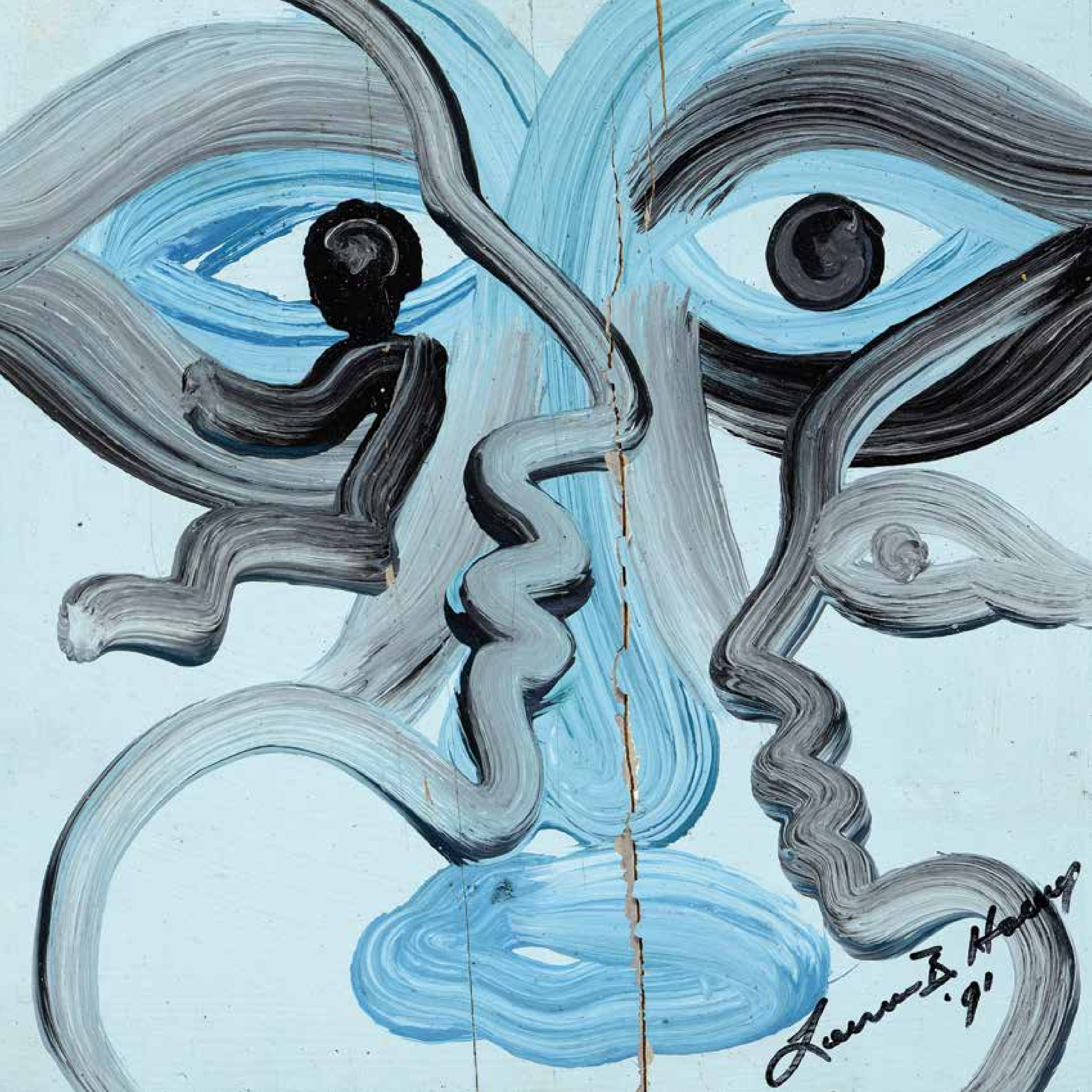

Duke Institute *for* Brain Sciences

NASHER
MUSEUM OF ART AT DUKE UNIVERSITY

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FRONT COVER: Lonnie Holley, *My Tear Becomes the Child*, 1991. Latex on panel, 9 ½ x 9 ½ x 1 inches (24.1 x 24.1 x 2.5 cm). Collection of the Nasher Museum of Art. Gift of Bruce Lineker, T'86, 2008.11.6. © Lonnie Holley. Photo by Peter Paul Geoffrion. BACK COVER: Heatmap indicating which portions of Lonnie Holley's painting *My Tear Becomes the Child*, participants looked at the most. The areas depicting facial features from multiple, overlapping figures received the most attention, suggesting viewers are drawn toward the ambiguity Holley created within these regions.

MAKING FACES

at the Intersection of Art & Neuroscience

MARCH 26 – JULY 24, 2016

Who sees the human face correctly: the photographer, the mirror or the painter?

– Pablo Picasso

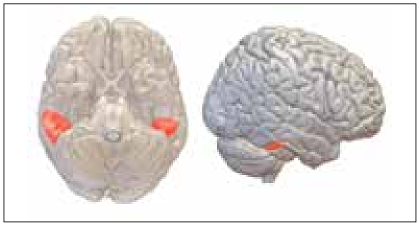
Introduction

We see faces everywhere: in electrical outlets, in the headlights and grill of a car, and even in the shadows of the moon. But why do we see faces in these objects and what are the necessary elements for us to perceive them? Do representations of faces have to be realistic for them to be recognizable? And why do faces capture our attention more than other objects? Humans have a particular expertise for faces that biases our perception of them.

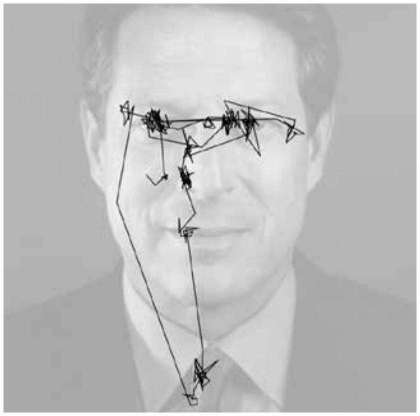
Faces intrigue both artists and scientists alike in their ability to captivate. From an artistic perspective, many of the works presented here push the boundaries of representation in their distortion of facial features, leading us to question the limits of what makes a face. For scientists, they may prompt questions about specific face processing neural mechanisms and the relationship between our perception and human nature.

Making Faces at the Intersection of Art and Neuroscience explores the limits of face perception in artwork across media, cultures, and historical periods in order to present a wide range of possibilities in the portrayal of faces and face-like representations. Many of these works seek to challenge our conventional ideas of what elements are necessary to compose a face, while others seek to reinforce them. By merging art and neuroscience, we can reframe our understanding of faces in artwork by exploring both why and how we see them.

Recognize this Face?



The Fusiform Face Area (FFA) is one of the primary regions of the visual cortex theorized to specialize in human face recognition. During fMRI (Funtional Magnetic Resonance Imaging) experiments, subjects' FFA show increased activity when viewing faces.



