I'm not a bot

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The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. As a library, NLM provides access to scientific literature. Inclusion in an NLM database does not imply endorsement of, or agreement with, the contents by NLM or the National Institutes of Health. Learn more: PMC Disclaimer | PMC Copyright Notice . 2018 Dec 18;2(4):44. doi: 10.3390/vision2040044 Visual recognition deficits are the hallmark symptom of visual agnosia, a neuropsychological disorder typically associated with damage to the visual system. Most research into visual agnosia focuses on characterizing the deficits through detailed behavioral testing, and structural and functional brain scans are used to determine the spatial extent of any cortical damage. Although the hierarchical nature of the visual system leads to clear predictions about the temporal dynamics of cortical deficits, there has been little research on the use of neuroimaging methods with high temporal resolution to characterize the temporal profile of agnosia deficits. Here, we employed high-density electroencephalography (EEG) to investigate alterations in the temporal dynamics of the visual system in two individuals with visual agnosia. In the context of a steady state visual evoked potential paradigm (SSVEP), individuals viewed pattern-reversing checkerboards of differing spatial frequency, and we assessed the responses of the visual system in the frequency and temporal domain. JW, a patient with early visual cortex damage, showed impaired SSVEP response relative to a control group and to the second patient (SM) who had right temporal lobe damage. JW also showed lower decoding accuracy for early visual responses (around 100 ms). SM, whose lesion is more anterior in the visual system, showed good decoding accuracy initially but low decoding after 500 ms. Overall, EEG and multivariate decoding methods can yield important insights into the temporal dynamics of visual responses in individuals with visual agnosia. Keywords: visual agnosia, EEG, decoding, SSVEP, neuropsychology Visual agnosia is a neuropsychological disorder characterized by severe difficulties in the recognition of common, everyday objects, and is not due to impairments in early sensory vision, memory or language function (for a review, see [1,2]). Visual agnosia ('agnosia' for short hereafter) is a highly heterogenous disorder that results from damage to a premorbidly normal region or regions of the cortical visual system, and is often referred to as 'acquired' visual agnosia. Agnosia can also result from brain damage that occurs in young children and is termed acquired 'developmental' agnosia (for review, see [3,4]) and can even be present in cases of 'congenital' agnosia in which behavior is impaired presumably from birth but without obvious neurological damage (for example, see [5]). The manifestation of deficits in acquired agnosia in adults (and perhaps in the other variants too) varies depending on the size and location of the lesion [6]. The classification of the behavioral profile of agnosia has traditionally been binary although more recently, there is growing recognition that the impairment may arise from any one of many transformations computed by the visual system. Standardly, the term 'apperceptive agnosia' refers to those individuals who have profound perceptual deficits resulting from a lesion to earlier parts of the visual cortex at which the elementary features of the stimulus are processed and a coarse structural description of the input is derived. The lesion typically associated with this form of agnosia results from comprehensive and widespread damage to the occipital cortex [7,8], often resulting from an anoxic episode or poisoning from mercury or lead [6]. Unsurprisingly, a person with apperceptive agnosia is markedly impaired on object recognition but also fails on a host of other basic tasks such as copying a target stimulus or matching a target with one of several choice objects. Apperceptive agnosia is sometimes differentiated from 'visual form agnosia' although there is some debate regarding this distinction [6,9]. At the opposite end of the agnosia continuum is 'associative agnosia' in which patients with damage to more rostral parts of the ventral cortex may be able to derive complex representations from the visual input but still cannot use the perceptual representation to access the stored knowledge of the object's meaning and function. These individuals are able to draw from memory as well as copy and match target objects. More recently, a third category 'integrative agnosia' that likely falls intermediate between the binary extremes refers to an impairment to mid-level vision computations [10]. Individuals with this last form of agnosia may be able to copy and match a target object, but this is executed in a slow, piecemeal, and laborious fashion, perhaps feature-by-feature, and grouping disparate elements of the display into a coherent whole is abnormal [11]. Aside from the behavioral studies, most investigations conducted on individuals with visual agnosia focus on the localization of the underlying neural damage, and the consequences for the preservation or disruption of various visual behaviors. Either structural magnetic resonance imaging (MRI) scans, perhaps acquired at the hospital, or MRI scans, both structural and functional, obtained in research settings have served as the evidence for the site and size of the cortical lesion (for example, [12,13,14,15]). Somewhat surprisingly, even though we understand that there is a time course associated with processing signals in the visual system, to date, there have been remarkably few studies that have investigated the temporal dynamics of perturbed neural processing in visual agnosia. Here, we argue that there is much to be learned from employing electrophysiological approaches to examine the temporal dynamics of visual processing, including the time points of perturbation in the waveform relative to the controls, and the downstream consequences of altered temporal dynamics for perception. Findings from such studies can further inform basic science questions by offering new insights into how early visual processing contributes to complex object processing and can provide insight into translational questions by elucidating the electrophysiological disturbances following brain damage in adulthood. The few studies that have employed high temporal resolution electroencephalography (EEG) have been informative. For example, several evoked-response potential (ERP) investigations have focused on face processing in individuals with face recognition deficits (prosopagnosia) and have examined the N170 (for a summary, see [16]) or the N250 and P600f components [17,18]. Key findings from these studies reveal that the presence or absence of the N170 waveform in individuals with acquired prosopagnosia corresponds to the locus of the lesion. That is, if the damage is to earlier regions of the visual cortex, then the N170 may be absent [19]. If, however, the damage is to the fusiform face area (FFA), then, unlike in the controls, the N170 does not evince a face inversion effect [20] and is less selective in that the signals do not differentiate between face versus non-face object stimuli. In one illustrative case, patient PS, with a lesion to the right inferior occipital gyrus, an early face-sensitive component was observed at approximately 170 ms post-stimulus over the right occipitotemporal region [21]. In the left hemisphere in which PS has a lesion in the middle fusiform gyrus, no N170 component was obtained, and these findings were replicated using magnetoencephalography. Related studies in individuals with prosopagnosia have focused on the P300 ERP to rare faces and have shown intact novelty detection [22], even when earlier visual ERPs such as the P100 are slower than those elicited from the healthy controls [23]. We also note that, just as in acquired prosopagnosia, there have been studies using ERP in individuals with congenital prosopagnosia and, again, these studies have focused primarily on the N170 component [20,24,25]. Last, there have been a few studies that have explored ERPs using stimuli other than faces. For example, one study examined ERPs to objects, faces, and Japanese and Chinese symbols in a single male with acquired associative agnosia believed to be related to his multiple sclerosis [26]. In this case, both the P190 and N170 to objects and faces were reduced compared to the controls, and P190 in response to symbols was smaller compared to control individuals. Another study reported ERPs to faces, watches and flowers in a patient with developmental visual agnosia [27]. Even though non-face stimuli are used in these studies, the focus of these papers was primarily on differences in the N170 in response to face stimuli in the single case/s compared to the controls with most emphasis on the N170 waveform for faces. As evident from this brief overview, the investigations conducted to date focus almost exclusively on event-related potentials (ERPs), which are neural components of the waveform reflecting an aggregate of activity over a period of time, and almost exclusively on the N170 component. Furthermore, the data are typically analyzed using univariate analyses to investigate visual responses (i.e., signal amplitude) by comparing the electrophysiological signal at particular components (like the N170) for upright versus inverted faces or for faces versus objects. This approach potentially obscures more subtle aspects of the electrophysiological signature that might be more apparent with multivariate analyses that assess patterns of activity. The use of multivariate statistical techniques as applied to EEG data has been advocated since 1978 [28] and, notwithstanding the fact that this may have more sensitivity than standard univariate ERP analyses, it has been used only infrequently (for example, [29]). Additionally, more robust approaches have been advocated recently and a particular advantage of this approach for neuropsychological investigations is that, with enough data, characterization of neural patterns within single subjects is possible. In the current study, we utilize the steady-state visual evoked potential (SSVEP) approach, which generates frequency information as well as temporal information in the EEG signal, in conjunction with multivariate analyses both to compare the patient electrophysiological profiles with that of the controls but also to differentiate between the two patients themselves. The current study investigated the temporal dynamics of visual processing in two individuals with acquired visual agnosia following damage to different parts of the visual system, and compared them to each other as well as to a group of control participants. Patient JW who has apperceptive agnosia sustained damage bilaterally to primary visual cortex (V1) whereas SM sustained damage to the lateral-inferior temporal lobe (further details below) and his profile is more similar to integrative or even associative agnosia. The goal of this paper is to exploit the high temporal resolution afforded by the EEG methodology to examine at what time points the visual signal was normal in visual agnosia, when the signal was degraded due to the acquired damage and what abnormalities characterized the waveforms. Furthermore, to permit fine-grained detection of differences between the patients and controls, the entire time course of the EEG signal across all electrodes was examined and decoded as a means of documenting the response profile of the patients compared with control individuals. This study takes advantage of the findings from Robinson et al. [30] in which we used decoding analyses in typical individuals to measure EEG responses to checkerboard stimuli (see Figure 1). In that study, we used checkerboard displays that differed in spatial frequency (low, medium and high) that could appear in either the left or the right visual field. Highest decoding accuracy (frequency × field; six-way) was observed around 100 ms, and this peak decoding accuracy was even evident on an individual-by-individual basis. To uncover the neural correlate of the signal at 100 ms, we compared the stimulus representations to a computational model of V1, and observed a significant correlation, supporting the claim that the EEG signal we decoded was likely the output of area V1. The decoding accuracy also remained above chance for the remainder of the time that the flickering stimulus was presented although the accuracy was lower, suggesting that as long as the stimulus was presented, early visual areas were processing the stimulus. This experiment and method of analysis offers us the opportunity to analyze the reliability of the EEG signal and benchmark the temporal profile, relative to a control sample, in two agnosic patients with lesions to different sites within the cortical visual system. The use of a checkerboard pattern ensures a strong EEG signal that can be easily decoded over time. In addition, checkerboard stimuli are processed initially in V1 but continue to be processed throughout the visual system, allowing for comparisons between early visual cortex and later more complex visual processing areas. Other stimuli such as objects rely on higher-level processes in the visual system and so may not be as sensitive to determining early impairments within V1. Stimuli and design of the experiment. (a) Stimuli were low, medium or high spatial frequency checkerboards presented in the left or right visual field. (b) A central grey fixation cross was presented for 500 ms, then the checkerboard stimulus counter-phased at 15 Hz to generate a steady state visual evoked potential paradigm (SSVEP). After 1000 ms, the cross became red or green, at which time participants discriminated its color and responded via a key-press.In the current study, we adopted the same stimulus protocol and similar electrode configuration as reported by Robinson et al. ([30]; see Figure 1 and Figure 2). The hypothesis is that the decoding accuracy of the EEG signal will differ between the two patients and that the patients' profiles will also differ from the controls. The more specific prediction is that JW's EEG responses should result in poor decoding early in the time course, consistent with damage to early visual areas, whereas SM's responses should initially be reliably decoded, but that the decoding accuracy should be at chance levels later in time, consistent with his intact V1 functions but damage to later visual areas. Support for these predictions will provide justification for the increased use of EEG systems in individuals with neuropsychological disorders and will further support the basic science use of EEG as a means of carefully documenting the microgenesis of neural signals across cortex. Head cap configuration. (a) Modified electroencephalography (EEG) head cap with high-density electrode configuration. (b) Map of electrode configuration on the back of the head, showing approximate locations of electrodes from the 10–20 standard configuration. Two male individuals with acquired visual agnosia, JW and SM, were recruited for this study and each is described in turn. Both patients exhibit deficits in being able to visually recognize objects [31,32,33,34]. JW (59 years old) acquired agnosia at age 35 due to anoxic encephalopathy associated with a cardiac valve abnormality. Based on a computed tomography (CT) scan, JW was diagnosed with generalized atrophy and ischemic infarction in both occipital cortices, extending slightly into the right parietal lobe and the extensive ischemic wrap around the occipital pole revealed widespread V2 and V1 injury ([35,36,37,38]; see Figure 3a). This diagnosis was provided independently by two neuroradiologists, neither of whom reported any damage affecting higher-level cortices. Unfortunately, we have not been able to obtain an MRI scan on JW as he has a prosthetic metal sternum, inserted during cardiac surgery. JW has recovered functioning in non-visual tasks such as language and movement and shows no memory loss. He has corrected retinal vision but has an incomplete scotoma in his upper left visual field. JW has some impairment in low-level visual tasks such as contrast sensitivity as well as difficulties in grouping, segregating figures from the background, segmenting and discriminating size and shape, as well as difficulties in contour integration and perceiving symmetry [31,35]. He also shows impaired face recognition and word recognition (perhaps unsurprising given the difficulties in signal processing in early visual areas). However, he shows intact object memory and imagery, color vision, visual-motor control [33], and spatial attention [37]. (a) Axial slice from the CT scan of JW showing bilateral posterior damage to parts of V1 and V2 and (b) axial slice from the MRI scan of SM showing lateralized damage to the right inferior temporal lobe. Adapted from Freud et al. [8], with permission from Oxford University Press, 2018.SM (42 years old) acquired agnosia at age 18 as a result of a motor vehicle accident that resulted in a lesion of the right inferior temporal lobe in the vicinity of the lateral occipital complex ([8,39], see Figure 3b). Interestingly, a functional MRI study revealed that not only was the BOLD signal in the lateral occipital complex (LOC) region in the right hemisphere abnormal but a similar abnormality was evident for the LOC region in the left hemisphere, suggesting that the impaired right side may suppress or inhibit the homologous region in the structurally preserved hemisphere [13]. SM recovered almost completely except for the visual agnosia and some weakness in his right arm and leg, which were injured in the accident. Unlike JW, SM has normal performance on low-level visual tasks such as judging line length, orientation, size, and gap position, has normal color vision, and can copy drawings of objects and scenes. He has 20/20 vision and no ophthalmological abnormalities. He can also read accurately but does so more slowly than healthy individuals. Object naming through haptic or auditory modalities is normal. However, face recognition, object categorization, and discriminating between overlapping objects are impaired [37,38]. Therefore, while both individuals have visual agnosia, JW's agnosia resulted from damage more posteriorly and bilaterally in the visual system while SM's damage is to more anterior structures and in the right hemisphere. These contrasting behavioral and neurological profiles provide the opportunity to investigate how the time course of the visual signal differs depending on the location of the damage. The control data were taken from Robinson et al. [30]. Twenty participants (18 male) from the Pittsburgh area were recruited. Four participants were excluded due to excess eye movements or poor data quality, leaving N = 16. All participants, including the patients, were compensated US $50 for their time. The study was conducted at Carnegie Mellon University and was approved by the University's Institutional Review Board (00000465). All participants gave their informed consent and the study was conducted in accordance with the Declaration of Helsinki. Stimuli were identical to those used by Robinson et al. [30]. Stimuli consisted of low, medium or high spatial frequency checkerboards with a radius of 28 degrees of arc that appeared in either the left or the right visual field (see Figure 1). The spatial frequencies radially were 0.036, 0.071 and 0.143 cycles per degree (equivalent to 1, 2 and 4 wavelengths of alternating black/white tiles), and 0.011, 0.022 and 0.044 cycles per angular degree respectively (equivalent to 2, 4 and 8 wavelengths in a semicircle). To generate a SSVEP, the contrast of the checkerboards reversed at a frequency of 15 Hz for 1 s. Spatial frequency and hemifield were sampled with equal probability in each block of trials. Following the 1 s checkerboard, the central fixation cross became red or green. Participants performed a simple orthogonal task: to discriminate the color of the fixation cross using key presses (and both JW and SM have normal color discrimination). No feedback was given regarding accuracy. The Psychophysics Toolbox in Matlab was used to present the visual stimuli on a 24-inch LCD monitor with 60 Hz refresh rate. There were 100 repeats of each of the 6 stimulus types split into ten blocks of trials, resulting in 600 trials for the whole experiment. Participants could take a break between blocks. Due to a script crash during one block, only 552 trials were collected from SM rather than the 600 from JW and control subjects. After rejection of bad trials (see Section 2.4), however, trial numbers were roughly comparable between the controls and patients. Continuous EEG data were recorded using a BioSemi Active Two system (BioSemi, Amsterdam, Netherlands), digitized at a 512 Hz sample rate with 24-bit A/D conversion. The 128 electrodes were approximately 14 mm apart and were arranged using the same nylon head cap and custom high-density configuration over the back of the head as Robinson et al. [30] (Figure 2). Note that the placement of two of SM's peripheral electrodes varied subtly compared with JW and the controls, but this small difference was unlikely to drive differences in the temporal dynamics of visual processing. All scalp electrodes were recorded relative to the standard BioSemi CMS and DRL electrodes, and were re-referenced offline to the average of the 128 electrodes. Eye movements were monitored using bipolar horizontal EOG electrodes placed at the outer canthi of each eye and bipolar vertical EOG electrodes placed above and below the left eye. Trials were excluded if the difference between the horizontal eye electrodes exceeded 100 µV between −100 and 300 ms from stimulus onset. EEG data were analyzed using EEGlab [40] and preprocessed using the PREP pipeline [41]. The preprocessing steps were as follows: data were high pass filtered at 1 Hz, line noise was filtered and were average referenced. No electrodes were interpolated. The data were then subjected to low-pass (0.1 Hz) and high-pass (100 Hz) zero-phase filters. To ensure that the results were not due to non-brain artefacts, we conducted the same analyses using more stringent filters (10–20 Hz). The results were similar and are included in Supplementary Material Figure S3. Epochs were constructed relative to the onset of the checkerboards and baseline corrected for 200 ms prior to onset. The epochs were then subsampled to 256 Hz using the decimate function in Matlab. For each participant, trials were excluded if they had any horizontal eye movements from −100 to 300 ms from image onset, or contained more than 10 channels exceeding 150 uV over the course of the trial. This step was to eliminate the noisiest trials; decoding analyses are particularly good at dealing with bad trials and thus, a stringent trial rejection step was unnecessary [42,43]. See Supplementary Material Figure S1 for mean event-related potentials per stimuli visual field for each of the patients and the controls. A support vector machine (SVM) classifier was used to decode the neural activity evoked by the six different stimuli from the SSVEP response. Decoding was performed for all pairs of stimulus types (frequency X field), for example, right visual field (RVF) low spatial frequency vs left visual field (LVF) low spatial frequency and RVF low spatial frequency vs. LVF med spatial frequency. This resulted in 15 pairwise classification tests with chance performance of 50%. Note that in Robinson et al [30], we assessed 6-way classification accuracy (chance = 16.67%), but here we analyze pairwise decoding in order to obtain accuracy distributions across the 15 pairs. After the elimination of bad trials, trial numbers were equated across stimulus classes per participant by taking the highest even number available for all classes (controls: min = 82, max = 100 trials per class; both patients: 90 trials per class). Two trials per stimulus class were averaged before classification (chosen randomly across all trials for that stimulus) to reduce non-stimulus related EEG noise. This pseudotrial technique has been shown to improve classification performance [42] and also increases the signal-to-noise ratio for SSVEP signals. For frequency domain analysis, a discrete Fourier transform was applied to the averaged pseudotrials from 0–1000 ms using the FFT function in Matlab. The amplitude at 15 Hz was selected for each electrode and pseudotrial, resulting in a matrix with dimensions 128 × P, representing the 15 Hz amplitude for each electrode over P pseudotrials. These data were z-scored across trials, and principal components analysis (PCA) was performed to reduce data dimensionality. These data were then fed to the classifier. For each pair of stimuli, an SVM classifier was used with 9-fold cross-validation. At each fold of cross-validation, PCA was performed on the training data and weights were applied to the test data [42]. PCA components accounting for 99% of the variance in the training data were used as features for classification. Similar to the frequency domain decoding, a support vector machine (SVM) classifier was used to decode the neural activity evoked by the six different stimuli. These analyses were performed in the temporal domain, at each time point from stimulus onset. The same preprocessing and decoding parameters were used with respect to pseudotrial construction, z-scoring and PCA feature selection. Analyses were conducted for each participant and time point separately. Three critical statistical tests were implemented per decoding analysis to assess (1) the significance of each patient's classification compared to chance, (2) the significance of each patient's classification compared to the control group, and (3) the comparison of the two patients to each other. First, the obtained individual patient classification accuracy was compared to a null permutation distribution from their own data. Using each patient's pseudotrial data, classification was performed 1000 times with shuffled class labels, producing a null decoding distribution with which to compare the decoding accuracy. The same randomization seed was used for each patient. This was done for each of the pairwise classification tasks, that is for 15 stimulus pairs, and averaged across pairs. For each time point or test, p-values were calculated as $p = (n + 1)/(1000 + 1)$, where n was the number of permutations (out of 1000) that were more extreme than the obtained "real" decoding accuracy. For frequency domain decoding, obtained classification accuracy was considered to be significant if it exceeded all values in the null distribution ($p < 0.001$). For time course classification, the criteria for significance were more stringent; decoding was considered significant only if three subsequent time points exceeded all values in the null distribution, $p < 0.001$ (the assumption is that it is unlikely for a single time point to be significant if none of its neighbors is significant). Second, the obtained classification accuracy per patient was compared to the control group. Z-scores were obtained for each of the agnosia patients compared with the control group. Absolute z-scores of more than 2 standard deviations from the control group are discussed. Again, for the time course analysis, patients are considered to differ if at least three subsequent time points are more extreme than the control group. Control group significance was assessed using one-sample t-tests comparing the group mean to chance performance (50%) at each time point. p-values were corrected using the Benjamini–Hochberg procedure for controlling the false discovery rate, for the 307 EEG time points that were assessed, and considered significant if $p < 0.001$. Finally, the obtained individual classification accuracies were compared for the two patients. A null difference distribution was obtained by taking the difference between each value in JW's null distribution and SM's null distribution (for each time point and frequency domain decoding). This yielded a distribution by which JW and SM would be expected to vary due to chance. The obtained difference in decoding accuracy between JW and SM was then compared to this distribution, for the frequency domain decoding as well as time course decoding. Again, p-values were calculated as $p = (n + 1)/(1000 + 1)$, and classification accuracy was considered to be significant for values $p < 0.001$. In this study, EEG was recorded from JW and SM while they viewed achromatic checkerboards that alternated in their contrast at 15 Hz, and the electrophysiological signals were compared to a group of individuals with no visual impairment as well as to each other. The checkerboards were presented in the left or right visual field and were low, medium or high spatial frequency, yielding six conditions of interest. Two main analyses were performed to compare the patient and control data: (1) decoding stimulus representations in the time-frequency domain, and (2) decoding stimulus representations across the time-course of a trial. Finally, the data from the two patients were compared to each other. First, to test the six-way discrimination of the signals, we decoded stimulus responses in time-frequency space, capitalizing on the stimuli evoking steady state visual evoked potentials (SSVEP; [44]. A fast Fourier transform was applied to each averaged pseudotrial 0–1000 ms from stimulus onset, and the amplitude at 15 Hz (the stimulus flicker frequency) for each electrode was fed to the classifier. This analysis established whether the spatial SSVEP information captured by EEG can reliably distinguish between the stimuli. Both JW and SM showed above