SEEING

SCIENCE GALLERY

Trinity
College
Dublin
The University of Dublin

24.06.16–25.09.16
SEEING

WHAT ARE YOU LOOKING AT?

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C O N T -
E N T S

WHEN WE SEE, WHAT IS GO-ING ON INSIDE OUR HEADS?

LYNN SCARFF

Director of Science Gallery Dublin
at Trinity College Dublin

Try this: Close your right eye, and with your open left eye, look to the right. Your field of vision is blocked substantially by your nose. Now do the opposite, close your left eye and look left with your open right eye. The same thing happens. And yet open both eyes and your nose disappears from your field of vision. Your visual cortex blocks out the information it doesn't need to see.

It's remarkable that we have not yet created a programme on SEEING at Science Gallery at Trinity College Dublin, as how we perceive the world around us and the mathematical, artistic, neuroscientific, design, engineering and biological opportunities it presents for investigation are vast. In Lawrence Weschler's book *Seeing is Forgetting the Name of the Thing One Sees*, he notes that the American artist Robert Irwin (famous for his treatise on perception) says that it's not all that surprising that explorers at the edges of their respective disciplines (physicists, philosophers, artists, mathematicians, architects, biochemists, and the like) keep bumping up against each other, because they are all engaged in what he likes to call "the dialogue of immanence."

Messing about at boundaries of the divine and material world may seem like strange territory for Science Gallery Dublin. However, it's this liminal space that SEEING: WHAT ARE YOU LOOKING AT? is exploring: the point of perception, the questions around what is there and what is not there, and what that means for how we distinguish and navigate the world, advancements in neuroscience, A.I. and robotics, as well as advancements in ophthalmic medicine, virtual reality and gaming. And yet, as Gerry Lacey, one of our curators, notes, even with the significant achievements made in cognitive computing in the last decade, machine vision is still in its infancy. There is still much to discover about how we see and that makes it a rich theme for Science Gallery Dublin to explore — an area where the collaboration of the disciplines of art and science are critical to making new discoveries.

I'd like to thank all of the participants of SEEING for bringing their work to Science Gallery Dublin and engaging in this conversation, as well as curators Kate Coleman, Gerry Lacey and Semir Zeki, who collaborated with our programming team to sift through and select from a huge range of potential exhibits. Like all Science Gallery exhibitions, the opening of the show is not a culmination of endeavour but the beginning of a discussion with you, our audience. We hope that you are as enthralled as we have been over these last few months, and we hope that what you see sparks off new conversations about the nature of seeing, perception, and a deeper, more complex understanding of what you're really looking at.

ARE WE LIVING IN A MENTAL VIRTUAL REALITY?

GERRY LACEY

Associate Professor of Computer Science at
Trinity College Dublin, and CEO and co-founder
of SureWash and co-curator of SEEING

Philosopher George Berkeley in An Essay Towards a New Theory of Vision (1709) explored the limits of a purely optical and geometric concept of vision to include artefacts of perception. He would go so far as to suggest that to exist, objects must be perceived to exist, but in the absence of humans, they were perceived within the mind of God. The theory was caricatured in limerick form as:

> There was a young man who said "God
> Must find it exceedingly odd
> To see that this tree
> Still continues to be
> When there's no-one about in the quad".
> Dear Sir, Your astonishment's odd;
> I am always about in the quad;
> And that's why the tree
> Still continues to be
> Since observed by, Yours faithfully, God.

We could choose to see in George Berkeley the seeds of active perception — perception as action, a creative process calling into being things that were not there before, creating from raw precepts new entities, the act of observation forcing the definition of probabilistic states of matter with potentially dire consequences for Schrödinger's cat. SEEING allows us to explore topics of human perception, how we encode knowledge, how we imagine and create colour, form and structure from crude, noisy and diverse information sources. Beauty, very much, is constructed in the mind of the beholder.

Through science, we have worked to understand the visual system and learned it is not a purely photographic paradigm, with images encoded on the photographic plate of the retina. In fact, it is a far more fascinating and complex process. To understand seeing, we must address challenges from many domains such as philosophy, anatomy, neuroscience, perception, computer science and robotics.

Seeing remains one of the grand challenges of artificial intelligence (A.I.) — we have developed computational intelligence that can triumph against grand masters in games of chess or Go, but A.I. still struggles to achieve even the perceptual level of an infant. Is vision simply reconstructing a high-fidelity mental representation of the 3D world around us? »

How do we build this virtual reality when the fovea in our eye capture only a thumbnail-sized high-resolution image of the world? Are we living our lives in a mental virtual reality that is only loosely based on the reality around us?

Loss of sight also exposes the act of seeing, as we explore new sensory modalities to construct our mental models, co-opting other senses and pushing our imagination to its limits. Optical illusions and artworks expose some of the mental machinery of seeing, giving us a glimpse into the artifice and illusion that our brains use to construct a working model of the world. Through the experience of SEEING: WHAT ARE YOU LOOKING AT? we are given the opportunity to appreciate the heightened perception of artists, radiologists and other experts who can see into the hidden depths of imagery allowing us to extract new meaning and augment our own understanding of this extraordinary sense.

Computer vision relies on algorithms to make sense of the world. *Unseen Portraits* investigates what face recognition algorithms consider to be a human face. How much do you have to deform someone's features to make them invisible to a machine?

Portrait photos of visitors are distorted on a screen. A surveillance camera films the distortion and uses facial recognition software to scan the camera footage for faces while the image becomes more and more obscured.

The moment the photo becomes too warped and the face can't be recognised by the algorithm anymore, the software takes a screenshot. The visitor is now invisible to computer vision.

Despite its subject matter, *Unseen Portraits* isn't a conceptual investigation of the algorithms used. Rather, the project uses computer vision software as an artistic tool, creating images reminiscent of Francis Bacon's self-portraits from the 1970s. It isn't so much a mechanism to hide from the software as it is a way to capture the software's flaws in a work of art.

BIO

Stephan Bogner and Philipp Schmitt are German designers (and sometimes artists), currently studying Interaction Design at the University of Design in Schwäbisch Gmünd, Germany. They are curious about new ways of using upcoming and established technologies. Stephan and Philipp are friends who enjoy working as a team to tackle topics such as machine vision or robotics. Their work has been featured on CreativeApplications, WIRED, Fast Company and at Bundes.Festival.Film.Technologies at the HKU.

Unseen Portraits

Artistic investigation of face-tracking algorithms, 2015
Philipp Schmitt &
Stephan Bogner (DE)

philippschmitt.com   @philippschmitt
stephanbogner.de   @st_phan

Daniel Kish's eyes were surgically removed before he was thirteen months old, to save him from an aggressive form of cancer. As Daniel grew up, he taught himself to see the world around him using echolocation. Daniel makes clicking noises with his tongue to understand his environment, navigating his surroundings by listening to the echoes as his clicks bounce off surfaces.

Seeing is not a metaphor for Daniel. He uses the same part of his brain — the visual cortex — to picture his surroundings as people with eyes do. It's just that the information comes in a different medium. It's sight without light.

This exhibit aims to give visitors a little glimpse into the world of sight without light by demonstrating one form of echolocation — seeing an object move closer to them by listening to the reflected sound of their own voice.

BIO

Story Inc is a New Zealand-based company that creates visitor experiences around the world. Daniel Kish is president of World Access for the Blind, and teaches others his echolocation technique. He believes that blind children can learn to see in this way, and lead richer and more independent lives as a result. He lives in Long Beach, California.

