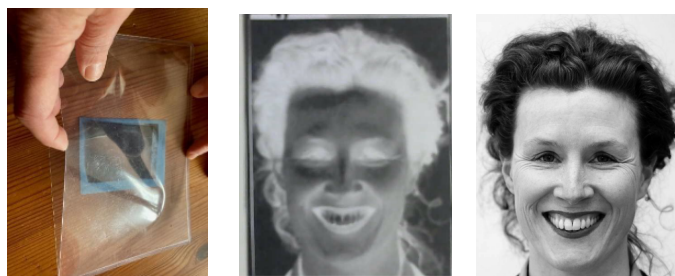


Fake pictures immunity – Double and distorted portrait negatives for cyanotypes

By Paula Bleckmann and Julia Kernbach
medienmuendig@alanus.edu



Short description of the practice

A multitude of learning goals foundational for and related to critical digital skills on many levels can be achieved by this practice. You can stay on the level of each pupil simply having fun creating analogue picture manipulation with solar photography using inverted black-and-white portrait photographs on overhead transparencies as “negatives”. In the basic version of the practice, you put one or more negatives on top of each other to create merged photographs, which look almost - but not quite - like portraits of a real person (Paula plus Julia equals “Paululia”, see photograph), and/or you use nylon strings to disfigure the negatives during exposition of the cyanotype paper to the sun for creating distorted portrait pictures. As optional add-ons, you can add beards, horns, glasses etc., or you can put portrait “heads” on different “bodies”, thus including reflections on cyberbullying using fake videos, or even lay

foundations for understanding why using the same prompt in ChatGPT has a ten- or even twentyfold higher energy consumption compared to a classical internet search.

Age span of children/adolescents

9 - 12 years
12 - 15 years
15 - 18 years
18 + years

Target group

Students
Educational staff
Parents/caregivers
Policy makers and approval authorities

HERMMES curriculum areas

COMPUTATIONAL THINKING (CT) AND PROBLEM SOLVING

ICT: CT, problem solving

(DIGITAL) MEDIA CONTENT CREATION

Visual / Image / Sculpture (VIS)

CRITICAL INFORMATION AND DATA LITERACY

Analyse and (self)-reflection

COMMUNICATION AND COOPERATION, EMPATHY

DESCRIPTION AND USE OF THE PRACTICE

Work instructions and roadmap

Time learners need for the practice

60 min to 360 min

Group size

Up to 30 learners, one or more teachers

Preparation time for teacher/facilitator

90 min plus 5 min per learner (if the teacher prepares negatives for all)

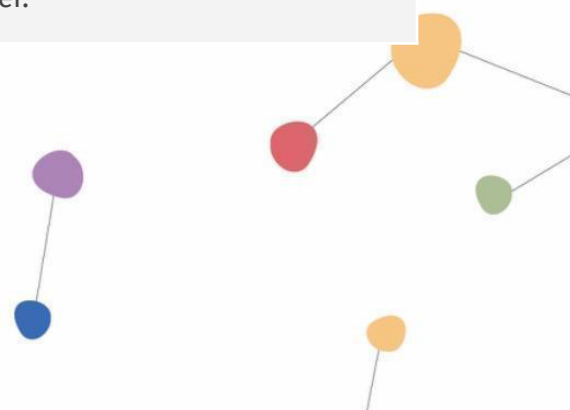
Location / setting / specific circumstances

Inside (no ultraviolet UV light) and outside space (or UV lamp)

Necessary equipment and materials

For teachers/for preparing the “negatives”: camera, computer with image editing software with image inversion function (e.g., Photoshop or Affinity Photo), printer, printable overhead transparencies

For learners: transparent “negatives”, photosensitive blue (cyanotype) paper, scissors, transparent document sleeves or plastic/glass pane, nylon string, cardboard, paperclips or strong foldback clips, widely slit inclined picture stand, tap water.



Detailed description

Intro and rationale

“Is this how AI generates fake pictures?”, a pupil asked while carrying out this program. The answer would be: “No, not precisely like that, but with some similarities in the technique.”