chance decoding at 15 Hz compared to their null distributions, $p = 0.001$ (Figure 4a,b). This result demonstrates that the flickering checkerboard stimuli were being encoded by the visual system of both patients. Frequency decoding for JW was lower than that of most of the controls: z-scores indicated that JW was 1.30 standard deviations below the control mean, whereas SM's accuracy was still within the control range, $z = 0.14$. It should be noted, however, that there was one control that did not achieve significant decoding in the frequency domain ($M = 50.62\%$), likely due to low SNR. Inclusion of this participant in the control distribution increased the group variance markedly. Excluding this participant, it was clear that JW's decoding was significantly below the control group, $z = -2.06$, $p = 0.040$. SM was still not significantly different from the controls, $z = -0.054$, $p = 0.957$. Examination of decoding accuracy for stimuli pairs within a visual field (e.g., LVF low vs. LVF medium spatial frequency) and for the same spatial frequency across visual fields (e.g., LVF low vs. RVF low) revealed that mean decoding for both patients was not entirely driven by differences across visual field, and that accuracy in general was lower for JW than the controls (see Supplementary Material Figure S2). Together, these results suggest that JW had impaired SSVEP signals relative to the controls. Frequency domain decoding results. (a) JW and (b) SM compared with their null distributions and individuals in the control group. Dotted lines designate the obtained classification accuracy for that patient. (c) Difference in decoding accuracy between JW and SM compared with the difference in the null distributions. JW's frequency domain decoding was significantly lower than SM's, $p = 0.001$. Note the single control outlier in the control distribution.Additional evidence for an impairment in JW's visual processing came from comparing the signals of the two patients directly. As seen in Figure 4c, JW's decoding was significantly below that of SM, $p < 0.001$. Overall, these results implicate JW's early visual system impairments in the reduced stimulus-specific neural responses in the frequency domain. SM, in contrast, did not appear to have obvious processing deficits in the frequency domain. Second, we examined the time course of decoding the stimuli. At each time point across the course of a trial, a linear support vector machine (SVM) classifier was used to decode the neural activity evoked by the different stimuli. Pairwise classification was performed for all pairs of stimuli (low, medium and high spatial frequency stimuli in left and right visual fields; 15 pairs). Chance decoding was at 50%. The responses reported by Robinson et al. [30] with typical controls revealed peak decoding around 100 ms, corresponding with the P1 ERP component, which is likely to originate from the early visual cortex. As evident from a quick glance at Figure 5c,d, the profile elicited for JW bears little resemblance to that of the controls whereas SM's profile is qualitatively similar to that of the controls. As can be seen in Figure 5a, the stimuli did not elicit a 100 ms peak for JW, although there was a suggestion of decoding at approximately 170 ms, and prolonged reliable decoding after ~400 ms. JW's decoding appeared to be much lower than the controls in early time period, but higher than the controls at later time points. In contrast, SM showed reliable decoding at 90–116 ms post stimulus-onset, and there was no reliable decoding after 480 ms (Figure 5b,d). Although lower in accuracy overall, SM's decoding was not reliably different from the control group. Time course classification results for visual agnosia patients. (a) JW's decoding performance compared to shuffled label permutations. (b) JW's decoding performance compared to the control group. (c) SM's decoding performance compared to shuffled label permutations. (d) SM's decoding performance compared to the control group. Error bars designate one standard deviation of the control group. Filled circles below plots a and c indicate significant decoding above chance, and open circles indicate those points that were not sustained for at least three successive time points. For plots b and d, filled black circles indicate significant decoding that was two standard deviations above or below the control group (b,d). Open black circles indicate those points that were not sustained for at least three successive time points. Grey circles indicate decoding that is above chance for the control group. Red (b) circles indicate decoding that is above chance for JW, and blue (d) circles indicate decoding that is above chance for SM.Finally, we compared the time course of decoding for the two patients directly. As seen in Figure 6, decoding of JW's data was below that of SM at 100 ms, at the time of the first peak. This is additional evidence of JW's early visual processing impairment. SM's decoding, however, was significantly lower than that of JW for later timepoints >600 ms. Together, these results echo the frequency domain results by showing that JW's early visual system impairments reduced stimulus-specific neural responses. Later, higher level processing for SM appeared to be lower than JW but was within the range of healthy individuals. A summary of the time course decoding results can be seen in Figure 7. Difference in time course classification results for the two visual agnosia patients (JW minus SM). Accuracy for the two agnosia patients differed over time; around 100 ms, SM outperformed JW, but from 500 ms onwards JW had much higher decoding accuracy than SM, $p < 0.01$. Time domain decoding results. For JW (top row), decoding at 100 ms was significant, but much lower than all of the controls. However, at 600 ms, JW's decoding accuracy exceeded most of the controls highlighting a delay in visual processing. For SM (middle row), decoding at 100 ms was significant, and while decoding accuracy was still lower than most of the controls, his responses still fell within the control distribution. At 600 ms, SM's decoding accuracy was not significant, and fell within the distribution of decoding from the controls. When comparing JW to SM (bottom row), JW's decoding was poorer at 100 ms than SM's, and the reverse is true at 600 ms.To ensure that the patterns of results were not driven by systematic artifacts in the data, we repeated the analysis using data that was filtered using a more stringent strategy. Before epoching, data were filtering using a 10 Hz highpass and 20 Hz lowpass to remove any low-frequency artefacts such as eye movements, and higher frequency muscular artefacts. As can be seen in the Supplementary Material Figure S3, the new analyses revealed that JW had poorer decoding in the frequency domain than the controls and SM, and JW had poorer decoding early in the time course (100–200 ms) relative to the controls and SM. Thus, this stringent filtering analysis provides additional evidence for JW's early visual processing impairment. We examined the EEG signal in two individuals with visual agnosia to characterize the electrophysiological response profile in agnosia and to ascertain whether the reliability of the signal might reveal the rough locus of the lesion site. We chose to focus on agnosia as the behavioral profiles of the two patients, JW and SM, have been widely documented offering a detailed understanding of preserved and impaired functioning. In addition, agnosia can be the result of damage to any of a number of region/s of the visual system. Understanding the time course of the visual signal may elucidate how some visual functioning remains intact despite damage to early visual cortical areas. We used the same protocol as described by Robinson et al. [30] allowing for a direct comparison of the two agnosia patients with healthy individuals as well as a comparison between the two individuals. Using decoding methods, we found that, in the frequency domain, both JW and SM produced steady-state visual signals that could be reliably decoded at 15 Hz, consistent with the oscillation rate of the checkerboard stimulus pattern. However, the accuracy of the frequency decoding was significantly poorer in JW compared to SM and to the controls. This demonstrates that, while the visual signal is clearly being encoded in both patients, the electrophysiological profile was not as robust in JW, suggesting that his impairments to the early visual cortex influenced the frequency domain responses. Indeed, pattern reversal SSVEP responses have been localized to the early visual cortex [45] and fast frequencies such as 15 Hz seem to bias processing to early visual stages relative to slower frequencies [46]. Also, as mentioned previously, this particular paradigm targets early visual areas and, in particular, V1, as evident from the significant high correlation of the stimulus dissimilarity matrices from layer S1 of the well-known model of the early visual cortex, HMAX [47], and measures of dissimilarity derived from the EEG responses at every time point [30]. Frequency decoding at 15 Hz can thus distinguish between those with healthy and those with abnormal early visual cortex functioning, such as JW. Temporal decoding can also distinguish between other types of abnormal functioning, by highlighting when the EEG signal becomes unreliable: SM showed more reliable decoding early in the time course, with a peak decoding accuracy around 100 ms which is consistent with the responses from the healthy controls. JW, on the other hand, produced weak decoding early in the time course, but did produce reliable sustained decoding much later, after 400 ms. Both of these results are consistent with where the damage to the visual system is located. In JW, the damage to the early visual cortex bilaterally is consistent with poor early visual processing. In SM, the damage is later in the visual pathway in the temporal lobe, and so preserved early visual processing is consistent with this prognosis. While there are other methods than can be used to explore the temporal dynamics of the visual system, such as modulating presentation times [48], EEG is more sensitive to precisely when in the visual stream the EEG signal becomes un/reliable. In addition to distinguishing between SM and JW, the temporal decoding offers some insight into how simple stimuli are encoded even when the early visual cortex is damaged. It is somewhat surprising that, in JW, decoding does eventually exceed chance. If signals being processed in the early visual cortex are degraded, then it is not obvious how these signals become stable with more time. There are several possible explanations for this. The first is that there is some top-down involvement that helps to regulate the incoming signal. JW has shown that he can learn to classify objects into different categories (Gabor patches with different spatial frequencies) visually and he can maintain this learning long term [31], demonstrating that while the visual signal is significantly degraded, it can still be useful for some complex visual processing. One of the explanations for the improved learning is that top-down mechanisms are able to generalize across trials, filling in the gaps of missing information and helping to restructure the incoming sensory information into a representation that is useable (for example, [49]). For JW, the damage is restricted to lower visual areas, while anterior visual areas are preserved, making this explanation plausible. The same may be true in the current study. The checkerboard alternates in contrast 15 times a second, and so by the time the decoding becomes stable in JW, he has already been exposed to five iterations of the checkerboard. The stimulus itself is relatively simple, and the only distinguishing features between the types of checkerboard is the spatial frequency. Therefore, five iterations may be sufficient to begin to stabilize the incoming information with the help of top-down mechanisms, potentially via stronger dorsal involvement which is relatively spared in JW compared to the ventral stream. Of course, this more stable extended signal is not obviously functional with regard to compensating for the agnosia as JW continues to evince a profound perceptual impairment even for simple visual inputs. It is also interesting to note that for JW decoding accuracy remained above chance after 400 ms, suggesting that the visual system was still responding to the stimulus. The controls, on the other hand, showed periodic accurate decoding, but little sustained activity. This could suggest that compensatory mechanisms take longer to encode stimuli, and could be a characteristic of impaired early visual functioning. The second possible explanation for the recovered EEG decoding is that while early visual cortex is impaired, some partial signal is able to be encoded but may take many iterations to become stable, perhaps with the help of secondary visual areas. Rosenthal and Behrmann [31] also suggest a bottom-up mechanism for learning from the degraded visual signal, that focuses on retraining of receptive fields that may have shrunk due to the ischemic damage. The result of the shrinking receptive fields is a loss of global processing, that can be retrained with help from secondary visual areas. This potential mechanism cannot explain the results from the current study, as the training would take much longer than the duration of the stimulus. However, it is possible that the initial involvement of secondary areas that helps start the retraining of the visual system may be causing the delayed recovery of the EEG signal. With EEG alone, we are unable to tease apart the top-down versus bottom-up alternatives. Due to a prosthetic metal sternum in JW, we cannot obtain MRI data in order to establish whether more anterior visual areas are more involved in JW's visual processing. SM, on the other hand, shows intact early sensory processing but an inability to comprehend global object structure [34] or to learn object categories (multi-part Fribbles in this case) even with training [50]. Together, this demonstrates that while early visual processing is intact, higher visual areas are impacted. This matches the decoding results from his EEG responses: the classifier was able to decode SM's EEG early in the time course, showing the same accuracy peak at 100 ms as healthy individuals, but decoding returned to chance later. It is important to note that SM's decoding, although lower than most of the controls, was still within the control range. It is likely that due to the use of simple visual stimuli and high frequency presentation rates in this study, early visual processing dominated the signal. Future work could investigate temporal and frequency-domain decoding of high-level visual objects in SM. These findings complement the behavioral profiles of JW and SM: low-level visual processing is impaired in JW even though higher-level processing is less impaired, in contrast with SM who shows intact low-level visual processing, but deficits in more complex visual processing. However, the recovery of some of the EEG signal in JW may recommend time course analyses: the recovered visual signal later in visual processing in a damaged system may be difficult to obtain behaviorally. The presence of two distinct patterns of EEG decoding accuracy in SM and JW corresponds to the site of the lesion in the visual system and complements previous behavioral findings of the extent to which early versus late visual signals are usable for processing visual information. While other imaging modalities such as MRI and MEG may be more helpful, faster, and cheaper for ascertaining where in the brain the damage is, these techniques may not be viable for individuals with metal in their bodies, such as JW. The use of EEG and a paradigm that allows assessment of visual responses in both time and frequency domains provides converging evidence of visual system impairments in individuals with agnosia. Agnosia has been standardly subdivided into the two main subtypes, apperceptive agnosia and associative agnosia, each assumed to be the consequence of damage to either one of the two stages of processing of visual input. Although this binary distinction has long served as the framework for understanding agnosia, a number of challenges to this nomenclature have been offered with the specific claim that visual form processing is subserved by a series of computations rather than simply by two distinct stages. Consistent with this idea of more graded processing of inputs, one might then predict that there might be cases of visual agnosia whose symptoms do not match either of the two established subtypes and, indeed, there have been reports in which the patients' deficits do not fall cleanly into either the associative or apperceptive stages. As an example, cases of agnosia have been described in whom lower-order perception is normal (patients can copy and match visual displays normally). These patients, however, are unable to integrate parts of visual inputs into a coherent holistic representation and this disorder has come to be labeled 'integrative agnosia' [10,51,52]. HJA, a well-studied integrative agnosic individual, illustrates the profile of integrative agnosia in his response to a photograph of a pepper shaker (or pepper pot): "a stand containing three separate pans; the top has a design on its lid; the second pan has a slightly smaller diameter than the top pan; the bottom pan has a wider diameter than the second pan and is longer in length" [53]. The temporal precision of EEG, the effective use of decoding methods, and the demonstration in this paper of the feasibility of differentiating between the electrophysiology of the two agnosic patients recommends the use of decoding EEG signals to help uncover the multiple different subtypes of agnosia, and how impaired visual processing at different levels of the visual system may differ between the subtypes. Particularly when compared with non-agnosic occipital lesion patient, multivariate EEG analyses may provide the differential temporal signatures associated with damage to different components of the cortical visual system. A future study contrasting decoding to low-level inputs like checkerboards and more complex patterns or objects might further differentiate between patients and their visual abilities. Here, we have demonstrated that EEG decoding, by using the time course of the EEG signal, can be employed to infer where along the visual pathway the damage is located in individuals with agnosia. A significant advantage of EEG decoding methods is that they produce reliable results from single individuals to compare against a normal distribution of responses, which highlights the potential of using EEG and decoding methods in the neuropsychological cases, and potentially even in the medical setting, to ascertain the extent of brain damage. In addition to the paradigm we have adopted, methods to use EEG to uncover spatial information have already shown some success. Dmochowski et al. [54] used Reliable Components Analysis on SSVEP signals to generate topographical maps that locate the spatial origin of the signal. This analysis utilized the high signal-to-noise ratio from the SSVEPs to maximize the trial-to-trial differences in signal. Similarly, using Representational Similarity Analysis, Kaneshiro et al. [55] found that the temporal information from single trial presentations of objects can help reconstruct spatial maps that are supported by fMRI results. Also, recent innovations by Murray and colleagues [56] have demonstrated that EEG can be recorded from patients at their bedside and that through their single-trial classification methods, heterogeneity among individuals as well trial-to-trial variability within subjects and patients can be evaluated [57,58]. Together, our findings as well as these demonstrations support the use of multivariate analyses on EEG signal to recover spatial information. In summary, EEG can be useful when understanding where in the visual pathway the damage may be by focusing on when the EEG signal is perturbed or degraded. Focusing on the time course of visual processing also offers some insight into how visual information may be recovered when the damage is early in the visual stream (as in the case of JW). Together, the use of precise temporally-recorded data and cutting-edge analytics reveals the utility of this approach for investigating visual disorders such as agnosia, and for elucidating the temporal signature associated with visual perception. This work was supported by CMU BrainHUB to MB and PG, and a NARSAD Young Investor Grant from the Brain & Behavior Research Foundation (26282) to SMH. We thank Shawn Kelly and Jeff Weldon for assistance in constructing the EEG cap and Michael Tarr for the fruitful comments. The following are available online at Figure S1: Event-related potentials, Figure S2: Decoding results by visual field, Figure S3: Refiltering. Conceptualization, A.K.R., P.G. and M.B.; Data curation, S.M.H.; Formal analysis, A.K.R.; Funding acquisition, P.G. and M.B.; Investigation, S.M.H., P.G. and M.B.; Methodology, P.G.; Project administration, S.M.H.; Supervision, M.B.; Visualization, A.K.R.; Writing—original draft, S.M.H. and A.K.R.; Writing—review & editing, P.G. and M.B. This research was funded by Brain and Behavior Research Foundation, grant number 26282. The authors declare no conflict of interest. 1.Humphreys G.W., Riddoch M.J. Neuropsychological disorders of visual object recognition and naming. In: Boller F., Grafman J., editors. Handbook of Neuropsychology (Vol. 4) Elsevier Science; North-Holland, The Netherlands: 2000. 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[DOI] [PubMed] [Google Scholar] This section collects any data citations, data availability statements, or supplementary materials included in this article. Articles from Vision are provided here courtesy of Multidisciplinary Digital Publishing Institute (MDPI) Agnosia is a rare condition where an individual has normally functioning senses such as vision or hearing but their brain is unable to process the information from one or more of the senses to recognise objects, locations, sounds or people1. This condition can be caused by disorders that damage the brain, not problems with memory, attention, language problems or new experiences or environments1. The nature of the disorder can also affect how agnosia develops in individuals, for example, a head injury can cause it to appear suddenly whereas dementia may lead to agnosia developing over time.1 Examples of disorders that can damage the brain and lead to agnosia are as follows:1 There are many different types of agnosia which depend on the parts of the brain, that are damaged1 and can be classified based on the senses involved. Some types of agnosia can also take two forms which are apperceptive or associative. The apperceptive form is where the individual can not interpret the features of a stimulus and connect it to its meaning whereas, individuals with the associative form of an agnosia can perceive or describe the stimulus but can not identify it.1,6 Figure 1: The image is of the lateral (side) view of the brain created with BioRender.com and licensed.7 In order to diagnose an individual with agnosia and the type, an extensive patient history is needed from both the patient and those who are familiar with them.1 The more information is given to the healthcare professional, the easier it is to determine what type the individual has. Before agnosia can be diagnosed, assessments will be completed of the patient's senses, and brain function and additional exams to ensure that their symptoms are not due to anything else such as memory loss, impairments or unfamiliarity with the objects or location.1 Therefore, understanding the characteristics of each type can aid in diagnosing and managing the condition. Visual agnosia is described as the most common type of agnosia where an individual is unable to recognise what object they are seeing despite functional vision and it can not be explained to be due to cognitive functions or cognitive decline.1,7 However, when other senses are used, the individual would be able to say what the object is. Many types of visual agnosia have been documented and the different types are described in table 1 below. Table 1: A list describing the different types of visual agnosia currently documented1,2,5, 8-10. Type of visual agnosia DescriptionApperceptive visual agnosia An individual can not recognise, draw or copy the correct form of objects they are seeing.Associative visual agnosiaAn individual is able to draw, describe, correctly copy and differentiate between objects they are seeing but they are unable to identify the object. ProsopagnosiaAn individual can not recognise familiar or new faces even though they can identify other aspects of the others such as age and hair.Subtypes of Prosopagnosia:Apperceptive Prosopagnosia: The individual can not recognise or interpret faces, facial expressions or cues.Associative Prosopagnosia: The individual is able to recognise facial information but can not recall the face. Colour agnosiaAn individual has problems with identifying colours they are seeing whether they are familiar with the coloured object or not.Topographical agnosiaAn individual is unable to navigate through their surroundings even if it is familiar to them and can not use visual guides to help them.SimultanagnosiaAn individual can recognise and describe objects individually but can not grasp the overall meaning of the objects together in a group or image.Types of simultanagnosia:Dorsal simultagnosia: An individual is only able to see and identify one object at a time but once their attention shifts to something else, they can not report the previous object they had just identified. Ventral simultagnosia: An individual can see multiple objects at once but they can only identify one object at a time from what they are seeing.Finger agnosiaAn individual can recognise a finger but is unable to name or tell the difference between the fingers on their own hands or others.Agnostic alexiaAn individual can write and talk but has difficulty reading as they can not recognise the words they are seeing, even if they have written them.AkinetopsiaAn individual is no longer able to perceive visual motion and moving objects appear to them as freeze-frame images. For example, a moving car will appear parked to an individual with akinetopsia. Auditory agnosia is when an individual is unable to recognise or react to sounds which can not be attributed to problems with hearing.1, 11 This condition has a number of subtypes and can range in severity for patients.11 Table 2: A list describing the different types of auditory agnosia.1,6,11-13 Type of auditory agnosiaDescriptionVerbal auditory agnosia or (pure) word deafnessThe individual is unable to understand words that have been said but is still able to read, write and speak to a degree.Non-verbal auditory agnosiaThe individual is able to understand the words people say but can not recognise environmental noises or non-verbal sounds such as a car honking.Generalised or mixed auditory agnosiaThe individual is unable to recognise verbal or non-verbal sounds and can be described as the most common type.Apperceptive PhonagnosiaThe individual is unable to differentiate between voices they hear whether they are familiar or not but can understand what is said.Associative phonagnosiaThe individual can tell that they are hearing different voices and understand what is said but is unable to identify if the voice is familiar or not.AmusiaThe individual is unable to understand and differentiate that the sounds they are hearing is music. Tactile agnosia is when an individual is unable to identify objects through touch but they may be able to with other senses .1 When an individual is unable to identify an object by touching its shape or feeling its size.1 When an individual can recognise the object only from feeling its shape or size but not from other physical characteristics such as texture, weight or density.1,14 There are also additional types of agnosia that have been documented outside of the main groups being visual, auditory and tactile. Olfactory agnosia is the inability to identify familiar scents15 Gustatory agnosia is where an individual has difficulty recognising familiar tastes 15 Lastly, there is another type of agnosia which is different from the others where individuals diagnosed with anosognosia are not aware of their health conditions and this unawareness is involuntary and not due to denial.16 The main ways agnosia is managed is to help the individual and those important to them adapt to the condition and make changes that will improve the individual's quality of life. For example, the individual can learn how to use their other senses to compensate for those involved in agnosia or rearrange the individual's environment to make it easier for them to locate objects and avoid hazards. Depending on the cause of agnosia, treatments of the cause can be offered such as if it is caused by an infection,1 antibiotic can be given, however, please note that this is not always possible. Overall, agnosia is a rare condition which can be caused by damage to the brain and results in an individual's inability to process information from one or more of their functional senses. There are many agnosias that can be divided into two forms in some types and characterised by the senses involved. Each type is unique and may be known by different names but knowing the differences can inform the management of conditions. If you are experiencing any of the symptoms described for the types of agnosia, consult a Healthcare Practitioner for further advice. Kumar A, Wroten M. Agnosia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Jun 9]. Available from: . Gainotti G. Agnosias: recognition disorders in patients with brain tumors. J Neurooncol [Internet]. 