Sight Without Light

Exploring human echolocation, 2016
Story Inc & Daniel Kish
(NZ & US)

worldaccessfortheblind.org
storyinc.co.nz
@WAFTB
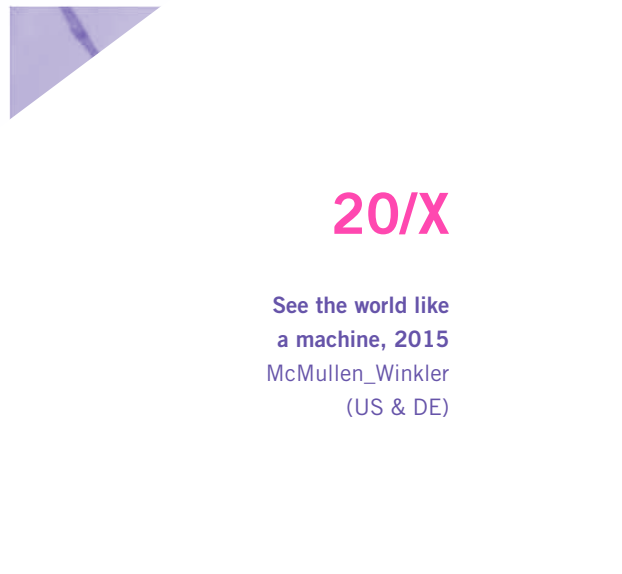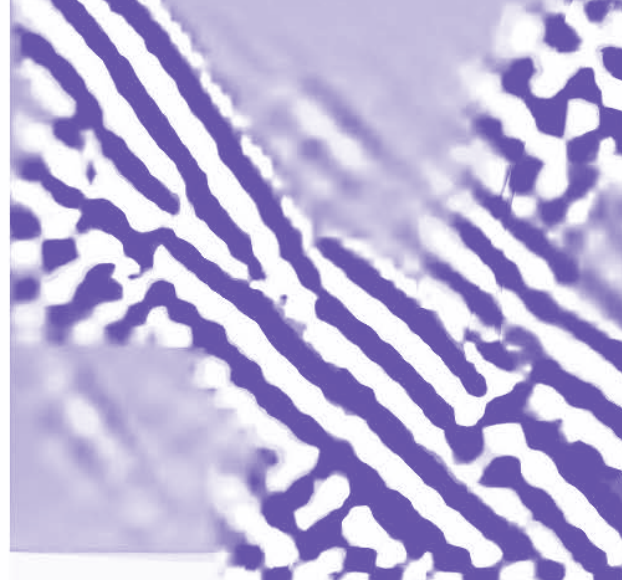
In order to understand, critique and shape the impact of machines that can exceed human vision capability, humans will need to learn to see like machines, to understand their rules and concepts, and their categorisations of things in the world.

20/X asks the question: do we need to acquire new literacy skills in the current culture of synthetic vision? This interactive interface allows users to navigate through the different levels of an algorithm used by a computer to identify objects in the world around them — from coarse and geometry-driven in the beginning to more specific and detail-oriented in the end. At this point, distinctive patterns, areas and objects that 'excite' the computer vision system can be identified.

The title of the work refers to the measurement of perfect human vision — 20/20 — contrasted with an as-yet unquantifiable measure of seeing for a computer vision system, represented by the variable "X". Visitors are invited to experience the process of seeing through a complex neural-network-based computer vision system to determine the value of "X" for themselves.

Based on an advanced synthetic vision system developed by Eugenio Culurciello and Alfredo Canziani in the Weldon School of Biomedical Engineering at Purdue University in the United States, *20/X* explores visuality, representation and knowledge in the age of intelligent seeing machines.

BIO

Shannon McMullen and Fabian Winkler (McMullen_Winkler) are interdisciplinary artists and researchers who use their backgrounds in new media art and sociology to produce collaborative artworks that combine image, code and installation to create temporary new social spaces and investigate relations between nature and technology. Their work has been shown internationally at venues such as the China Science and Technology Museum; Center for Art and Media Karlsruhe in Germany; VISAP '14 in Paris, France; Gallery on Wade in Toronto, Canada; and Art Center Nabi in Seoul, Korea. They have also published articles in *Leonardo; Plurale. Zeitschrift für Denkversionen*; *Media-N, Journal of the New Media Caucus*; *The Senses and Society*; and *The Environmentalist*. Their large-scale investigation at the intersection of art, engineering and science, Images of Nature, was awarded a grant from the National Science Foundation. Shannon and Fabian teach in the Electronic and Time-Based Art Program at Purdue University in West Lafayette in Indiana, USA.

gardensandmachines.com

20/X

**See the world like
a machine, 2015**
McMullen_Winkler
(US & DE)
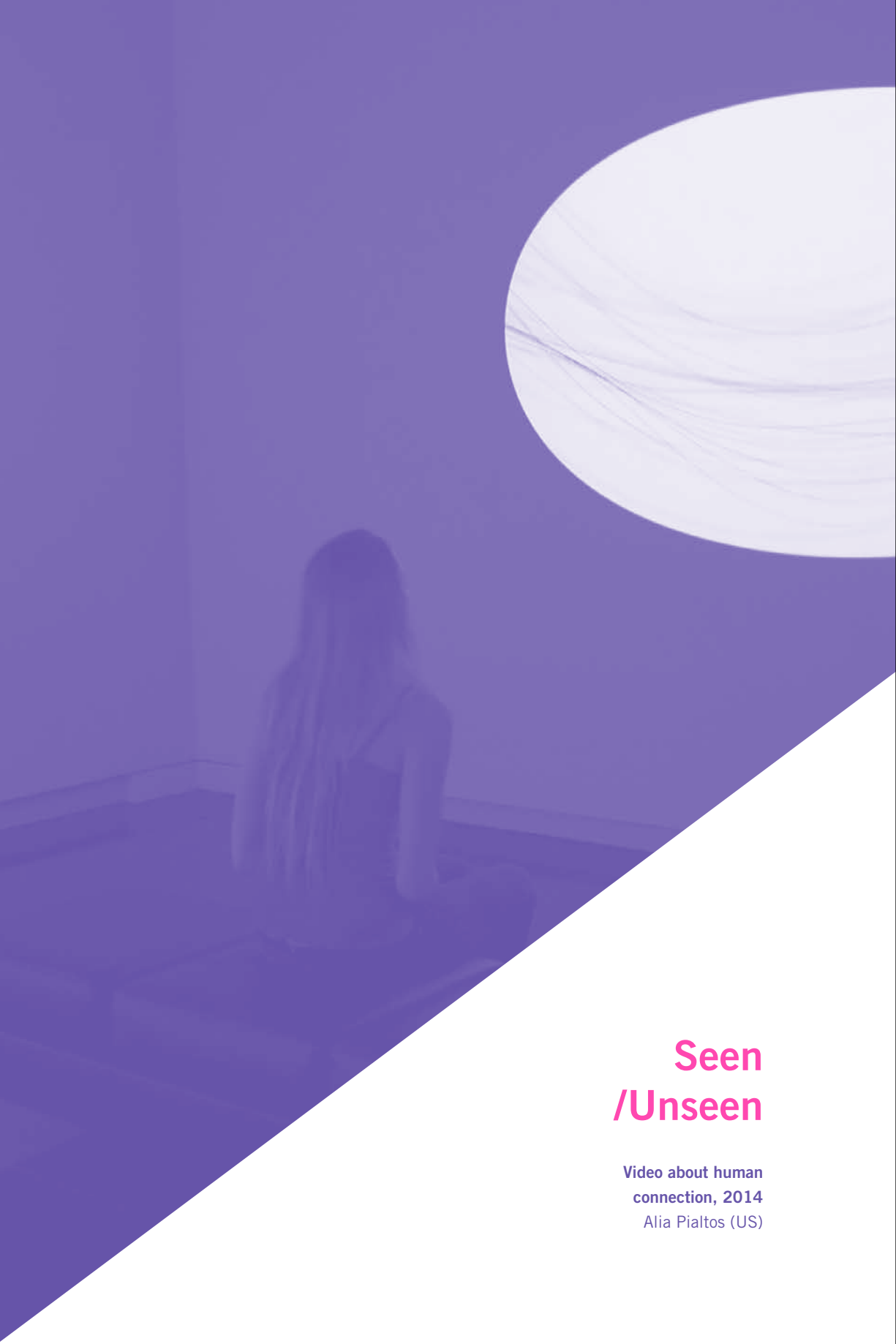
Seen/Unseen is a video projection that draws from human connection, amplifying the effects of the unconscious reactions we experience while engaging with others. It stems from a desire to visualise the gaze and to make visible the invisible sight lines between individuals.

In the piece, an oblong frame acts as a peephole or pupil that reveals a view of suspended threads which span across the frame. At first, the piece seems very abstract; the viewers are left to witness the curious movements of these hanging strings. Although the mechanisms that create the movements are not obvious at first, the delicate lines appear to be alive. Within the last few seconds of the video, a slow zoom reveals the source of the movement to the viewer. The use of the hair acts as a physical extension of the body and amplifies the effects of the unconscious reactions we experience while engaging with those to whom we feel closest.

Seen/Unseen is part of a series by the artist called *Projections of Ourselves*, a collection of works which offer suggestions for alternative ways of seeing our personal relationships. Beginning with a physiological process or psychological scenario, each piece aims to reimagine the way in which we understand our attachment to others.

BIO

Alia Pialtos is an American artist who explores ideas of connection, perception, and personal relationships through sculpture, installation, video installation, photography and performance. She has exhibited extensively within the United States at venues such as Hunter College in New York City; Glassell School of Art in Houston, Texas; The Clay Studio in Philadelphia; University of Colorado Art Museum; and the Kansas City Museum. In 2013, she received a grant through the Center for Craft, Creativity & Design in North Carolina to study connections between art and science. She is currently an Artist-in-Residence at Worcester Center for Crafts in Massachusetts.