ABOVE: These lines represent the path that an individual's eyes travelled as they viewed *Al Gore*, demonstrating that features such as the eyes, nose, mouth (and in this case necktie) attract the most attention. For more information on eye tracking studies see p. 10) OPPOSITE: Chuck Close, *Al Gore* from the portfolio *America: Now and Here*, 2009. Printed and Published by America: Now and Here, American. Digital C photographic print. Edition 94/100. Gift of Dr. and Mrs. Ronald Francesco, 2013.15.1.3.

CHUCK CLOSE (b. 1940)
Al Gore, 2000

How often do you recognize a familiar face, yet completely draw a blank when trying to recall the name of the person? While recalling a name is a memorization task dictated by many different parts of the brain, remembering a face is a task heavily governed by regions of the brain dedicated to facial recognition, such as the Fusiform Face Area (see inset). Impairment to this area can cause "face-blindness," also called prosopagnosia.

Artist Chuck Close was born with this disorder, rendering recognition of even familiar faces difficult. Those with prosopagnosia are able to perceive a face when they see eyes, nose, and mouth, but they are not able to discern and recognize individuals, even friends and family, from this information. Close has discovered that he can more easily recognize individuals when he renders them in two dimensional formats, as seen in this photograph, than he can when they are present with him in the real three-dimensional world.

By now you may have recalled the name of this politician and environmental activist, Al Gore. Here, he is photographed straight on, without the slightest deviation or tilt of his head. Such extreme symmetry in combination with the sharp focus of the photograph accentuates his individual facial features. By no means is this portrayal natural: it is black and white, and artificial lighting manipulates contour and shadows. This photograph isolates Gore into a single expression to commit to memory, a slight smile perhaps reflecting pensiveness.

ANDRES SERRANO (b. 1950)
America (Jewel–Joy Stevens, America's Little Yankee Miss), 2003 (printed 2009)

Looking at Chuck Close's photograph *Al Gore*, on page 5, you may have been struck by the strong symmetry and evenly, if somewhat starkly, lit image. However, on this page, to the right, you can see that this perception of both the symmetry and lighting are skewed.

These images were created by mirroring each half of the face, reflected across the midline, to make a new, symmetrical expression. The resulting images significantly alter the tone and emotion found in the original.

In each case does the expression become more positive or negative? Viewers perceive negative emotions, such as fear, sadness, disgust, and anger, more readily from the left side of the face (the viewer's right side), and happier emotions on the right side. What happens to the emotional tone of the *Al Gore* when the subtle smile on the right half of the image is duplicated on the left half? Does it change how you interpret his appearance? In each manipulation, the emotional expression moves toward opposing dramatic extremes, demonstrating the precise and powerful balance Close created in the original composition.

Artists like Close can take advantage of these image processing asymmetries in the brain to enhance, or in some cases, diminish the perceived emotions in their subjects. Consider, for instance, *America (Jewel–Joy Stevens, America's Little Yankee Miss)*, by Andres Serrano on the facing page. Here, we are presented with the right cheek of the young girl as she gazes dreamily beyond the frame. Although she appears to have won the crown, her expression is eerily vacant. Given the emotional biases discussed above, what might the artist have been intending by orienting the subject so that the right half of her face is most prominent, and depicting her facial expression in this way?

ABOVE, TOP TO BOTTOM: Chuck Close's *Al Gore*, left side of his face mirrored: Chuck Close's *Al Gore*, right half mirrored. OPPOSITE: Andres Serrano, *America (Jewel---Joy Stevens, America's Little Yankee Miss)* from the portfolio *America: Now and Here* (detail), 2003 (printed 2009). Printed and Published by *America: Now and Here*, American. Chromogenic print. Edition 94/100. Gift of Dr. and Mrs. Ronald Francesco. 2013.15.1.8. Art © Andres Serrano.

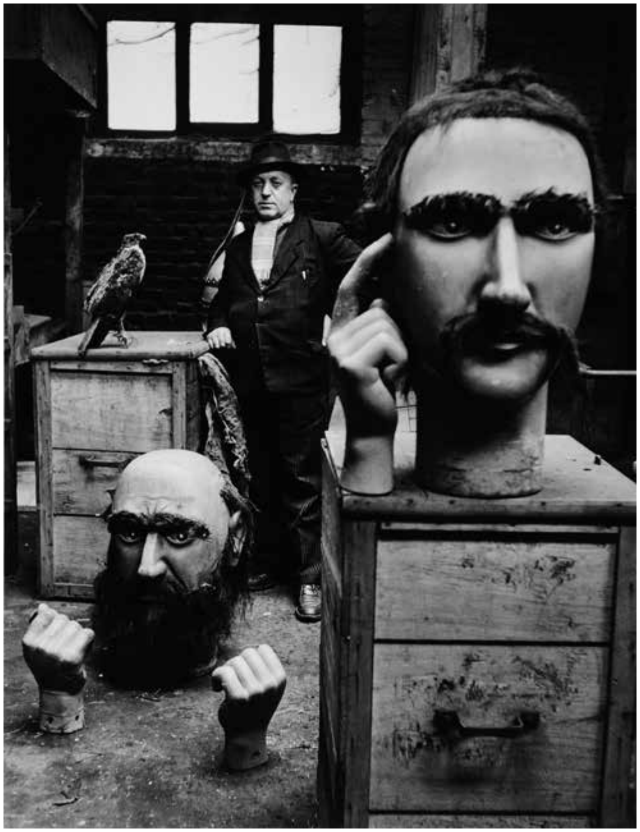
ROBERT DOISNEAU (1912-1994)

Les Geants du Nords, 1951

When you look at this photograph, you may not see the bird or man in the background at first; you probably saw the giant faces before anything else. Why? These faces have a great visual impact because of their size and brightness; they are in sharp focus in the foreground of the image. Furthermore, human faces get more attention from our brains, visually, than other objects. Looking at a face gives us a much more contextually relevant information such as emotional cues, than other objects. The brain prioritizes faces, and Doisneau has capitalized on this tendency.

Focusing in on the large faces, you may even begin to assign emotional states to them, given the position of their accompanying hands. The figure on the right seems contemplative, while the one on the left may appear angry. Making these types of social judgments relies on the ability to convert expressions made from specific facial configurations into meaningful, recognizable emotions. For example, upward curved lips are an indication of happiness.

We learn these feature-based emotional relationships from birth as we interact with others. Key to this is the connection of face processing brain areas and the amygdala, a brain region that integrates information about emotions, emotional behavior and motivation. Processing emotional information from faces is important for social interactions, as it allows us to respond and react to others.



Robert Doisneau, *Les Geants du Nords* from the portfolio *Robert Doisneau*, 1951. Gelatin silver print, edition 41/100, 12 x 9 ⅝ inches (30.5 x 24.4 cm). Collection of the Nasher Museum of Art at Duke University. Gift of James R. McNab, Jr., 1984.55.5. Art © Robert Doisneau.