2012 [cited 2024 Jun 9]; 108(2):257–60. Available from: . Bhutta BS, Alghoula F, Berim I. Hypoxia. In: StatPearls [Internet]. 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Sensory Agnosias. In: Gottfried JA, editor. Neurobiology of Sensation and Reward [Internet]. Boca Raton (FL): CRC Press/Taylor & Francis; 2011 [cited 2024 Jun 13]. Available from: . Acharya AB, Sánchez-Manso JC. Anosognosia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Jun 13]. Available from: . The information on this page can be accessed in the following formats: This page explains the different types of agnosia and how they can cause problems with recognition after stroke On this page: What is agnosia? Signs of agnosia What can I do about agnosia? What is agnosia? There are two stages to recognising something: The first stage uses the information you get from your senses about the way it looks, feels and sounds, to develop a picture of what it is.The second stage compares this to the information in your memory, so that you can remember what it's called and what it does. A stroke can affect both of these stages. Types of agnosia Apperceptive agnosia is when your stroke affects how your brain processes the information you receive about an object.Associative agnosia affects the way you remember information about objects. Agnosia may only affect you in very specific ways. For example, some people find that although they cannot recognise an actual object, they can recognise a picture of it. Some people have agnosia for colour or faces. Having trouble recognising faces is known as prosopagnosia, sometimes called face-blindness. Signs of agnosia Apperceptive agnosia Apperceptive agnosia can affect any sense. You may lose the ability to recognise objects by touch, sound or sight. It usually affects just one sense, so although you may not be able to recognise an object by looking at it, you may be able to by touching it. Problems recognising an object by sight are most common. It's not that you cannot see the object at all. If someone asks you to describe the object they're holding, you'll be able to tell them about some of its features. You'll know that it's white, or that it's got a handle, for example. But you will not be able to recognise that it's a cup. However, if you're asked what a cup is, you'll know exactly what it looks like and what it's for. Associative agnosia If you have associative agnosia, you'll have a full picture of the object you're looking at, but you will not be able to remember what it's called. So you'll often use the wrong name. Even if you're told the correct name, you may not be able to explain what it's used for. What can I do about agnosia? Usually, if you have agnosia problems these will be picked up by your doctors or therapists while you're in hospital or by your community team when you're back at home. If they haven't been, and you start to notice that you may be having problems, then go back to your GP to get them properly diagnosed and assessed. If these problems are making day-to-day life difficult for you, then you need to be referred to an occupational therapist. They will work with you to find ways to help you cope with them. They will also be able to suggest aids and equipment that can help you. Associative Agnosia, also known as Visual Object Agnosia, is a neurological disorder that impairs the ability to recognize and identify visually presented objects. Overview: Associative Agnosia is characterized by the inability to assign meaning or extract information from visual stimuli, despite having intact visual perception. Individuals with this condition will have intact sensory perception, but their ability to recognize objects will be significantly impaired. Symptoms: Individuals with Associative Agnosia may exhibit the following symptoms: Object Recognition Impairment: They struggle to recognize familiar objects, faces, or shapes, often mistaking them for other objects. Loss of Visual Knowledge: They have difficulty recalling facts or information associated with visually presented objects. Inability to Categorize: They struggle to group objects into categories or identify similarities and differences between objects. Normal Sensory Perception: Their sensory organs, such as eyes, are functioning normally, and they can perceive and describe the physical characteristics of objects. Causes: Associative Agnosia is typically caused by damage or abnormalities in the visual processing areas of the brain, particularly the occipitotemporal regions. Common causes include: Stroke Brain injury Neurodegenerative diseases, such as Alzheimer's disease or Parkinson's disease Treatment: Currently, there is no specific cure for Associative Agnosia. However, therapeutic interventions such as visual training, cognitive rehabilitation, and compensatory strategies can help individuals improve their ability to recognize objects and enhance their quality of life. Lissauer was one of the earliest theorists of agnosia's and he claimed associative agnosia have "object representations themselves, which would prevent recognition because of lost visual memory representation" (Gilds 568). To put this in better terms to understand what associative agnosia is, you can think of this as being the opposite of apperceptive agnosia. People with associative agnosia have no trouble copying and object, but they may not be able to recognize exactly what that object is. For example, if someone with associative agnosia was asked to describe what an anchor does they would have no problem completing that task. But if they were presented with the picture of anchor they would not be able to recognize it as an anchor. Also, like said previously, levels of severity vary in this type of agnosia too. Theory for Associative Agnosia and Visual Agnosias AlikeThere is one theory that encompass's both apperceptive and associative agnosia. This is called the sensory-deficit account. This account is a very broad generalized view of visual agnosia's. It is described as 'a degraded low-level visual processing'(Gilds 569). Since this encompasses both agnosias, it is not a sure theory but does help in understanding both as a whole.Still want more information on associative agnosia. Click here to read about a case study that was published in the Journal of Neurology, Neurosurgey, and Psychiatry. (See PP slide 4)A Case Report on a Patient with Associative Agnosia This case report was based upon seventy-seven year old FRA. In this paper 'experimenters have documented the syndrome of visual associative agnosia'. An MRI scan showed lesions in his lower occipital lobe (Warrington 1234).Symtoms (Warrington 1234-1235)Patient FRA had fluent speech with his vocabulary intact. But on object naming tasks that experiemtners gave him he scored really low. But scored high in action words, for example, running jumping etc. Patient FRA had trouble naming single letters of the alphabet and also, had trouble distinguishing between the same letter of upper and lower case; example 'a' & 'A' (1234-1235). Experimenters also tested him on recognizing objects of the same category. FRA could not easily point to pictures of the same category.FRA's everyday problemsIt was reported that patient FRA struggled with normal everyday tasks like setting the table. Recognizing a fork to put on the left or a knife to put on the right became a struggle for him. So 'despite the excellence of his visual and spatial abilites, FRA reported difficulties in everyday life that suggested impaired recognition'(1235).TreatmentsJust like prosopagnosia and apperceptive agnosia there are no cures or treatments. Basic object discrimination tasks and object recognition tasks can be administered so stimulate that part of the brain but it is not proven to be 100% affective. Medical conditionAssociative visual agnosiaInferior view of the brain, depicting the cerebral lobes. Lesions on the occipito-temporal lobes are correlated with associative agnosia. Associative visual agnosia is a form of visual agnosia. It is an impairment in recognition or assigning meaning to a stimulus that is accurately perceived and not associated with a generalized deficit in intelligence, memory, language or attention.[1] The disorder appears to be very uncommon in a "pure" or uncomplicated form and is usually accompanied by other complex neuropsychological problems due to the nature of the etiology.[1] Affected individuals can accurately distinguish the object, as demonstrated by the ability to draw a picture of it or categorize accurately, yet they are unable to identify the object, its features or its functions. Agnosias are sensory modality specific, usually classified as visual, auditory, or tactile.[2][3] Associative visual agnosia refers to a subtype of visual agnosia, which was labeled by Lissauer (1890), as an inability to connect the visual percept (mental representation of something being perceived through the senses) with its related semantic information stored in memory, such as, its name, use, and description.[4][5][6] This is distinguished from the visual apperceptive form of visual agnosia, apperceptive visual agnosia, which is an inability to produce a complete percept, and is associated with a failure in higher order perceptual processing where feature integration is impaired, though individual features can be distinguished.[7] In reality, patients often fall between both distinctions, with some degree of perceptual disturbances exhibited in most cases, and in some cases, patients may be labeled as integrative agnostics when they fit the criteria for both forms.[1] Associative visual agnosias are often category-specific, where recognition of particular categories of items are differentially impaired, which can affect selective classes of stimuli, larger generalized groups or multiple intersecting categories. For example, deficits in recognizing stimuli can be as specific as familiar human faces or as diffuse as living things or non-living things.[7] An agnosia that affects hearing, auditory sound agnosia, is broken into subdivisions based on level of processing impaired, and a semantic-associative form is investigated within the auditory agnosias.[2] Associative visual agnosias are generally attributed to anterior left temporal lobe infarction (at the left inferior temporal gyrus),[8] caused by ischemic stroke, head injury, cardiac arrest, brain tumour, brain hemorrhage, or demyelination.[7][9] Environmental toxins and pathogens have also been implicated, such as, carbon monoxide poisoning or herpes encephalitis and infrequent developmental occurrences have been documented.[1][10] The separate streams of the visual processing system. The ventral "what" stream is in purple and the dorsal "where" stream is in green. Most cases have injury to the occipital and temporal lobes and the critical site of injury appears to be in the left occipito-temporal region, often with involvement of the splenium of the corpus callosum.[11] The etiology of the cognitive impairment, as well the areas of the brain affected by lesions and stage of recovery are the primary determinants of the pattern of deficit.[1] More generalized recognition impairments, such as, animate object deficits, are associated with diffuse hypoxic damage, like carbon monoxide poisoning; more selective deficits are correlated with more isolated damage due to focal stroke.[1] Damage to the left hemisphere of the brain has been explicitly implicated in the associative form of visual agnosia.[12][13] Goldberg suggested that the associative visual form of agnosia results from damage to the ventral stream of the brain, the occipito-temporal stream, which plays a key role in object recognition as the so-called "what" region of the brain, as opposed to the "where," dorsal stream.[12] Teuber[14] described the associative agnostic as having a "percept stripped of its meaning," because the affected individual cannot generate unique semantic information to identify the percept, since though it is fully formed, it fails to activate the semantic memory associated with the stimulus.[8] Warrington (1975)[15] offered that the problem lies in impaired access to generic engrams (memory traces) that describe categories of objects made up of a multitude of similar elements.[12] Essentially, damage to a modality-specific meaning process (semantic system), is proposed, either in terms of defective access to or a degradation of semantic memory store for visual semantic representations themselves.[13][16] The fact that agnosias are often restricted to impairments of particular types of stimuli, within distinct sensory modalities, suggests that there are separate modality specific pathways for the meaningful representation of objects and pictures, written material, familiar faces, and colors.[17] Depiction of the object recognition model, adapted from Bauer's Clinical Application of a Cognitive Neuropsychological Model of Object Recognition[1] Cognitive psychology often conceptualizes this deficit as an impairment in the object recognition process. Currently visual agnosias are commonly explained in terms of cognitive models of object recognition or identification.[9] The cognitive system for visual object identification is a hierarchal process, broken up into multiple steps of processing.[16] In the object recognition unit model by Marr (1980),[18] the process begins with sensory perception (vision) of the object, which results in an initial representation via feature extraction of basic forms and shapes. This is followed by an integration stage, where elements of the visual field combine to form a visual percept image, the 'primary sketch'. This is a 2+1⁄2 dimensional (2+1⁄2D) stage with a 'viewer-centered' object representation, where the features and qualities of the object are presented from the viewer's perspective.[5] The next stage is formation of a 3 dimensional (3D) 'object-centered' object representation, where the object's features and qualities are independent of any particular perspective. Impairment at this stage would be consistent with apperceptive agnosia.[1] This fully formed percept then triggers activation of stored structural object knowledge for familiar things.[9] This stage is referred to as "object recognition units" and distinctions between apperceptive and associative forms can be made based on presentation of a defect before or after this stage, respectively.[16] This is the level at which one is proposed to perceive familiarity toward an object, which activates the semantic memory system, containing meaning information for objects, as well as descriptive information about individual items and object classes. The semantic system can then trigger name retrieval for the objects. A patient who is not impaired up until the level of naming, retaining access to meaning information, are distinguished from agnostics and labeled as anomic.[1] In an alternate model of object recognition by Carbonnel et al.[19] episodic and semantic memory arise from the same memory traces, and no semantic representations are stored permanently in memory. By this view, the meaning of any stimulus emerges momentarily from reactivation of one's previous experiences with that entity. Each episode is made of several components of many different sensory modalities that are typically engaged during interactions with an object. In this scenario, a retrieval cue triggers reactivation of all episodic memory traces, in proportion to the similarity between the cue its 'echo,' the components shared by most activated traces. In a process called 're-injection,' the first echo acts as a further retrieval cue, evoking the 'second echo,' the less frequently associated components of the cue. Thus, the 're-injection' process provides a more complete meaning for the object. According to this model, different types of stimuli will evoke differential 'echos' based on typical interactions with them.[9] For example, a distinction is made between functional and visual components of various stimuli, such that impairment to these aspects of the memory trace will inhibit the re-injection process needed to complete the object representation. This theory has been used to explain category-specific agnosias that impair recognition of various object types, such as animals and words, to different degrees.[9] Disorder Recognition impairment Retained abilities Location of lesion Visual object agnosia Often specific to a particular category or categories of stimuli, i.e. living/animate things, tools, musical instruments, etc. Images can be copied, demonstrating intact object perception Objects usually identifiable by sensory modalities other than vision[20] Bilateral occipito-temporal cortex[11] Associative prosopagnosia Familiar faces In associative form, can match and discriminate between unrecognized faces based on facial features[16] Usually bilateral, sometimes right unilateral, inferior occipital and posterolateral temporal cortex[11] Pure alexia Written words Comprehension of verbal speech, shows intact word knowledge Words can be copied, shows intact perception of words[20] Left occipital lobe and related fibers connecting right and left hemispheres in subjacent white matter or splenium[11] Cerebral achromatopsia Color associations Can discriminate between and match shades of color, therefore hue perception intact Bilateral or left unilateral occipito-temporal cortex[16] Topographical disorientation Familiar places Can describe layouts of buildings or spaces, therefore topographical memory retained Right posterior cingulate cortex Visual object agnosia (or semantic agnosia) is the most commonly encountered form of agnosia.[16] The clinical "definition" of the disorder is when an affected person is able to copy/draw things that they cannot recognize. Individuals often cannot identify, describe or mimic functions of items, though perception is intact, since images of objects can be copied or drawn.[7] Individuals may retain semantic knowledge of the items, as exemplified during tasks where objects are presented through alternate modalities, through touch or verbal naming or description. Some associative visual object agnostics retain the ability to categorize items by context or general category, though unable to name or describe them.[16] Diffuse hypoxic damage is the most common cause of visual object agnosias.[8] Category-specific agnosias are differential impairments in subject knowledge or recognition abilities pertaining to specific classes of stimuli, such as living things vs. non-living things, animate vs. inanimate things, food, metals, musical instruments, etc. Some of the most common category-specific agnosias involve recognition impairments for living things, but not non-living things, or human faces, as in prosopagnosia. This type of deficit is typically associated with head injury or stroke, though other medical conditions have been implicated, such as, herpes encephalitis.[2] Prosopagnosia (or "face blindness") is a category-specific visual object agnosia, specifically, impairment in visual recognition of familiar faces, such as close friends, family, husbands, wives, and sometimes even their own faces. Individuals are often able to identify others through alternate characteristics, such as, voice, gait, context or unique facial features. This deficit is typically assessed through picture identification tasks of famous persons. This condition is associated with damage to the medial occipito-temporal gyri, including the fusiform and lingual gryi, as the suggested location of the brain's face recognition units.[7][11][16] Two subtypes are distinguished behaviorally as being associative or apperceptive in nature. Associative prosopagnosia is characterized by an impairment in recognition of a familiar face as familiar; however, individuals retain the ability to distinguish between faces based on general features, such as, age, gender and emotional expression.[20] This subtype is distinguished through facial matching tasks or feature identification tasks of unknown faces.[16] Pure alexia ("alexia without dysgraphia" or "pure word blindness") is a category-specific agnosia, characterized by a distinct impairment in reading words, despite intact comprehension for verbally presented words, demonstrating retained semantic knowledge of words.[7][20] Perceptual abilities are also intact, as assessed by word-copying tasks.[2] Color agnostics fail to identify abnormally colored objects or pictures Cerebral achromatopsia, also known as Color agnosia, is a category-specific semantic impairment pertaining to semantic color associations, such that individuals retain perceptual abilities for distinguishing color, demonstrated through color categorization or hue perception tasks; however knowledge of typical color-object relationships is defective.[7][8][16] Color agnostics are assessed on performance coloring in black and white images of common items or identifying abnormally colored objects within a set of images.[2] This deficit should be distinguished from color anomia, where semantic information about color is retained, but the name of a color cannot be retrieved, though co-occurrence is common. Both disorders linked to damage in the occipito-temporal cortex, especially in the left hemisphere, which is believed to play a significant role in color memory.[16] A recognition disorder is not considered to be agnosia unless there is a lack of aphasia, dementia, or other generalized defect that affects any stage of the object recognition process, such as, deficiencies in intelligence, linguistic ability, memory, attention or sensory perception.[1][2] Therefore, individuals must be assessed for language ability, auditory comprehension, fluency, repetition, praxis, and reading and writing. A Flowchart for Clinical Assessment of Forms of Visual Agnosia Ruling out alternative conditions leading to the recognition impairment, such as, primary sensory disruption, dementia, aphasia, anomia, or unfamiliarity with the object category or elements. Determination of the scope and specific nature of the recognition impairment. Including: Specific sensory modality Specific category of stimuli Specific conditions under which recognition is possible[1] Specialists, like ophthalmologists or audiologists, can test for perceptual abilities. Detailed testing is conducted, using specially formulated assessment materials, and referrals to neurological specialists is recommended to support a diagnosis via brain imaging or recording techniques. The separate stages of information processing in the object recognition model are often used to localize the processing level of the deficit.[1] Testing usually consists of object identification and perception tasks including: object-naming tasks object categorization or figure matching drawing or copying real objects or images or illustrations unusual views tests overlapping line drawings partially degraded or fragmented image identification face or feature analysis fine line judgment figure contour tracking visual object description object-function miming tactile ability tests (naming by touch) auditory presentation identification[5][8] Sensory modality testing allows practitioners to assess for generalized versus specific deficits, distinguishing visual agnosias from optic aphasia, which is a more generalized deficit in semantic knowledge for objects that spans multiple sensory modalities, indicating an impairment in the semantic representations themselves.[13] The distinction between visual agnosias can be assessed based on the individual's ability to copy simple line drawings, figure contour tracking, and figure matching.[5] Apperceptive visual agnostics fail at these tasks, while associative visual agnostics are able to perform normally, though their copying of images or words is often slavish, lacking originality or personal interpretation.[1] The affected individual may not realize that they have a visual problem and may complain of becoming "clumsy" or "muddled" when performing familiar tasks such as setting the table or simple DIY. Anosognosia, a lack of awareness of the deficit, is common and can cause therapeutic resistance.[2] In some agnosias, such as prosopagnosia, awareness of the deficit is often present; however shame and embarrassment regarding the symptoms can be a barrier in admission of a deficiency.[16] Because agnosias result from brain lesions, no direct treatment for them currently exists, and intervention is aimed at utilization of coping strategies by patients and those around them. Sensory compensation can also develop after one modality is impaired in agnostics[1] General principles of treatment: restitution repetitive training of impaired ability development of compensatory strategies utilizing retained cognitive functions[1] Partial remediation is more likely in cases with traumatic/vascular lesions, where more focal damage occurs, than in cases where the deficit arises out of anoxic brain damage, which typically results in more diffuse damage and multiple cognitive impairments.[2] However, even with forms of compensation, some affected individuals may no longer be able to fulfill the requirements of their occupation or perform common tasks, such as, eating or navigating. Agnostics are likely to become more dependent on others and to experience significant changes to their lifestyle, which can lead to depression or adjustment disorders.[1] ^ a b c d e f g h i j k l m n o p Bauer, Russell M. (2006). "The Agnosias". In Snyder, P.J. (ed.). 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It is an impairment in recognition or assigning meaning to a stimulus that is accurately perceived and not associated with a generalized deficit in intelligence, memory, language or attention.[1] The disorder appears to be very uncommon in a "pure" or uncomplicated form and is usually accompanied by other complex neuropsychological problems due to the nature of the etiology.[1] Affected individuals can accurately distinguish the object, as demonstrated by the ability to draw a picture of it or categorize accurately, yet they are unable to identify the object, its features or its functions. Agnosias are sensory modality specific, usually classified as visual, auditory, or tactile.[2][3] Associative visual agnosia refers to a subtype of visual agnosia, which was labeled by Lissauer (1890), as an inability to connect the visual percept (mental representation of something being perceived through the senses) with its related semantic information stored in memory, such as, its name, use, and description.[4][5][6] This is distinguished from the visual apperceptive form of visual agnosia, apperceptive visual agnosia, which is an inability to produce a complete percept, and is associated with a failure in higher order perceptual processing where feature integration is impaired, though individual features can be distinguished.[7] In reality, patients often fall between both distinctions, with some degree of perceptual disturbances exhibited in most cases, and in some cases, patients may be labeled as integrative agnostics when they fit the criteria for both forms.[1] Associative visual agnosias are often category-specific, where recognition of particular categories of items are differentially impaired, which can affect selective classes of stimuli, larger generalized groups or multiple intersecting categories. For example, deficits in recognizing stimuli can be as specific as familiar human faces or as diffuse as living things or non-living things.[7] An agnosia that affects hearing, auditory sound agnosia, is broken into subdivisions based on level of processing impaired, and a semantic-associative form is investigated within the auditory agnosias.[2] Associative visual agnosias are generally attributed to anterior left temporal lobe infarction (at the left inferior temporal gyrus),[8] caused by ischemic stroke, head injury, cardiac arrest, brain tumour, brain hemorrhage, or demyelination.[7][9] Environmental toxins and pathogens have also been implicated, such as, carbon monoxide poisoning or herpes encephalitis and infrequent developmental occurrences have been documented.[1][10] The separate streams of the visual processing system. The ventral "what" stream is in purple and the dorsal "where" stream is in green. Most cases have injury to the occipital and temporal lobes and the critical site of injury appears to be in the left occipito-temporal region, often with involvement of the splenium of the corpus callosum.[11] The etiology of the cognitive impairment, as well the areas of the brain affected by lesions and stage of recovery are the primary determinants of the pattern of deficit.[1] More generalized recognition impairments, such as, animate object deficits, are associated with diffuse hypoxic damage, like carbon monoxide poisoning; more selective deficits are correlated with more isolated damage due to focal stroke.[1] Damage to the left hemisphere of the brain has been explicitly implicated in the associative form of visual agnosia.[12][13] Goldberg suggested that the associative visual form of agnosia results from damage to the ventral stream of the brain, the occipito-temporal stream, which plays a key role in object recognition as the so-called "what" region of the brain, as opposed to the "where," dorsal stream.[12] Teuber[14] described the associative agnostic as having a "percept stripped of its meaning," because the affected individual cannot generate unique semantic information to identify the percept, since though it is fully formed, it fails to activate the semantic memory associated with the stimulus.