Seen /Unseen

Video about human connection, 2014
Alia Pialtos (US)

aliapialtos.com
@aliapialtos

Using a pinhole camera — one of the simplest image-creating technologies — this installation demonstrates how light passing through tiny holes into a dark space projects an image.

A pinhole camera is a simple light-proof box with a small hole in one side. Light from outside passes through this single opening and projects an upside-down image onto the opposite side of the box. In the human eye, light shines through the cornea, which focuses images onto the retina, just as light through a lens projects an image onto film.

Seeing Stars expands on the single-lens image we are used to seeing with our eyes. The multiple pinhole 'lenses' project a galaxy-shaped cluster of lights onto ground glass. We recognise a starry pattern at first, but upon closer examination, we can see that each star is in fact a tiny image of what's on the opposite side of the device — in this case, a light bulb. Each view differs slightly depending on where the aperture is located within the overall star pattern.

BIO

Dianne Bos was born in Hamilton, Ontario in Canada, and received her B.F.A. from Mount Allison University in Sackville, New Brunswick. She currently divides her time between the foothills of the Rockies and the Pyrenees. Her photographs have been exhibited internationally in numerous group and solo exhibitions since 1981. Recent important national exhibitions of Dianne's work include: *Light Echo* at the McMaster Museum of Art, in collaboration with Astronomer Doug Welch, which linked celestial and earthly history; and *Reading Room* at the Cambridge Galleries, an exhibition exploring the book as a camera. Her work is currently part of the exhibition *Poetics of Light: Contemporary Pinhole Photography*, at the New Mexico History Museum. Her recent exhibitions include *See Attached*, a photographic dialogue with photographer Sarah Fuller; and *THE SLEEPING GREEN: No Man's Land 100 Years Later*, unique images inspired by World War 1 Canadian battlefields.

diannebos.ca
@DBosphoto

Seeing Stars

**Pinhole star projector
exploring light and
optics, 2003**
Dianne Bos (CA)

Lucida III

**Demonstrating the
mechanics of visual
perception, 2016**
Suki Chan (UK)

Lucida III **is an immersive moving image installation designed to show the viewer how we see
with our central and peripheral vision.**

Using eye tracking technology, the artwork invites the audience to participate and make the
discovery that their gaze changes what they are seeing and hearing.

At first, the visitor will see a still image of the endothelium — a single layer of hexagonal
cells on the inner surface of the cornea — accompanied by an atmospheric soundscape.
When a visitor sits on the seat in front of the screen, the movement of their gaze across this
still image begins to 'burn' through this cellular surface at precisely the area on which their
central vision is focused. Over time, the trajectory of their gaze and a view of the night sky are
simultaneously revealed.

For the audience watching this screen, they will be able to observe the rapid movement of
someone else's eyes and a trail of the trajectory of their gaze across the moving image artwork.
The atmospheric soundtrack responding to visitors' eye movements was composed by Dominik
Scherrer, winner of the 2014 Ivor Novello Award for Best Soundtrack for *Ripper Street* and a
2015 Emmy Awards nominee *The Missing*.

Lucida III is supported by the Wellcome Trust Small Arts Awards and Arts Council England.

BIO

Suki Chan is a London-based moving image and installation artist. Suki studied at Goldsmiths,
University of London and Chelsea College of Art. Her practice combines light, moving image
and sound to explore our physical and psychological experience of time and space. Suki is
currently a recipient of a Wellcome Trust Small Arts Award and a Grant for the Arts Award from
the Arts Council of England to develop *Lucida*, a project exploring perception. *Lucida* seeks
to make the viewer distinctly aware of seeing by bringing the perceptual process — including
its flaws, imperfections and assumptions — to the forefront. *Lucida* is commissioned by
the Centre for Chinese Contemporary Art and the University of Salford art collection, and
culminates in a UK tour of interactive moving image artworks and a publication.

**sukichan.co.uk
lucidafilm.com
@missSukiChan**

We are increasingly living our lives through filters. Through social networks, through smartphones, through the coil of fibre and unseen airborne signals. In the communication age, we very often speak to the ones closest to us through digital means. The screen is no longer a window to somewhere else; it is, instead, the here and now, while our physical surroundings are slowly becoming the 'other world'. We're closer, yet further apart, than ever.

Screen Mutations explores the growing role of video communication applications — such as Skype and Facetime — in blurring the line between the physical and digital world. It imagines a speculative future where our physical reality is deformed to be viewed through a camera. This is achieved by designing a set of props — cups, teapots, utensils — that look deformed off-screen, while on-screen they look 'normal' due to optical illusions achieved by the geometric distortion of a 3D object. Thus, the point of view of the webcam becomes the main design tool.

The result is like a reversal of a Salvador Dali painting: the objects have surrealistic and impractical shapes in the tangible world, while the image as it appears digitally seems to suggest otherwise.

BIO

Louisa Zahareas grew up in a diverse family with Greek, American, Spanish and Russian influences. After studying architecture in Greece and architectural design in Minnesota, she continued her studies to get an M.A. in Social Design from the Design Academy in Eindhoven, Germany. Louisa's work has been focused primarily around perception, and it strives to challenge our increasingly visual culture. Her projects use illusion, perceptive tricks and other techniques to remind the viewer that the space between the real and the virtual is becoming increasingly blurred. Louisa communicates the story through the use of video and performance. She doesn't consider the objects that she designs products, but props that facilitate and guide the plot of a fictional narrative.
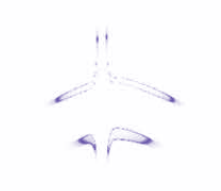
Screen Mutations

Deforming reality to fit the screen, 2015
Louisa Zahareas (GR)

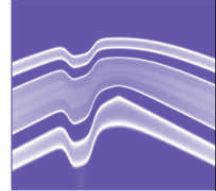**Iamdazita.com**
@ZahareasLouisa

Pole
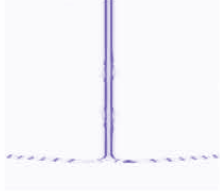
Stupa

Space Shuttle

Perfume

Quill

Swing

Prison

Sunglasses

Snowmobile

Studio Couch

Shower Cap

Projector

Sunglass

Stove

Theater Curtain

The Innovation Engine

Get an insight into how a computer 'thinks' and 'sees', 2015
Frederik De Wilde (BE),
in collaboration with Jeff Clune
and Anh Nguyen (US)

Machines can't do what the human imagination can… yet. This installation researches the failure of machines and computers to simulate the human mind. The artist was inspired by the inability of machines to accurately simulate the process of evolution due to their lack of processing power and other key functions required to run complex simulations.

A touchscreen allows the visitor to navigate through and explore a deep neural network. In machines, an artificial neural network is a computer algorithm inspired by the central nervous systems of animals. The webcam analyses in realtime what it sees and what it has been 'taught' to detect. What is detected is visualised as highlighted artificial neurons. The audience can then browse through all the neural layers and get an insight into how a computer 'thinks' and 'sees'. A voice tells visitors which layer they are looking at and what's happening. In a lot of cases, the visitor may not recognise these images, but the artificial intelligence appears to, demonstrating the limits of machine comprehension.

This work demonstrates how A.I. and deep neural networks are easily fooled, a dystopian thought when you take into account the fact that they are already used by the military, drones, and Tesla's self-driving cars. How much confidence do we have in ourselves and the technologies we develop? Or in societies and industries that are accelerating the development of A.I. and automatisation?

BIO

Frederik De Wilde works at the intersection of art, science and technology. The conceptual core of his artistic practice is the notion of the inaudible, intangible and invisible — as exemplified by the conceptualisation and creation of the Blackest-Black art, made in collaboration with NASA. The project received the Ars Electronica Next Idea Award, the Best European Collaboration Award between an artist and scientist, and it was extensively covered by *The Huffington Post*, The Creators Project, TED, and more. In 2016, Frederik was a finalist in *Giant Steps: Artist Residency on the Moon*, a speculative exhibition about making art on the Moon. Frederik has collaborated with the Karlsruhe Institute of Technology Collective MicroRobotics lab, is a finalist of the ZKM AppArtAward with *Coremites*, and often uses data — like data visualisations and sonifications — as a source for his creations.