ANDY WARHOL (1928-1987)

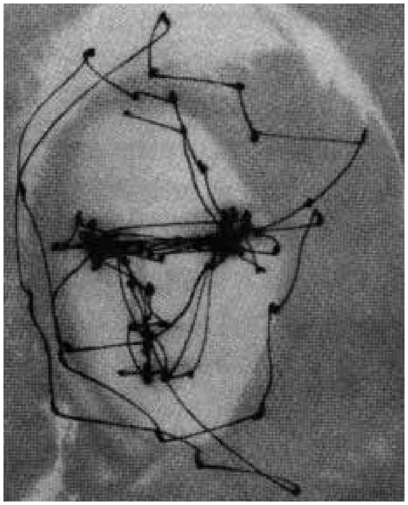
Mao, 1972

In this silkscreen, Andy Warhol distorts our expectations of a normal human face by applying unnatural coloration that disrupts our normal face processing. Mao Zedong was the leader of Communist China from 1949-1976, and portraits of him, especially in China, remain iconic. Warhol used this commonly reproduced photo to make a familiar image unfamiliar. On the top left, Warhol laid dark blue ink over the face, subverting our expectations by taking away natural shadowing and effectively flattening the face.

The brain uses the relative constancy of color and brightness relationships to maintain face recognition, even when lighting varies because eyes and lips are normally darker than their surroundings. The Mao with a dark blue face reverses these expectations since both are brighter than the adjacent areas of the face. The color and brightness relationships in this particular portrait are not what the brain expects to see in a realistic face, making it harder to identify Mao and discern his emotional expression.

One way to test brightness relationships in an image is to convert it to grayscale. Contrast the blue Mao with another Warhol print where Mao's face and lips are more naturally colored. Although the two images are identical except for the altered color and brightness, the expression of Mao in the other print appears much softer. Natural coloration and contrast are useful when determining social cues.

TOP AND BOTTOM LEFT: Andy Warhol, *Mao*, 1972. Published by Castelli Graphics and Multiples, Inc., New York, New York. Printed by Styria Studio, Inc., New York, New York. Screenprint on paper, edition 62/250, 36 x 36 inches (91.4 x 91.4 cm). Collection of the Nasher Museum of Art at Duke University. Gift of Douglas and Whitney H. More, 2006.5.1 and 2. Art ©The Andy Warhol Foundation for the Visual Arts, Inc. / Artists Rights Society (ARS), New York. Photo by Peter Paul Geoffrion.



Eye-tracking

Psychologist Alfred Yarbus performed original experiments in the 1960s exploring typical gaze fixation patterns used by humans to scan faces. His data show that people spend the majority of their gaze time fixating on the eyes and then the mouth, resulting in a triangular pattern.

ABOVE: One example of Yarbus' original eye-tracking experiements from Alfred L. Yarbus, Eye Movements and Vision. New York: Plenum, 1967. OPPOSITE: Jeff Sonhouse, *Decompositioning* (detail), 2010. Mixed media on canvas, 82 x 76 ¼ inches (208.3 x 193.7 cm). Collection of the Nasher Museum. Museum purchase, 2010.15.1.. © Jeff Sonhouse. Photo by Peter Paul Geoffrion.

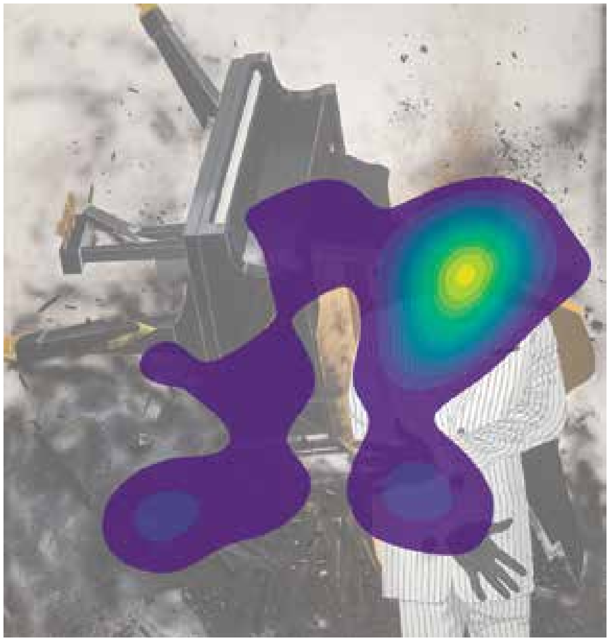
RIGHT: This heatmap represents where viewers spent the most time looking at *Decompositioning*. Yellow indicates where viewers looked the most. From this we can see that while viewers were interested in exploring the exploding piano, they were inevitably drawn to the face, and especially the mouth of the figure, perhaps in an attempt to understand his mood.

JEFF SONHOUSE (b. 1968),

Decompositioning, 2010

Decompositioning presents a chaotic scene showing a masked man standing next to an exploding piano. Such a scene might be unnerving; why? The answer may lie partially in the ambiguity surrounding the mysterious masked man. The striped, patterned surface allows mere glimpses of the eyes, nose and mouth, exposing very few details about his identity or emotional state. We are left with many questions: What is he doing there? Is the man angry or indifferent? Is he responsible for the exploding piano? Is he a superhero or villain?

As humans, we regularly scan other human faces for information, especially anything that could hint at a particular emotional state. This essential information allows us to react appropriately to others' emotional states. Without the necessary emotional information, we are left to speculate and try to create a link between this mysterious figure and the chaos surrounding him.



ALEXANDER CALDER (1898-1976)

***Untitled*, 1964**

At what point does an an assemblage of shapes begin to look like a face? Here we see a blue dot, an orange dot, and a black boomerang-like shape with black dots in it. However, if the work is viewed at a certain angle with the curved shape below the two dots (the minimal features for a smiley face), you may be able to see a face.

Scientists have labeled this psychological phenomenon "face pareidolia," which is the illusory perception of non-existent faces (see inset). Because of the brain's expertise and familiarity with detecting faces, Calder's placement of the three geometric shapes (with the circles above the curved shape) might be enough for us to see them as eyes and mouth in certain contexts, such as when this work is viewed with the collection of faces in this exhibition.

Face perception involves processing information about individual facial features (eyes, mouth, etc.) as well as configuration and spatial layout of these features. If the two dots were on either side of the boomerang shape, the face-like impression would fall apart. Even with faces familiar to us, recognition can be disrupted when the spatial distances between features are altered.

OPPOSITE: Alexander Calder, *Untitled*, 1964. Lithograph on paper, edition of 2000, 10 x 7 ½ inches (25.4 x 19.1 cm). Collection of the Nasher Museum of Art at Duke University. Gift of Mr. Jack Lord, 1973.3.15. Photo by Peter Paul Geoffrion.