[8] Warrington (1975)[15] offered that the problem lies in impaired access to generic engrams (memory traces) that describe categories of objects made up of a multitude of similar elements.[12] Essentially, damage to a modality-specific meaning process (semantic system), is proposed, either in terms of defective access to or a degradation of semantic memory store for visual semantic representations themselves.[13][16] The fact that agnosias are often restricted to impairments of particular types of stimuli, within distinct sensory modalities, suggests that there are separate modality specific pathways for the meaningful representation of objects and pictures, written material, familiar faces, and colors.[17] Depiction of the object recognition model, adapted from Bauer's Clinical Application of a Cognitive Neuropsychological Model of Object Recognition[1] Cognitive psychology often conceptualizes this deficit as an impairment in the object recognition process. Currently visual agnosias are commonly explained in terms of cognitive models of object recognition or identification.[9] The cognitive system for visual object identification is a hierarchal process, broken up into multiple steps of processing.[16] In the object recognition unit model by Marr (1980),[18] the process begins with sensory perception (vision) of the object, which results in an initial representation via feature extraction of basic forms and shapes. This is followed by an integration stage, where elements of the visual field combine to form a visual percept image, the 'primary sketch'. This is a 2+1⁄2 dimensional (2+1⁄2D) stage with a 'viewer-centered' object representation, where the features and qualities of the object are presented from the viewer's perspective.[5] The next stage is formation of a 3 dimensional (3D) 'object-centered' object representation, where the object's features and qualities are independent of any particular perspective. Impairment at this stage would be consistent with apperceptive agnosia.[1] This fully formed percept then triggers activation of stored structural object knowledge for familiar things.[9] This stage is referred to as "object recognition units" and distinctions between apperceptive and associative forms can be made based on presentation of a defect before or after this stage, respectively.[16] This is the level at which one is proposed to perceive familiarity toward an object, which activates the semantic memory system, containing meaning information for objects, as well as descriptive information about individual items and object classes. The semantic system can then trigger name retrieval for the objects. A patient who is not impaired up until the level of naming, retaining access to meaning information, are distinguished from agnostics and labeled as anomic.[1] In an alternate model of object recognition by Carbonnel et al.[19] episodic and semantic memory arise from the same memory traces, and no semantic representations are stored permanently in memory. By this view, the meaning of any stimulus emerges momentarily from reactivation of one's previous experiences with that entity. Each episode is made of several components of many different sensory modalities that are typically engaged during interactions with an object. In this scenario, a retrieval cue triggers reactivation of all episodic memory traces, in proportion to the similarity between the cue its 'echo,' the components shared by most activated traces. In a process called 're-injection,' the first echo acts as a further retrieval cue, evoking the 'second echo,' the less frequently associated components of the cue. Thus, the 're-injection' process provides a more complete meaning for the object. According to this model, different types of stimuli will evoke differential 'echos' based on typical interactions with them.[9] For example, a distinction is made between functional and visual components of various stimuli, such that impairment to these aspects of the memory trace will inhibit the re-injection process needed to complete the object representation. This theory has been used to explain category-specific agnosias that impair recognition of various object types, such as animals and words, to different degrees.[9] Disorder Recognition impairment Retained abilities Location of lesion Visual object agnosia Often specific to a particular category or categories of stimuli, i.e. living/animate things, tools, musical instruments, etc. Images can be copied, demonstrating intact object perception Objects usually identifiable by sensory modalities other than vision[20] Bilateral occipito-temporal cortex[11] Associative prosopagnosia Familiar faces In associative form, can match and discriminate between unrecognized faces based on facial features[16] Usually bilateral, sometimes right unilateral, inferior occipital and posterolateral temporal cortex[11] Pure alexia Written words Comprehension of verbal speech, shows intact word knowledge Words can be copied, shows intact perception of words[20] Left occipital lobe and related fibers connecting right and left hemispheres in subjacent white matter or splenium[11] Cerebral achromatopsia Color associations Can discriminate between and match shades of color, therefore hue perception intact Bilateral or left unilateral occipito-temporal cortex[16] Topographical disorientation Familiar places Can describe layouts of buildings or spaces, therefore topographical memory retained Right posterior cingulate cortex Visual object agnosia (or semantic agnosia) is the most commonly encountered form of agnosia.[16] The clinical "definition" of the disorder is when an affected person is able to copy/draw things that they cannot recognize. Individuals often cannot identify, describe or mimic functions of items, though perception is intact, since images of objects can be copied or drawn.[7] Individuals may retain semantic knowledge of the items, as exemplified during tasks where objects are presented through alternate modalities, through touch or verbal naming or description. Some associative visual object agnostics retain the ability to categorize items by context or general category, though unable to name or describe them.[16] Diffuse hypoxic damage is the most common cause of visual object agnosias.[8] Category-specific agnosias are differential impairments in subject knowledge or recognition abilities pertaining to specific classes of stimuli, such as living things vs. non-living things, animate vs. inanimate things, food, metals, musical instruments, etc. Some of the most common category-specific agnosias involve recognition impairments for living things, but not non-living things, or human faces, as in prosopagnosia. This type of deficit is typically associated with head injury or stroke, though other medical conditions have been implicated, such as, herpes encephalitis.[2] Prosopagnosia (or "face blindness") is a category-specific visual object agnosia, specifically, impairment in visual recognition of familiar faces, such as close friends, family, husbands, wives, and sometimes even their own faces. Individuals are often able to identify others through alternate characteristics, such as, voice, gait, context or unique facial features. This deficit is typically assessed through picture identification tasks of famous persons. This condition is associated with damage to the medial occipito-temporal gyri, including the fusiform and lingual gryi, as the suggested location of the brain's face recognition units.[7][11][16] Two subtypes are distinguished behaviorally as being associative or apperceptive in nature. Associative prosopagnosia is characterized by an impairment in recognition of a familiar face as familiar; however, individuals retain the ability to distinguish between faces based on general features, such as, age, gender and emotional expression.[20] This subtype is distinguished through facial matching tasks or feature identification tasks of unknown faces.[16] Pure alexia ("alexia without dysgraphia" or "pure word blindness") is a category-specific agnosia, characterized by a distinct impairment in reading words, despite intact comprehension for verbally presented words, demonstrating retained semantic knowledge of words.[7][20] Perceptual abilities are also intact, as assessed by word-copying tasks.[2] Color agnostics fail to identify abnormally colored objects or pictures Cerebral achromatopsia, also known as Color agnosia, is a category-specific semantic impairment pertaining to semantic color associations, such that individuals retain perceptual abilities for distinguishing color, demonstrated through color categorization or hue perception tasks; however knowledge of typical color-object relationships is defective.[7][8][16] Color agnostics are assessed on performance coloring in black and white images of common items or identifying abnormally colored objects within a set of images.[2] This deficit should be distinguished from color anomia, where semantic information about color is retained, but the name of a color cannot be retrieved, though co-occurrence is common. Both disorders linked to damage in the occipito-temporal cortex, especially in the left hemisphere, which is believed to play a significant role in color memory.[16] A recognition disorder is not considered to be agnosia unless there is a lack of aphasia, dementia, or other generalized defect that affects any stage of the object recognition process, such as, deficiencies in intelligence, linguistic ability, memory, attention or sensory perception.[1][2] Therefore, individuals must be assessed for language ability, auditory comprehension, fluency, repetition, praxis, and reading and writing. A Flowchart for Clinical Assessment of Forms of Visual Agnosia Ruling out alternative conditions leading to the recognition impairment, such as, primary sensory disruption, dementia, aphasia, anomia, or unfamiliarity with the object category or elements. Determination of the scope and specific nature of the recognition impairment. Including: Specific sensory modality Specific category of stimuli Specific conditions under which recognition is possible[1] Specialists, like ophthalmologists or audiologists, can test for perceptual abilities. Detailed testing is conducted, using specially formulated assessment materials, and referrals to neurological specialists is recommended to support a diagnosis via brain imaging or recording techniques. The separate stages of information processing in the object recognition model are often used to localize the processing level of the deficit.[1] Testing usually consists of object identification and perception tasks including: object-naming tasks object categorization or figure matching drawing or copying real objects or images or illustrations unusual views tests overlapping line drawings partially degraded or fragmented image identification face or feature analysis fine line judgment figure contour tracking visual object description object-function miming tactile ability tests (naming by touch) auditory presentation identification[5][8] Sensory modality testing allows practitioners to assess for generalized versus specific deficits, distinguishing visual agnosias from optic aphasia, which is a more generalized deficit in semantic knowledge for objects that spans multiple sensory modalities, indicating an impairment in the semantic representations themselves.[13] The distinction between visual agnosias can be assessed based on the individual's ability to copy simple line drawings, figure contour tracking, and figure matching.[5] Apperceptive visual agnostics fail at these tasks, while associative visual agnostics are able to perform normally, though their copying of images or words is often slavish, lacking originality or personal interpretation.[1] The affected individual may not realize that they have a visual problem and may complain of becoming "clumsy" or "muddled" when performing familiar tasks such as setting the table or simple DIY. Anosognosia, a lack of awareness of the deficit, is common and can cause therapeutic resistance.[2] In some agnosias, such as prosopagnosia, awareness of the deficit is often present; however shame and embarrassment regarding the symptoms can be a barrier in admission of a deficiency.[16] Because agnosias result from brain lesions, no direct treatment for them currently exists, and intervention is aimed at utilization of coping strategies by patients and those around them. Sensory compensation can also develop after one modality is impaired in agnostics[1] General principles of treatment: restitution repetitive training of impaired ability development of compensatory strategies utilizing retained cognitive functions[1] Partial remediation is more likely in cases with traumatic/vascular lesions, where more focal damage occurs, than in cases where the deficit arises out of anoxic brain damage, which typically results in more diffuse damage and multiple cognitive impairments.[2] However, even with forms of compensation, some affected individuals may no longer be able to fulfill the requirements of their occupation or perform common tasks, such as, eating or navigating. Agnostics are likely to become more dependent on others and to experience significant changes to their lifestyle, which can lead to depression or adjustment disorders.[1] ^ a b c d e f g h i j k l m n o p Bauer, Russell M. (2006). "The Agnosias". In Snyder, P.J. (ed.). 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Evidence from a case study of modality and category-specific "semantic" im- pairment". Cortex. 33 (3): 391–417. doi:10.1016/s0010-9452(08)70227-2. PMID 9339326. S2CID 4479759. ^ a b c d Farah, Martha J., ed. (2000). "Chapter 12: Disorders". Patient-Based Approaches to Cognitive Neuroscience. Todd E Feinberg. Cambridge, Massachusetts: The MIT Press. pp. 79–84, 143–154. ISBN 978-0262561235. Archived from the original on 2012-03-18. Retrieved 2012-04-10. Retrieved from " , the free encyclopedia that anyone can edit. 107,766 active editors 7,028,513 articles in English Liz Truss (born 26 July 1975) is a British politician who was prime minister from September to October 2022. A Liberal Democrat in her youth, she defected to the Conservatives in 1996. After several bids for public office she was elected as an MP in 2010 and served continuously in government in the Cameron, May and Johnson ministries, latterly as foreign secretary. After Johnson resigned in July 2022 Truss stood in the election to replace him, defeating Rishi Sunak and becoming the leader of the party. Two days after her appointment as prime minister Queen Elizabeth II died, freezing government business for ten days during a national mourning period; after its conclusion Truss's ministry announced a mini-budget which was received badly by markets, the fallout from which subsequently engulfed her government. Facing a rapid loss of confidence in her leadership, Truss resigned fifty days into her premiership and was succeeded by Sunak, becoming the shortest-serving British prime minister. (Full article...) Recently featured: Lesley J. 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Carl Jung (b. 1875)Ana María Matute (b. 1925)George W. Romney (d. 1995)Olivia de Havilland (d. 2020) More anniversaries: July 25 July 26 July 27 Archive By email List of days of the year About Cytoplasmic streaming is a biological process in which cytoplasm flows inside a cell, driven by forces from the cytoskeleton. It is usually observed in large plant and animal cells, as well as amoebae, fungi, and slime moulds. It is likely that its function is, at least in part, to speed up the transport of molecules and organelles around the cell. The process was first discovered by the Italian scientist Bonaventura Corti in 1774, within the algae genera Nitella and Chara. While its mechanism is not fully understood, what is clearly visible in plant cells which exhibit cytoplasmic streaming is the motion of the chloroplasts moving with the cytoplasmic flow. This motion results from fluid being entrained by moving motor molecules of the plant cell. This video, taken through a microscope, shows cytoplasmic streaming occurring in an onion epidermal cell. Video credit: Heiti Paves Recently featured: Hudson Yards Emperor angelfish Amália Rodrigues Archive More featured pictures Community portal – The central hub for editors, with resources, links, tasks, and announcements. Village pump – Forum for discussions about Wikipedia itself, including policies and technical issues. Site news – Sources of news about Wikipedia and the broader Wikimedia movement. Teahouse – Ask basic questions about using or editing Wikipedia. Help desk – Ask questions about using or editing Wikipedia. Reference desk – Ask research questions about encyclopedic topics. Content portals – A unique way to navigate the encyclopedia. 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January February March April May June July August September October November December From top to bottom, left to right: The Vietnam War escalates as the United States begins regular bombing campaigns in Operation Rolling Thunder and deploys ground combat troops for the first time; the Indo-Pakistani War of 1965 erupts over Kashmir, drawing international concern and resulting in thousands of casualties before a UN-brokered ceasefire; the Voting Rights Act of 1965 is signed into law by President Lyndon B. Johnson, prohibiting racial discrimination in voting; Malcolm X is assassinated while delivering a speech in New York City, silencing one of the most influential and controversial voices in the civil rights movement; the Dominican Civil War breaks out as constitutionalist and loyalist factions clash, prompting a U.S. military intervention amid fears of a second Cuba; former British Prime Minister Winston Churchill dies at the age of 90, prompting a global outpouring of tributes and a state funeral attended by world leaders; the Battle of Ia Drang becomes the first major battle between U.S. and North Vietnamese forces, signaling a new phase of intense ground combat in the Vietnam War; the Indonesian mass killings of 1965–66 begin following an attempted coup, leading to the deaths of an estimated 500,000 to 1,000,000 people in a brutal anti-communist purge; the Selma to Montgomery marches for voting rights take place in Alabama, culminating in the violent crackdown known as Bloody Sunday and ultimately leading to new federal protections. Calendar year Years Millennium 2nd millennium Centuries 19th century 20th century 21st century Decades 1940s 1950s 1960s 1970s 1980s Years 1962 1963 1964 1965 1966 1967 1968 vte 1965 by topic Subject Animation Archaeology Architecture Art Aviation Awards Comics Film Literature Poetry Meteorology Music Country Jazz Rail transport Radio Science Spaceflight Sports Football Television American Belgian Brazilian British Scottish Canadian Danish Irish Italian By country Afghanistan Argentina Australia Belgium Brazil Bulgaria Canada Denmark France Germany India Indonesia Ireland Iran Israel Italy Japan Kuwait Luxembourg Malaysia New Zealand Norway Pakistan Philippines Portugal Singapore South Africa South Korea Soviet Union Spain Sweden Switzerland Thailand Turkey United Kingdom United States Lists of leaders Sovereign states Sovereign state leaders Territorial governors Religious leaders Law Birth and death categories Births Deaths Establishments and disestablishments categories Establishments Disestablishments Works category Works Introductions vte 1965 in various calendarsGregorian calendar1965MCMLXVAb urbe condita2718Armenian calendar1414ԹՎ ՌՆԺԴAssyrian calendar6715Bahá'í calendar121–122Balinese saka calendar1886–1887Bengali calendar1371–1372Berber calendar2915British Regnal year13 Eliz. 2 – 14 Eliz. 2Buddhist calendar2509Burmese calendar1327Byzantine calendar7473–7474Chinese calendar甲辰年 (Wood Dragon)4662 or 4455 — to —乙巳年 (Wood Snake)4663 or 4456Coptic calendar1681–1682Discordian calendar3131Ethiopian calendar1957–1958Hebrew calendar5725–5726Hindu calendars - Vikram Samvat2021–2022 - Shaka Samvat1886–1887 - Kali Yuga5065–5066Holocene calendar11965Igbo calendar965–966Iranian calendar1343–1344Islamic calendar1384–1385Japanese calendarShōwa 40(昭和４０年)Javanese calendar1896–1897Juche calendar54Julian calendarGregorian minus 13 daysKorean calendar4298Minguo calendarROC 54民國54年Nanakshahi calendar497Thai solar calendar2508Tibetan calendar(male Wood-Dragon)2091 or 1710 or 938 — to —(female Wood-Snake)2092 or 1711 or 939 Wikimedia Commons has media related to 1965. 1965 (MCMLXV) was a common year starting on Friday of the Gregorian calendar, the 1965th year of the Common Era (CE) and Anno Domini (AD) designations, the 965th year of the 2nd millennium, the 65th year of the 20th century, and the 6th year of the 1960s decade. Calendar year Main article: January 1965 Main article: February 1965 January 14 – The First Minister of Northern Ireland and the Taoiseach of the Republic of Ireland meet for the first time in 43 years. January 20 Lyndon B. Johnson is sworn in for a full term as President of the United States. Indonesian President Sukarno announces the withdrawal of the Indonesian government from the United Nations. January 29 – Hakametsä, the first ice rink of Finland, is inaugurated in Tampere.[1] January 30 – The state funeral of Sir Winston Churchill takes place in London with the largest assembly of dignitaries in the world until the 2005 funeral of Pope John Paul II.[2] February 4 – Trofim Lysenko is removed from his post as director of the Institute of Genetics at the Academy of Sciences in the Soviet Union. Lysenkoist theories are now treated as pseudoscience.[3][4] February 12 – The African and Malagasy Common Organization (Organization Commune Africaine et Malgache; OCAM) is formed as successor to the Afro-Malagasy Union for Economic Cooperation (Union Africaine et Malgache de Cooperation Economique; UAMCE), formerly the African

and Malagasy Union (Union Africaine et Malgache; UAM). February 18: Flag of the newly independent Gambia February 15 – The maple leaf is adopted as the flag of Canada, replacing the Canadian Red Ensign flag. February 18 – The Gambia becomes independent from the United Kingdom. February 20 Ranger 8 crashes into the Moon, after a successful mission of photographing possible landing sites for the Apollo program astronauts. Suat Hayri Ürgüplü forms the new (interim) government of Turkey (29th government). February 21 – Malcolm X is gunned down while giving a speech at the Audubon Ballroom in Harlem. Main article: March 1965 Main article: April 1965 March 2 – Vietnam War: Operation Rolling Thunder – The United States Air Force 2nd Air Division, United States Navy and South Vietnamese air force begin a 31⁄2-year aerial bombardment campaign against North Vietnam. March 7 Mass in the Catholic Church worldwide is said in local languages (rather than Latin) for the first time.[5][6] "Bloody Sunday": Some 200 Alabama State Troopers attack 525 civil rights demonstrators in Selma, Alabama, as they attempt to march to the state capitol of Montgomery. March 8 – Vietnam War: Some 3,500 United States Marines arrive in Da Nang, South Vietnam, becoming the first American ground combat troops in Vietnam. March 9 – The "Turnaround Tuesday" march from Selma to Montgomery, Alabama, under the leadership of Martin Luther King Jr., stops at the site of "Bloody Sunday", to hold a prayer service and return to Selma, in obedience to a court restraining order. On the same day, White supremacists attack three white ministers, leaving Unitarian Universalist minister James J. Reeb in a coma. March 10 – An engagement is announced between Princess Margriet of the Netherlands and Pieter van Vollenhoven, who will become the first commoner and the first Dutchman to marry into the Dutch royal family. March 18 – Cosmonaut Alexei Leonov leaves his Voskhod 2 spacecraft for 12 minutes, becoming the first person to walk in space.[7] March 20 "Poupée de cire, poupée de son", sung by France Gall (music and lyrics by Serge Gainsbourg), wins the Eurovision Song Contest 1965 (staged in Naples) for Luxembourg.[8] The Indo-Pakistani War of 1965 begins. March 23 Events of March 23, 1965: Large student demonstration in Morocco, joined by discontented masses, meets with violent police and military repression. Gemini 3: NASA launches the United States' first 2-person crew (Gus Grissom, John Young) into Earth orbit. The first issue of The Vigilant is published from Khartoum. March 25 – Martin Luther King Jr. and 25,000 civil rights activists successfully end the 4-day march from Selma, Alabama, to the capitol in Montgomery. March 28 – At least 400 are killed or missing after an earthquake triggered a series of dam failures in La Ligua, Chile.[9] March 30 – The second ODECA charter, signed by Central American states on December 12, 1962, becomes effective. April 3 – The world's first space nuclear power reactor, SNAP-10A, is launched by the United States from Vandenberg AFB, California. The reactor operates for 43 days and remains in low Earth orbit. April 5 – At the 37th Academy Awards, My Fair Lady wins 8 Academy Awards, including Best Picture and Best Director. Rex Harrison wins an Oscar for Best Actor. Mary Poppins takes home 5 Oscars. Julie Andrews wins an Academy Award for Best Actress for her performance in the title role. Sherman Brothers receives 2 Oscars including Best Song, "Chim Chim Cher-ee". April 6 – The Intelsat I ("Early Bird") communications satellite is launched. It becomes operational May 2 and is placed in commercial service in June. April 9 – The West German parliament extends the statute of limitations on Nazi war crimes. April 12 – A historic and extremely destructive tornado outbreak struck the Midwest region of the United States, killing 266. April 18 – Consecration of Saint Clement of Ohrid Macedonian Orthodox Cathedral in Toronto, Canada. April 23 – The Pennine Way officially opens. April 24 The 1965 Yerevan demonstrations start in Yerevan, demanding recognition of the Armenian genocide. The bodies of Portuguese opposition politician Humberto Delgado and his secretary Arajaryr Moreira de Campos are found in a forest near Villanueva del Fresno, Spain (they were killed February 12). In the Dominican Republic, officers and civilians loyal to deposed President Juan Bosch mutiny against the right-wing junta running the country, setting up a provisional government. Forces loyal to the deposed military-imposed government stage a countercoup the next day, and civil war breaks out, although the new government retains its hold on power. April 26 – Rede Globo is founded in Rio de Janeiro, Brazil. April 28 U.S. troops occupy the Dominican Republic. Vietnam War: Prime Minister of Australia Robert Menzies announces that the country will substantially increase its number of troops in South Vietnam, supposedly at the request of the Saigon government (it is later revealed that Menzies had asked the leadership in Saigon to send the request at the behest of the Americans). April 29 – Australia announces that it is sending an infantry battalion to support the South Vietnam government. Main article: May 1965 Main article: June 1965 May 1 Bob Askin replaces Jack Renshaw as Premier of New South Wales. The Battle of Dong-Yin occurs as a conflict between Taiwan and the People's Republic of China. May 9 – Pianist Vladimir Horowitz returns to the stage after a 12-year absence, performing a legendary concert in Carnegie Hall in New York. May 12 –West Germany and Israel establish diplomatic relations. Muhammad Ali standing over Sonny Liston May 25 – Muhammad Ali knocks out Sonny Liston in the first round of their championship rematch with the "Phantom Punch" at the Central Maine Civic Center in Lewiston. May 27 – Internazionale beats Benfica 1–0 at the San Siro, Milan and wins the 1964–65 European Cup in Association football. May 29 – A mining accident in Dhanbad, India, kills 274. May 31 – Scottish racing driver Jim Clark wins the Indianapolis 500, later this year winning the Formula One world driving championship. June 1 – A coal mine explosion in Fukuoka, Japan, kills 237. June 2 – Vietnam War: The first contingent of Australian combat troops arrives in South Vietnam. June 7 – Kakanj mine disaster: A mining accident in Kakanj, Bosnia and Herzegovina, results in 128 deaths. June 10 – Vietnam War – Battle of Dong Xoai: About 1,500 Viet Cong mount a mortar attack on Đồng Xoài, overrunning its military headquarters and the adjoining militia compound. June 19 Houari Boumediene's Revolutionary Council ousts Ahmed Ben Bella, in a bloodless coup in Algeria. Air Marshal Nguyen Cao Ky, head of the South Vietnamese Air Force, was appointed prime minister at the head of the military junta, with General Nguyễn Văn Thiệu becoming a figurehead president, ending two years of short-lived military juntas.[10][non sequitur] June 20 – Police in Algiers break up demonstrations by people who have taken to the streets chanting slogans in support of deposed President Ahmed Ben Bella. June 22 – The Treaty on Basic Relations between Japan and the Republic of Korea is signed in Tokyo. June 25 – A U.S. Air Force Boeing C-135 Stratolifter bound for Okinawa crashes just after takeoff at MCAS El Toro in Orange County, California, killing all 85 on board. Main article: July 1965 Main article: August 1965 July – The Commonwealth secretariat is created. July 14 – U.S. spacecraft Mariner 4 flies by Mars, becoming the first spacecraft to return images from the Red Planet. July 15 – Greek Prime minister Georgios Papandreou and his government are dismissed by King Constantine II. July 16 – The Mont Blanc Tunnel, a highway tunnel between France and Italy, is inaugurated by presidents Giuseppe Saragat and Charles de Gaulle. July 24 – Vietnam War: Four F-4C Phantoms escorting a bombing raid at Kang Chi are targeted by antiaircraft missiles, in the first such attack against American planes in the war. One is shot down and the other 3 sustain damage. July 26 – The Maldives obtains full independence from Great Britain.