frederik-de-wilde.com

3RNP

**A human model is drawn by three
robots named Paul, 2014**
Patrick Tresset (FR)

**3RNP — or '3 Robots Named Paul' — is a theatrical robotic installation where the human
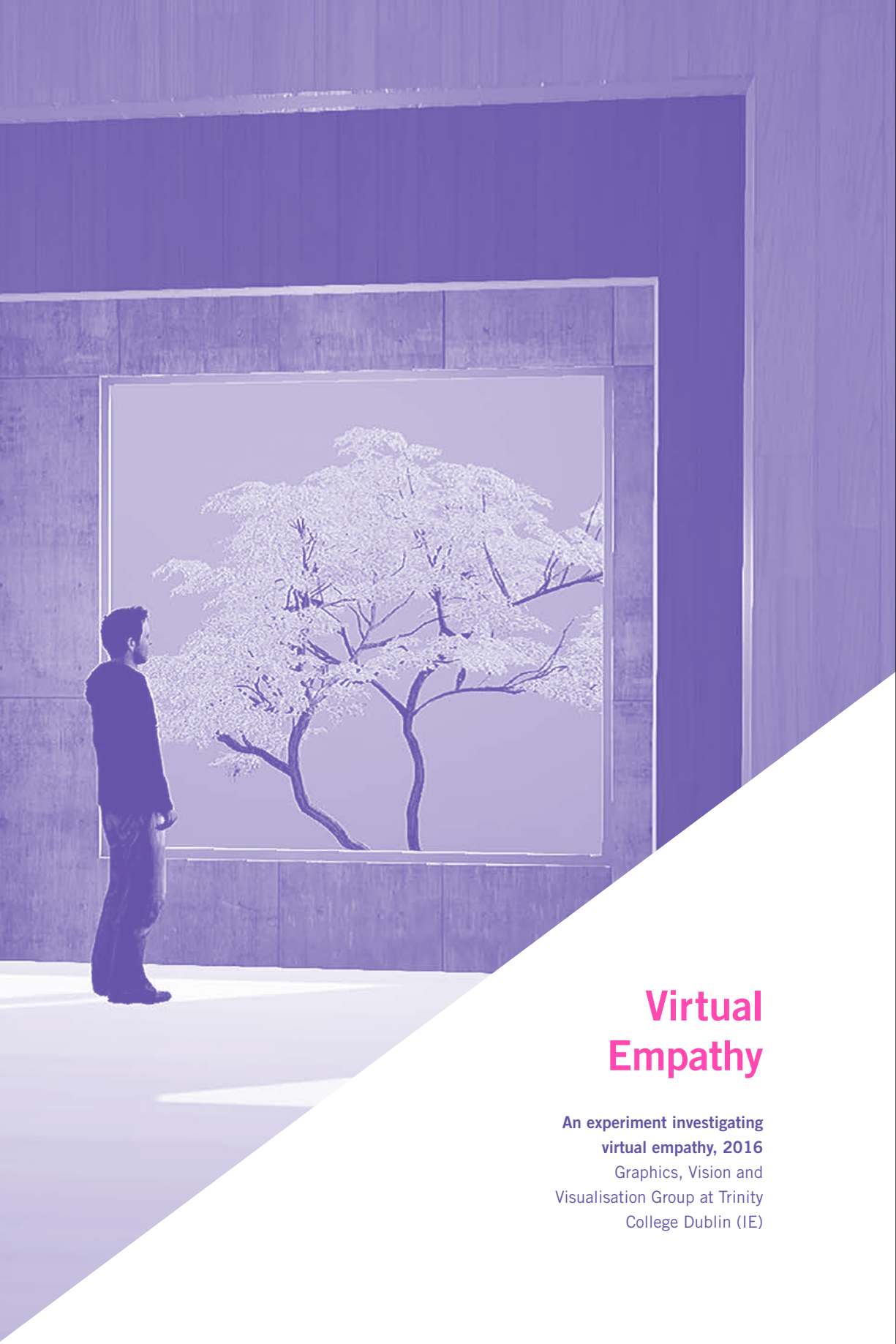becomes a model.**

In a scene reminiscent of a life drawing class, the human takes the sitter's role and is
sketched by three robots, drawing obsessively. Their bodies are old school desks. The drawing
sessions last up to forty minutes, during which time the human cannot see the drawings
in progress. The sitter only sees the robots alternating between observing and drawing,
sometimes pausing between the two. The sounds produced by each robot's motors create an
improvised soundtrack.

As the model in a life drawing class, the human is personality-less, an object of study. The
human sitter is passive, the robots taking what is perceived as the artistic role. Visitors to
Science Gallery Dublin can sit for the robots and receive a digital version of their portraits.
Will a computer see you the way you see yourself?

BIO

Patrick Tresset is a London-based artist, originally from France, who creates theatrical
installations with robotic agents as actors or cybernetic evocations of humanness. Patrick's
installations use computational systems which aim to introduce artistic, expressive and
obsessive aspects to robots' behaviour. These systems are influenced by research into
human behaviour and, more specifically, how human artists depict other humans, as well
as how humans perceive artworks and how humans relate to robots. Patrick also develops
and uses robots and autonomous computational systems to produce drawings, paintings and
animations. His award-winning work has been internationally exhibited in association with
major museums and institutions such as the Centre Georges Pompidou in Paris, the Tate
Modern in London, the Israel Museum, the Victoria & Albert Museum in London, MMCA
in Seoul, BOZAR in Brussels, the Fondazione Prada in Milan, and at events such as Ars
Electronica, Update_5, WRO2015, BIAN, London Art Fair, Kinetica and Istanbul Biennial.

patricktresset.com
@patricktresset

What happens to the empathy levels of users when virtual characters are depicted in emotionally charged scenarios? This experiment measures the level of responsiveness and warmth visitors have towards virtual characters in highly immersive virtual reality.
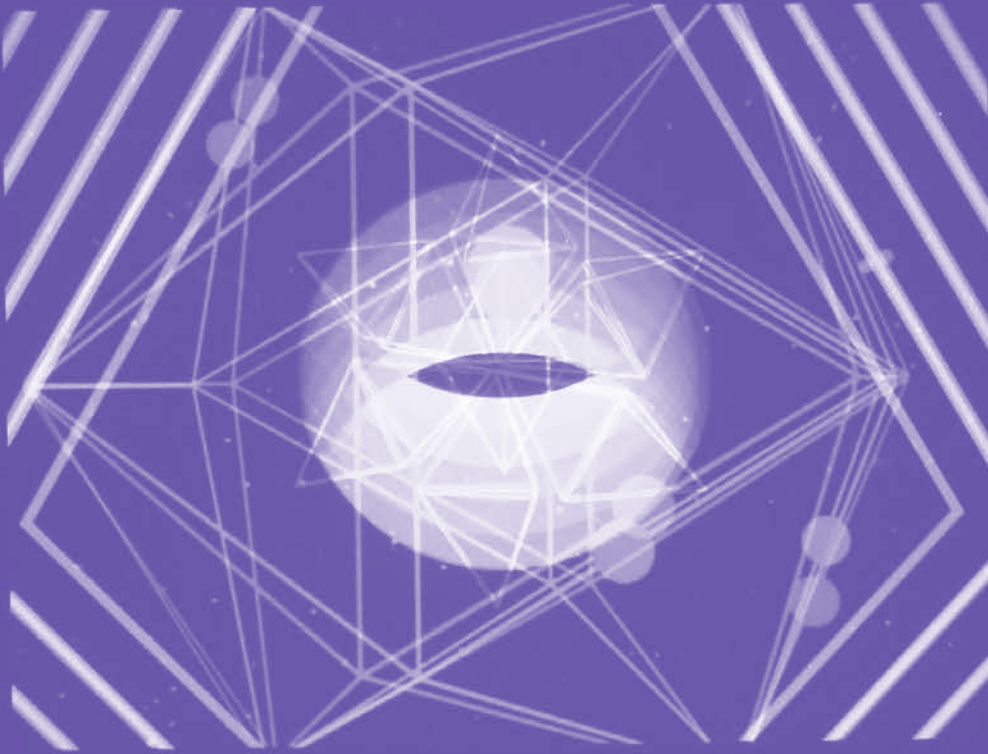
When they don an Oculus Rift and co-exist with an avatar in virtual reality, do visitors have higher levels of rapport with the character than they would with a typical character displayed in movies and games? Will high levels of visual realism in the character affect their empathy levels?

The project involves visitors making decisions about the feelings they are experiencing while co-existing with realistic virtual humans, seeking a deeper understanding of human empathy.

BIO

The Graphics, Vision and Visualisation group (GV2) at Trinity College Dublin is an internationally active research group dedicated to carrying out innovative research in computer graphics, computer vision and all aspects of visual computing.

Virtual Empathy

An experiment investigating virtual empathy, 2016
Graphics, Vision and Visualisation Group at Trinity College Dublin (IE)

gv2.scss.tcd.ie

**Synesthesia:
Colored Music**

Interactive installation inspired by
synesthetic experiences, 2012
Rox Vazquez (AR)

Has a sound ever reminded you of a shape, colour or taste? The term "synaesthesia" is formed from the fusion of the Ancient Greek words for "together" and "sensation". Synaesthesia is a rare neurological condition in which different sensations perceived by different senses are mixed up. In one of the most common forms of synesthesia, letters or numbers are perceived as coloured. A synaesthetic person may have the capacity to 'hear' colour, 'see' music, or even perceive different taste sensations by touching objects with certain textures.