Seeing Faces in Odd Places

Face Pareidolia

Have you ever seen a face in an odd place? An electrical outlet? The grill of a car? A piece of bark? Face Pareidolia is the psychological phenomenon of perceiving a face where none exists due to the perception of face-like patterns. As a result, simple objects that suggest the presence of eyes above a nose and/or a mouth may cause the brain to generate a rough representation of a face. Because the composition of a face is so familiar, we are biased to see them in everyday objects and conformations, like the "man in the moon."

ABOVE: Photo by Larry Carlson.

ABOVE, LEFT TO RIGHT: Beck Shoe Polisher, Model 277, Deluxe Twin. Romuald Hazoumé, *C.I.A.*, 2000.15.1. *K.G.B.*, 2000.15.2. BOTH: 1999. Mixed media, 12 x 6 x 8 in. (30.5 x 15.2 x 20.3 cm). Collection of the Nasher Museum of Art at Duke University. Museum purchase. Art © Romuald Hazoumé / Artists Rights Society (ARS), New York. Photo by Peter Paul Geoffrion.

ROMUALD HAZOUME (b. 1962)

C.I.A. and *K.G.B.*, 1999

In these two works, Romuald Hazoume purposefully configures mixed materials to provoke the phenomenon of face pareidolia.

In *C.I.A.*, fake fur looks like hair that covers the expected location of eyes, a pipe functions as a nose, and a sunglass lens creates a mouth on the footbed of a plaid slipper. When this assortment of objects are placed in this specific configuration they lose their distinction as distinct objects and create a new whole, a face, instead of appearing as separate elements.

K.G.B. is more ambiguous as the work comprises the base of a shoeshining machine, an intact example seen above, leaving more to the imagination than *C.I.A.*'s multi-material presentation. Rotated upright and displayed vertically, the machine begins to resemble a head. Notice that compared to an unaltered shoeshiner, an exposed nozzle becomes a mouth, the handle a nose, and the voids to the left and right of the handle become locations for eyes.

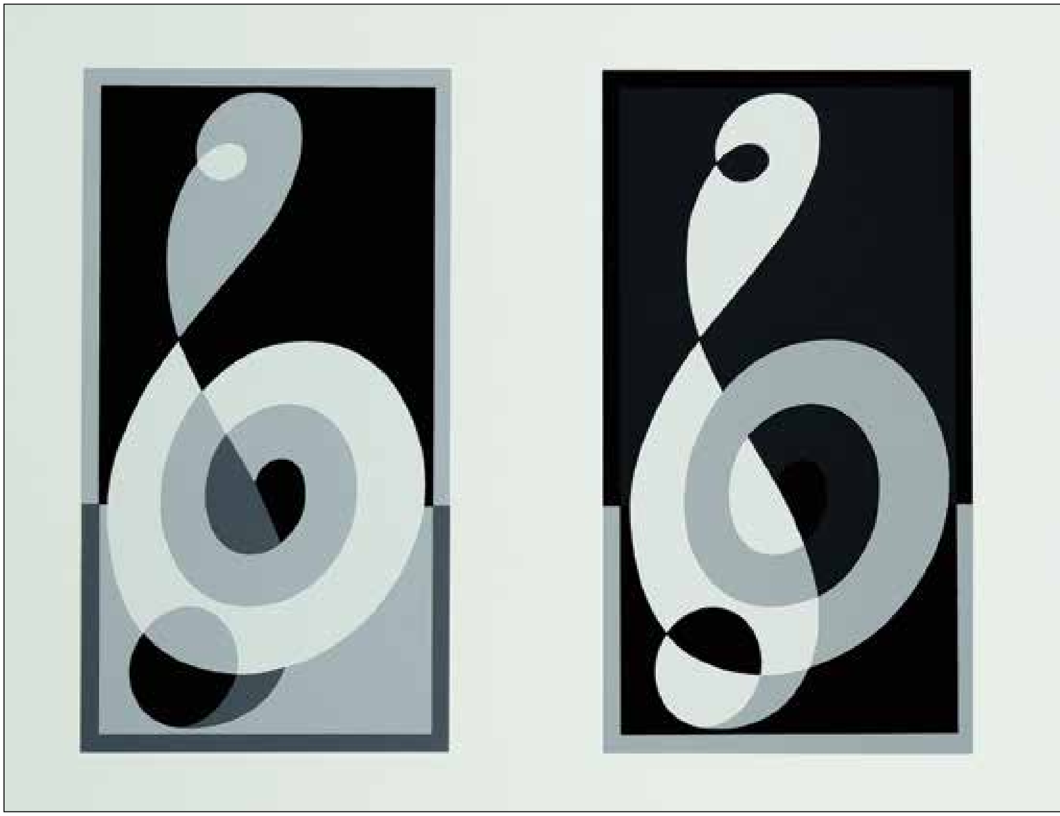
DAN PEOPLES (LIBERIA)

Spoon handle

This small object is the decorative handle of a wooden spoon created by the Dan peoples. Although it is devoid of internal features (eyes, nose, mouth), it may still appear to have a face. With the familiar oval of a human head, the object also includes forms evoking the external features of human ears and hair. These, along with a sharp crease that interrupts the blank, smooth surface at the exact location where we would expect eyes, are enough to suggest the presence of a face.

The face processing hubs of the brain, such as the Fusiform Face Area (see inset pg. 4) respond strongly when both the internal and external features of a face are presented together. However, the FFA will still respond to internal and external features when presented separately as well, although the response is weakest for external features alone. This demonstrates a human bias for the internal features of a face. However, it also explains why we may be able to recognize someone from their hair without being able to see their eyes, nose, or mouth distinctly. The minimal amount of detail contained in the external features can be enough for the brain to perceive a face.

Dan peoples (Liberia), Carved head, possibly from a spoon handle, n.d. Wood, 4 ½ x 2 ¾ x 2 ¼ inches (11.4 x 7 x 5.7 cm). Nasher Museum of Art at Duke University. George Way Harley Memorial Collection, Duke University; L.2.1974.88. Photo by Peter Paul Geoffrion.



Josef Albers, *Untitled* from the portfolio *Formulation: Articulation*, 1972. Published by Ives Sillman, Inc., New Haven, Connecticut in collaboration with Harry N. Abrams, New York, New York. Printed by Sirocco Screenprints, New Haven, Connecticut. Screenprint on Mohawk Superfine Bristol paper, edition 362/1000, 12 ⅛ x 6 ½ inches (30.8 x 16.5 cm) (each). Collection of the Nasher Museum of Art at Duke University. Gift of The Josef Albers Foundation,1975.8.1.16. Art © The Josef and Anni Albers Foundation / Artists Rights Society (ARS), New York. Photo by Peter Paul Geoffrion.