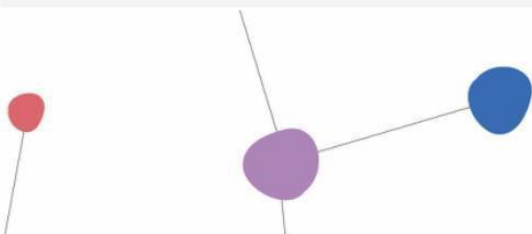
In today's world children are surrounded by images that show things that do not represent reality. Central learning goals of this practice are to help children produce photographs, manipulate photographs and above all grasp how image manipulation works. The practice is designed to allow learners to experience how photographic manipulation can be seen as an artistic, creative process, as a fun activity, and as a threatening activity that can scare us, hurt our privacy, and undermine our realistic view of the world, all at the same time. This approach is very different from other approaches because it does not work with showing pre-existing (mostly digital) content, and informs and alerts pupils to this problem on a cognitive level.

The advantages of the solar photography approach are that learners

- ... grasp with their own hands how to manipulate photographic images, which also requires structured planning of the process and fine motor skills
- ... put into practice various different approaches to image manipulation and optionally combine them in further developing them to create unique works of art
- ... experience that if well performed, the act of manipulation is almost invisible in the final result
- ... are not required to use digital screen media and even spend time outdoors in the sunlight
- ... experience concepts from the history of photography: over- and under-exposure, negatives, dipping photographs in liquid for developing them, etc.
- ... often experience negative feelings (“this is uncanny”, “this is so weird”) when viewing the products of their own manipulation and optionally get a chance to relate this to digital risks such as fake porn videos, fake news, and cyberbullying
- ... by identifying anchor points and scaling (compressing or elongating) their surroundings and superimposing two or more processed images, grasp simple predecessors of fundamental principles that AI image-generating software employs.
- ... lay foundations for understanding the basis for the immense energy consumption linked to using generative AI (e.g., ChatGPT) compared to classical online searches (e.g., Google)

Optional prequel: live face distortion and manipulation techniques

The HERMMES practice “This mirror makes me look like a funny cat” is advisable as a first step before the manipulation techniques described here. As seeing one's own face distorted and merged can cause feelings of loss of control over one's own body, it is wise to experiment with changing their appearance “live” first using a flexible mirror. Learners can control the amount of distortion that they can apply without fear by bending the mirror strongly, slightly, or not at all.



Working with portrait negatives for cyanotypes

For an introduction into the basic techniques of solar photography (also known as blueprinting or cyanotypes), see the HERMMES practice “The blueprint of photographic reproduction”.

Step 1: Producing the negatives

Black and white frontal portrait photos are inverted to create a negative, which is then printed out on overhead transparencies. We suggest copy-pasting the photographs into a table, e.g., a 3x3 table to fit 9 photographs on one A4 transparency. Cut the transparencies into smaller pieces with one photograph on each. This first step can be carried out by the teacher, depending on the learner’s age, to create a fully offline, analogue learning scenario if desired.

Note: All photographs show the authors of this HERMMES practice, Paula Bleckmann and Julia Kernbach. The reason is that we do not have consent to publish the original and manipulated portraits from the learners who piloted this practice.



1 Black and white portrait

2 Inverted portrait

3 Solar photograph

Step 2: Produce a “normal” blue-and-white portrait (or several of them) with solar photography paper (see also: HERMMES practice on “SafeBook before FaceBook”).

Step 3: For the next photos made with the “negative”, the transparencies are manipulated before putting them on the blue paper and exposing it. Our favourite manipulation techniques are:

- a) Hybrid portraits (HP) with layered negatives. Paula and Julia = Paululia: putting one or more negatives on top of each other to create scary layered photographs, which look almost - but not quite - like portraits of a real person.
- b) Using nylon strings to disfigure the negatives to create distorted portraits in the tradition of concave and convex mirrors.