When they describe their experience, synaesthetes often talk about visual shapes on a 'screen' located in front of their faces. Through the use of new technologies, this project aims to bring you closer to an audiovisual synaesthetic experience. Using coloured shapes, a camera, a screen and a programming tool, participants can assemble a sequence of colours and a computer will transform it into an audio-visual experience. This merging of senses evokes the experience of synaesthesia.

BIO

An Argentinian graphic designer, illustrator and motionographer, Rox Vazquez started her career working in post-production for movies, commercials and video games. In 2011 she started experimenting as a VJ, using video mapping techniques and working with artists at different cultural events in Buenos Aires, San Francisco, California and Berlin. In 2012, she presented her *Synesthesia: Colored Music* project at Pixelations in Argentina. In 2014, she developed new collaborative digital installations called *+++* and *Biot-Hub*, which were presented at the Let It Vj Festival and at the Cinematographic Investigation Center in Buenos Aires. Her last digital collaborative art piece, called *SynBiosis*, was exhibited at Espacio Pla and is currently at the Contemporary Art Space in Uruguay.
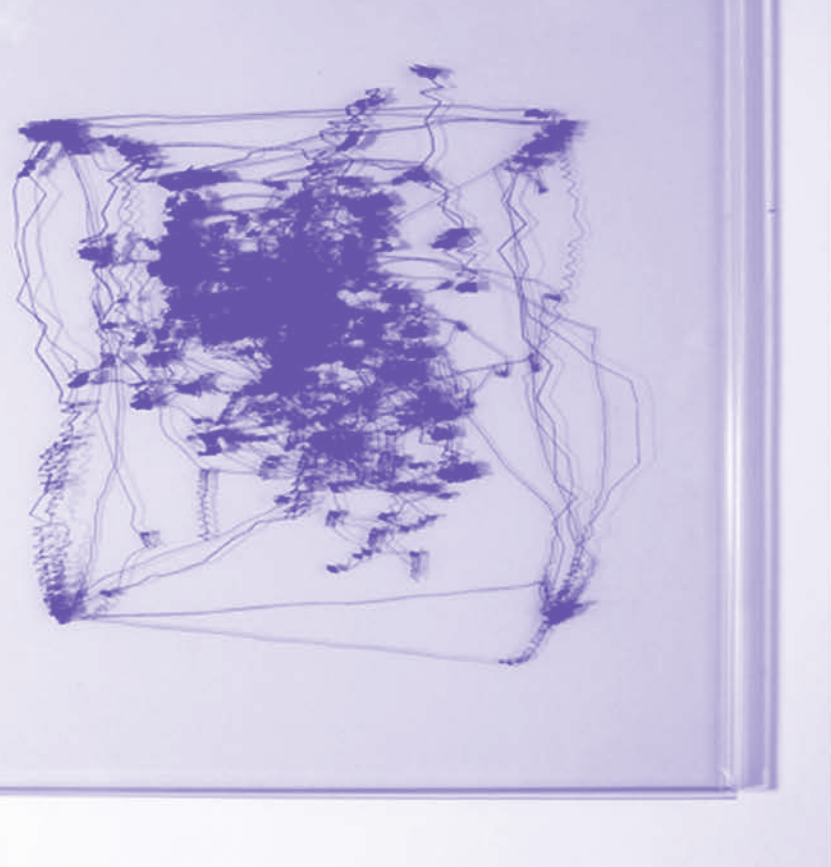
roxvazquez.com
@vj_roxvazquez

You step into a room. The walls are made up of coloured stripes. Above you, red, green and blue lights cycle through the spectrum of different colours. As the lighting changes, the walls around you seem to throb and move.

Magical Colour Space looks at the basics of colour perception. When light hits an object, the object absorbs some of the light wavelengths and reflects the rest. The human eye and brain work together to translate this reflected light into colour. As the light in *Magical Colour Space* slowly changes its proportions of red, green and blue, the coloured stripes on the wall reflect only the wavelengths in their own colour. Because the brain uses changes in light levels to help detect motion, this creates the illusion that the walls are moving.

BIO

Kurt Laurenz Theinert is a photographer and light artist who concentrates his work on visual experiences that do not refer, as images, to anything. Instead, he strives for an abstract, reductive aesthetic, which has ultimately led him to switch from photography to light as a medium. In his installations he creates dynamic light environments that transform the perception of space.

Magical
Colour Space

**Experience your colour perception
in a poetic way, 2015**
Kurt Laurenz Theinert (DE)

theinert-lichtkunst.de

Eye-tracking technology forms the basis of *Blanks*, a series of portraits characterised by the figure four. Four people each looked at a square sheet of blank paper, their range of vision restricted to a 40x40 cm section, for a single minute. Their eye movements are recorded in black on a pane of glass.

This process was repeated four times for each portrait, with each pane then placed on top of the others to create a single level. The first time, eye movements are recorded while the subject views the blank paper. The second time, the subject is presented with a recording of the eye movements from the first, and their eye movements recorded as they observe this. Likewise for the third and fourth times.

Thus, the subject and the observer are embodied as one in the piece. The piece recounts a dialogue between the person as the observer and the person as the subject.

Standing directly in front of the composition, all the levels merge and the pieces can be viewed as one image. Only by changing the angle of observation can the viewer distinguish individual layers and the dialogues between the different viewing processes.

BIO

Angelika Böck is a visual artist and interior architect. Her work deals with the phenomena of human perception, and contains elements from both art and research derived from field studies within different cultural settings. Her artwork ranges from eye drawing and video to installation, photography, text and sculpture, and it has been exhibited internationally. It has also been published in art catalogues, scientific journals and books. She currently lives and works in Munich, Germany and Bario, Malaysia.

Blanks

**Capturing visual tracks
across blank paper, 1996**
Angelika Böck (DE)

angelika-boeck.de/en

D-EYE is a sophisticated lens that attaches to a smartphone and uses the light source and camera of the phone to capture an image of the back of the eye — the retina. It is a low-cost and portable modern-day digital ophthalmoscope, a device that allows you to see the structures inside the eye. It is used as a screening tool by healthcare professionals to examine the retinal wall for signs of health issues.

The retina is a window to our health, and can reveal diseases such as diabetes, glaucoma, age-related macular degeneration, hypertension, and melanomas or cancers. According to the World Health Organization, almost 300 million people in the world suffer from vision loss, and 80% of those people could have avoided losing their sight with earlier intervention.

D-EYE can be used in rural or remote areas, and retinal images can be transmitted via cellular networks, connecting to a care team wherever they may be. *D-EYE* is a pocket-sized telehealth solution that could potentially help millions of people worldwide.

BIO

Andrea Russo M.D., is an ophthalmologist in Brescia, Italy. He has authored and co-authored numerous articles on clinical investigations of glaucoma and retinal diseases. Andrea received his medical degree from the University of Brescia, and served an observership at Moorfields Eye Hospital in London. He serves as the medical advisor for *D-EYE*.

D-EYE

**Smartphone-based retinal
screening device, 2014**
Andrea Russo (IT)

d-eyecare.com
@DEYE2015

At the heart of *SIMULACRA* are four LCD monitor panels, assembled in the form of a hollow square. The ensemble appears to have been gutted, and looks almost overgrown. A tangle of cables and control devices pours out of the middle of the square. Around it, several magnifying lenses with polarised lenses dangle from chains. The monitors don't display any pictures, and shine with an intense white light — but with the help of the magnifying lenses, function is restored to the screens and their secrets are revealed. Is this process happening in our brains, or in the lenses?

SIMULACRA builds a bridge between technology and perception, and explores the difference between subject and view, and between image and reality.

BIO

Karina Smigla-Bobinski lives and works as a freelance intermedia artist in Munich and Berlin, Germany. She studied art and visual communication at the Academy of Fine Arts in Krakow, Poland and in Munich. Karina works with analogue and digital media, and produces and collaborates on projects ranging from kinetic sculptures to interactive installations and art interventions, which feature mixed reality and interactive art objects. She also works with video, multimedia physical theatre performances and online projects. Her works have been shown in 43 countries on five continents at festivals, galleries and museums. Currently, she is a Visiting Research Fellow and Artist in Residence at ZiF Center for Interdisciplinary Research, Bielefeld University's Institute for Advanced Study in Germany. She has broadcast and lectured widely and held artist residencies at many universities and cultural organisations worldwide.