JOSEF ALBERS (1888-1976)

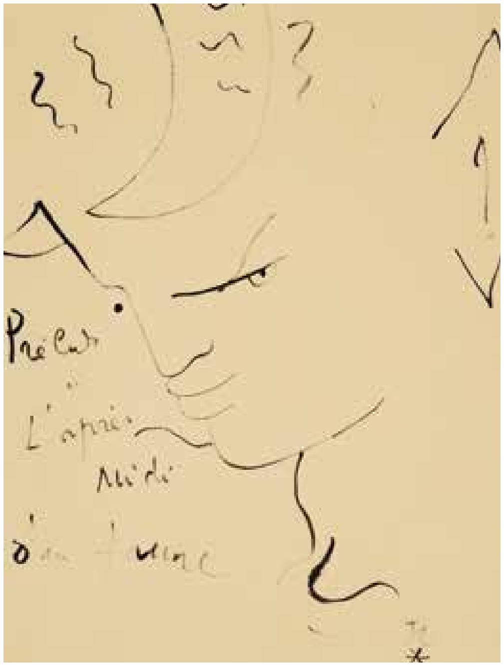
Formulation: Articulation (folio 16), 1972

Do you see a face in this work? You might see the four forms pictured here as treble clefs, blobs, or upside down snails. Focus on the third form from the left and look at the gray teardrop shape on the top. Now look at the white oval in it–can you see it now as a face in profile, with the gray teardrop as a head and the white oval as an eye?

Looking at the other forms, it may be harder to see profiles because we expect more contrast between the eyes and the rest of a face. Josef Albers recognized the ambiguities in this work when he wrote about this work, "These show that any shape

permits and invites various readings, which are caused by changing associations and different reactions and which result all together in a change of meaning…"

Because of our brains' established expertise with faces—there are regions of the brain dedicated to facial recognition and face processing—humans often perceive faces from abstract face-like arrangements, especially when prompted to do so. In this way, the brain tries to find meaningful patterns from the sensory information we are presented with, and we often find patterns that we know well, like faces. This allows our brains to reduce uncertainty and ambiguity about the visual information we encounter.



Jean Cocteau, *Nijinsky*, 1950s. Ink on paper, 10 ⅝ x 8 ¼ inches (27 x 21 cm). Collection of the Nasher Museum of Art at Duke University. Bequest of Wallace Fowlie, 2004.1.7. Art © ADAGP, Paris / Avec l'aimable autorisation de M. Pierre Bergé, président du Comité Jean Cocteau. Photo by Peter Paul Geoffrion.

JEAN COCTEAU (1889-1963)

Nijinsky, 1950s

This drawing consists of just a few lines—how then is a face so discernible? In fact, only the important boundaries of the face are outlined. Although outlines rarely exist in real life, the brain encodes visual information in two dimensions making important contours into lines. The drawing is so effective because Cocteau depicted the critical face components (mouth, eyes, ears, etc.) with contours that match a familiar prototype, so our brains can easily fill in what is missing. Here, Cocteau has exploited this tendency to create a discernable face from fundamental components.

Our lifetime of exposure to faces and our brains' expertise in face perception allows us to automatically fill in the sketch with any missing parts, transforming a few lines into a full face. While doing this, we temporarily ignore the nonhuman features portrayed in this work: the pointed, elf like ears, and horns. The power of Nijinsky lies in the brain's ability to simultaneously add and subtract significant elements.

Greek Helmet cheek piece, 4th century BCE

Can a face be perceived from only a fragment? We expect a face to consist of a fixed arrangement of two eyes, one nose, and one mouth. This piece is a portion of a helmet that would have been worn to protect most of the face in battle, and the only clearly formed facial feature is the right half of a pair of lips, viewed in profile.

Research that tracks where our eyes move when we see faces in profile indicates that we spend the majority of our viewing time looking at the eye. In this case, however, we lack nearly every feature that would normally prompt our perception of a face. Since this helmet fragment is incomplete, the only available clues are a sharply defined jaw line and a curving ridge, forming a moustache. Ultimately, knowing that this had practical use as a battle mask may be the most powerful cue that aids us in making a face, and we can call on a lifetime of experience to fill in the missing pieces.

ABOVE: Greek, Helmet cheek piece, 4th century BCE. Bronze, 6 $\frac{11}{16}$ inches (17 cm). Nasher Museum of Art at Duke University. Collection of Walter Kempner, M.D., gift of Barbara Newborg, M.D. 2006.1.205. Photo by Peter Paul Geoffrion. RIGHT: Macedonian or Thracian iron helmet, c 4th century BCE. Christie's, Antiquities, 9 December 2015, lot 50. Photo by David Schelgel and Marqueax Walter

French, Corbel with head (of a monk?), 14th century. Limestone, 10 x 8 x 5 ¾ inches (25.4 x 20.3 x 14.6 cm). Nasher Museum of Art at Duke University. The Brummer Collection, 1966.75.1. Photo by Peter Paul Geoffrion.

FRENCH, Corbel with head (of a monk?), 14th century

Here we have a stone corbel—a functional and decorative object that would have projected from a wall to support an arch or beam—decorated with a strikingly asymmetrical face. One side of the face is caved in around the eye and that cheek is pulled upwards, seeming to smile, but the other side of the face does not seem to have the same expression.

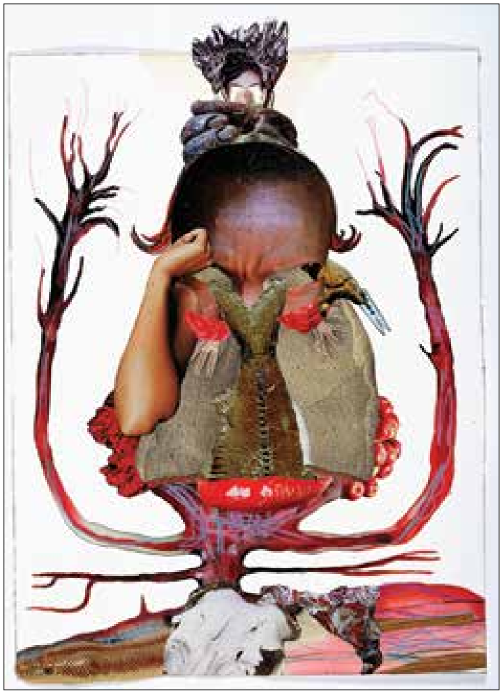
How would you describe this figure's emotional state? Is he injured? Smirking? Maybe it's a grimace? The ambiguity lies in the face being both asymmetrical and static. We understand emotions in real life settings due to our perception of dynamic changes, like the quick quirk of upturned lips in a smile. When a face is unchanging, such as in this sculpture, it is impossible to see such changes. We can only see an expression frozen in time. This makes his expression ambiguous and we do not know whether this is the resting face of a damaged individual or the depiction of a fleetingly expressed emotion.