Step 3a. Choose two (or more) negatives that have a similar distance between the eyes. Put one on top of the other, eyes matching.

Indoors, gently put the negatives on top of one small piece of blue paper (cyanotype paper). Insert the paper and the two (or more) negatives into a solid transparent plastic sleeve (a pane of glass will do the same trick, but you should use it only when working with adults, as it can break and lead to cuts).





Step 4b: Expose to the sun. Use a picture stand if the sun is in an unfavourably low position (winter, early morning).



Step 5b: Back indoors, remove the negative, rinse, dry, and smooth



Step 6: Discuss and relate to fake images online and GenAI

Discuss with pupils: is it possible to recognise that the hybrid person does not exist? This should be easy if there are negatives of 20 pupils well known to each other. They will detect the fake easily. But what about if you did NOT know them? Look for signs of manipulation, like the missing half of the glasses or the strange shape of the teeth, in the case of the smiling “Paululia”. In the case of the distorted negatives, you may be able to see the shadow of the nylon thread. What if you used something thinner, like hair?

The idea of merging similar images via identifying anchor points and scaling (compressing or elongating) their surroundings, then superimposing two or more images onto each other, thus creating a “mean” image, has similarities to some of the fundamental principles that AI image-generating software employs. The technique will not work for images that do not have enough similarity. You can try superimposing a group of people with Joe being one of them, Joe’s frontal body, Joe’s half-profile portrait and Joe’s frontal portrait: you get a blurred picture with less of Joe to be seen than in the originals. The idea of creating a standardised version of a photograph (biometric) is also relevant for understanding facial recognition software. These concepts can be explored in more detail in add-on 3.

While both the merging, as well as the distorting technique have an uncontested didactic value, the “fun factor” was highest in a third manipulation technique, the cut-out or scratch-off technique described in add-on 1. This was the pupils’ favourite.

Add-on 1: beards, horns, glasses, animal ears and other accessories

Whereas it is easy to add objects to a printed photograph using pencils, crayons or cut-and-paste techniques, it is more difficult to do this with the solar portrait photos.



If the pupils have merged photographs of pupils with glasses or hats or earrings with other students without these, they will be familiar with the idea of ADDING another “negative” to add attributes.

- a) Ask the pupils if they have a different idea how they could add glasses, beards, or even rabbit ears or unicorn horns to the finished photographs.
- b) If they do not come up with the idea to cut out areas of the negative, present a manipulated photo (ideally, make one of yourself with the desired accessories) and ask again how they think this was made.
- c) Bottom: use pencils to sketch and permanent fine liners to confirm the outline of the cutouts, then fine scissors (nail scissors are ideal) for cutting out. Provide a thick craft foam or needle cushion as a support for punching the scissors through the overhead transparency negative (the first punch is difficult and has a danger of causing bleeding fingertips).
- d) Top: use scissors to scratch away part of the black colour on the overhead transparency negative. This usually produces less detectable “fakes”.

Add-on 2: Advanced solar photography manipulation and copyrights, exploitation rights, privacy rights

For younger pupils, we suggest that each pupil use only their own negatives for the distortions with the nylon thread and only produce merged photographs together with one other pupil, and ONLY if both pupils have given their consent for the use of their negatives in this way. For older pupils, you can go beyond this, but discuss the rules that need to be established before and discuss some of the questions listed above before, during or after performing solar image manipulation.