SIMULACRA

Images appear as if from nowhere, 2013
Karina Smigla-Bobinski (DE)

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How can we sense distant objects without vision? This question led to the development of the *EyeCane*: **a lightweight, finger-sized, low-cost virtual cane. The** *EyeCane* **operates as a kind of virtual flashlight, replacing or strengthening the familiar white cane.**

The device uses infrared sensors to estimate the distance between the user and the object at which it is pointing. This information undergoes a 'sensory transformation' and becomes vibrations, which are sent to the user's hand via the device. The closer the user is to an object, the stronger the vibration. This allows people who are blind or who have a visual impairment to identify obstacles of different heights, understand the distance between themselves and the objects around them, and create a spatial picture through which they can navigate safely. The device is intuitive, and its application can be taught with a few minutes of use.

BIO

Amir Amedi is an internationally acclaimed brain scientist with fifteen years of experience in the field of brain plasticity and multisensory integration. He has a particular interest in visual rehabilitation. He is an Associate Professor at the Department of Medical Neurobiology at the Hebrew University of Jerusalem and the The Edmond & Lily Safra Center for Brain Sciences. He is also an Adjoint Research Professor in the Sorbonne Universités and the Institut de la Vision in Paris, France. He holds a PhD in Computational Neuroscience from the Interdisciplinary Center for Neural Computation at Hebrew University, and a Postdoctoral Fellow and Instructor of Neurology at Harvard Medical School. Amir has won several international awards and fellowships such as The Krill Prize for Excellence in Scientific Research, the Wolf Foundation (2011); The international Human Frontiers Science Program Organization Postdoctoral fellowship and later a Career Development award (2004 and 2009), and the JSMF Scholar Award in Understanding Human Cognition (2011). He was recently selected as a European Research Council (ERC) fellow.

EyeCane

**Unobtrusive mobility aid
for blind people, 2010**
Amir Amedi & the Hebrew
University of Jerusalem (IL)

**brainvisionrehab.com
@AmediLab**

What does it mean, "to see"? Can a person with sight loss 'see' again by substituting one sense for another using? *The vOICe* **is an interactive demonstration of a sensory substitution device technology that allows people to see with sound.**

Sensory substitution devices for people with a visual impairment provide for missing visual input by converting images into a format that another sense can process non-invasively, such as sound. This is possible due to neuroplasticity — the ability the brain has to reorganise itself throughout an individual's life by creating new neural pathways to adapt to changes as it needs to, whether that be as a result of changes in the environment or injury.

The vOICe, invented by Dutch engineer Peter Meijer, is now being used by Michael Proulx and other cognitive neuroscientists, philosophers and artists to explore the nature of the senses and how the brain allows us to see, even without vision.

BIO

Michael J. Proulx is Senior Lecturer in Psychology and Director of the Crossmodal Cognition Lab at the University of Bath. He also works with the Centre for Digital Entertainment in the Department of Computer Science. He investigates several aspects of multisensory cognition with a particular interest in the impact of blindness on cognition and assistive technology. His interdisciplinary research spans psychology, computer science, neuroscience, and biology, in collaboration with researchers in several countries. He received his Ph.D. in Psychological and Brain Sciences from Johns Hopkins University, and his B.Sc. in Psychology from Arizona State University. He is a Fellow of the Society for Experimental Psychology and Cognitive Science in the American Psychological Association, and was a torchbearer for the London 2012 Paralympic Games.

bath.ac.uk/psychology/staff/michael-proulx
@MichaelProulx

The vOICe: Seeing with Sound

Device that turns images into sound, 2016
Michael Proulx (US)

Peeping Hole

**A simple hole betrays
your eyes, 2010**
Kenichi Okada &
Naoaki Fujimoto (JP)

In the near future, it's possible that we will use our eyes not only to take in information but also to deliver information. What if our gaze was monitored by someone else? How would we feel and how would this affect our communication?

Peeping Hole is an interactive installation that tracks a viewer's gaze and reveals what they are staring at to an audience, without the viewer noticing.

Though a small hole in the exhibit, visitors will gaze at an image. The audiences around the viewer can see what they are staring at, thanks to eye tracking technology. The viewer may not notice their audience and what they can see until the next visitor steps up to view the exhibit. *Peeping Hole* is a playful look at vision monitoring and privacy, but will this technology become ubiquitous in the years to come, and how will it be used?

BIO

Kenichi Okada is an artist, designer and researcher with a keen interest in analogue and digital interaction. After studying at Royal College of Art in the UK, he worked at Sony's Creative Center. The aim of his artistic study is to design a trigger for creation by using several media such as films, products and installations. Kenichi's works have been shown in several museums, including the Museum of Modern Art in New York and 21_21 DESIGN SIGHT in Tokyo. Naoaki Fujimoto graduated from Tokyo Institute of Technology's Department of Physics. After being involved in the development of interactive content and digital signage as a programmer, Naoaki started his own business in 2009. He now develops artworks using physics calculations and technology like image recognition and, and creates pieces that place emphasis on experiences. One of his representative works is an interactive projection mapping piece, *Immersive Shadow*.

kenichiokada.com
@naokiring_en
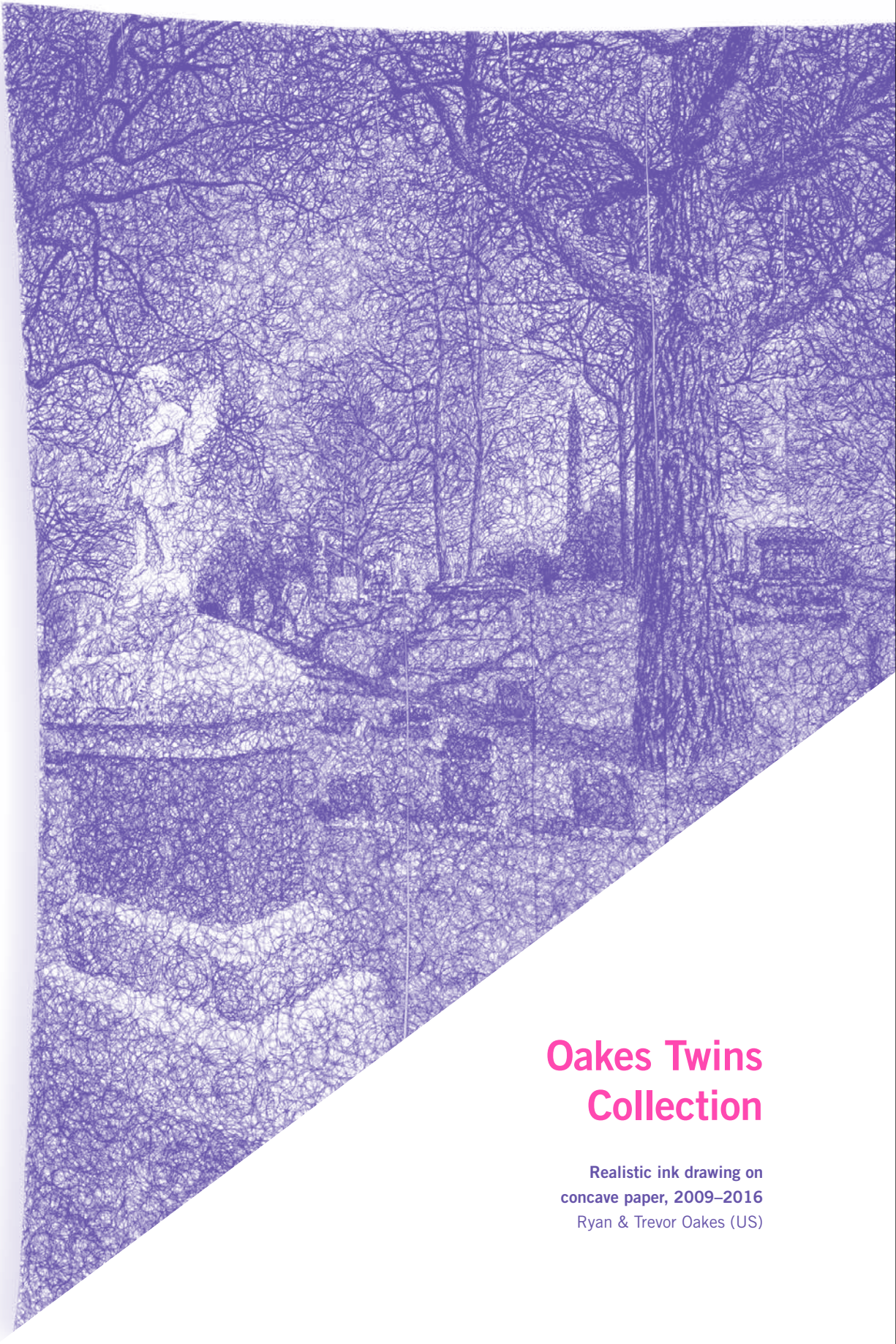
Oakes Twins Collection

**Realistic ink drawing on
concave paper, 2009–2016**
Ryan & Trevor Oakes (US)

While analysing human vision, twins Ryan and Trevor Oakes noticed that when looking beyond a foreground object to the distance, a person's two eyes split the near object into a transparent double image of itself. With this optical phenomenon, they invented a drawing technique. To acknowledge the fanned-out formation of light rays human eyes see, they construct curved paper and support it with a concave easel. To draw, they split their pen into a double image simply by looking past it. Holding the pen's left image to the right edge of the curved drawing paper, the pen's right image will hover in mid-air beyond the paper's edge. The hovering pen may then trace over the distant scene, thereby simultaneously marking the scene's proportions onto the paper.