[11] July 27 – Edward Heath becomes Leader of the British Conservative Party. July 28 – Vietnam War: U.S. President Lyndon B. Johnson announces his order to increase the number of United States troops in South Vietnam from 75,000 to 125,000, and to more than double the number of men drafted per month - from 17,000 to 35,000. July 30 – War on Poverty: U.S. President Lyndon B. Johnson signs the Social Security Act of 1965 into law, establishing Medicare and Medicaid. August 7 – Tunku Abdul Rahman, Prime Minister of Malaysia, recommends the expulsion of Singapore from the Federation of Malaysia following a deterioration of PAP–UMNO relations, negotiating its separation with Lee Kuan Yew, Prime Minister of Singapore. August 9 Proclamation of Singapore: Singapore is expelled from the Federation of Malaysia, which recognises it as a sovereign nation. Lee Kuan Yew announces Singapore's independence and assumes the position of Prime Minister of the new island nation – a position he holds until 1990. An explosion at an Arkansas missile plant kills 53. Indonesian president Sukarno collapses in public. August 11 – Racial rioting in the Los Angeles, California neighborhood of Watts breaks out after an African American motorist, Marquette Frye,[12] is stopped on suspicion of drunken driving. Six days of unrest are quelled by over 14,000 members of the California National Guard. There are 34 deaths and over $40 million in property damage. It is the largest and costliest urban rebellion of the Civil Rights movement.[13] August 18 – Vietnam War: Operation Starlite – 5,500 United States Marines destroy a Viet Cong stronghold on the Van Tuong peninsula in Quảng Ngãi Province, in the first major American ground battle of the war. The Marines were tipped off by a Viet Cong deserter who said that there was an attack planned against the U.S. base at Chu Lai. August 19 – At the conclusion of the Frankfurt Auschwitz trials, 66 ex-SS personnel receive life sentences, 15 others shorter ones. August 21 – NASA launches Gemini 5 (Gordon Cooper, Pete Conrad) on the first 1-week space flight, as well as the first test of fuel cells for electrical power on such a mission. August 30 – An avalanche buries a dam construction site at Saas-Fee, Switzerland, killing 90 workers. August 31 – U.S. President Johnson signs a law penalizing the burning of draft cards with up to 5 years in prison and a $1,000 fine. Main article: September 1965 Main article: October 1965 September 2 Pakistani troops enter the Indian sector of Kashmir, while Indian troops counter at Lahore. The People's Republic of China announces that it will reinforce its troops on the Indian border. Vietnam War: In a follow-up to August's Operation Starlite, United States Marines and South Vietnamese forces initiate Operation Piranha on the Batangan Peninsula, 23 miles (37 km) south of the Chu Lai Marine base. September 8 India opens 2 additional fronts against Pakistan. The Pakistan Navy destroys Indian Port of Dwarka. Operation Dwarka (Pakistan celebrates Victory Day annually). September 9 U.N. Secretary General U Thant negotiates with Pakistan President Ayub Khan. U Thant recommends China for United Nations membership. September 14 – The fourth and final period of the Second Vatican Council opens. September 16 – In Iraq, Prime Minister Arif Abd ar-Razzaq's attempted coup fails. September 17 – King Constantine II of Greece forms a new government with Prime Minister Stephanos Stephanopoulos, in an attempt to end a 2-year-old political crisis. September 18 In Denmark, Palle Sørensen shoots 4 policemen in pursuit; he is apprehended the same day. Comet Ikeya–Seki is first sighted by Japanese astronomers. Soviet Premier Alexei Kosygin invites the leaders of India and Pakistan to meet in the Soviet Union to negotiate. September 19 – Pakistani Forces achieve a decisive victory at the Battle of Chawinda, ultimately halting the Indian advance and successfully stabilizing the Sialkot Front, it is the world's largest tank battle since the Battle of Kursk in the Second World War between Nazi Germany and the Soviet Union September 20 – Vietnam War: An USAF F-104 Starfighter piloted by Captain Philip Eldon Smith is shot down by a Chinese MiG-19 Farmer. The pilot is held until March 15, 1973. September 21 – Gambia, Maldives and Singapore are admitted as members of the United Nations. September 22 – Radio Peking announces that Indian troops have dismantled their equipment on the Chinese side of the border. September 24 Fighting resumes between Indian and Pakistani troops. The British governor of Aden cancels the constitution and takes direct control of the protectorate, due to the bad security situation. September 27 – The largest tanker ship at this time, Tokyo Maru, is launched in Yokohama, Japan. September 28 Fidel Castro announces that anyone who wants to can emigrate to the United States. Taal Volcano in Luzon, Philippines, erupts, killing hundreds. September 30 The Indonesian army, led by General Suharto, crushes an alleged communist coup attempt (see Transition to the New Order and 30 September Movement). The classic family sci-fi show Thunderbirds debuts on ITV in the United Kingdom. October 3 – Fidel Castro announces that Che Guevara has resigned and left Cuba. October 4 At least 150 are killed when a commuter train derails at the outskirts of Durban, KwaZulu-Natal, South Africa. Prime minister Ian Smith of Rhodesia and Arthur Bottomley of the Commonwealth of Nations begin negotiations in London. Pope Paul VI makes the first papal visit to the United States. He appears for a Mass in Yankee Stadium and makes a speech at the United Nations. The University of California, Irvine opens its doors. October 5 – Pakistan severs diplomatic relations with Malaysia because of their disagreement in the UN. October 6 – Ian Brady, a 27-year-old stock clerk from Hyde in Cheshire, is arrested for allegedly hacking to death (with a hatchet) 17-year-old apprentice electrician Edward Evans at a house on the Hattersley housing estate. October 7 – Seven Japanese fishing boats are sunk off Guam by Super Typhoon Carmen; 209 are killed. October 8 Indonesian mass killings of 1965–1966: The Indonesian army instigates the arrest and execution of communists which last until next March.[14] The 7 Fundamental Principles of the Red Cross and Red Crescent are adopted at the XX International Conference in Vienna, Austria. The International Olympic Committee admits East Germany as a member. October 10 – The first group of Cuban refugees travels to the U.S. October 12 Per Borten forms a government in Norway. The U.N. General Council recommends that the United Kingdom try everything to stop a rebellion in Rhodesia. October 13 – Congo President Joseph Kasavubu fires Prime Minister Moise Tshombe and forms a provisional government, with Évariste Kimba in a leading position. October 15 – Vietnam War: The Catholic Worker Movement stages an anti-war protest in Manhattan. One draft card burner is arrested, the first under the new law. October 17 – The New York World's Fair at Flushing Meadows, closes. Due to financial losses, some of the projected site park improvements fail to materialize. October 18 – The Indonesian government outlaws the Communist Party of Indonesia.[15] October 20 – Ludwig Erhard is re-elected Chancellor of West Germany (he had first been elected in 1963). October 21 Comet Ikeya–Seki approaches perihelion, passing 450,000 kilometres (280,000 mi) from the sun. The Organization of African Unity meets in Accra, Ghana. October 22 African countries demand that the United Kingdom use force to prevent Rhodesia from declaring unilateral independence. Colonel Christophe Soglo stages a second coup in Dahomey. October 25 – The Soviet Union declares its support of African countries in case Rhodesia unilaterally declares independence. October 27 Brazilian president Humberto de Alencar Castelo Branco removes power from parliament, legal courts and opposition parties. Süleyman Demirel of AP forms the new government of Turkey (30th government). October 28 – Pope Paul VI promulgates Nostra aetate, a "Declaration on the Relation of the (Roman Catholic) Church with Non-Christian Religions" by the Second Vatican Council which includes a statement that Jews are not collectively responsible for the death of Jesus (Jewish deicide). October 29 – An 80-kiloton nuclear device is detonated at Amchitka Island, Alaska, as part of the Vela Uniform program, code-named Project Long Shot. October 30 – Vietnam War: Near Da Nang, United States Marines repel an intense attack by Viet Cong forces, killing 56 guerrillas. A sketch of Marine positions is found on the dead body of a 13-year-old Vietnamese boy who sold drinks to the Marines the day before. Main article: November 1965 Main article: December 1965 November 1 – A trolleybus plunges into the Nile at Cairo, Egypt, killing 74 passengers. November 3 – French President Charles de Gaulle announces (just short of his 75th birthday) that he will stand for re-election. November 5 – Martial law is announced in Rhodesia. The United Nations General Assembly accepts British intent to use force against Rhodesia if necessary by a vote of 82–9. November 6 – Freedom Flights begin: Cuba and the United States formally agree to start an airlift for Cubans who want to go to the United States (by 1971, 250,000 Cubans take advantage of this program). November 8 – Vietnam War – Operation Hump: The United States Army 173rd Airborne is ambushed by over 1,200 Viet Cong. November 11 In Rhodesia (modern-day Zimbabwe), the white-minority government of Ian Smith unilaterally declares de facto independence ('UDI'). United Airlines Flight 227 crashes short of the runway and catches fire at Salt Lake City International Airport, killing 43 out of 91 passengers and crew. November 12 – A UN Security Council resolution (voted 10–0) recommends that other countries not recognize independent Rhodesia. November 13 The SS Yarmouth Castle burns and sinks 60 miles (97 km) off Nassau, Bahamas, with the loss of 90 lives. British theatre critic Kenneth Tynan says "fuck" during a discussion on BBC satirical programme BBC-3 for what many believed was the first time on British television. The corporation later issues a public apology. November 14 – Vietnam War – Battle of Ia Drang: In the Ia Drang Valley of the Central Highlands in Vietnam, the first major engagement of the war between regular United States and North Vietnamese forces begins. November 15 – U.S. racer Craig Breedlove sets a new land speed record of 600.601 mph (966.574 km/h). November 16 – Venera program: The Soviet Union launches the Venera 3 space probe from Baikonur, Kazakhstan toward Venus (on March 1, 1966, it becomes the first spacecraft to reach the surface of another planet). November 20 – The United Nations Security Council recommends that all states stop trading with Rhodesia. November 22 – The United Nations Development Programme (UNDP) is established as a specialized agency of the United Nations. November 23 – Soviet general Mikhail Kazakov assumes command of the Warsaw Pact. November 24 – Congolese lieutenant general Mobutu ousts Joseph Kasavubu and declares himself president. November 26 – At the Hammaguir launch facility in the Sahara Desert, France launches a Diamant A rocket with its first satellite, Astérix-1 on board, becoming the third country to enter outer space. November 27 Tens of thousands of Vietnam War protesters picket the White House, then march on the Washington Monument. Vietnam War: The Pentagon tells U.S. President Lyndon B. Johnson that if planned major sweep operations to neutralize Viet Cong forces during the next year are to succeed, the number of American troops in Vietnam will have to be increased from 120,000 to 400,000. November 28 – Vietnam War: In response to U.S. President Lyndon B. Johnson's call for "more flags" in Vietnam, Philippines President-elect Ferdinand Marcos announces he will send troops to help fight in South Vietnam. November 29 – The Canadian satellite Alouette 2 is launched. December 5 Charles de Gaulle is re-elected as French president with 10,828,421 votes. The "Glasnost Meeting" in Moscow becomes the first spontaneous political demonstration, and the first demonstration for civil rights in the Soviet Union. December 8: End of the Second Vatican Council December 8 The Second Vatican Council closes. Rhodesian prime minister Ian Smith warns that Rhodesia will resist a trade embargo by neighboring countries with force. The Race Relations Act becomes the first legislation to address racial discrimination in the UK. December 9 – A Charlie Brown Christmas, the first Peanuts television special, debuts on CBS in the United States. It becomes a Christmas tradition. December 15 The Caribbean Free Trade Association (CARIFTA) is formed. Gemini 6 and Gemini 7 perform the first controlled rendezvous in Earth orbit. December 20 – The World Food Programme is made a permanent agency of the United Nations. December 21 The Soviet Union announces that it has shipped rockets to North Vietnam. In West Germany, Konrad Adenauer resigns as chairman of the Christian Democratic Party. The United Nations adopts the International Convention on the Elimination of All Forms of Racial Discrimination. A new 1-hour German-American production of the ballet The Nutcracker, with an international cast that includes Edward Villella in the title role, makes its U.S. television debut. It is repeated annually by CBS over the next 3 years but after that is virtually forgotten until issued on DVD in 2009 by Warner Archive. December 22 – A military coup is launched in Dahomey. December 25 – The Yemeni Nasserist Unionist People's Organisation is founded in Ta'izz. December 30: Ferdinand Marcos is the 10th President of the Philippines December 30 Ferdinand Marcos becomes President of the Philippines. President Kenneth Kaunda of Zambia announces that Zambia and the United Kingdom have agreed on a deadline before which the Rhodesian white government should be ousted. December 31 – Bokassa takes power in the Central African Republic. Aborigines are given the vote in Queensland, Australia. Hainzl Industriesysteme GmbH company is founded in Austria.[16] Tokyo officially becomes the largest city of the world, taking the lead from New York City.[17] World population 1965 1960 1970 World 3,334,874,000 3,021,475,000 313,399,000 3,692,492,000 357,618,000 Africa 313,744,000 277,398,000 36,346,000 357,283,000 43,539,000 Asia 1,899,424,000 1,701,336,000 198,088,000 2,143,118,000 243,694,000 Europe 634,026,000 604,401,000 29,625,000 655,855,000 21,829,000 Latin America 250,452,000 218,300,000 32,152,000 284,856,000 34,404,000 Northern America 219,570,000 204,152,000 15,418,000 231,937,000 12,367,000 Oceania 17,657,000 15,888,000 1,769,000 19,443,000 1,786,000 Julia Ormond Vinnie Jones Joely Richardson Diane Lane January 4 Julia Ormond, British actress[18] Yvan Attal, Israeli-born French actor and director January 5 Vinnie Jones, British footballer-turned-actor[19] Patrik Sjöberg, Swedish high jumper[20] January 9 Haddaway, German singer Farah Khan, Indian choreographer, film director Joely Richardson, British actress January 10 – Butch Hartman, American animator and voice actor January 12 Nikolai Borschevsky, Russian ice hockey player Maybrit Illner, German television journalist and presenter Rob Zombie, American musician January 14 Shamil Basayev, Chechen terrorist (d. 2006) Marc Delissen, Dutch field hockey player Bob Essensa, Canadian ice hockey player January 15 Adam Jones, American musician, guitarist of metal band Tool James Nesbitt, Northern Irish actor[21] January 20 – Sophie, Duchess of Edinburgh, wife of Prince Edward, Duke of Edinburgh January 21 – Jam Master Jay, American DJ, rapper and producer (d. 2002) January 22 DJ Jazzy Jeff, American disc jockey Diane Lane, American actress January 23 – Catherine Guillouard, French businesswoman January 24 – Porfirio Fisac, Spanish basketball coach January 25 – Esa Tikkanen, Finnish ice hockey player January 26 – Natalia Yurchenko, Soviet artistic gymnast January 27 Alan Cumming, Scottish actor Ignacio Noé, Argentine artist January 29 Dominik Hašek, Czech hockey player Jo Min-su, South Korean actress Chris Rock Adama Barrow Michael Bay Dr. Dre February 1 Dave Callaghan, South African cricketer Brandon Lee, Chinese-American actor (d. 1993) Sherilyn Fenn, American actress Princess Stéphanie of Monaco February 3 – Maura Tierney, American actress February 5 – Gheorghe Hagi, Romanian footballer, manager and club owner[22] February 7 – Chris Rock, African-American actor, comedian, and film director February 8 – Dicky Cheung, Hong Kong actor February 11 – Roberto Moya, Cuban athlete (d. 2020) February 12 – Brett Kavanaugh, American attorney and Supreme Court Justice February 15 – Héctor Beltrán Leyva, Mexican drug lord (d. 2018) February 16 – Adama Barrow, Gambian politician, 3rd President of Gambia February 17 – Michael Bay, American film director[23] February 18 – Dr. Dre, African-American rapper and music producer February 23 Kristin Davis, American actress[24] Michael Dell, American computer manufacturer[25] Vincent Chalvon-Demersay, French producer Helena Suková, Czech tennis player[26] February 25 – Sylvie Guillem, French ballerina February 27 – Claudia Zobel, Filipina actress (d. 1984) February 28 – Park Gok-ji, South Korean film editor Aamir Khan Mark Carney Rick Harrison The Undertaker Sarah Jessica Parker March 1 Mike Dean, Record producer Stewart Elliott, Canadian jockey Jack Tu, Taiwanese-Canadian cardiologist (d. 2018) March 2 – Ami Bera, American politician[27] March 3 Tedros Adhanom, Director of the World Health Organization March 4 Greg Alexander, Australian rugby league player Paul W. S. Anderson, British filmmaker, producer and screenwriter March 5 – Harry Bevers, Dutch politician March 8 Mac Jack, South African educator and politician (d. 2020) Caio Júnior, Brazilian football forward and manager (d. 2016) March 9 – Antonio Saca, 43rd President of El Salvador March 11 Catherine Fulop, Venezuelan actress, model, beauty pageant contestant, and television presenter Jesse Jackson Jr., African-American politician Laurence Llewelyn-Bowen, British designer and television presenter March 14 – Aamir Khan, Indian film director, producer, film and scriptwriter and actor March 16 Utut Adianto, Indonesian chess grandmaster and politician Mark Carney, Canadian economist and politician, 24th Prime Minister of Canada[28] March 22 – Rick Harrison, American businessman and reality television personality March 23 – Marti Pellow, Scottish singer (Wet Wet Wet) March 24 Rob MacCachren, American racecar driver The Undertaker, American professional wrestler March 25 Stefka Kostadinova, Bulgarian high jumper and president of the Bulgarian Olympic Committee Sarah Jessica Parker, American actress March 26 – Prakash Raj, Indian actor, producer and director March 29 – Voula Patoulidou, Greek athlete March 30 – Piers Morgan, British journalist and television personality Robert Downey Jr. Martin Lawrence Leni Robredo Kevin James April 1 Brian Marshall, Canadian retired track and field athlete Bekir Bozdağ, Turkish theologian, lawyer, and politician April 3 – Nazia Hassan, Pakistani pop singer-songwriter, lawyer and social activist (d. 2000) April 4 – Robert Downey Jr., American actor, producer, and singer April 6 Black Francis, American musician Rica Reinisch, German swimmer April 9 – Paulina Porizkova, Swedish-American model and actress April 10 Anna-Leena Härkönen, Finnish author[29] Jure Robič, Slovenian cyclist (d. 2010) April 11 – Eelco van Asperen, Dutch computer scientist April 12 – Kim Bodnia, Danish actor and director April 15 – Linda Perry, American musician April 16 – Martin Lawrence, American actor, comedian, and producer April 18 – Camille Coduri, English actress April 19 – Suge Knight, American record producer and convicted felon April 20 – Jovy Marcelo, Filipino racing driver (d. 1992) April 21 – Julio Robaina, Republican politician, Mayor of Hialeah, Florida April 23 – Leni Robredo, 14th Vice President of the Philippines April 24 – Michel Leclerc, French director and screenwriter April 25 – Édouard Ferrand, French politician (d. 2018) April 26 – Kevin James, American comedian and actor April 27 – Edwin Poots, Irish politician April 29 – David Shafer, American politician, Georgia April 30 – Adrian Pasdar, Iranian-American actor and voice artist Trent Reznor John C. Reilly Yahya Jammeh Brooke Shields May 2 – Myriam Hernández, Chilean singer May 3 Gary Mitchell, Irish playwright Rob Brydon, Welsh actor, comedian, impressionist and presenter May 7 Owen Hart, Canadian professional wrestler (d. 1999)[30] Norman Whiteside, Northern Irish football player May 9 – Steve Yzerman, Canadian hockey player May 10 – Linda Evangelista, Canadian supermodel May 11 – Monsour del Rosario, Filipino Olympic athlete and actor May 12 – Renée Simonsen, Danish model and writer May 13 – José Antonio Delgado, Venezuelan mountain climber (d. 2006) May 14 – Eoin Colfer, Irish novelist May 16 Rodica Dunca, Romanian artistic gymnast Krist Novoselic, American musician and activist (Nirvana) May 17 – Trent Reznor, American rock musician (Nine Inch Nails) May 19 – Philippe Dhondt, French singer May 23 Melissa McBride, American actress (The Walking Dead) May 24 Carlos Franco, Paraguayan golfer John C. Reilly, American actor and comedian Shinichirō Watanabe, Japanese anime director May 25 – Yahya Jammeh, President of the Gambia May 29 – Emilio Sánchez, Spanish tennis player May 30 – Guadalupe Grande, Spanish poet (d. 2021) May 31 – Brooke Shields, American actress and model Mick Foley Frank Grillo Elizabeth Hurley Kim Dickens June 1 Larisa Lazutina, Russian cross-country skier Nigel Short, English chess player June 2 – Steve and Mark Waugh, Australian cricketers June 4 Mick Doohan, Australian motorcycle racer Andrea Jaeger, American tennis player[31] June 6 Cam Neely, Canadian ice hockey player Megumi Ogata, Japanese voice actress and singer[32] June 7 Mick Foley, American professional wrestler Damien Hirst, British artist Christine Roque, French singer June 8 Frank Grillo, American actor[33] Rob Pilatus, German model, dancer and singer (d. 1998) June 10 Veronica Ferres, German actress Elizabeth Hurley, English model and actress June 11 – Manuel Uribe, morbidly obese Mexican (d. 2014) June 12 – Carlos Luis Morales, Ecuadorian journalist (d. 2020) June 13 – Infanta Cristina of Spain, Spanish princess June 15 – Bernard Hopkins, American boxer June 16 – Andrea M. Ghez, American astronomer, recipient of the Nobel Prize in Physics[34] June 17 Dana Eskelson, American actress[35] Dan Jansen, American speedskater Dara O'Kearney, Irish ultra runner and professional poker player June 18 Kim Dickens, American actress Hani Mohsin, Malaysian celebrity, actor and host (d. 2006) June 21 Yang Liwei, Chinese major general, military pilot and China National Space Administration astronaut Gabriella Selmeczi, Hungarian jurist and politician Tim Lajcik, Czech American mixed martial artist, stuntman, actor and writer June 22 – Anubhav Sinha, Indian film director June 23 – Paul Arthurs, English Musician (Oasis) June 24 – Son Hyun-joo, South Korean actor June 25 – Jean Castex, French politician June 26 – Jana Hybášková, Czech politician and diplomat June 27 Frédéric Lemoine, French businessman S. Manikavasagam, Malaysian politician June 28 – Belayneh Dinsamo, Ethiopian long-distance runner June 29 Véronique Laury, French businesswoman Dado Villa-Lobos, Brazilian musician Matthew Weiner, American television writer, director and producer[36] June 30 Philippe Duquesne, French actor Cho Jae-hyun, South Korean actor Mitch Richmond, American basketball player Connie Nielsen Hailemariam Desalegn Shawn Michaels Slash Illeana Douglas Jeremy Piven J. K. Rowling July 1 Teddy McCarthy, hurler and Gaelic footballer Carl Fogarty, English motorcycle racer Mohammed Abdul Hussein, Iraqi former footballer Ramdas Ambatkar, Indian politician, Maharashtra MLC (d. 2025)[37] July 2 – Fredrik Sejersted, Norwegian jurist July 3 Komsan Pohkong, Thai lawyer Shinya Hashimoto, Japanese professional wrestler (d. 2005) Connie Nielsen, Danish actress Tommy Flanagan, Scottish actor July 4 – Tracy Letts, American actor, playwright and screenwriter July 5 Kathryn Erbe, American actress Eyran Katsenelenbogen, Israeli jazz pianist July 7 Paula Devicq, Canadian actress Jeremy Kyle, English radio and television presenter July 10 Danny Boffin, Belgian footballer Princess Alexia of Greece and Denmark Alec Mapa, American comedian July 11 – Ernesto Hoost, Dutch kickboxer July 12 – Mama Kandeh, Gambian politician July 13 – Akina Nakamori, Japanese singer and actress July 14 – Lou Savarese, American boxer July 15 – Dafna Rechter, Israeli actress and singer July 17 Santiago Segura, Spanish actor, screenwriter, producer and director Rosa Gumataotao Rios, 43rd Treasurer of the United States Alex Winter, British actor July 18 – Eva Ionesco, French actress, film director and screenwriter July 19 Dame Evelyn Glennie, Scottish virtuoso percussionist Hailemariam Desalegn, 15th Prime Minister of Ethiopia July 21 – Guðni Bergsson, Icelandic footballer July 22 – Shawn Michaels, American professional wrestler July 23 Grace Mugabe, First Lady of Zimbabwe Slash (Saul Hudson), English-born American rock guitarist July 25 – Illeana Douglas, American actress and producer[38] July 26 Vladimir Cruz, Cuban actor Jeremy Piven, American actor Jimmy Dore, American comedian and political commentator July 27 José Luis Chilavert, Paraguayan footballer[39] Trifon Ivanov, Bulgarian footballer (d. 2016)[40] July 28 – Daniela Mercury, Brazilian singer, songwriter, dancer, producer, actress and television host July 29 – Chang-Rae Lee, Korean-American novelist July 31 – J. K. Rowling, English author Sir Sam Mendes Viola Davis Kyra Sedgwick August 1 – Sam Mendes, English film director August 2 Sandra Ng, Hong Kong actress Hisanobu Watanabe, Japanese baseball player and coach August 4 Terri Lyne Carrington, American jazz drummer Dennis Lehane, American crime writer Fredrik Reinfeldt, Swedish Prime Minister[41] August 5 – Monica Ward, Italian actress and voice actress August 6 – David Robinson, American basketball player August 10 Claudia Christian, American actress, writer, singer, musician, and director Mike E. Smith, American jockey John Starks, American basketball player August 11 – Viola Davis, African-American actress August 15 – Vincent Kok, Hong Kong director and actor August 16 – Michael O'Gorman, American coxswain (d. 2018) August 19 Kevin Dillon, American actor Maria de Medeiros, Portuguese actress Kyra Sedgwick, American actress James Tomkins, Australian rower August 22 – David Reimer, Canadian man, born male but reassigned female and raised as a girl after a botched circumcision (d. 2004)[42] August 24 – Reggie Miller, American basketball player and commentator August 25 – Mia Zapata, American singer (d. 1993) August 26 – Azela Robinson, Mexican actress August 28 Satoshi Tajiri, Japanese video game designer and Pokémon creator[43] Amanda Tapping, Canadian actress Shania Twain, Canadian country singer and songwriter August 31 – Daniel Bernhardt, Swiss actor and martial artist Charlie Sheen Bashar al-Assad Dmitry Medvedev Kyle Chandler Tim Scott Petro Poroshenko September 1 – Craig McLachlan, Australian actor and singer September 2 – Lennox Lewis, British boxer September 3 Costas Mandylor, Greek-Australian actor Charlie Sheen, American actor and producer September 5 – Derby Makinka, Zambian footballer (d. 1993) September 6 – Gleisi Hoffmann, Brazilian lawyer and politician September 7 – Jörg Pilawa, German television presenter September 8 Tutilo Burger, German Benedictine monk and abbot Darlene Zschech, Australian singer and worship leader September 10 – Marco Pastors, Dutch politician September 11 Bashar al-Assad, President of Syria Moby, American musician September 12 Einstein Kristiansen, Norwegian cartoonist, designer, and television host September 14 – Dmitry Medvedev, former President of Russia September 15 – Fernanda Torres, Brazilian actress September 16 – Katy Kurtzman, American actress, director and producer September 17 Kyle Chandler, American actor Yuji Naka, Japanese video game programmer September 19 Goldie, English record producer and DJ Iliya Lazarov, Bulgarian politician Tim Scott, African-American politician and businessman Tshering Tobgay, former Prime Minister of Bhutan September 20 – Robert Rusler, American actor September 21 Cheryl Hines, American actress Johanna Vuoksenmaa, Finnish film director David Wenham, Australian actor Pramila Jayapal, American politician September 23 – Mark Woodforde, Australian tennis player September 25 – Scottie Pippen, American basketball player September 26 Radisav Ćurčić, Serbian-Israeli basketball player[44] Alexei Mordashov, Russian businessman Petro Poroshenko, former President of Ukraine September 27 – Steve Kerr, American basketball player Lennie James Steve Coogan October 1 – Andreas Keller, German field hockey player October 2 Gerardo Reyero, Mexican voice actor Ferhan and Ferzan Önder, Turkish-Austrian pianists[45][46] October 3 Adriana Calcanhotto, Brazilian singer and composer Jan-Ove Waldner, Swedish table tennis player[47] October 5 Mario Lemieux, Canadian ice hockey player Patrick Roy, Canadian ice hockey player October 6 – Steve Scalise, House Majority Whip and U.S. Representative of Louisiana's 1st district[48] October 8 Matt Biondi, American swimmer C. J. Ramone, American musician October 9 – Dionicio Cerón, Mexican long-distance runner October 10 – Chris Penn, American actor (d. 2006) October 11 Julianne McNamara, American artistic gymnast Lennie James, English actor, screenwriter, and playwright[49] October 13 – Kalpana, Indian film actress (d. 2016) October 14 Steve