly, from an applied psychology perspective, to propose an early identification of potential atypical patterns, even before the appearance of the clinical signs observed generally late in childhood.

Hemispheric lateralisation of body perception in right- and non-right-handers with left and right cerebral language dominance

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Session: M2

There are distinct cortical regions that respond preferentially to human bodies. It is generally accepted that these body-selective regions are lateralised with a preference for the right hemisphere. It is, however, unknown how frequently these biases occur or if they differ in handedness groups or in individuals with atypical, right hemisphere, language dominance. Here, we examine the processing of body perception in right-handers and non-right-handers with left (typical) or right (atypical) hemispheric dominance for language to examine (a) the frequency of this bias in the two handedness groups, and (b) if these regions are lateralised in a complementary fashion to language processing. Brain activity was measured in 72 participants using functional magnetic resonance imaging whilst viewing pictures of human bodies and performing a word generation task. Laterality indices were calculated for each participant and task, using the LI toolbox, to quantify hemispheric processing. A large proportion of language typical right-handers and non-right-handers had more activation in the non-language hemisphere for body perception. Language atypicals did not have a population level bias. Only language typical right-handers were, on average, right lateralised for body perception. Right-handers were also significantly more right lateralised, on average, as compared to non-right-handers. These results add to the growing literature which suggests that many right hemisphere processes are not lateralised in a fully complementary fashion to language, and that non-right-handers seem to have more varied lateralisation patterns even when language dominance is controlled for.

A dual-monaural investigation of hemispheric language dominance

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Session: M1

Studies consistently reveal that language is predominantly left-dominant with most people. This lateralization has been assessed using a variety of measures (including Wada's test, visual half-field procedures, dichotic listening, and fTCD). This study shows that the direction of sequencing auditory inputs affects processing speed via semantic-judgment tasks. A sequential, dual-monaural measure was employed using English compounds. Stimuli—24 in total—consisted of two monosyllabic parts, with an adjective first (delivered to just one ear) followed by a noun (reaching only the other ear), e.g. redeye. Half of the inputs with their respective first constituent went into the left ear first; the remainder, to the right first. Participants—20 healthy, anglophone right-handers—were instructed to select between possible meanings (using a key press) after exposure to each stimulus. Left-ear-first inputs were parsed significantly faster—average: 166 milliseconds—and more accurately than their right-ear-first counterparts. These results suggest that right-first stimuli entail longer processing than do left-first stimuli. In addition, the effectiveness of left-ear-first processing could be related to (1) its first, left-ear constituent's signal (namely, red) traveling primarily contralaterally then through the corpus callosum to the right hemisphere, is sent earlier, whereas (2) the latter, right-ear constituent (resp., eye) takes a shorter route contralaterally to the left hemisphere, avoiding a right-hemisphere detour. These findings implicate hemispheric asymmetries in speech processing, with the left hemisphere crucially processing both sound and meaning. This tool thus corroborates Kimura's right-ear advantage, crucially adding semantic processing to real words rather than mere sequences of sound signals.

Temporal consistency of hand preference in sanctuary-housed chimpanzees (Pan troglodytes) for unimanual and bimanual coordinated tasks

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Session: A

Longitudinal research on manual preferences in humans and non-human primates has mainly been conducted from a developmental perspective, with only a few studies exploring long-term stability of this trait during adulthood. In this study, we investigated short-term (1 year) and long-term (10 and 11 years) consistency of hand preference in 19 juvenile and adult chimpanzees (Pan troglodytes) housed at Fundació Mona primate sanctuary (Girona, Spain). Specifically, we assessed two experimental tasks, one unimanual (simple reaching) and one bimanual coordinated (tube task). Data were collected over a similar period in three different years: 2007, 2008 and 2018. We found that the direction of hand preference (right vs. left) in the tube task remained stable after both short and long time periods, except for the youngest individual of the sample. Conversely, hand preference direction for simple reaching was not consistent after the longest period (11 years). Nonetheless, the handedness index (HI) and the absolute handedness index (ABS-HI) between 2007 and 2008 (1-year period) and between 2008 and 2018 (10-year period) were positively correlated, thus suggesting a certain degree of temporal stability for this task. The comparison between tasks confirmed the hypothesis that chimpanzees are more strongly lateralised for coordinated bimanual tasks than for tasks performed unimanually. Interestingly,

however, the strength of hand preference in the tube task showed an increasing trend in the long term. We hypothesize that this could be a consequence of practice and experience with a particular motor action.