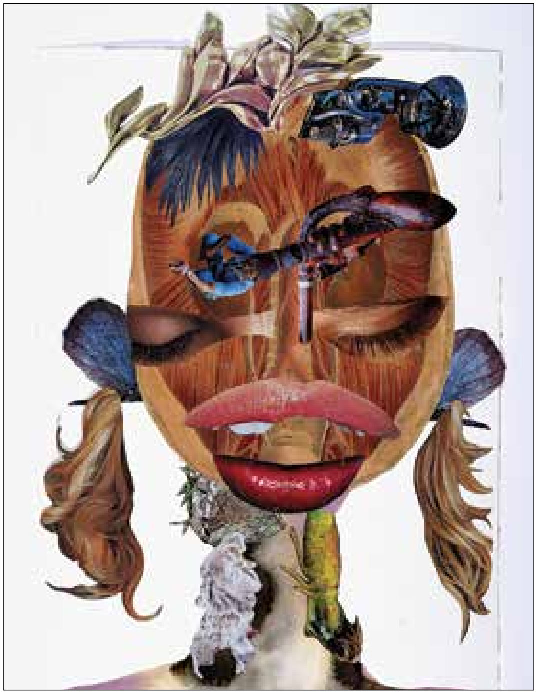
G. H. Rothe, *Window* (detail), 1977. Mezzotint on paper, edition 125/150, 25 ⅝ x 23 ⅞ inches (65.1 x 60.6 cm). Collection of the Nasher Museum of Art at Duke University. Gift of Michael Judge, 1987.8.2. © Estate of Gatja Rothe. Photo by Peter Paul Geoffrion.

G.H. ROTHE (b. 1935-2007), *Window,* 1977

Alluded to by this work's title, the eyes are often referred to as the 'window to the soul' because they provide information that helps us understand the emotional state and intentions of another individual. Research indicates that when viewing images of faces, we spend a majority of our time examining the eyes, with significant time also spent observing the lips.

In this case, the eyes at the center of the work quickly grab our attention. The longer we look at the print, however, the more abstract it becomes, calling into question our instinctive notion of what makes a face. Transparent foliage partially covers the lips, even appearing to merge with the lips themselves. This raises the question of whether leaves cover the face, or in fact compose it.





Wangechi Mutu, *Family Tree* (4 of 13 shown), 2012. Suite of 13, mixed-media collage on paper, 20 x 14.25 inches (50.8 x 36.2 cm). Collection of the Nasher Museum of Art at Duke University. Museum purchase with additional funds provided by Trent Carmichael (T'88, P'17), Blake Byrne (T'57), Marjorie and Michael Levine (T'84, P'16), Stefanie and Douglas Kahn (P'11, P'13), and Christen and Derek Wilson (T'86, B'90, P'15), 2013.1.1. D, H, J & K. © Wangechi Mutu. Photo by Peter Paul Geoffrion.

WANGECHI MUTU (b. 1972)

Family Tree, 2012

This work shows how an artist may intentionally play with abstractions and rely on the viewer to piece together disparate elements. Mutu collages images from magazines and books along with decorative papers to make a face when looked at as a whole. Although thoroughly lacking in proportionality and natural configuration, these disparate parts somehow satisfy our expectations of what makes a face.

On pg. 23, in the collage on the left the eyes and a single ear are identifiable facial features. The ear is a magazine cutout of a human ear, and while the eyes are non-human, they are nonetheless still easily perceived as eyes. Although these features are out of

proportion with our expectations for a representational depiction of a person, their placement on a distinctly head-like shape allows for them to add up to a face. The brain fills in the rest of the necessary information if the feature's location, shading and shape remain vaguely representational, despite its foreign nature.

Each of these collages from Mutu's *Family Tree* lacks certain recognizable facial features, and they are certainly abstract, but our brain is still able to make a face from the disparate components.

PABLO PICASSO (1881-1973)