Coogan, British comedian and actor Jüri Jaanson, Estonian rower and politician October 16 – Kang Kyung-ok, South Korean artist October 17 Aravinda de Silva, Sri Lankan cricketer Rhys Muldoon, Australian actor, writer, and director October 18 – Zakir Naik, Indian doctor and Islamic activist October 19 The Renegade, American professional wrestler (d. 1999) Ty Pennington, American television presenter Tracy Griffith, American actress, sushi chef, and painter October 20 Amos Mansdorf, Israeli tennis player[50] Stefano Pioli, Italian football player and manager[51] October 22 – Sumito Estévez, Venezuelan chef[52] October 26 Aaron Kwok, Hong Kong singer and actor Kelly Rowan, Canadian actress Kenneth Rutherford, New Zealand cricketer October 29 – Christy Clark, Canadian politician October 30 – Zaza Urushadze, Georgian film director, producer and screenwriter (d. 2019) October 31 – Rob Rackstraw, British actor Shah Rukh Khan Björk Mads Mikkelsen Ben Stiller November 1 Patrik Ringborg, Swedish conductor November 2 Paweł Adamowicz, Polish politician and lawyer (d. 2019) Shah Rukh Khan, Indian actor, film/television producer and television presenter November 4 – Wayne Static, American singer and musician (Static-X) (d. 2014) November 7 – Sigrun Wodars, German athlete November 8 – Patricia Poleo, Venezuelan journalist[53] November 9 – Sir Bryn Terfel, Welsh baritone November 10 – Eddie Irvine, Northern Irish racing driver November 11 – Max Mutchnick, American television producer November 13 – Rick Roberts, Canadian actor November 17 – Pam Bondi, American attorney and politician, 87th U.S. Attorney General [54] November 19 Paulo Barreto, Brazilian cryptographer Laurent Blanc, French football player and manager November 20 – Yoshiki Hayashi, Japanese rock composer, pianist and drummer November 21 Björk, Icelandic singer-songwriter and musician Reggie Lewis, American basketball player (d. 1993) Alexander Siddig, Sudanese-British actor November 22 – Mads Mikkelsen, Danish actor November 23 – Radion Gataullin, Uzbek-Russian pole-vaulter November 24 – Shirley Henderson, Scottish actress November 25 – Ana Paula Padrão, Brazilian journalist, chief editor, entrepreneur, writer and television presenter November 26 – Scott Adsit, American actor November 29 Lauren Child, American author Raffaella Reggi, Italian tennis player[55] November 30 Ben Stiller, American actor, comedian and filmmaker Tashi Tenzing, Indian mountaineer Salman Khan Andrew Stanton Jeffrey Wright Andy Dick December 3 Steve Harris, American actor Katarina Witt, German figure skater Andrew Stanton, American animator, storyboard artist, film director, and screenwriter December 5 – Johnny Rzeznik, American rock singer and guitarist December 7 Teruyuki Kagawa, Japanese actor Jeffrey Wright, African-American actor December 8 – David Harewood, English actor December 9 – Brad Savage, American actor December 10 – Stephanie Morgenstern, Canadian actress December 15 – Luis Fabián Artime, Argentine footballer December 16 – J. B. Smoove, African-American actor and comedian December 18 – John Moshoeu, South African footballer (d. 2015)[56] December 19 – Jessica Steen, Canadian actress December 21 Andy Dick, American actor and comedian Anke Engelke, German comedian, actress and voice-over actress December 23 – Andreas Kappes, German cyclist (d. 2018) December 27 – Salman Khan, Indian actor, television presenter December 30 Valentina Legkostupova, Soviet and Russian pop singer, teacher and producer (d. 2020) Robert Rep, Dutch politician December 31 Nicholas Sparks, American author[57] Gong Li, Chinese actress Yklymberdi Paromov, Turkmen politician Marga Hoek, Dutch businesswoman T. S. Eliot Winston Churchill January 4 – T. S. Eliot, American-British poet, Nobel Prize laureate (b. 1888)[58] January 10 Antonín Bečvář, Czechoslovak astronomer (b. 1901) Frederick Fleet, British sailor and lookout aboard the RMS Titanic (b. 1887) January 12 – Lorraine Hansberry, African-American playwright and writer (b. 1930) January 14 – Jeanette MacDonald, American actress and singer (b. 1903) January 15 – Pierre Ngendandumwe, 4th and 6th Prime Minister of Burundi (assassinated) (b. 1930) January 20 – Alan Freed, American disc jockey (b. 1921) January 24 – Sir Winston Churchill, British politician and statesman, twice Prime Minister of the United Kingdom, World War II leader, recipient of the Nobel Prize in Literature (b. 1874)[59] January 27 – Hassan Ali Mansur, Iranian politician, 69th Prime Minister of Iran (b. 1923) January 28 Taimur bin Feisal, Sultan of Oman (b. 1886) Tich Freeman, English cricketer (b. 1888)[60] Maxime Weygand, French general (b. 1867) January 31 – Konstantin Muraviev, 31st Prime Minister of Bulgaria (b. 1893) Nat King Cole Malcolm X February 5 – Irving Bacon, American actor (b. 1893) February 6 – Frederick, Prince of Hohenzollern (b. 1891) February 7 – Nance O'Neil, American stage and film actress (b. 1874) February 9 – Khan Bahadur Ahsanullah, Indian educationist, philosopher, philanthropist, social reformer and spiritualist (b. 1874)[61] February 13 Humberto Delgado, Portuguese general and opposition politician (b. 1906) William Heard Kilpatrick, American mathematician and philosopher (b. 1871) February 14 – Désiré-Émile Inghelbrecht, French composer (b. 1880) February 15 – Nat King Cole, American singer and musician (b. 1919)[62] February 19 Forrest Taylor, American actor (b. 1883)[63] Tom Wilson, American actor (b. 1880) February 20 – Michał Waszyński, Polish film director and producer (b. 1904)[64] February 21 – Malcolm X, American civil rights activist (b. 1925)[65] February 22 – Felix Frankfurter, U.S. Supreme Court Justice (b. 1882) February 23 – Stan Laurel, British actor (b. 1890)[66] February 24 – Takeo Itō, Japanese general (b. 1889) February 28 – Adolf Schärf, Austrian politician, 6th President of Austria (b. 1890) King Farouk of Egypt Mary, Princess Royal and Countess of Harewood March 5 – Salvador Castaneda Castro, 31st President of El Salvador (b. 1888) March 6 Margaret Dumont, American actress (b. 1889) Herbert Morrison, British politician (b. 1888)[67] March 7 – Louise Mountbatten, queen consort of Sweden as second wife of King Gustaf VI Adolf (b. 1889) March 13 Corrado Gini, Italian statistician (b. 1884)[68] Vittorio Jano, Italian automobile designer (b. 1891)[69] Fan Noli, Albanian bishop, poet and politician, 13th Prime Minister of Albania (b. 1882) March 14 – Marion Jones Farquhar, American tennis champion (b. 1879) March 17 Nancy Cunard, English writer, heiress and political activist (b. 1896) Amos Alonzo Stagg, American baseball, basketball and football player and coach (b. 1862) March 18 – Farouk of Egypt, deposed king (b. 1920) March 19 – Gheorghe Gheorghiu-Dej, Romanian communist leader, 47th Prime Minister of Romania (b. 1901) March 22 – Fidel Dávila, Spanish general and minister (b. 1878) March 23 – Mae Murray, American silent film actress (b. 1885) March 25 – Viola Liuzzo, American Unitarian Universalist and civil rights activist (b. 1925) March 28 Mary, Princess Royal and Countess of Harewood, member of the British royal family (b. 1897) Jack Hoxie, American actor, rodeo performer (b. 1885) March 30 – Philip Showalter Hench, American physician, recipient of the Nobel Prize in Physiology or Medicine (b. 1896) Edward Victor Appleton April 3 – Ray Enright, American film director (b. 1896) April 9 – Sherman Minton, American politician and Associate Justice of the Supreme Court of the United States (b. 1890)[70] April 10 Linda Darnell, American actress (b. 1923) La Belle Otero, Spanish actress, dancer and courtesan (b. 1868) April 14 Leonard Mudie, English actor (b. 1883)[71] Perry Smith (b. 1928) and Richard Hickock (b. 1931), American convicted murderers April 16 – Sydney Chaplin, English actor (b. 1885) April 18 – Guillermo González Camarena, Mexican inventor (b. 1917) April 21 Sir Edward Victor Appleton, English physicist, Nobel Prize laureate (b. 1892) Pedro Albizu Campos, advocate of Puerto Rican independence (b. 1891)[72] April 23 – George Adamski, Polish-American UFO writer (b. 1891) April 24 – Louise Dresser, American actress (b. 1878) April 27 – Edward R. Murrow, American journalist (b. 1908)[73] April 30 – Helen Chandler, American actress (b. 1906) Leopold Figl May 1 – Spike Jones, American musician and bandleader (b. 1911) May 6 – Oren E. Long, American politician, 10th Governor of Hawai'i (b. 1889) May 7 Charles Sheeler, American photographer (b. 1883) Alf Bjørnskau Bastiansen, Norwegian priest and politician (b. 1883) May 9 – Leopold Figl, 14th Chancellor of Austria and acting President of Austria (b. 1902) May 10 – Hubertus van Mook, Dutch Governor-General of the Dutch East Indies (b. 1894)[74] May 14 – Frances Perkins, first woman appointed as a United States presidential cabinet member (Labor) (b. 1880) May 15 – Yisrael Bar-Yehuda, Zionist activist and Israel politician (b. 1895) May 18 – Eli Cohen, Israeli spy (b. 1924) May 19 – Maria Dąbrowska, Polish writer (b. 1889) May 21 – Sir Geoffrey de Havilland, British aviation pioneer and aircraft company founder (b. 1882)[75] May 23 Rosina Anselmi, Italian actress (b. 1880) David Smith, American sculptor (b. 1906) May 24 – Sonny Boy Williamson, American blues musician (b. 1899) May 27 – John Rinehart Blue, American military officer, educator, businessperson, and politician (b. 1905)[76] Martin Buber June 1 – Curly Lambeau, American football player and coach (b. 1898) June 5 Eleanor Farjeon, British author of children's literature (b. 1881) Prince Wilhelm, Duke of Södermanland (b. 1884) June 7 – Judy Holliday, American actress, comedian, and singer (b. 1921) June 11 – José Mendes Cabeçadas, Portuguese navy officer, 94th Prime Minister of Portugal and 9th President of Portugal (b. 1883) June 13 – Martin Buber, Austrian-Israeli philosopher (b. 1878) June 15 – Steve Cochran, American actor (b. 1917) June 19 – James Collip, Canadian biochemist (b. 1892) June 20 – Bernard Baruch, American financier and presidential adviser (b. 1870) June 22 – David O. Selznick, American film producer (b. 1902) June 23 – Mary Boland, American actress (b. 1882) June 28 – Red Nichols, American jazz cornettist (b. 1905) June 30 – Bessie Barriscale, American actress (b. 1884) Syngman Rhee July 1 – Wally Hammond, English cricketer (b. 1903) July 7 – Moshe Sharett, 2nd Prime Minister of Israel (b. 1894) July 8 – T. S. Stribling, American novelist (b. 1881)[77] July 11 – Ray Collins, American actor (b. 1889) July 13 – Laureano Gómez, 43rd President of Colombia (b. 1889) July 14 Adlai Stevenson II, American politician (b. 1900) Max Woosnam, English sportsman (b. 1892) July 19 Clyde Beatty, American animal trainer (b. 1903) Ingrid Jonker, South African Afrikaans poet (b. 1933) Syngman Rhee, Korean statesman, 1st President of South Korea (b. 1875) July 24 – Constance Bennett, American actress (b. 1904) July 28 – Rampo Edogawa, Japanese author and critic (b. 1894) July 30 Pier Ruggero Piccio, Italian World War I fighter ace, air force general (b. 1880)[78] Jun'ichirō Tanizaki, Japanese writer (b. 1886) Le Corbusier August 1 – John Miller, American Olympic rower - Men's eights (b. 1903) August 6 Nancy Carroll, American actress (b. 1903) Everett Sloane, American actor (b. 1909) August 8 – Shirley Jackson, American author (b. 1916) August 9 – Creighton Hale, American actor (b. 1882) August 13 – Hayato Ikeda, Japanese politician, 38th Prime Minister of Japan (b. 1899) August 25 – Johnny Hayes, American Olympic athlete (b. 1886) August 27 – Le Corbusier, Swiss architect (b. 1887) August 28 Rashid Ali al-Gaylani, Iraqi politician, 9th Prime Minister of Iraq (b. 1892) Giulio Racah, Israeli physicist (b. 1909) August 29 – Paul Waner, American baseball player (b. 1903) Yunus Hussain Dorothy Dandridge September 4 Tommy Hampson, British Olympic athlete (b. 1907) Albert Schweitzer, Alsatian physician and missionary, recipient of the Nobel Peace Prize (b. 1875) September 6 – Yunus Hussain, Pakistani fighter pilot (b. 1935) September 8 Dorothy Dandridge, American actress (b. 1922) Hermann Staudinger, German chemist, Nobel Prize laureate (b. 1881) September 12 – Lucian Truscott, American general (b. 1895) September 16 – Fred Quimby, American animated film producer (b. 1886) September 17 – Alejandro Casona, Spanish poet and playwright (b. 1903) September 22 – Othmar Ammann, Swiss-born American engineer (b. 1879)[79] September 27 – Clara Bow, American silent film actress (b. 1905) Samir Al-Rifai Paul Hermann Müller October 1 – Anton Boisen, American founder of the clinical pastoral education movement (b. 1876)[80] October 3 – Zachary Scott, American actor (b. 1914) October 8 – Thomas B. Costain, Canadian author and journalist (b. 1885)[81] October 11 Dorothea Lange, American photographer (b. 1895) Walther Stampfli, member of the Swiss Federal Council (b. 1884) October 12 – Samir Al-Rifai, 6-time Prime Minister of Jordan (b. 1901) October 13 – Paul Hermann Müller, Swiss chemist, recipient of the Nobel Prize in Physiology or Medicine (b. 1899) October 14 – Randall Jarrell, American poet (b. 1914) October 15 – Abraham Fraenkel, Israeli mathematician and recipient of the Israel Prize (b. 1891) October 17 – Bart King, American cricketer (b. 1873)[82] October 18 Oscar Beregi, Hungarian actor (b. 1876) Henry Travers, English actor (b. 1874) October 21 Bill Black, American musician and bandleader (b. 1926) Marie McDonald, American actress (b. 1923) October 22 – Paul Tillich, German American Christian existentialist philosopher and theologian (b. 1886) October 23 – Luis de la Puente Uceda, Peruvian guerrilla leader (b. 1926) October 24 – Hans Meerwein, German chemist (b. 1879) October 26 – Sylvia Likens, American murder victim (b. 1949) October 29 – Miller Anderson, American Olympic diver (b. 1922) October 30 – Arthur Schlesinger, Sr., American historian (b. 1888)[83] October 31 – Rita Johnson, American actress (b. 1913) Henry A. Wallace Emir Abdullah III Al-Salim Al-Sabah November 2 Félix Paiva, 28th President of Paraguay (b. 1877) H.V. Evatt, Australian politician, judge (b. 1894) November 6 Edgard Varèse, French-born American composer (b. 1883) Clarence Williams, American musician (b. 1893) November 8 Dorothy Kilgallen, American newspaper columnist and television personality (b. 1913) Emma Gramatica, Italian actress (b. 1874) Mirza Basheer-ud-Din Mahmood Ahmad, second caliph (b. 1889) November 12 – Taher Saifuddin, Indian Bohra spiritual leader (b. 1888)[84] November 16 Harry Blackstone Sr., American magician and illusionist (b. 1885)[85] W. T. Cosgrave, Irish politician, president of the Provisional Government and the Executive Council of the Irish Free State (b. 1880) November 18 Khalid al-Azm, 5-time Prime Minister of Syria and acting President of Syria (b. 1903) Henry A. Wallace, 33rd Vice President of the United States (b. 1888) November 24 – Abdullah III Al-Salim Al-Sabah, Emir of Kuwait (b. 1895) November 25 – Dame Myra Hess, English pianist (b. 1890) Somerset Maugham December 5 – Joseph Erlanger, American physiologist and academic, Nobel Prize laureate (b. 1874) December 9 – Branch Rickey, American baseball executive (b. 1881) December 10 – Henry Cowell, American composer (b. 1897) December 11 – George Constantinescu, Romanian scientist (b. 1881) December 15 – Joseph Bamina, 8th Prime Minister of Burundi (executed) (b. 1927) December 16 W. Somerset Maugham, English writer (b. 1874) Tito Schipa, Italian tenor (b. 1889) Queen Sālote Tupou III of Tonga, (b. 1900)[86] December 24 – William M. Branham, American minister (b. 1909) December 27 – Edgar Ende, German painter (b. 1901) December 29 – Kosaku Yamada, Japanese composer and conductor (b. 1886) Physics – Shin'ichirō Tomonaga, Julian Schwinger, Richard P. Feynman Chemistry – Robert Burns Woodward Physiology or Medicine – François Jacob, André Michel Lwoff, Jacques Monod Literature – Mikhail Sholokhov Peace – United Nation's Children's Fund (UNICEF)

^ Matson-Mäkelä, Kirsi (January 29, 2015). "Suomen ensimmäinen jäähalli täyttää 50 vuotta – "Hakamettä" on monelle kiekkoilijalle toinen koti". Yle (in Finnish). Retrieved January 29, 2025. ^ "Holding history's largest funeral". BBC News. April 8, 2005. Retrieved March 29, 2010. ^ Cohen, Barry M. (1965). "The descent of Lysenko". Journal of Heredity. 56 (5): 229–33. doi:10.1093/oxfordjournals.jhered.a107425. ^ Joravsky, David (1970). The Lysenko Affair. Russian Research Center studies, 61. Cambridge, Mass.: Harvard University Press. ISBN 0-674-53985-0. ^ "Biggest Change Greets Catholics Tomorrow". Daily Citizen. Tucson. March 6, 1965. p. 10. ^ Marini, Piero (2007). A Challenging Reform: Realizing the Vision of the Liturgical Renewal, 1963-1975. Liturgical Press. p. 97. ^ "Alexei Leonov: First person to walk in space dies aged 85". BBC News. October 11, 2019. Retrieved October 11, 2019. ^ "Official Eurovision Song Contest 1965 scoreboard". 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3One hundred years, from 1801 to 1900 For other uses, see 19th century (disambiguation). An 1835 illustration of power loom weaving, as part of the Industrial Revolution Millennia 2nd millennium Centuries 18th century 19th century 20th century Timelines 18th century 19th century 20th century State leaders 18th century 19th century 20th century Decades 1800s 1810s 1820s 1830s 1840s 1850s 1860s 1870s 1880s 1890s Categories: Births – Deaths Establishments – Disestablishments vte The 19th century began on 1 January 1801 (represented by the Roman numerals MDCCCI), and ended on 31 December 1900 (MCM). It was the 9th century of the 2nd millennium. It was characterized by vast social upheaval. Slavery was abolished in much of Europe and the Americas. The First Industrial Revolution, though it began in the late 18th century, expanded beyond its British homeland for the first time during the 19th century, particularly remaking the economies and societies of the Low Countries, France, the Rhineland, Northern Italy, and the Northeastern United States. A few decades later, the Second Industrial Revolution led to ever more massive urbanization and much higher levels of productivity, profit, and prosperity, a pattern that continued into the 20th century. The Catholic Church, in response to the growing influence and power of modernism, secularism and materialism, formed the First Vatican Council in the late 19th century to deal with such problems and confirm certain Catholic doctrines as dogma. Religious missionaries were sent from the Americas and Europe to Asia, Africa and the Middle East. In the Middle East, it was an era of change and reform. The Islamic gunpowder empires fell into decline and European imperialism brought much of South Asia, Southeast Asia, and almost all of Africa under colonial rule. Reformers were opposed at every turn by conservatives who strove to maintain the centuries-old Islamic laws and social order.[1] The 19th century also saw the collapse of the large Spanish, Portuguese, French and Mughal empires, which paved the way for the growing influence of the British, French, German, Russian, Austro-Hungarian, Italian, and Japanese empires along with the United States. Following the defeat of France in the Napoleonic Wars, it marked the end of France's status as the world superpower. Britain took France's status as the world superpower, the British and Russian empires expanded considerably, becoming two of the world's leading powers. Russia expanded its territory to the Caucasus and Central Asia. The Ottoman Empire underwent a period of Westernization and reform known as the Tanzimat, vastly increasing its control over core territories in the Middle East. However, it remained in decline and became known as the sick man of Europe, losing territory in the Balkans and North Africa. The remaining powers in the Indian subcontinent, such as the Maratha and Sikh empires, suffered a massive decline, and their dissatisfaction with the British East India Company's rule led to the Indian Rebellion of 1857 and the company's dissolution. India was later ruled directly by the British Crown through the establishment of the British Raj. During the post-Napoleonic era (after 1815), Britain enforced what became known as the Pax Britannica, which ushered in unprecedented globalization on a massive scale. Britain's overseas possessions grew rapidly in the first half of the century, especially with the expansion of vast territories in Canada, Australia, India, and in the last two decades of the century in Africa. By the end of the 19th century, the British controlled a fifth of the world's land and a quarter of the world's population. By the end of the century, Britain, France, Germany, and the United States had colonized almost all of Oceania. In East Asia, China under the Qing dynasty endured its century of humiliation by foreign powers that lasted until the first half of the 20th century. The last surviving man and woman, respectively, verified to have been born in the 19th century were Jiroemon Kimura (1897–2013) and Nabi Tajima (1900–2018), both Japanese. Official portrait of Queen Victoria, 1859 The first electronics appeared in the 19th century, with the introduction of the electric relay in 1835, the telegraph and its Morse code protocol in 1837, the first telephone call in 1876,[2] and the first functional light bulb in 1878.[3] The 19th century was an era of rapidly accelerating scientific discovery and invention, with significant developments in the fields of mathematics, physics, chemistry, biology, electricity, and metallurgy that laid the groundwork for the technological advances of the 20th century.[4] The Industrial Revolution began in Great Britain and spread to continental Europe, North America, and Japan.[5] The Victorian era was notorious for the employment of young children in factories and mines, as well as strict social norms regarding modesty and gender roles.[6] Japan embarked on a program of rapid modernization following the Meiji Restoration, before defeating China, under the Qing dynasty, in the First Sino-Japanese War. Advances in medicine and the understanding of human anatomy and disease prevention took place in the 19th century, and were partly responsible for rapidly accelerating population growth in the Western world. Europe's population doubled during the 19th century, from approximately 200 million to more than 400 million.[7] The introduction of railroads provided the first major advancement in land transportation for centuries, changing the way people lived and obtained goods, and fuelling major urbanization movements in countries across the globe. Numerous cities worldwide surpassed populations of a million or more during this century. London became the world's largest city and capital of the British Empire. Its population increased from 1 million in 1800 to 6.7 million a century later. The last remaining undiscovered landmasses of Earth, including vast expanses of interior Africa and Asia, were explored during this century, and with the exception of the extreme zones of the Arctic and Antarctic, accurate and detailed maps of the globe were available by the 1890s. Liberalism became the pre-eminent reform movement in Europe.[8] Arab slave traders and their captives along the Ruvuma River, 19th century Slavery was greatly reduced around the world. Following a successful slave revolt in Haiti, Britain and France stepped up the battle against the Barbary pirates and succeeded in stopping their enslavement of Europeans. The UK's Slavery Abolition Act 1833 charged the British Royal Navy with ending the global slave trade.[9] The first colonial empire in the century to abolish slavery was the British, who did so in 1834. America's Thirteenth Amendment following their Civil War abolished slavery there in 1865, and in Brazil slavery was abolished in 1888 (see abolitionism). Similarly, serfdom was abolished in Russia in 1861. The 19th century was remarkable in the widespread formation of new settlement foundations which were particularly prevalent across North America and Australia, with a significant proportion of the two continents' largest cities being founded at some point in the century. Chicago in the United States and Melbourne in Australia were non-existent in the earliest decades but grew to become the 2nd largest cities in the United States and British Empire respectively by the end of the century. In the 19th century, approximately 70 million people left Europe, with most migrating to the United States.[10] The 19th century also saw the rapid creation, development, and codification of many sports, particularly in Britain and the United States. Association football, rugby union, baseball, and many other sports were developed during the 19th century, while the British Empire facilitated the rapid spread of sports such as cricket to many different parts of the world. Also, women's fashion was a very sensitive topic during this time, as women showing their ankles was viewed to be scandalous. The boundaries set by the Congress of Vienna, 1815 It also marks the fall of the Ottoman rule of the Balkans which led to the creation of Serbia, Bulgaria, Montenegro, and Romania as a result of the second Russo-Turkish War, which in itself followed the great Crimean War. Map of the world from 1897. The British Empire (marked in pink) was the superpower of the 19th century. Industrial Revolution European imperialism British Regency, Victorian era (UK, British Empire) Bourbon Restoration, July Monarchy, French Second Republic, Second French Empire, French Third Republic (France) Risorgimento (Italy) Belle Époque (Europe) Edo period, Meiji period (Japan) Qing dynasty (China) Nguyen dynasty (Vietnam) Joseon dynasty (Korea) Zulu Kingdom (South Africa) Tanzimat, First Constitutional Era (Ottoman Empire) Russian Empire Manifest destiny, Antebellum era, Reconstruction era, American frontier, Gilded Age (United States) Main article: Napoleonic Wars For a chronological guide, see Timeline of the Napoleonic era. Napoleon's retreat from Russia in 1812. The war is turning decisively against the French Empire. The Napoleonic Wars were a series of major conflicts from 1803 to 1815 pitting the French Empire and its allies, led by Napoleon I, against a fluctuating array of European powers formed into various coalitions, financed and usually led by the United Kingdom. The wars stemmed from the unresolved disputes associated with the French Revolution and its resultant conflict. In the aftermath of the French Revolution, Napoleon Bonaparte gained power in France in 1799. In 1804, he crowned himself Emperor of the French. In 1805, the French victory over an Austrian-Russian army at the Battle of Austerlitz ended the War of the Third Coalition. As a result of the Treaty of Pressburg, the Holy Roman Empire was dissolved. Later efforts were less successful. In the Peninsular War, France unsuccessfully attempted to establish Joseph Bonaparte as King of Spain. In 1812, the French invasion of Russia had massive French casualties, and was a turning point in the Napoleonic Wars.Napoleon Bonaparte, Emperor of the First French EmpireIn 1814, after defeat in the War of the Sixth Coalition, Napoleon abdicated and was exiled to Elba. Later that year, he escaped exile and began the Hundred Days before finally being defeated at the Battle of Waterloo and exiled to Saint Helena, an island in the South Atlantic Ocean. After Napoleon's defeat, the Congress of Vienna was held to determine new national borders. The Concert of Europe attempted to preserve this settlement was established to preserve these borders, with limited impact. Main article: Spanish American wars of independence The Chilean Declaration of Independence, 18 February 1818 Mexico and the majority of the countries in Central America and South America obtained independence from colonial overlords during the 19th century. In 1804, Haiti gained independence from France. In Mexico, the Mexican War of Independence was a decade-long conflict that ended in Mexican independence in 1821. Due to the Napoleonic Wars, the royal family of Portugal relocated to Brazil from 1808 to 1821, leading to Brazil having a separate monarchy from Portugal. The Federal Republic of Central America gained independence from Spain in 1821 and from Mexico in 1823. After several rebellions, by 1841 the federation had dissolved into the independent countries of Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica.[11] In 1830, the post-colonial nation of Gran Colombia dissolved and the nations of Colombia (including modern-day Panama), Ecuador, and Venezuela took its place. Main article: Revolutions of 1848 Liberal and nationalist pressure led to the European revolutions of 1848. The Revolutions of 1848 were a series of political upheavals throughout Europe in 1848. The revolutions were essentially democratic and liberal in nature, with the aim of removing the old monarchical structures and creating independent nation states. The first revolution began in January in Sicily.[clarification needed] Revolutions then spread across Europe after a separate revolution began in France in February. Over 50 countries were affected, but with no coordination or cooperation among their respective revolutionaries. According to Evans and von Strandmann (2000), some of the major contributing factors were widespread dissatisfaction with political leadership, demands for more participation in government and democracy, demands for freedom of the press, other demands made by the working class, the upsurge of nationalism, and the regrouping of established government forces.[12] Main articles: Abolitionism and American Civil War Politician and philanthropist William Wilberforce (1759–1833) was a leader of the movement to abolish the slave trade. The abolitionism movement achieved success in the 19th century. The Atlantic slave trade was abolished in the United States in 1808, and by the end of the century, almost every government had banned slavery. The Slavery