Key words: bimanual; hand preference; Pan troglodytes; temporal consistency; unimanual.

Visuospatial Attention Bias in Viewing Human and Canine Emotional Faces

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Session: M1

It has previously been supported by empirical research that people tend to rely on the left side (from the viewer's perspective) of the face when they are decoding visual emotional information (Burt & Perrett, 1997). However, most studies have only focused on gaze towards human faces (e.g., Eisenbarth & Alpers, 2011; Guo et al., 2010). The proposed study therefore aimed to contribute to new knowledge by adding the novel element of both human and canine emotional face stimuli. The fundamental research questions had been addressed regarding the occurrence of visuospatial attention bias towards human and canine emotional facial expressions in terms of three different emotions. The study had been conducted online and applied an implicit measure of eye gaze (chimeric faces). Stimuli had been constructed from the researchers' own database and the Japanese and Caucasian Facial Expressions of Emotion (JACFEE) and Neutral Faces (JACNeuF) image databases (Matsumoto & Ekman, 1988). Participants were asked to determine which chimeric face conveys stronger emotion and identify the target emotion. Their accuracy was noted down for potential analysis with confounding variables: whether dog ownership and belief in animal minds (Morris, Knight & Lesley, 2012) is related to emotion perception. T-tests are used to determine whether the laterality index differs for the dog vs. human faces. Then, ANOVAs investigate differences in the laterality index across the three emotions. Questionnaire data is analysed through correlation with accuracy data. Results will be discussed in the context of lateralised emotion and visuospatial processing in humans.

Prenatal (amniotic) testosterone and estradiol as predictors of handedness at 15 years of age

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Session: A

Although there are several theories that posit roles for foetal steroid hormones in the development of human handedness, few studies have examined this possibility using actual hormonal measures, and results from such studies have been generally inconsistent. We present here the findings of a longitudinal study (30 males, 30 females) in which amniotic testosterone and estradiol are used as predictors of hand preference (Dutch language version of the Edinburgh Handedness Inventory) and relative hand skill (Annett pegboard task) at 15 years of age. Although foetal sex hormone exposure did not correlate with direction of hand preference, in females, high concentrations of testosterone predicted weak lateralisation of hand skill, and high concentrations of estradiol predicted weak hand preference scores. Additionally, exposure to high levels of foetal testosterone predicted increased task

duration (slow hand speed) in males. These results are not wholly consistent with any of the main theories that posit hormonal influences in the development of handedness, and therefore suggest that any such associations may be more complex than initially thought.

Tracking brain asymmetry across life, aging and Alzheimer's disease: A multi-sample longitudinal replication

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Session: M2

Aging and Alzheimer's Disease (AD) are associated with progressive brain disorganization. Although structural asymmetry is an organizing feature of the cortex, it is unknown whether continuous age- and AD-related cortical degradation leads to changes in cortical asymmetry. Consequently, the foundational question of whether and where the cerebral hemispheres thin at different rates in aging and AD remains open.
Applying vertex-wise data-driven clustering in an initial longitudinal discovery sample (aged 20-89; 2577 observations; 1851 longitudinal) we first identified cortical regions exhibiting similar age-trajectories of cortical thickness asymmetry across the adult lifespan. We then sought replication in 4 independent longitudinal aging cohorts.
Results revealed that aging is associated with progressive, system-wide loss of the pattern of regional thickness asymmetry that characterised heteromodal cortex at age ~20. Both leftward and rightward asymmetry is lost on a similar time-scale across life. Hence, regionally across cortex, the hemisphere that is thicker when younger, thins faster. This simple organizational principle showed high consistency in 4 out of 5 of the world's largest longitudinal aging cohorts, and both the topological patterns and lifespan trajectories of asymmetry-loss were markedly preserved across samples. Finally, we found that regions exhibiting gradual asymmetry-loss over life exhibit accelerated asymmetry-change in AD.
Results uncover a new principle of brain aging – thicker homotopic cortex thins faster – and suggest a system-wide dedifferentiation of the asymmetric organization of heteromodal cortex in aging and AD. Thickness asymmetry is thus a viable marker for reduced hemispheric specialization in brain systems subserving higher-order cognition in aging and AD.