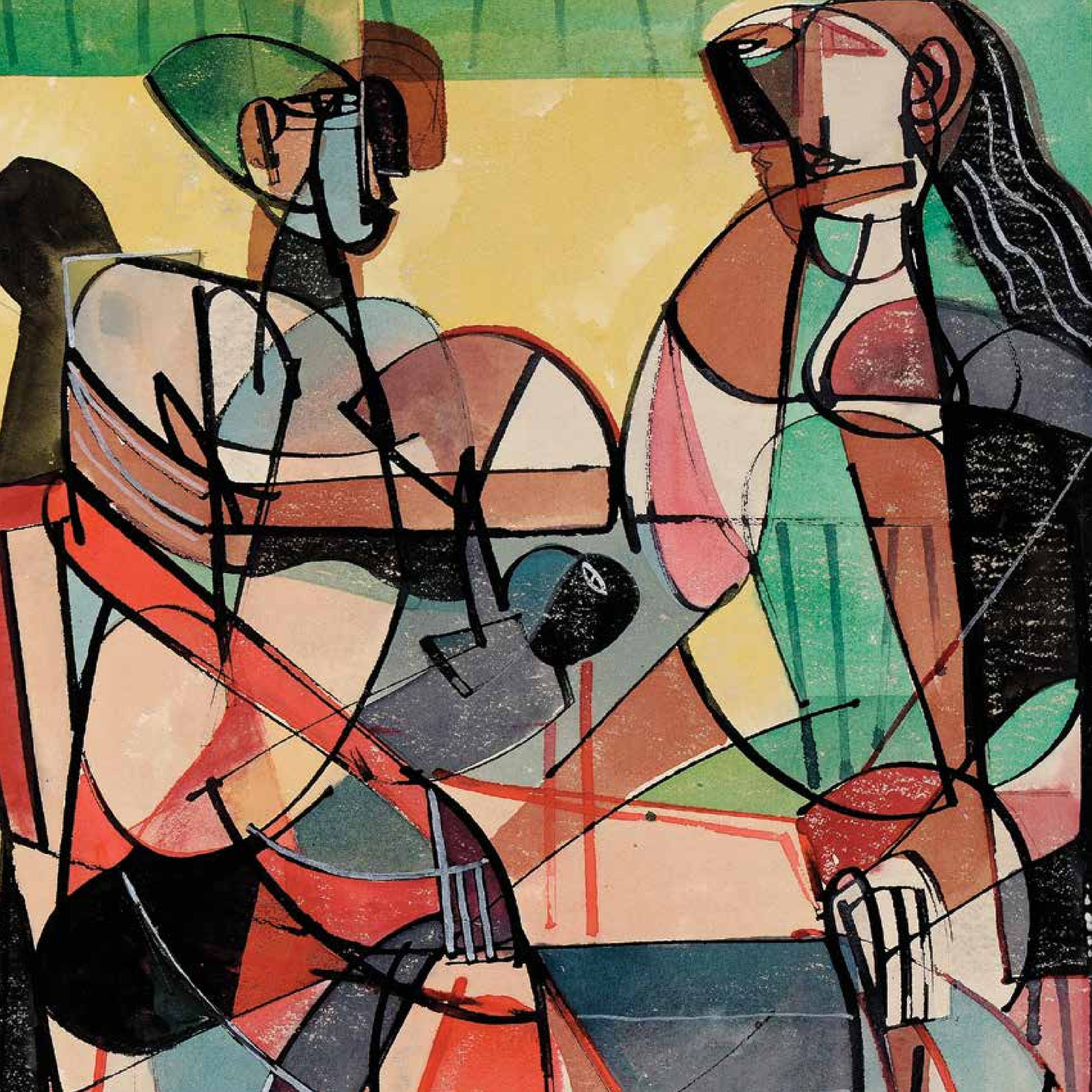
Head of a Woman, 1960

This Cubist work distorts the most critical component for face processing: the orientation and presence of important features. Can you see a complete face in this work? One eye might make you think of a side profile. But what happens when you think of the dot to the left of the eye as an eye too? Can you make out a face that looks out towards you? It may now be difficult to make out a profile when you see both nostrils; the mouth and nose seem to go in opposite directions. Here, we alternate between perceiving two common face orientations: a profile and a face that looks out at you.

One of the main objectives of Cubism is to challenge the viewer with all possible viewpoints of objects at the same time. How can we make sense of such contradictory orientation cues to create a whole and informative face?

The appropriate arrangement of facial features is necessary for our brains to understand them; babies spend significantly more time looking at facial features in a typical face configuration than if they are arranged in a random configuration. In this case, although Picasso painted the individual features from multiple viewpoints, they are still placed in a natural configuration relative to each other – eyes in line with each other above a nose and mouth, an ear to the side, and the whole framed by hair. When trying to recognize and construct a face, humans simultaneously focus on identifying the presence of individual facial features while also configuring features together to see a face as one unified object.

OPPOSITE: Pablo Picasso, *Head of a Woman (Tête de femme)* (detail), 1960. Oil on canvas, 32 x 26 inches (81.3 x 66 cm). The J. D. Nasher Collection, Dallas, Texas. © Estate of Pablo Picasso / Artists Rights Society (ARS), New York. Photo by Peter Paul Geoffrion.



ROMARE BEARDEN (1911-1988)

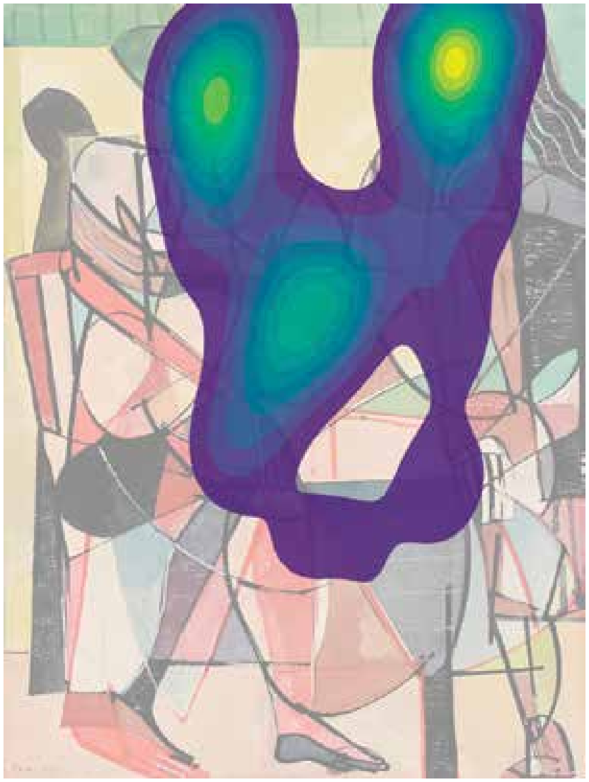
The Family, 1948

The Family by Romare Bearden uses distinct colors and sharp lines to fragment the figures of a father, mother, and child in a distinctly cubist-inspired manner.

In most contexts, we see faces first, despite abstraction. The heads of these figures have very few identifiable facial features, but the inclusion of recognizable eyes within head-like shapes is enough to perceive faces. Bearden has also composed these with fewer color changes and finer lines than used in the bodies. The faces of the figures are thus less abstract in contrast, enabling us to see the entire family portrayed.

Although the father and mother are discernible, contextual clues help with the identification of the child. Would you have seen the infant if the artwork was not titled "The Family?" Without knowing the title of this work, observers from our eye tracking study spend more time looking at the faces of the adults than the child (see inset). The infant in the middle of the work is less discernible, perhaps due to the absence of clear facial features. Knowing the title may encourage us to look for more than two individuals to satisfy our expectations of a family.

Romare Bearden, *The Family* (detail), 1948. Watercolor and gouache on paper, 25 x 19 inches (63.5 x 48.3 cm). Collection of the Nasher Museum of Art at Duke University. Museum purchase. Art © Romare Bearden Foundation/Licensed by VAGA, New York, New York. Photo by Peter Paul Geoffrion.



This heatmap, indicating where participants spent the most time looking, can help answer how many figures are typically seen in this image. While the two adult faces on the upper left and right received the majority of attention, participants also focused on the face of child being cradled. Notably, participants were unaware of the title of this piece; even without that clue, the figure of the child is apparent.

Fritz Hundertwasser, *Columbus Rainy Day in India* from the *Look at it on a Rainy Day* or *Regentag* Portfolio (detail), 1971-72. Screenprint on paper, edition 2172/3000, 18 x 23 1/8 inches (45.7 x 58.7 cm). Collection of the Nasher Museum of Art at Duke University. Gift of Bart N. and Barrett Stephens, 1986.10.6. Art © The Hundertwasser Non Profit Foundation. Photo by Peter Paul Geoffrion.

FRITZ HUNDERTWASSER (1928-2000)

Columbus Rainy Day in India, 20th century

Irinaland over the Balkans, 20th century

What do we expect to see in a face, and how do we compensate when these expectations are not met? *Columbus Rainy Day in India* and *Irinaland over the Balkans* both portray faces embedded within landscapes, detectable by the expected two eyes, a nose, and a mouth. Both lack outer facial boundaries, however. There is no upper edge for the face in *Columbus*, and *Irinaland* is missing edges on either side of the face, making it difficult to delineate where the faces end and the landscapes begin.

This ambiguity causes a bi-stable image (see pg. 31) to form: two different perceptions of the same image exist, but only one can be seen at a time. We can compensate for this incompleteness by visualizing boundaries and ignoring the surrounding landscape, or we can allow the faces to blend into the surroundings, viewing them as landscapes. In each case, the brain is tasked with ignoring inconsistent elements in order to accommodate our expectations.