Abolition Act 1833 banned slavery throughout the British Empire, and the Lei Áurea abolished slavery in Brazil in 1888. Abolitionism in the United States continued until the end of the American Civil War. Frederick Douglass and Harriet Tubman were two of many American abolitionists who helped win the fight against slavery. Douglass was an articulate orator and incisive antislavery writer, while Tubman worked with a network of antislavery activists and safe houses known as the Underground Railroad. The American Civil War took place from 1861 to 1865. Eleven southern states seceded from the United States, largely over concerns related to slavery. In 1863, President Abraham Lincoln issued the Emancipation Proclamation. Lincoln issued a preliminary[13] on September 22, 1862, warning that in all states still in rebellion (Confederacy) on January 1, 1863, he would declare their slaves "then, thenceforward, and forever free."[14] He did so.[15] The Thirteenth Amendment to the Constitution,[16] ratified in 1865, officially abolished slavery in the entire country. Five days after Robert E. Lee surrendered at Appomattox Courthouse, Virginia, Lincoln was assassinated by actor and Confederate sympathizer John Wilkes Booth. Main article: Decline and modernization of the Ottoman Empire Ibrahim Pasha of Egypt, leader of the Egyptian Army in the Egyptian–Ottoman War (1831–1833)[17] In 1817, the Principality of Serbia became suzerain from the Ottoman Empire, and in 1867, it passed a constitution that defined its independence from the Ottoman Empire. In 1830, Greece became the first country to break away from the Ottoman Empire after the Greek War of Independence. In 1831, the Bosnian Uprising against Ottoman rule occurred. In 1831, The First Egyptian–Ottoman War (1831–1833) occurred, between the Ottoman Empire and Egypt brought about by Muhammad Ali Pasha's demand to the Sublime Porte for control of Greater Syria, as reward for aiding the Sultan during the Greek War of Independence. As a result, Egyptian forces temporarily gained control of Syria, advancing as far north as Kütahya.[18] In 1876, Bulgarians instigated the April Uprising against Ottoman rule. Following the Russo-Turkish War, the Treaty of Berlin recognized the formal independence of the Serbia, Montenegro, and Romania. Bulgaria became autonomous. Main article: Taiping Rebellion A scene of the Taiping Rebellion The Taiping Rebellion was the bloodiest conflict of the 19th century, leading to the deaths of around 20–30 million people. Its leader, Hong Xiuquan, declared himself the younger brother of Jesus Christ and developed a new Chinese religion known as the God Worshipping Society. After proclaiming the establishment of the Taiping Heavenly Kingdom in 1851, the Taiping army conquered a large part of China, capturing Nanjing in 1853. In 1864, after the death of Hong Xiuquan, Qing forces recaptured Nanjing and ended the rebellion.[19] Main article: Meiji Restoration During the Edo period, Japan largely pursued an isolationist foreign policy. In 1853, United States Navy Commodore Matthew C. Perry threatened the Japanese capital Edo with gunships, demanding that they agree to open trade. This led to the opening of trade relations between Japan and foreign countries, with the policy of Sakoku formally ended in 1854. By 1872, the Japanese government under Emperor Meiji had eliminated the daimyō system and established a strong central government. Further reforms included the abolition of the samurai class, rapid industrialization and modernization of government, closely following European models.[20] Main articles: Western imperialism in Asia and Scramble for Africa Arrival of Marshal Randon in Algiers, French Algeria in 1857 The Maratha Confederacy and the East India Company sign the Treaty of Bassein in 1802. 1803: United States more than doubles in size when it buys out France's territorial claims in North America via the Louisiana Purchase. This begins the U.S.'s westward expansion to the Pacific, referred to as its Manifest Destiny, which involves annexing and conquering land from Mexico, Britain, and Native Americans. 1817 – 1819: British Empire annexed the Maratha Confederacy after the Third Anglo-Maratha War. 1823 – 1887: British Empire annexed Burma (now also called Myanmar) after three Anglo-Burmese Wars. 1848 – 1849: Sikh Empire is defeated in the Second Anglo-Sikh War. Therefore, the entire Indian subcontinent is under British control. 1862: France gained its first foothold in Southeast Asia and in 1863 annexed Cambodia. 1867: United States purchased Alaska from Russia. Comparison of Africa in the years 1880 and 1913 In Africa, European exploration and technology led to the colonization of almost the entire continent by 1898. New medicines such as quinine and more advanced firearms allowed European nations to conquer native populations.[21] Motivations for the Scramble for Africa included national pride, desire for raw materials, and Christian missionary activity. Britain seized control of Egypt to ensure control of the Suez Canal, but Ethiopia defeated Italy in the First Italo–Ethiopian War at the Battle of Adwa. France, Belgium, Portugal, and Germany also had substantial colonies. The Berlin Conference of 1884–1885 attempted to reach agreement on colonial borders in Africa, but disputes continued, both amongst European powers and in resistance by the native populations.[21] In 1867, diamonds were discovered in the Kimberley region of South Africa. In 1886, gold was discovered in Transvaal. This led to colonization in Southern Africa by the British and business interests, led by Cecil Rhodes.[21] 1801–1815: First Barbary War and the Second Barbary War between the United States and the Barbary States of North Africa. 1802: Tay Son army recaptured Phu Xuan, causing Vo Tanh to commit suicide, Nguyen Phuc Anh successfully captured Thang Long, founded the Nguyen dynasty 1804–1810: Fulani Jihad in Nigeria. 1804–1813: Russo-Persian War. 1806–1812: Russo-Turkish War, Treaty of Bucharest. 1807–1837: Musket Wars among Māori in many parts of New Zealand. 1808–1809: Russia conquers Finland from Sweden in the Finnish War.1816: Shaka rises to power over the Zulu Kingdom. Zulu expansion was a major factor of the Mfecane ("Crushing") that depopulated large areas of southern Africa. 1810: Grito de Dolores begins the Mexican War of Independence. 1811: Battle of Tippecanoe: U.S. outnumbering Native Americans resulting in defeat and burning of community 1812–1815: War of 1812 between the United States and Britain; ends in a draw, except that Native Americans lose power. 1813–1837: Afghan–Sikh Wars. 1814–1816: Anglo-Nepalese War between Nepal (Gurkha Empire) and British Empire. 1817: First Seminole War begins in Florida. 1817: Russia commences its conquest of the Caucasus. 1820: Revolutions of 1820 in Southern Europe 1821–1830: Greek War of Independence against the Ottoman Empire. 1825–1830: Java War begins. 1826–1828: After the final Russo-Persian War, the Persian Empire took back territory lost to Russia from the previous war. 1828–1832: Black War in Tasmania leads to the near extinction of the Tasmanian aborigines 1830: July Revolution overthrew old line of Bourbons. 1830: November Uprising in Poland against Russia. 1830: Belgian Revolution results in Belgium's independence from Netherlands. 1830: End of the Java War. The whole area of Yogyakarta and Surakarta Manca nagara Dutch seized. 27 September, Klaten Agreement determines a fixed boundary between Surakarta and Yogyakarta and permanently divide the kingdom of Mataram was signed by Sasradiningrat, Pepatih Dalem Surakarta, and Danurejo, Pepatih Dalem Yogyakarta. Mataram is a de facto and de yure controlled by the Dutch East Indies. 1831: France invades and occupies Algeria. 1831–1833: Egyptian–Ottoman War. 1832–1875: Regimental rebellions of Brazil 1835–1836: Texas Revolution results in Texas's independence from Mexico. 1839–1842: First Opium War begins. 1846–1848: Mexican–American War leads to Mexico's cession of much of the modern-day Southwestern United States. 1848: February Revolution overthrew Louis Philippe's government. Second Republic proclaimed; Louis Napoleon, nephew of Napoleon I, elected president. 1853–1856: Crimean War between France, the United Kingdom, the Ottoman Empire and Russia. 1856–1860: Second Opium War 1857: Indian Rebellion against the Company Raj. After this the power of the East India Company is transferred to the British Crown. 1859: Franco-Austrian War is part of the wars of Italian unification. 1861–1865: American Civil War between the Union and seceding Confederacy. Dead Confederate soldiers. In the American Civil War, 30% of all Southern white males aged 18–40 were killed.[22] 1861–1867: French intervention in Mexico and the creation of the Second Mexican Empire, ruled by Maximilian I of Mexico and his consort Carlota of Mexico. 1863–1865: January Uprising against the Russian Empire. 1864–1870: Paraguayan War ends Paraguayan ambitions for expansion and destroys much of the Paraguayan population. 1866: Austro-Prussian War results in the dissolution of the German Confederation and the creation of the North German Confederation and the Austrian-Hungarian Dual Monarchy. 1868–1869: Boshin War results in end of the shogunate and the founding the Japanese Empire. 1868–1878: Ten Years' War between Cuba and Spain. 1870–1871: Franco-Prussian War results in the unifications of Germany and Italy, the collapse of the Second French Empire and the emergence of a New Imperialism. 1870: Napoleon III abdicated after unsuccessful conclusion of Franco-Prussian War. Third Republic proclaimed. 1876: The April Uprising in Bulgaria against the Ottoman Empire. 1879: Anglo-Zulu War results in British victory and the annexation of the Zulu Kingdom. 1879–1880: Little War against Spanish rule in Cuba leads to rebel defeat. 1879–1883: Chile battles with Peru and Bolivia over Andean territory in the War of the Pacific. 1880–1881: First Boer War begins. 1881–1899: Mahdist War in Sudan.A depiction of the Battle of Omdurman, 1898. During the battle, Winston Churchill took part in a cavalry charge. 1882: Anglo-Egyptian War British invasion and subsequent occupation of Egypt 1883–1898: Mandingo Wars between the French colonial empire and the Wassoulou Empire of the Mandingo people led by Samory Touré. 1894–1895: After the First Sino-Japanese War, China cedes Taiwan to Japan and grants Japan a free hand in Korea. 1895: Taiwan is ceded to the Empire of Japan as a result of the First Sino-Japanese War. 1895–1896: Ethiopia defeats Italy in the First Italo-Ethiopian War at the Battle of Adwa. 1895–1898: Cuban War for Independence results in Cuban independence from Spain. 1896–1898: Philippine Revolution results in a Filipino victory. 1898: Spanish–American War results in the independence of Cuba. 1899–1901: Boxer Rebellion in China is suppressed by the Eight-Nation Alliance. 1899–1902: Thousand Days' War in Colombia breaks out between the "Liberales" and "Conservadores", culminating with the loss of Panama in 1903. 1899–1902: Second Boer War begins. 1899–1902: Philippine–American War begins. Distinguished Men of Science.[23] Use the cursor to see who is who.[24] Main article: 19th century in science The 19th century saw the birth of science as a profession; the term scientist was coined in 1833 by William Whewell,[25] which soon replaced the older term of natural philosopher. Among the most influential ideas of the 19th century were those of Charles Darwin (alongside the independent researches of Alfred Russel Wallace), who in 1859 published the book The Origin of Species, which introduced the idea of evolution by natural selection. Another important landmark in medicine and biology were the successful efforts to prove the germ theory of disease. Following this, Louis Pasteur made the first vaccine against rabies, and also made many discoveries in the field of chemistry, including the asymmetry of crystals. In chemistry, Dmitri Mendeleev, following the atomic theory of John Dalton, created the first periodic table of elements. In physics, the experiments, theories and discoveries of Michael Faraday, André-Marie Ampère, James Clerk Maxwell, and their contemporaries led to the creation of electromagnetism as a new branch of science. Thermodynamics led to an understanding of heat and the notion of energy was defined. Other highlights include the discoveries unveiling the nature of atomic structure and matter, simultaneously with chemistry – and of new kinds of radiation. In astronomy, the planet Neptune was discovered. In mathematics, the notion of complex numbers finally matured and led to a subsequent analytical theory; they also began the use of hypercomplex numbers. Karl Weierstrass and others carried out the arithmetization of analysis for functions of real and complex variables. It also saw rise to new progress in geometry beyond those classical theories of Euclid, after a period of nearly two thousand years. The mathematical science of logic likewise had revolutionary breakthroughs after a similarly long period of stagnation. But the most important step in science at this time were the ideas formulated by the creators of electrical science. Their work changed the face of physics and made possible for new technology to come about including a rapid spread in the use of electric illumination and power in the last two decades of the century and radio wave communication at the end of the 1890s. Michael Faraday (1791–1867) Charles Darwin (1809–1882) 1807: Potassium and Sodium are individually isolated by Sir Humphry Davy. 1831–1836: Charles Darwin's journey on HMS Beagle. 1859: Charles Darwin publishes On the Origin of Species. 1861: James Clerk Maxwell publishes On Physical Lines of Force, formulating the four Maxwell's equations. 1865: Gregor Mendel formulates his laws of inheritance. 1869: Dmitri Mendeleev creates the Periodic table. 1873: Maxwell's A Treatise on Electricity and Magnetism published. 1877: Asaph Hall discovers the moons of Mars 1896: Henri Becquerel discovers radioactivity; J. J. Thomson identifies the electron, though not by name. Robert Koch discovered the tuberculosis bacilli. In the 19th century, the disease killed an estimated 25% of the adult population of Europe.[26] 1804: Morphine first isolated. 1842: Anesthesia used for the first time. 1847: Chloroform invented for the first time, given to Queen Victoria at the birth of her eighth child, Prince Leopold in 1853 1855: Cocaine is isolated by Friedrich Gaedcke. 1885: Louis Pasteur creates the first successful vaccine against rabies for a young boy who had been bitten 14 times by a rabid dog. 1889: Aspirin patented. Thomas Edison was an American inventor, scientist, and businessman who developed many devices that greatly influenced life around the world, including the motion picture camera, phonograph and long-lasting, practical electric light bulb. Built for the Netphener bus company in 1895, the Benz Omnibus was the first motor bus in history. 1804: First steam locomotive begins operation. 1816: Laufmaschine invented by Karl von Drais. 1825: Erie Canal opened connecting the Great Lakes to the Atlantic Ocean. 1825: First isolation of aluminium. 1827: First photograph taken (technique of heliography) by Joseph Nicephore Niepce. 1825: The Stockton and Darlington Railway, the first public railway in the world, is opened. 1826: Samuel Morey patents the internal combustion engine. 1829: First electric motor built. 1837: Telegraphy patented. 1841: The word "dinosaur" is coined by Richard Owen. 1844: First publicly funded telegraph line in the world—between Baltimore and Washington—sends demonstration message on 24 May, ushering in the age of the telegraph. This message read "What hath God wrought?" (Bible, Numbers 23:23) 1849: The safety pin and the gas mask are invented. 1852: The first successful blimp is invented 1855: Bessemer process enables steel to be mass-produced. 1856: World's first oil refinery in Romania 1858: Invention of the phonautograph, the first true device for recording sound. 1859: The first ironclad was launched into sea by the French Navy. 1860: Benjamin Tyler Henry invents the 16-shot Henry Rifle 1861: Richard Gatling invents the Gatling Gun, first modern machine gun used notably in the battles of Cold Harbor and Petersburg 1862: First meeting in combat of ironclad warships, USS Monitor and CSS Virginia, during the American Civil War. 1863: First section of the London Underground opens. 1866: Successful transatlantic telegraph cable follows an earlier attempt in 1858. 1867: Alfred Nobel invents dynamite. 1868: Safety bicycle invented. 1869: First transcontinental railroad completed in United States on 10 May. 1870: Rasmus Malling-Hansen's invention the Hansen Writing Ball becomes the first commercially sold typewriter. 1873: Blue jeans and barbed wire are invented. 1877: Thomas Edison invents the phonograph 1878: First commercial telephone exchange in New Haven, Connecticut. c. 1875/1880: Introduction of the widespread use of electric lighting. These included early crude systems in France and the UK and the introduction of large scale outdoor arc lighting systems by 1880.[27] 1879: Thomas Edison patents a practical incandescent light bulb. 1882: Introduction of large scale electric power utilities with the Edison Holborn Viaduct (London) and Pearl Street (New York) power stations supplying indoor electric lighting using Edison's incandescent bulb.[28][29] 1884: Sir Hiram Maxim invents the first self-powered Machine gun, the Maxim gun. 1885: Singer begins production of the 'Vibrating Shuttle'. which would become the most popular model of sewing machine. 1886: Karl Benz sells the first commercial automobile. 1890: The cardboard box is invented. 1892: John Froelich develops and constructs the first gasoline/petrol-powered tractor. 1894: Karl Elsener invents the Swiss Army knife. 1894: First gramophone record. 1895: Wilhelm Röntgen identifies x-rays. Brigham Young led the LDS Church from 1844 until his death in 1877. 1818: The first permanent Reform Judaism congregation, the Neuer Israelitischer Tempel, is founded in Hamburg on October 18. Around the same time, through the development of Wissenschaft des Judentums, the seeds of Conservative Judaism are sown. 1830: The Church of Jesus Christ of Latter Day Saints is established. 1844: The Báb announces his revelation on 23 May, founding Bábism. He announced to the world of the coming of "He whom God shall make manifest". He is considered the forerunner of Bahá'u'lláh, the founder of the Bahá'í Faith. 1850s–1890s: In Islam, Salafism grows in popularity. 1851: Hong Xiuquan, the leader of the God Worshipping Society, founds the Taiping Heavenly Kingdom. 1857: In Paris, France, Allan Kardec, publishes The Spirits' Book and founds the Spiritism. 1868: In Japan, State Shinto is established amidst the Meiji Restoration. 1869–1870: The First Vatican Council is convened, articulating the dogma of papal infallibility and promoting a revival of scholastic theology. 1871–1878: In Germany, Otto von Bismarck challenges the Catholic Church in the Kulturkampf ("Culture War") 1875: Helena Blavatsky co-founds the Theosophical Society and becomes the leading articulator of Theosophy. 1879: Mary Baker Eddy founds the Church of Christ, Scientist. The Watchtower, published by the Jehovah's Witnesses, releases its first issue. 1881: In the Sudan, Muhammad Ahmad claims to be the Mahdi, founding the Mahdist State and declaring war on the Khedivate of Egypt. 1889: Mirza Ghulam Ahmad establishes the Ahmadiyya Muslim Community. 1891: Pope Leo XIII issues the papal encyclical Rerum novarum, the first major document informing modern Catholic social teaching. The Great Exhibition in London. Starting during the 18th century, the UK was the first country in the world to industrialize. 1808: Beethoven composes his Fifth Symphony 1813: Jane Austen publishes Pride and Prejudice 1818: Mary Shelley publishes Frankenstein; or, The Modern Prometheus. 1819: John Keats writes his six of his best-known odes. 1819: Théodore Géricault paints his masterpiece The Raft of the Medusa, and exhibits it in the French Salon of 1819 at the Louvre. 1824: Premiere of Beethoven's Ninth Symphony. 1829: Johann Wolfgang von Goethe's Faust premieres. 1833–1834: Thomas Carlyle publishes Sartor Resartus. 1837: Charles Dickens publishes Oliver Twist. 1841: Ralph Waldo Emerson publishes Self-Reliance. 1845: Frederick Douglass publishes Narrative of the Life of Frederick Douglass, an American Slave. 1847: The Brontë sisters publish Jane Eyre, Wuthering Heights and Agnes Grey. 1848: Karl Marx and Friedrich Engels publish The Communist Manifesto. 1849: Josiah Henson publishes The Life of Josiah Henson, Formerly a Slave, Now an Inhabitant of Canada, as Narrated by Himself. 1851: Herman Melville publishes Moby-Dick. 1851: Sojourner Truth delivers the speech "Ain't I a Woman?". 1852: Harriet Beecher Stowe publishes Uncle Tom's Cabin. 1855: Walt Whitman publishes the first edition of Leaves of Grass. 1855: Frederick Douglass publishes the first edition of My Bondage and My Freedom. 1862: Victor Hugo publishes Les Misérables. 1863: Jules Verne begins publishing his collection of stories and novels, Voyages extraordinaires, with the novel Cinq semaines en ballon. 1865: Lewis Carroll publishes Alice's Adventures in Wonderland. 1869: Leo Tolstoy publishes War and Peace.Auguste Renoir, Bal du moulin de la Galette, 1876, Musée d'Orsay 1875: Georges Bizet's opera Carmen premiers in Paris. 1876: Richard Wagner's Ring Cycle is first performed in its entirety. 1883: Robert Louis Stevenson's Treasure Island is published. 1884: Mark Twain publishes the Adventures of Huckleberry Finn. 1886: Strange Case of Dr Jekyll and Mr Hyde by Robert Louis Stevenson is published. 1887: Sir Arthur Conan Doyle publishes his first Sherlock Holmes story, A Study in Scarlet. 1889: Vincent van Gogh paints The Starry Night. 1889: Moulin Rouge opens in Paris. 1892: Tchaikovsky's Nutcracker Suite premières in St Petersburg. 1894: Rudyard Kipling's The Jungle Book is published 1895: Trial of Oscar Wilde and premiere of his play The Importance of Being Earnest. 1897: Bram Stoker writes Dracula. 1900: L. Frank Baum publishes The Wonderful Wizard of Oz. Main articles: Romantic poetry and 19th century in literature Russian writer Leo Tolstoy, author of War and Peace and Anna Karenina On the literary front the new century opens with romanticism, a movement that spread throughout Europe in reaction to 18th-century rationalism, and it develops more or less along the lines of the Industrial Revolution, with a design to react against the dramatic changes wrought on nature by the steam engine and the railway. William Wordsworth and Samuel Taylor Coleridge are considered the initiators of the new school in England, while in the continent the German Sturm und Drang spreads its influence as far as Italy and Spain. French arts had been hampered by the Napoleonic Wars but subsequently developed rapidly. Modernism began.[30] The Goncourts and Émile Zola in France and Giovanni Verga in Italy produce some of the finest naturalist novels. Italian naturalist novels are especially important in that they give a social map of the new unified Italy to a people that until then had been scarcely aware of its ethnic and cultural diversity. There was a huge literary output during the 19th century. Some of the most famous writers included the Russians Alexander Pushkin, Nikolai Gogol, Leo Tolstoy, Anton Chekhov and Fyodor Dostoyevsky; the English Charles Dickens, John Keats, Alfred, Lord Tennyson and Jane Austen; the Scottish Sir Walter Scott, Thomas Carlyle and Arthur Conan Doyle (creator of the character Sherlock Holmes); the Irish Oscar Wilde; the Americans Edgar Allan Poe, Ralph Waldo Emerson, and Mark Twain; and the French Victor Hugo, Honoré de Balzac, Jules Verne, Alexandre Dumas and Charles Baudelaire.[31] Some American literary writers, poets and novelists were: Walt Whitman, Mark Twain, Harriet Ann Jacobs, Nathaniel Hawthorne, Ralph Waldo Emerson, Herman Melville, Frederick Douglass, Harriet Beecher Stowe, Joel Chandler Harris, and Emily Dickinson to name a few. See also: History of photography, List of photojournalists, Photojournalism, and Daguerreotype One of the first photographs, produced by Nicéphore Niépce in 1826 Nadar, self-portrait, c. 1860 Ottomar Anschütz, chronophotographer Mathew Brady, documented the American Civil War Edward S. Curtis, documented the American West notably Native Americans Louis Daguerre, inventor of daguerreotype process of photography, chemist Thomas Eakins, pioneer motion photographer George Eastman, inventor of roll film Hércules Florence, pioneer inventor of photography Auguste and Louis Lumière, pioneer film-makers, inventors Étienne-Jules Marey, pioneer motion photographer, chronophotographer Eadweard Muybridge, pioneer motion photographer, chronophotographer Nadar a.k.a. Gaspard-Félix Tournachon, portrait photographer Nicéphore Niépce, pioneer inventor of photography Louis Le Prince, motion picture inventor and pioneer film-maker Sergey Prokudin-Gorsky, chemist and photographer William Fox Talbot, inventor of the negative / positive photographic process. Main articles: History of art § 19th century, Western painting, and Ukiyo-e Francisco Goya, The Third of May 1808, 1814, Museo del Prado Eugène Delacroix, Liberty Leading the People, 1830, Louvre Vincent van Gogh, Self-portrait, 1889, National Gallery of Art Biscuits Lefèvre-Utile poster artwork by Alphonse Mucha, 1897 The Realism and Romanticism of the early 19th century gave way to Impressionism and Post-Impressionism in the later half of the century, with Paris being the dominant art capital of the world. In the United States the Hudson River School was prominent. 19th-century painters included: Ivan Aivazovsky Léon Bakst Albert Bierstadt William Blake Arnold Böcklin Rosa Bonheur William Burges Mary Cassatt Camille Claudel Paul Cézanne Frederic Edwin Church Thomas Cole Jan Matejko John Constable Camille Corot Gustave Courbet Honoré Daumier Edgar Degas Eugène Delacroix Thomas Eakins Caspar David Friedrich Paul Gauguin Théodore Géricault Vincent van Gogh William Morris Francisco Goya Andō Hiroshige Hokusai Winslow Homer Jean-Auguste-Dominique Ingres Isaac Levitan Édouard Manet Claude Monet Gustave Moreau Berthe Morisot Edvard Munch Mikhail Nesterov Camille Pissarro Augustus Pugin Pierre-Auguste Renoir Ilya Repin Auguste Rodin Albert Pinkham Ryder John Singer Sargent Valentin Serov Georges Seurat Ivan Shishkin Vasily Surikov James Tissot Henri de Toulouse-Lautrec Joseph Mallord William Turner Viktor Vasnetsov Eugène Viollet-le-Duc Mikhail Vrubel James Abbott McNeill Whistler Tsukioka Yoshitoshi Main articles: List of Romantic-era composers, Romantic music, and Romanticism Ludwig van Beethoven (1770–1827) Pyotr Ilyich Tchaikovsky (1840–1893) Sonata form matured during the Classical era to become the primary form of instrumental compositions throughout the 19th century. Much of the music from the 19th century was referred to as being in the Romantic style. Many great composers lived through this era such as Ludwig van Beethoven, Franz Liszt, Frédéric Chopin, Pyotr Ilyich Tchaikovsky, and Richard Wagner. The list includes: Mily Balakirev Ludwig van Beethoven Hector Berlioz Georges Bizet Alexander Borodin Johannes Brahms Anton Bruckner Frédéric Chopin Claude Debussy Antonín Dvořák Mikhail Glinka Edvard Grieg Scott Joplin Alexandre Levy Franz Liszt Gustav Mahler Felix Mendelssohn Modest Mussorgsky Jacques Offenbach Niccolò Paganini Nikolai Rimsky-Korsakov Gioachino Rossini Anton Rubinstein Camille Saint-Saëns Antonio Salieri Franz Schubert Robert Schumann Alexander Scriabin Arthur Sullivan Pyotr Ilyich Tchaikovsky Giuseppe Verdi Richard Wagner 1858: The Melbourne Football Club was formed, starting the sport of Australian Rules Football 1867: The Marquess of Queensberry Rules for boxing are published. 1872: The first recognised international football match, between England and Scotland, is played. 1877: The first test cricket match, between England and Australia, is played. 1891: Basketball is invented by James Naismith. 1895: Volleyball is invented. 1896: Olympic Games revived in Athens. For a chronological guide, see Timeline of the 19th century. Main articles: 1800s, 1810s, 1820s, 1830s, and 1840s 1801: The Kingdom of Great Britain and the Kingdom of Ireland merge to form the United Kingdom. 1801: Thomas Jefferson is elected the third President of the United States; he serves until 1809. 1802: The Wahhabis of the First Saudi State sack Karbala. 1803: William Symington demonstrates his Charlotte Dundas, the "first practical steamboat". 1803: The Wahhabis of the First Saudi State capture Mecca and Medina. 1804: Austrian Empire founded by Francis I. 1804: World population reaches 1 billion. 1805: The Battle of Trafalgar eliminates the French and Spanish naval fleets and allows for British dominance of the seas, a major factor for the success of the British Empire later in the century. 1805–1848: Muhammad Ali modernizes Egypt. 1819: 29 January, Stamford Raffles arrives in Singapore with William Farquhar to establish a trading post for the British East India Company; 8 February, the treaty is signed between Sultan Hussein of Johor, Temenggong Abdul Rahman and Stamford Raffles. Farquhar is installed as the first Resident of the settlement. 1810: The University of Berlin was founded. Among its students and faculty are Hegel, Marx, and Bismarck. The German university reform proves to be so successful that its model is copied around the world (see History of European research universities). 1814: Elisha Collier invents the Flintlock Revolver. 