- Do we want to make sure the person depicted on the negative gives consent that someone else can use their negative to change it?
- Do we want the person depicted on the negative to have a right to destroy the negative (e.g., when scratching off or cutting out parts of it)? If one pupil uses the negative with the portrait of another pupil and applies distortions to it or places it on top of other portraits, who has the copyright?
- Does the pupil manipulating the portrait have to ask permission from the other pupil? There are laws regulating the rights of artists. If you change more than a certain percentage of an image, then the privacy rights are generally considered not to be endangered any more. What if we use the portrait negative to mount the head of a student on the naked body of a porn star?
- What is the pupil's view of the entanglement of copyrights and privacy rights? How about restrictions on publishing these portraits on the pinboard, in the school corridor, on the school website? Do the pupils' parents need to give consent to their children's photos being used in this way?
- Wouldn't it be the best idea that BOTH the pupil and their parents (if they are under age) need to consent to a photograph being published if someone wants to use it for the school's newspaper, or publish it on the school's website in the open access area?
- How about the rights of children NOT to work as child influencers? Is it only the parents that need to agree to publishing their children's private life online? There is a debate going on about [whether it can be considered child labour](#) and what should be done to protect these children from exploitation. For older pupils, the following question can be discussed: if one pupil uses the negative with the portrait of another pupil and applies distortions to it or places it on top of other

portraits, who has the copyright? Does the pupil manipulating the portrait have to ask permission from the other student? How about restrictions on publishing these portraits on the pinboard, in the school corridor, on the school website? What is the pupil's view of the entanglement of copyrights and privacy rights?

Add-on 3: “Merged group photos”, biometric passport rules, AI-generated art, AI energy consumption

Create up to three versions of a “group photo” by layering many negatives on top of each other in the way described above for two portrait negatives. If the group has up to 20 people, the summer noon sun is strong, and you use large negatives like an A4 format, you can even make a “group photo” of the entire group of learners, all in one photo. Ask pupils to take a frontal portrait photograph of each pupil, one with a closed mouth and without glasses. Optionally, you can also have a smiling frontal portrait and even thirdly, a less structured frontal portrait with different facial expressions, with glasses, etc. The second step can be carried out by the teacher/facilitator or by pupils themselves, depending on didactic intention, age of learners and availability of digital devices. A black-and-white version of both (or all three) portraits is saved as a first “raw” version.

Remember to save as separate files with clear indication of content (e.g., nameofstudent_BW_non-smiling_raw.jpg). The photo is then changed in size, but not in proportions, so that the distance between the pupil of the right and the pupil of the left eye is the same in the photographs of all pupils, as in the basic version of the project, but with a larger format (we suggest five times bigger than a 35 mm x 45 mm passport photo). An additional version “eye and mouth” is created, in which the pictures are compressed or stretched in the vertical dimension to make the mouths of the negatives match as well. The pupils can also be informed about the relevance of “standardising” portraits in the context of [biometric passport photographs](#).



- As an art teacher, you may want to ask: “Who has the copyright for the merged group solar photograph as the final product?” “Who has the rights of use, i.e., who would receive the money if we were to sell it?” “Do you think it is fair that when using AI-generated images, you do not need to pay, whereas if you use a single photo, you have to pay the owner of the photograph?” and/or let students read and discuss [this article on AI-generated art](#).
- You may want to link the pupils’ experience to the topic of AI and energy consumption. Generative AI creates merged images based on thousands of existing pictures and existing texts. For genAI generating text, the sequential approach is important to understand: given a history of words x_1 , x_2 , and x_3 , the next word generated is the one that has the highest probability of being next, based on the training dataset.

$$\begin{array}{cc} \text{next element} & \text{history} \\ P_{\theta}(X_{t+1} = x_{t+1} \mid x_1, \dots, x_t) \end{array}$$

With image generation, there is a first step of “labelling” similar pictures required to link up text and image. But on the part of the actual image generation, there are more similarities to the process of creating the “merged group picture”. The

hands-on experience of increasing preparation times to make the portraits “fit” and increasing exposure times in the sun that are needed for adding more and more photographs to a merged group photograph is a good starting point. Questions like this could arise: “How much more preparatory effort and how much more exposition time to make a “merged group photograph” with two, five or even ten portraits, compared to one single photograph?” “How many grams of CO₂ do you think are released into the atmosphere for an average ChatGPT search query?” “How much more or less do you think a classical Google search uses?” In 2024, the answer was that it is a [factor of about 20](#) (some references claim it is a much higher factor still, but it is [difficult to estimate the carbon footprint](#) of large language models.) [Be sure to check for more recent publications in this rapidly changing field of research, meaning that generative AI increasingly being used for search queries is a pressing ecological problem. If you can find similar publications on comparing the carbon footprint of genAI to generate images compared to using existing stock photos, let us know.]