By contrast to many artworks that render the world and human vision as flat, the Oakes Twins' art corresponds to the natural curvature of the human eye, and their position as viewers at the centre of a sphere of visual experience.

Their artworks shown in SEEING include *Have No Narrow Perspectives: Field Museum* (black line period), *Ocean Horizon Line 2: Pacific Coast Highway*, *Los Angeles, CA* (colour period), *Evergreen Cemetery in Late Winter* (swirlism period), *Bond Street Terrace* (ripples period), and a brand new piece Ryan and Trevor will work on during the show.

BIO

Ryan and Trevor Oakes are twin brothers from New York who have been engaged in a conversation about the nuances of vision since they were children. They explored their mutual fascination with vision throughout grade school and during college at Cooper Union's School of Art in New York City. Since graduating in 2004, they've continued their dialogue with jointly built artworks addressing human vision, light, perception, and the experience of space and depth. Ryan and Trevor have artwork in the permanent collections of the Museum of Modern Art and the New York Public Library in New York City, The Field Museum and the Spertus Institute for Jewish Learning and Leadership Museum in Chicago, and the Getty Research Institute in Los Angeles.

oakesoakes.com   @oakes_r
@oakestwins   @oakes_t

Mirror II - Distance examines the distances between individuals who occupy, protect and work in worlds that they don't really belong to.

The Diplomatic Enclave in Islamabad is a heavily gated expat community in the capital city of Pakistan. This enclave is cut off from the rest of the country by high walls and heavy security. Inside the enclave is a network of country and organisational compounds further barricaded from each other.

Entry into the enclave and entry into the various demarcated territories inside is monitored by local Pakistani guards. These men are privy to the culture, conversations and experiences of the international communities that they are responsible to protect.

In this piece, two Pakistani guards stand watch over the expat compounds. They observe each other from a distance as they listen to the visitors, experts and specialists discuss Pakistan, its people, and its future.

Using a cable mounted camera system, both forward and rear views are filmed simultaneously. This piece uses an experimental filming format called "collimation", which manipulates perception to provide an illusion of depth.

This installation is part of the *Mirror* project, a series of two-screen works devised to provide insight into global communities that experience distancing and objectification.

BIO

David Cotterrell is one of Britain's leading visual artists. He uses media and technology to explore the social and political tendencies of a world at once shared and divided. His work has been commissioned and shown extensively in Europe, the United States and Asia. He is Director of Research at the University of Brighton and is represented by Danielle Arnaud. Ruwanthie de Chickera, an Eisenhower Fellow, is a leading playwright, screenwriter and theatre director from Sri Lanka. Her award winning film *Machan* has been screened in over fifty countries. She is the Artistic Director of Stages Theatre Group, an ensemble theatre company that produces socially and politically conscious original Sri Lankan Theatre.

cotterrell.com
stages.lk
@davidcotterrell

Mirror II - Distance

An expanded cinema dialogue between strangers, 2016
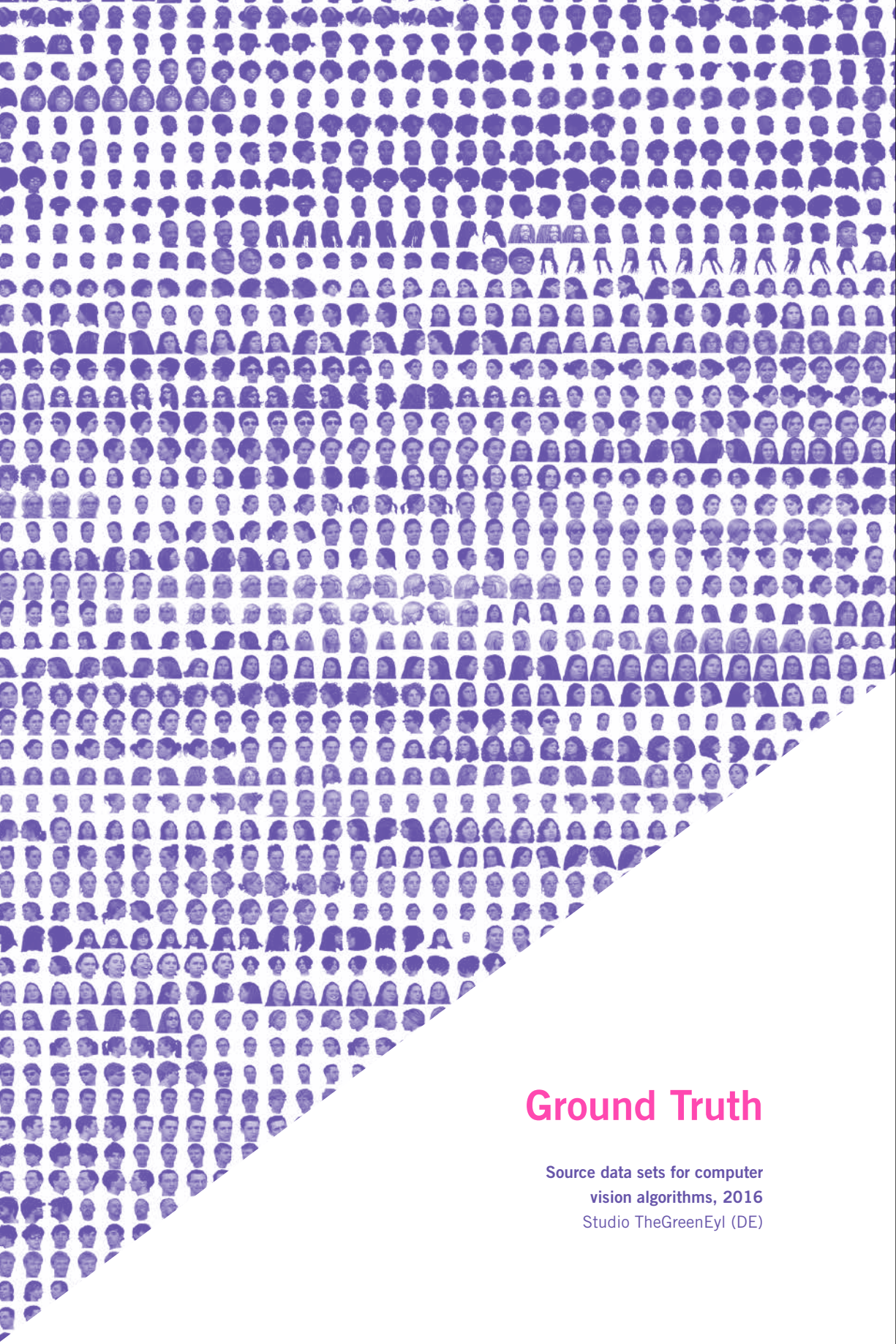David Cotterrell (UK) & Ruwanthie de Chickera (LK)

The Unresolved Image **is a structural, fractal-like image that resolves one image into another. As you walk towards it, you zoom deeper into its layers of images, from architectural to microscopic scale. It is an investigation into the topic of visual resolution and granularity of data, and ultimately explores the limits of our perception and comprehension.**

The image has a resolution of approximately 10,000 dpi, most common in semiconductor manufacturing. It is composed of myriads of images from different data-sets that are used in computer vision to teach machines to recognise and understand the human body. As the propagation of computer vision increases, so does the quantisation of data about the body: posture, face structure, fingerprints, ear shapes, iris patterns, veins – they all become machine readable aspects of the human.

BIO

Richard The is a graphic and interaction designer. After having studied at University of the Arts Berlin and the MIT Media Lab he has worked at Sagmeister Inc. and Google Creative Lab in New York. Frédéric Eyl holds a masters degree from the University of the Arts Berlin and is a founding partner at Studio TheGreenEyl Berlin, a design practice based in Berlin and New York. They create exhibitions, installations, objects, graphics and algorithms. In the past they have developed the algorithmic corporate design for the MIT Media Lab, have created various installations for exhibitions at the Jewish Museum Berlin, Museum für Naturkunde, GRIMMWELT Kassel. Their work has been exhibited at the MoMA New York, Ars Electronica in Linz, Bauhaus-Archiv Berlin and at the Design Museum, London.