1814 : February 1 Eruption of Mayon Volcano 1815: April, Mount Tambora in Sumbawa island erupts, becoming the largest volcanic eruption in recorded history, destroying Tambora culture, and killing at least 71,000 people, including its aftermath. The eruption created global climate anomalies known as "volcanic winter".[32] 1816: Year Without a Summer: Unusually cold conditions wreak havoc throughout the Northern Hemisphere, likely influenced by the 1815 explosion of Mount Tambora. 1816–1828: Shaka's Zulu Kingdom becomes the largest in Southern Africa. 1819: The Republic of Colombia (Gran Colombia) achieves independence after Simón Bolívar's triumph at the Battle of Boyacá. 1819: The modern city of Singapore is established by the British East India Company. 1820: Discovery of Antarctica. 1820: Liberia founded by the American Colonization Society for freed American slaves. 1820: Dissolution of the Maratha Empire. 1821–1823: First Mexican Empire, as Mexico's first post-independence government, ruled by Emperor Agustín I of Mexico. 1822: Pedro I of Brazil declared Brazil's independence from Portugal on 7 September. 1823: Monroe Doctrine declared by US President James Monroe. 1825: The Decembrist revolt. Decembrists at the Senate Square 1829: Sir Robert Peel founds the Metropolitan Police Service, the first modern police force. Emigrants leaving Ireland. From 1830 to 1914, almost 5 million Irish people emigrated to the U.S. 1830: Anglo-Russian rivalry over Afghanistan, the Great Game, commences and concludes in 1895. 1831: November Uprising ends with crushing defeat for Poland in the Battle of Warsaw. 1832: The British Parliament passes the Great Reform Act 1832. 1834–1859: Imam Shamil's rebellion in Russian-occupied Caucasus. 1835–1836: The Texas Revolution in Mexico resulted in the short-lived Republic of Texas. 1836: Samuel Colt popularizes the revolver and sets up a firearms company to manufacture his invention of the Colt Paterson revolver, a six bullets firearm shot one by one without reloading manually. 1837–1838: Rebellions of 1837 in Canada. 1838: By this time, 46,000 Native Americans have been forcibly relocated in the Trail of Tears. 1839–1860: After the First and Second Opium Wars, France, the United Kingdom, the United States and Russia gain many trade and associated concessions from China resulting in the start of the decline of the Qing dynasty. 1839–1919: Anglo-Afghan Wars lead to stalemate and the establishment of the Durand line 1842: Treaty of Nanking cedes Hong Kong to the British. 1843: The first wagon train sets out from Missouri. 1844: Rochdale Society of Equitable Pioneers establish what is considered the first cooperative in the world. 1845–1849: The Great Famine of Ireland leads to the Irish diaspora. 1848: The Communist Manifesto published. 1848: Seneca Falls Convention is the first women's rights convention in the United States and leads to the battle for women's suffrage. 1848–1855: California Gold Rush. 1849: Earliest recorded air raid, as Austria employs 200 balloons to deliver ordnance against Venice. 1850: The Little Ice Age ends around this time. 1850: Franz Hermann Schulze-Delitzsch establishes the first cooperative financial institution. Historical territorial expansion of the United States Main articles: 1850s, 1860s, 1870s, 1880s, 1890s, and 1900s For later events, see Timeline of the 20th century. 1851: The Great Exhibition in London was the world's first international Expo or World Fair. 1852: Frederick Douglass delivers his speech "The Meaning of July Fourth for the Negro" in Rochester, New York. 1857: Sir Joseph Whitworth designs the first long-range sniper rifle. 1857–1858: Indian Rebellion of 1857. The British Empire assumes control of India from the East India Company. 1858: Construction of Big Ben is completed. 1859–1869: Suez Canal is constructed. The first vessels sail through the Suez Canal. 1860: Giuseppe Garibaldi launches the Expedition of the Thousand. 1861: Russia abolishes serfdom. 1862–1877: Muslim Rebellion in north-west China. 1863: Formation of the International Red Cross is followed by the adoption of the First Geneva Convention in 1864. 1865–1877: Reconstruction in the United States; Slavery is banned in the United States by the Thirteenth Amendment to the United States Constitution. 1867: Canada is formed, via the process of Canadian Confederation. 1868: Michael Barrett is the last person to be publicly hanged in England. 1869: The Suez Canal opens linking the Mediterranean to the Red Sea. A barricade in the Paris Commune, 18 March 1871. Around 30,000 Parisians were killed, and thousands more were later executed. Black Friday, 9 May 1873, Vienna Stock Exchange. The Panic of 1873 and Long Depression followed. 1870: Official dismantling of the Cultivation System and beginning of a 'Liberal Policy' of deregulated exploitation of the Netherlands East Indies.[33] 1870–1890: Long Depression in Western Europe and North America. 1871–1872: Famine in Persia is believed to have caused the death of 2 million. 1871: The Paris Commune briefly rules the French capital. 1872: Yellowstone National Park, the first national park, is created. 1874: The Société Anonyme Coopérative des Artistes Peintres, Sculpteurs, and Graveurs, better known as the Impressionists, organize and present their first public group exhibition at the Paris studio of the photographer Nadar. 1874: The Home Rule Movement is established in Ireland. 1875: HMS Challenger surveys the deepest point in the Earth's oceans, the Challenger Deep 1876: Battle of the Little Bighorn leads to the death of General Custer and victory for the alliance of Lakota, Cheyenne and Arapaho 1876–1914: The massive expansion in population, territory, industry and wealth in the United States is referred to as the Gilded Age. 1877: Great Railroad Strike in the United States may have been the world's first nationwide labour strike. 1881: Wave of pogroms begins in the Russian Empire. 1881–1882: The Jules Ferry laws are passed in France establishing free, secular education. 1883: Krakatoa volcano explosion, one of the largest in modern history. 1883: The quagga is rendered extinct. 1886: Construction of the Statue of Liberty; Coca-Cola is developed. 1888: Founding of the shipping line Koninklijke Paketvaart-Maatschappij (KPM) that supported the unification and development of the colonial economy.[33] 1888: The Golden Law abolishes slavery in Brazil. 1889: Eiffel Tower is inaugurated in Paris. Studio portrait of Ilustrados in Europe, c. 1890 1889: A republican military coup establishes the First Brazilian Republic. The parliamentary constitutional monarchy is abolished. 1889–1890: 1889–1890 pandemic kills 1 million people. 1890: First use of the electric chair as a method of execution. 1892: The World's Columbian Exposition was held in Chicago celebrating the 400th anniversary of Christopher Columbus's arrival in the New World. 1892: Fingerprinting is officially adopted for the first time. 1893: New Zealand becomes the first country to enact women's suffrage. 1893: The Coremans-de Vriendt law is passed in Belgium, creating legal equality for French and Dutch languages. 1894: The Dutch intervention in Lombok and Karangasem[33] resulted in the looting and destruction of Cakranegara Palace in Mataram.[34] J. L. A. Brandes, a Dutch philologist, discovers and secures Nagarakretagama manuscript in Lombok royal library. 1896: Philippine Revolution ends declaring Philippines free from Spanish rule. 1898: The United States gains control of Cuba, Puerto Rico, and the Philippines after the Spanish–American War. 1898: Empress Dowager Cixi of China engineers a coup d'état, marking the end of the Hundred Days' Reform; the Guangxu Emperor is arrested. 1900: Exposition Universelle held in Paris, prominently featuring the growing art trend Art Nouveau. 1900–1901: Eight nations invade China at the same time and ransack Forbidden City. Born on 19 April 1897, Japanese Jiroemon Kimura died on 12 June 2013, marking the death of the last man verified to have been born in the century.[35][36][37] Kimura remains to date the oldest verified man in history.[38] Subsequently, on 21 April 2018, Japanese Nabi Tajima (born 4 August 1900) died as the last person to verifiably have been born in the century.[39] Carl Friedrich Gauss Charles Darwin Victor Hugo, c. 1876 Dmitri Mendeleev Louis Pasteur, 1878 Marie Curie, c. 1898 Nikola Tesla José Rizal Jane Austen Leo Tolstoy, c. 1897 Edgar Allan Poe Jules Verne Charles Dickens Arthur Rimbaud, c. 1872 Mark Twain, 1894 Ralph Waldo Emerson Henry David Thoreau, 1861 Émile Zola, c. 1900 Anton Chekhov Fyodor Dostoevsky, 1876 John L Sullivan in his prime, c. 1882 David Livingstone 1864, left Britain for Africa in 1840 Jesse and Frank James, 1872 Sitting Bull and Buffalo Bill, in a studio portrait from 1885 Geronimo, 1887, prominent leader of the Chiricahua Apache William Bonney aka Henry McCarty aka Billy the Kid, c. late 1870s Deputies Bat Masterson and Wyatt Earp in Dodge City, 1876 Mathew Brady, self-portrait, c. 1875 Alfred, Lord Tennyson Thomas Nast, c. 1860–1875, photo by Mathew Brady or Levin Handy Mirza Ghulam Ahmad Mikhail Bakunin Søren Kierkegaard Solomon Northup Dred Scott Madam C. J. Walker Claude Monet's Impression, Sunrise (1872) gave the name to Impressionism. Paul Cézanne, self-portrait, 1880–1881 Scott Joplin Niccolò Paganini, c. 1819 Frédéric Chopin, 1838 John D. Rockefeller Timelines of modern history Long nineteenth century 19th century in film 19th century in games 19th-century philosophy Nineteenth-century theatre International relations (1814–1919) List of wars: 1800–1899 Victorian era France in the long nineteenth century History of Spain (1808–1874) History of Russia (1855–1892) Slavery in the United States Timeline of 19th-century Muslim history Timeline of historic inventions ^ Cleveland, William L.; Bunton, Martin (2016). A History of the Modern Middle East. doi:10.4324/9780429495502. ISBN 9780429495502. S2CID 153025861. The 19th century is frequently characterized as a period of tension between forces of continuity and change. The reformers who advocated the adoption of European institutions and technology, have often been portrayed as the progressive elements of society courageously charting the course toward an inevitably Westernized twentieth century. Conversely, the adherents of continuity, who viewed with alarm the dismantling of the Islamic order and sought to preserve tradition and retain the values and ideals that had served Ottoman and Islamic society so well for so long, are sometimes portrayed as nothing but archaic reactionaries. But we should avoid these simplistic characterizations if we are to appreciate the agonizing and dangerous process of transforming an established religious, social and political worldview. ^ "The First Telephone Call". www.americaslibrary.gov. Archived from the original on 2015-10-22. Retrieved 2015-10-25. ^ "Dec. 18, 1878: Let There Be Light — Electric Light". WIRED. 18 December 2009. Archived from the original on 21 October 2016. 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According to Campbell, DeJong and Haerer, “agnosia refers to the loss or impairment to know or recognize the meaning or import of a sensory stimulus, even though it has been perceived (Campbell et al., 2005, p.91). Numerous types of agnosia has been reported till now, like finger agnosia, visuospatial agnosia, optic agnosia , apperceptive and associative agnosia to name a few. The following essay discusses the last two forms.Apperceptive and associative agnosia was originally distinguished by Lissauer in Andrewes in 2001. Apperceptive agnosia is identified as failure in perception of vision despite intact visual sensation, put forward by Lissauer It is reported that these patients are unable to identify because their perception of objects in impaired in this form of agnosia (Andrewes, 2001). However, in associative agnosia perception remains unaltered but the patient is fails to recognize what the object is (Andrewes, 2001). Associative agnosia can be rightly defined as ‘normal percept stripped of meaning’ (Teuber, 1968 as cited in Andrewes, 2001, p.50) The two terms, apperceptive and associative agnosia is used in two different ways (Farah, 1990 as cited in Andrewes, 2001) The first way is to do with rare neuropsychological syndromes and closely relating to Lissauer’s description of agnosia (Andrewes, 2001). The second way of using the terms is much broader and includes numerous neuropsychological signs (Andrewes, 2001). Hence, it can be said, “a patient may be described as showing some signs of apperceptive agnosia without actually having all the features of the clinical syndrome” (Farah 1990 as cited in Andrewes, 2001, p.50). This can be better understood from the following example.Signs of apperceptive agnosia may coexist with problems in recognizing pictures from atypical views or when it is surrounded by shadows (Warrington & Taylor as cited in Andrewes, 2001) in a single patient. Some of the patients may also find it difficult to correctly recognize figures which is in midst of confusing and distracting shapes (Andrewes, 2001). When signs of apperceptive agnosia exist alone in an individual then he is able to recognize the object and corresponds it with its use. For instance, if a patient sees a bucket not only he will recognize it but when it is kept in its usual /normal orientation tell its use as well (Andrewes, 2001).It is often seen that patients showing signs of apperceptive agnosia have an unaffected conceptual knowledge but knowledge of common objects in unusual orientation deters (Andrewes, 2001). Hence, it can be said that “top down information about the structural features of the objects are impoverished” (Andrewes, 2001, p. 50). Such patients having signs of apperceptive agnosia are commonly referred to as “apperceptive perceptive disorders”.Apperceptive agnosics have better acuity, colour and brightness differentiation skills from the other visual capabilities although their shape perception is markedly impaired (Farah & Feinberg, 1997). In fact, they have very good local perception of visual properties, it is only when they are asked to extract a structure from an image they fail (Farah & Feinberg, 1997). Associative agnosics have far better visual perception than apperceptive agnosics (Farah & Feinberg, 1997). For example, they are able to recognize an object from its feel or spoken definition, thus implying that the general knowledge of the object is still at place (Farah & Feinberg, 1997). It should be noted that associative agnosics fail to recognize an object (by sight) when kept alone (Farah & Feinberg, 1997) thus indicating towards that this is not just a naming deficit but failure to recognize an object by nonverbal means (Farah & Feinberg, 1997). Associative agnosia varies from person to person. For instance, some associative agnosics may suffer from face recognition, object recognition and printed word recognition problems, face recognition is being the most common and printed word recognition being rare (Farah & Feinberg, 1997). The scans (MRI and CAT) of brains of apperceptive and associative agnosics have helped in understanding the localisation of lesion in this disorder (Kemp et al., 2004). Jankowiak & Albert (1994) have put forward that in apperceptive agnosia lesions are found to be localized in the posterior cerebral hemisphere including occipital, parietal and posterior temporal regions bilaterally. Unilateral lesion is also found in this agnosia however, the possibility of it is very scarce (Kemp et al., 2004). Furthermore, poisoning by carbon monoxide is a very common cause of apperceptive agnosia (Adler, 1950; Benson & Greenberg, 1969; Champion & Latto, 1985; Mendez, 1988; Sparr et al., 1991 as cited in Kemp et al., 2004), it is reported that carbon monoxide poisoning results in spread of large number of small lesions known ‘salt and pepper’ lesions resulting in scotomas all across the visual field (Champion & Latto, 1985 as cited in Kemp et al., 2004). It is believed that since apperceptive agnosia results from bilateral lesions, its occurrence is much rare. However, it is opined by Jankowiak & Albert (1994) that due to the paucity of accurate PET scans and imaging studies confirming the localisation of lesions no concrete conclusion can be drawn at this stage (Kemp et al., 2004). Associative agnosia is an outcome of bilateral posterior lesions (Jankowiak & Albert, 1994 as cited in Kemp et al., 2004). The lesions occur in the region of posterior cerebral artery whose function is to supply of blood to visual cortex and temporal lobe (Jankowiak & Albert, 1994 as cited in Kemp et al., 2004). It is suggested that lesion size is a decisive factor here, as large lesions will lead to perceptual deficits; additionally, considering the symptoms it is also said that the lesions in associative agnosia might cause damage to the perceptual pathway which links visual information with stored visual memory in posterior hemisphere of either side (Jankowiak & Albert, 1994 as cited in Kemp et al., 2004). Moreover, occurrence of associative agnosia is more than apperceptive agnosia (Kemp et al., 2004).A very useful and a practical method through which we can distinguish apperceptive and associative agnosia can be testing them on the basis of their ability to copy drawings (Kemp et al, 2004). Rey figure copying test can come very handy here. Apperceptive agnosics are unable to copy a drawing due to their impaired perception of a picture, associative agnosics on the other hand can successfully copy a drawing although they are unable to recognize what the object is (Kemp et al., 2004).However, Lissauer gave his distinction between apperceptive and associative agnosia hundred years before but it is found to closely relate to the David Marr’s distinction of the two forms of agnosia given in 1982 (Kemp et al., 2004). According to Marr, apperceptive agnosia is failure to form a three dimensional picture or a representation of a object whereas in associative agnosia an individual achieves a three dimensional picture but fails to connect it to the stored knowledge of the object perceived (Kemp et al.,2004). Share this: Facebook Twitter Reddit LinkedIn WhatsApp The information on this page can be accessed in the following formats: This page explains the different types of agnosia and how they can cause problems with recognition after stroke On this page: What is agnosia? Signs of agnosia What can I do about agnosia? What is agnosia? There are two stages to recognising something: The first stage uses the information you get from your senses about the way it looks, feels and sounds, to develop a picture of what it is.The second stage compares this to the information in your memory, so that you can remember what it’s called and what it does. A stroke can affect both of these stages. Types of agnosia Apperceptive agnosia is when your stroke affects how your brain processes the information you receive about an object.Associative agnosia affects the way you remember information about objects. Agnosia may only affect you in very specific ways. For example, some people find that although they cannot recognise an actual object, they can recognise a picture of it. Some people have agnosia for colour or faces. Having trouble recognising faces is known as prosopagnosia, sometimes called face-blindness. Signs of agnosia Apperceptive agnosia Apperceptive agnosia can affect any sense. You may lose the ability to recognise objects by touch, sound or sight. It usually affects just one sense, so although you may not be able to recognise an object by looking at it, you may be able to by touching it. Problems recognising an object by sight are most common. It’s not that you cannot see the object at all. If someone asks you to describe the object they’re holding, you’ll be able to tell them about some of its features. You’ll know that it’s white, or that it’s got a handle, for example. But you will not be able to recognise that it’s a cup. However, if you’re asked what a cup is, you’ll know exactly what it looks like and what it’s for. Associative agnosia If you have associative agnosia, you’ll have a full picture of the object you’re looking at, but you will not be able to remember what it’s called. So you’ll often use the wrong name. Even if you’re told the correct name, you may not be able to explain what it’s used for. What can I do about agnosia? Usually, if you have agnosia problems these will be picked up by your doctors or therapists while you're in hospital or by your community team when you're back at home. If they haven't been, and you start to notice that you may be having problems, then go back to your GP to get them properly diagnosed and assessed. If these problems are making day-to-day life difficult for you, then you need to be referred to an occupational therapist. They will work with you to find ways to help you cope with them. They will also be able to suggest aids and equipment that can help you. As mentioned earlier, agnosias affect a single sensory modality and because of this they can be described in terms of the modality affected. There are several categories of agnosias but there are three most common categories presented in the literature: visual, auditory and tactile. Visual agnosia is the most common agnosia and refers to the inability to recognize familiar objects and faces in the context of preserved visional functions (i.e. visual acuity, visual field). Visual agnosia can be classified into two broad categories: appreceptive and associative. In 1890 Heinrich Lissauer came up with these categories to explain object recognition deficits following brain damage. Lissauer theorized that processing what we see occurs in a two-stage process: 1) the brain assembles incoming information into an image; and 2) the brain then associates that image to past memories to understand its meaning (Coslett, 2007).Appreceptive agnosia occurs due to impairment at the first stage and associative agnosia occurs at the second stage. Appreceptive visual agnosia is characterized by the inability to reliable name, match, or discriminate visually presented objects, despite adequate function (Baugh, Desanghere, & Marotta, 2010). For instance, an individual with appreceptive agnosia is unable to copy and match a drawing of an object but able to verbally identify the object (see diagram below). Copying abilities of individuals with associative agnosia Copying abilities of individuals with apperceptive agnosia Associative agnosia is characterized by the inability to use derived perceptual representation to access stored information of the object's functions and associations (Baugh, Desanghere, & Marotta, 2010). Contrary to appreceptive agnosia, an individual with associative visual agnosia is able to copy and match a drawing of an object but unable to identify it (see diagram above). Farah (2004) emphasized, however, that although those with associative agnosia may be able to copy a drawing with detail, they do so without being informed by stored knowledge of the stimulus. In other words, if given a copy of a deliberately distorted drawing, an individual with associative agnosia may include the distortion in their drawing without being unaware of the error. Some individuals get diagnosed with a form of visual agnosia called integrative agnosia, whereby symptoms of both aperceptive and associative agnosias are present.Lissauer's distinction has continue to be clinically useful but it has been clearly shown that all forms of agnosia have some degree of apperceptive ("perceptual") disturbances (Bauer, 2006). Since Lissauer's classification of agnosia, several other forms and syndromes of visual agnosia have been recognized in the literature. It is important to note that "pure" forms of agnosias are quite rare, whereas subtypes are more common clinically and in the literature. Some subtypes of visual agnosia include:Colour Agnosia: Inability to recognize and discriminate colours.Object Agnosia: Inability to recognize and name objects.Simultanagnosia: Inability to perceive overall meaning of a whole image or shape, despite ability to recognize individual details or elements.Prosopagnosia: Inability to recognize familiar faces. Also referred to as facial agnosia (play video to right to learn more). Auditory agnosia is characterized by an inability to recognize spoken words or environmental sounds despite preserved hearing. Individuals with auditory agnosia can still have the ability to detect and make simple judgments about sounds but they are unable to identify the sources of sounds (Coslett, 2007). For example, upon hearing a car horn, an individual with auditory agnosia may describe the sound as loud and of short duration but would not be able to recognize that it is a car horn. Individuals with auditory agnosia have adequate elementary sensory processing -- including hearing Compared to visual agnosia, auditory agnosia have not been extensively studied. However, similar to visual agnosia, auditory agnosia can be described in terms of apperception and association terms. Individuals with apperceptive auditory agnosia will not be able to repeat a word or imitate a sound (auditory). In contrast, individuals with associative auditory agnosias will be able to perform the above tasks normally but will not be able to match different examples of sounds. For example, an individual would not be able to match two different doorbell sounds, baby cries, or a man and woman saying the same word. The following are several forms and syndromes of auditory agnosia identified in the literature. These forms and syndrome may have apperceptive and associative subtypes or forms (Mesulam, 2000). Auditory Sound Agnosia: Inability to identify non-verbal sounds.Pure Word Deafness: Inability to comprehend spoken language.Nonverbal Auditory Agnosia: Inability to recognize environmental sounds.Cortical Deafness: Loss of awareness of sound; In the most severe form, an individual may appear to be deaf.Amusia: Inability to express and perceive music. In addition, there is also a loss in the ability to sing, hum or whistle and provide recognition or emotional response to music (Ghadiali, 2004). Tactile agnosia is the inability to recognize objects by touch Similar to visual and auditory agnosia, tactile or somatosensory agnosia refers to the inability to recognize an object through touch despite the physical ability to manipulate the object. Individuals with tactile agnosia can still perceive an object's tactile characteristics such as its weight and texture, but unable to name or comprehend the significance of the object. For example, an individual with auditory agnosia would feel a quarter and be able to apprehend its size, temperature, and shape, but not be able to recognize that it is a quarter. Individuals with tactile agnosia often describe their hands as being "numb" or "stiff" and that the feeling is not distinct or strong enough to identify objects by touch (Reed, 2010). Interestingly this category of agnosia causes unilateral lesions in the brain. As a result, the hand that is contralateral to the lesion is the hand that is "agnostic". For example, an individual with a right hemisphere stroke causing agnosia would have difficulty with recognizing objects with his or her left hand. Several classifications of tactile agnosia have been identified in the literature. However, the understanding of these classifications is not well understood, especially when compared against other conditions. However, the literature covers apperceptive and associative tactile agnosias. Apperceptive tactile agnosia refers to the ability to distinguish tactile characteristics (i.e. temperature, texture, size) but difficulty with making an association with the tactile characteristics and a perceptual representation of an object. For example, an individual with apperceptive agnosia, when feeling a shoe, would be able to describe its hard sole and skinny laces but would not be able to put the descriptions together and recognize that the object is a shoe. Associative tactile agnosia, on the other hand, refers to deficits that occur when individuals cannot use the integrated tactile percepts to access their knowledge or an object (Reed, 2010). In other words, an individual with associative agnosia cannot verbally describe the characteristics of an object such as its texture or shape. However, the ability to draw objects that are tactually presented is in tact but despite this capability, individuals are unable to recognize the objects, determine if two objects felt are from the same category, or whether both objects perform the same function (Reed, 2010). Like the other categories of agnosias, this lack of recognition is due to disrupted pathways between incoming perceptual information and stored knowledge of the object. As mentioned above, agnosia tends to only affect one sensory modality. Individuals with tactile agnosia can still identify objects with their eyes and ears. Hence, tactile agnosia and auditory agnosias are less often identified and discussed in the literature than visual agnosia. In particular, tactile agnosia has received the least attention and is overall poorly understood compared to visual and auditory agnosias. A possible reason why is because audition and touch is often not needed in the context of normal vision for object identification (Coslett, 2011). This is true if we consider the fact that we rarely identify an object on the basis of sound or touch alone. This was evident when I was searching for literature and multimedia on tactile and auditory agnosias. The amount of material on visual agnosia significantly overweighs the other two categories of agnosias. Nevertheless, another possible reason why tactile and auditory agnosias are less prevalent could be because they are underreported in practice. To read more on the different categories and types of agnosias, please refer to the Resources page. 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