Additional information

Further online or offline information on the practice

Order materials.

High-quality ready-made solar photography paper, A4 (also available in A5)

<https://astromedia.de/Das-Solar-Fotopapier-215-x-28cm>

Chemistry teachers may consider mixing the chemicals and applying them to the paper (or other materials) from scratch – but you need a chemistry lab for this for safety reasons.

<https://www.jacquardproducts.com/cyanotype-chemistry>

Explaining the HERMMES curriculum rationale to parents

This practice is especially suitable for the HERMMES whole-school approach. Ask the pupils whether you can show the products of the manipulation to their parents at a parent evening. Demonstrate what the students have done and report part of what they have discussed. Take it to a meta-level and relate this to the HERMMES curriculum principles: 1. Analogue before digital, 2. Producing before consuming, 3. Transparency before black box, and possibly a fourth principle: Fun before fear. In this project, the pupils usually tremendously enjoy being the ones to perform the acts of manipulation themselves, and other ways of raising awareness are much less fun; sometimes they sound all too patronising to young people’s ears: “Don’t rely on what you find online! The internet is a dangerous place. There are a lot of fakes out there! Beware!” This may also reduce the impact of fear- (and information-) based approaches.

Additional information that might help

When visiting schools with alternative pedagogical approaches such as Montessori, Waldorf, outdoor and experience-based education, I am often confronted with internal team quarrels.

- Part of the team advocates that children come to school already with an overload of digital screen time, so that school should not add to that, an attitude that is sometimes linked to a wish of older colleagues to continue teaching in the same way as some decades ago when they started teaching.
- Another part of the team demands that pupils be informed about a number of risks they encounter in the digital world and that therefore digital media have to be used at a far earlier age than some decades ago.

When I visited a school like that in 2023, during the sessions we had together at the school, we made individual prints from real-life objects first, then the single portrait photographs of some “negatives” from my research team, and then we made the merged photographs. After that, when I explained the cognitive stuff, I saw many colleagues smiling and nodding. I talked about how this project is linked to the history of photography (nod), to media production and content creation in DigCom (smile), to AI used for image generation (nod), to fake videos (smile), to cyberbullying with pupils' heads "grafted" into porn videos, to copyrights and privacy rights (worried look, nod), to the idea of demystifying technology, and to the three principles of Analogue Didactics (see below text on parents).

In the mail after the two-day visit, I was informed that this had been an eye-opener and a peacemaker between the quarrelling opponent teams – and lots of fun, too. If we train digital competences in such a clever way, they agreed, no-one is opposed to it any more. The debate has moved to a much more practical, solution-orientated level: who will order the material, and who will put the project into practice? They still quarrel about which grades appear most suitable for doing it, though.

Next time I visit a school, I am planning to ask a favour beforehand: could they please send me photographs of all the colleagues in the school so that I have time to get “negatives” for solar photographs prepared, and they can each make portrait prints of themselves and merge them with those of their favourite colleagues? This may even be the ones they considered to be their enemies before.

Explaining the HERMMES curriculum rationale to parents

Ask the pupils whether you can show the products of the manipulation to their parents at a parent evening. Demonstrate what the students have done and report part of what they have discussed. Take it to a meta-level and relate this to the HERMMES curriculum principles: 1. Analogue before digital, 2. Producing before consuming, 3. Transparency before black box, and possibly a fourth principle: Fun before fear. In this project, the pupils usually tremendously enjoy being the ones to perform the acts of manipulation themselves, and other ways of raising awareness are much less fun; sometimes they sound all too patronising to young people's ears: “Don't rely on what you find online! The internet is a dangerous place. There are a lot of fakes out there! Beware!” This may also reduce the impact of fear- (and information-) based approaches.