Fritz Hundertwasser, *Irinaland over the Balkans* from the *Look at it on a Rainy Day* Portfolio (detail), 1971-72. Screenprint on paper, edition 2172/3000, 16 1/4 x 23 inches (41.3 x 58.4 cm). Collection of the Nasher Museum of Art at Duke University. Gift of Bart N. and Barrett Stephens, 1986.10.7. Art © The Hundertwasser Non Profit Foundation. Photo by Peter Paul Geoffrion.

How Many Faces Do You See?

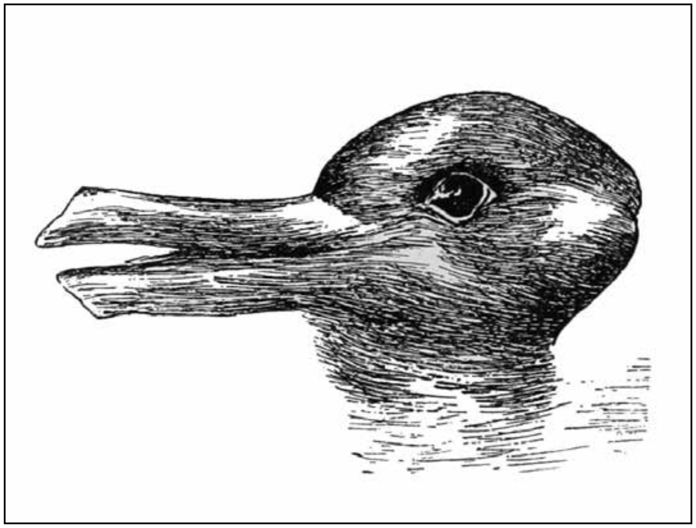
Lonnie Holley, *My Tear Becomes the Child*, 1991. Latex on panel, 9 ½ x 9 ½ x 1 inches (24.1 x 24.1 x 2.5 cm). Collection of the Nasher Museum of Art. Gift of Bruce Lineker, T'86, 2008.11.6. © Lonnie Holley. Photo by Peter Paul Geoffrion.

LONNIE HOLLEY, (b. 1950)

My Tear Becomes the Child, **1991**

When we first see an image our brains attempt to organize all the parts into groups. One of the most basic ways to do this is to find the edges. How many faces do you see in this painting? Were you able to see three faces and a seated stick figure in profile?

There are multiple purposes for almost every element drawn by the artist in this work. For example, the eye on the left serves as an eye for both a face that looks forward, as well as one in profile. The pupil of that eye also forms the head of the seated stick figure. The lower edge of the right eye merges into the top of another head in profile. Thus, the painting has a multi-stable quality. You cannot see all four figures simultaneously; instead your perception alternates quickly between them.



How are we able to perceive all of these different faces in one work with so few brush strokes? A fundamental part of visual processing is extracting the essential contours and edges–all of which are in this painting. *My Tear Becomes the Child* plays with a visual ambiguity that is impossible in reality when individual contours function as part of two faces at the same time. In the real world, edges belong to only one object. This makes it difficult to separate the parts of this painting into different objects or groups. The visual system can still detect the edges easily, but the brain must now also resolve the ambiguity of which contours belong to each figure or face. Ultimately, we resolve this by making inferences based on previous experience with face and object grouping patterns.

Bi-stable Images

Do you see a duck or a rabbit? When images are too ambiguous for the visual system, the brain creates two consistent versions out of the conflicting information. This leads to perception of two, mutually-exclusive interpretations of the same stimuli.

By Unknown - *Popular Science Monthly* Volume 54 (Jastrow, Joseph: "The Mind's Eye", p.299-312), Public Domain, https://commons.wikimedia.org/w/index.php?curid=25629170

Art, Vision and the Brain (2015-16): Making Faces

The ambiguities of faces versus objects have long fascinated artists and scientists alike. Importantly, faces, but not objects, play an important role in social interactions from birth. Newborn infants prefer to look at faces and “face-like” images, and there are specific areas of the brain that respond maximally to faces and facial features. Notably, nonhuman primates also attend to faces, discriminate individual identity and social status and follow the gaze of others—just like typically-developing humans—and do so using the same brain circuits. Face processing is a highly adaptive faculty necessary for complex social behavior. When this system does not function properly, as in “face blindness” or autism, the consequences can be severe.

This Bass Connections project team has explored a wide range of artworks to examine the perceptual responses to these kinds of stimuli in humans. We are exploring how differences in image statistics (color, contrast, spatial detail) influence the results and behavioral measures of shape and face salience. We are doing eye tracking experiments aimed to uncover the rules governing normal perception of faces that range from representational to abstract depictions, allowing us to measure eye fixations and paths of gaze while people view images drawn from artwork from the Nasher Museum of Art’s collection as well as portraits and photographs from other sources. We also organized the installation presented here exploring the intersection of art and neuroscience of making faces at the Nasher Museum of Art (March 18-July 24, 2016). Ultimately, our team is using art to uncover how the brain makes sense of our visual and social worlds, and why our brains respond the way they do to particular kinds of art.

Monica Huerta, PhD, Provost’s Postdoctoral Associate, Women’s Studies

Elizabeth Johnson, PhD, Assistant Research Professor, Neurobiology, and Associate Director, Duke Institute for Brain Sciences

Eleonora Lad, MD, PhD, Assistant Professor, Ophthalmology

Jeff MacInnes, PhD, Postdoctoral Fellow, Center for Cognitive Neuroscience

Guillermo Sapiro, PhD, Edmund T. Pratt, Jr. School Professor of Electrical and Computer Engineering

Marianne Wardle, PhD, Andrew W. Mellon Curator of Academic Programs, Head of Education & Interpretation, Nasher Museum of Art

Students

Kaitlin Henderson, Masters in Liberal Studies (’16)

Anuhita Basavaraju, Neuroscience Major (’18)

Peter Cangialosi, Neuroscience and French Major (’16)

Sophie Katz, Neuroscience Major (’17)

Eduardo Salgado, Neuroscience and Psychology Major (’18)

Christopher Yoo, Biology Major (’18)

OPPOSITE, CLOCKWISE: Yoruba peoples (Nigeria), Ceremonial crown, 19th-20th century. Beads and leather, 13 ¾ x 8 inches (34.9 x 20.3 cm). Collection of the Nasher Museum of Art at Duke University. Gift of Dr. and Mrs. Edward Last, 1976.20.2. Photo by Peter Paul Geoffrion. Chimú (Peru), Mask, 1000-1470. Gold. Nasher Museum of Art at Duke University. The Paul A. and Virginia Clifford Collection, 1973.1.562.5. Guro peoples (Ivory Coast), Mask, n.d. Wood, 17 11⁄16 x 10 7⁄16 x 5 ½ inches (45 x 26.5 x 14 cm). Collection of the Nasher Museum of Art at Duke University. Gift of George C. and Cecilia DeGolyer McGhee, 1991.3.22.