The Unresolved Image

A fractal-like image which changes depending on distance, 2016
Studio TheGreenEyl (DE & FR)

thegreeneyl.com
@thegreeneyl

Today, computer vision plays an essential role in everything from robotics and healthcare to surveillance. In order to train algorithms to see, researchers feed them with image data sets, which are translated into statistical models. These models in turn form the basis of computer vision software, for example for face tracking or optical character recognition.

Ground Truth is a collection of image data sets of the human body — such as faces, fingerprints and hand gestures. Mapping them out as large format prints lets us see images we usually never get to see. What are the aesthetics of these data sets? What are their peculiarities? How large are they? How many faces are enough to develop a face recognition algorithm? What is included, what is not included? What are possible biases?

BIO

Richard The is a graphic and interaction designer. Having studied at University of the Arts Berlin and the MIT Media Lab, he has worked at Sagmeister Inc. and Google Creative Lab in New York. Frédéric Eyl holds a masters degree from the University of the Arts Berlin and is a founding partner at Studio TheGreenEyl Berlin, a design practice based in Berlin and New York. They create exhibitions, installations, objects, graphics and algorithms. In the past they have developed the algorithmic corporate design for the MIT Media Lab, have created various installations for exhibitions at the Jewish Museum Berlin, Museum of Natural History Berlin, GRIMMWELT Kassel. Their work has been exhibited at the MoMA New York, Ars Electronica in Linz, Bauhaus-Archiv Berlin and at the Design Museum, London.

Ground Truth

Source data sets for computer
vision algorithms, 2016
Studio TheGreenEyl (DE)

thegreeneyl.com
@thegreeneyl

Mobility Device & White Cane Amplified

Documentaries of collaborative
performances, 2013 & 2015
Carmen Papalia (CA)

Mobility Device is a collaborative performance in which Carmen Papalia is accompanied by a marching band to replace his white cane as his primary means of gathering information about his surroundings. As a piece of music, *Mobility Device* is an extension of the musicality of the white cane — fixtures such as curbs, lampposts and sandwich boards become notes in the soundscape of a place. *Mobility Device* proposes the possibility of user-generated, creative process-based systems of access. It represents a non-institutional (and non-institutionalising) temporary solution for the problem of the white cane. On 1 June 2013, Carmen performed a site-specific rendition of *Mobility Device*, with accompaniment by the Great Centurion Marching Band from Century High School, at the Grand Central Art Center in Santa Ana, California.

White Cane Amplified documents the experiential research that Carmen conducted in preparation for a visit to the Franklin W. Olin College of Engineering in Massachusetts, where he is currently producing an acoustic mobility device in collaboration with students in Sara Hendren's 'Investigating Normal' class.

The narrative depicts Carmen speaking into a bullhorn as he attempts to perform the social function of the white cane while maintaining his agency, finding support and communicating his nuanced and emergent needs.

BIO

Carmen Papalia designs experiences that invite those involved to expand their perceptual mobility and claim access to public and institutional spaces. He is a Social Practice artist who makes participatory projects on the topic of access as it relates to public space, art and visual culture. Carmen is the recipient of the 2014 Adam Reynolds Memorial Bursary and the 2013 Wynn Newhouse Award. In 2015, Carmen served as artist-in-residence at the Victoria & Albert Museum in London and at the Model Contemporary Art Centre (Sligo, IE) where he made site-specific interventions in response to a history of disabling practices at each institution. His work has been featured at the Guggenheim museum, MoMA New York, the Whitney Museum, the L.A. Craft and Folk Art Museum, the CUE Art Foundation, the Portland Art Museum and the Vancouver Art Gallery.

carmenpapalia.com

In association with renowned eye surgeon Kate Coleman, me&him&you present a contemporary take on the eye test. The aim is to illustrate Kate's vision to 'democratise' eye care, making vision testing possible across the world in, quite literally, 'the blink of an eye'. Visitors will be able to test their own eyesight using two machines from optical equipment supplier, Topcon — an Automatic Refractor and a Non-Mydriatic Fundus Camera — while learning about the latest advancements in digital eye testing.

me&him&you have also worked with Kate to present a contemporary take on the classic colour blindness test in the Science Gallery Café, drawing on abstract expressionism and colours of the rainbow to explore the spectrum of light in a two-dimensional piece.

This exhibit was made possible through support from CAP Advisers Ltd, Colombus Circle Investments, Inkspo, Kinsale Capital Investment, Ocuco, Ovelle and Topcon.

BIO

me&him&you are an Irish boutique design agency established in 2010 by Ronan Dillon and Peter O'Gara. They are creatively and strategically led and love what they do. Kate Coleman is an ophthalmologist and general ophthalmic surgeon. Kate has a special interest in global health, in particular needless blindness. She founded Right to Sight in 2006 and is currently coordinating an international movement to contribute to the elimination of preventable blindness.

Eye Care Works

Eye tests in the blink of an eye, 2016
me&him&you and Kate Coleman (IE)

meandhimandyou.com
@meandhimandyou

AC-KNOW-LEDGE-ME-NTS

CURATORS:

Kate Coleman — Consultant eye and oculoplastic surgeon, and founder of Right to Sight

Gerry Lacey — Associate Professor of Computer Science at Trinity College Dublin, and CEO and co-founder of SureWash

Semir Zeki — Professor of Neuroaesthetics at University College London

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Shaun O'Boyle

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EXHIBITION 3D DESIGN

Claire Healy

EXHIBITION 2D DESIGN

James Kelleher and Sinéad Foley

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We would also like to thank the extended Science Gallery Dublin team and mediators for their work on all aspects of SEEING.

For more details on the people behind the scenes please see:

dublin.sciencegallery.com/staff

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UNSEEN PORTRAITS

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SIGHT WITHOUT LIGHT

Daniel Kish and World Access for the Blind

20/X:

McMullen_Winkler

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Karina Smigla-Bobinski

EYECANE

Amedi Lab

SEEING WITH SOUND: THE VOICE

Nicolas Delves-Broughton

PEEPING HOLE

Kenichi Okada

OAKES TWINS COLLECTION

Ryan Oakes

MIRROR II - DISTANCE

David Cotterrell

GROUND TRUTH

The Green Eyl

MOBILITY DEVICE & WHITE CANE AMPLIFIED

Grand Central Arts Center

EYE CARE WORKS

me&him&you

ABOUT SCIENCE GALLERY

WHAT IS SCIENCE GALLERY DUBLIN?

In 2008, a car park in a forgotten corner of Trinity College Dublin was transformed into a living experiment called Science Gallery. Through a cutting-edge programme that ignites creativity and discovery where science and art collide, Science Gallery Dublin encourages young people to learn through their interests. Since opening in 2008, over two million visitors to the gallery have experienced 38 unique exhibitions ranging from living art experiments to materials science and from the future of the human race to the future of play. Science Gallery Dublin develops an ever-changing programme of exhibitions and events fuelled by the expertise of scientists, researchers, students, artists, designers, inventors, creative thinkers and entrepreneurs. The focus is on providing programmes and experiences that allow visitors to participate and facilitate social connections, always providing an element of surprise. Science Gallery Dublin is kindly supported by the Wellcome Trust as founding partner, and by 'Science Circle' members — Deloitte, ESB, Google, ICON, NTR Foundation, and Pfizer. Science Gallery Dublin receives support from programme partner Bank of Ireland, Intel Ireland, The Ireland Funds and The Marker Hotel. It also receives government support from the Department of Arts, Heritage and Gaeltacht and Science Foundation Ireland. Science Gallery Dublin's media partner is The Irish Times. For more information visit: **dublin.sciencegallery.com**

ABOUT THE GLOBAL SCIENCE GALLERY NETWORK

In 2012 the Global Science Gallery Network was launched with the support of Google.org, and the aim of establishing eight university-linked galleries worldwide by 2020. Based on the model pioneered at Trinity College Dublin, the Network is set to take the Science Gallery mission global. The first new gallery will open in London in 2017, followed by galleries in Melbourne and Bengaluru (Bangalore) in 2018. The development of the Network is being driven by Science Gallery International, a non-profit headquartered in Dublin that is also charged with touring Science Gallery exhibitions worldwide. Exhibitions from Dublin have now toured to thirteen locations internationally, reaching more than 400,000 people in science and art centres across the globe. For more information visit: **international.sciencegallery.com**

SCIENCE GALLERY

Trinity College Dublin
The University of Dublin

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SCIENCE GALLERY DUBLIN IS PART OF THE GLOBAL SCIENCE GALLERY NETWORK PIONEERED BY TRINITY COLLEGE DUBLIN