The genetic architecture of structural left-right asymmetry of the human brain

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Session: M2

Left-right hemispheric asymmetry is an important aspect of healthy brain organization for many functions including language, and can be altered in cognitive and psychiatric disorders. No mechanism has yet been identified for establishing the human brain's left-right axis. We performed multivariate

genome-wide association scanning (mvGWAS) of cortical regional surface area and thickness asymmetries, and subcortical volume asymmetries, using data from 32,256 participants from the UK Biobank. There were 21 significant loci affecting different aspects of brain asymmetry, with functional enrichment involving microtubule-related genes and embryonic brain expression. These findings are consistent with a known role of the cytoskeleton in left-right axis determination in other organs of invertebrates and frogs. Genetic variants affecting brain asymmetry overlapped with those influencing autism, educational attainment and schizophrenia.

Emotion lateralisation in a gradated emotional chimeric faces task

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Session: M1

Past research has shown a robust laterality bias in emotional chimeric faces tasks (ECFT) where the mirror versions of a chimeric faces (one hemiface shows an emotional facial expression whereas the other hemiface is neutral) are presented above each other and participants have to decide which chimeric face appears more emotional. ECFT typically reveals that chimeric faces with the emotion in the left hemiface are perceived more emotional, suggesting a right hemisphere dominance in emotion lateralisation with little variation across specific emotions. Here, we utilised a novel set emotional chimeric faces, where the intensity of the emotions presented on one half of the faces varied from 0-100%, in increments of 20%. In a second task, participants saw each chimeric face for 100 ms and they had to determine which hemiface was emotional. By manipulating intensity of the emotional facial expressions, we investigated three partly conflicting hypotheses: 1. The RH bias will gradually increase with task difficulty because the dominant becomes more engaged, 2. the RH bias will gradually decrease because the non-dominant hemisphere becomes more engaged the more demanding the task, and 3. the RH bias will abruptly disappear when participants deny explicitly seeing the emotion. The results will contribute to the ongoing debate about task demands and degree of (emotion) lateralisation.

Lateralised and bilateral brain networks for speech and stone tool-making: a neuroarchaeology study

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Session: A

The possible co-evolution of brain areas supporting language and tool-use has been the focus of intense debate in recent years. Functional neuroimaging data can help us identify signals of co-evolution (exaptation) or the absence of functional overlap indicating separate evolution. There is, however, a scarcity of neuroimaging data on both language and stone tool-making from the same participants. We used fMRI to compare directly brain activations in the same individuals, with matched paradigms for action observation of stone-age tool-use, modern tool-use, and speech syllables. In two action observation experiments, we found significant increases in functional activation in bilateral frontal mirror neuron regions (IFG and PMC), as well as the classic lateralised areas in left SMG and IPL. Univariate analyses revealed overlapping activation clusters in the mirror neuron network. A multivariate analysis, MVPA, showed overlapping but separable activation patterns for speech and tool-

use. Our study failed to replicate the lateralised activations for stone tool-use reported in previous studies. Taken together, our findings support the hypothesis of co-evolution (exaptation) for tool-use and language. Fossil evidence from human brain evolution suggests that bilateral frontal areas are a key region which experienced the first selection pressures, with increasing asymmetry of temporal lobes over time. We propose that increased processing demands on mirror neuron regions for both stone toolmaking and language skills could explain why these regions showed the earliest trace of brain reorganization in our fossil ancestors starting 3 million years ago.

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