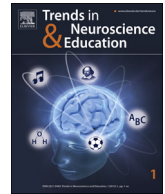




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## Opinion paper

## Masked education? The benefits and burdens of wearing face masks in schools during the current Corona pandemic

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## ABSTRACT

Face masks can prevent the spread of the virus SARS-CoV-2, in particular as this spread can occur from people with no symptoms. However, covering the lower half of the face reduces the ability to communicate, interpret, and mimic the expressions of those with whom we interact. Positive emotions become less recognizable, and negative emotions are amplified. Emotional mimicry, contagion, and emotionality in general are reduced and (thereby) bonding between teachers and learners, group cohesion, and learning – of which emotions are a major driver. The benefits and burdens of face masks in schools should be seriously considered and made obvious and clear to teachers and students. The school's specific situation must also inform any decision regarding face mask use.

## 1. Introduction

A new coronavirus, SARS-CoV-2, has caused a global pandemic of the disease Covid-19, with – as of July 31st – almost 300.000 new cases within a single day, more than 17 million confirmed infections, and more than 670.000 deaths [16]. Initially regarded as some form of flu with symptoms such as fever and cough, it has been found to be much more severe, affecting not only the lungs but also the liver, heart, kidneys, and brain, with symptoms such as anosmia [12] and cognitive dysfunction due to defects of neuro-axonal integrity (even in mild to moderate cases; [1]). In severely ill patients, the virus causes a two-pronged attack by a dysfunctional immune system (“cytokine storm”) and blood clotting system (“multi-organ thrombosis”; [33,66]), causing strokes with chronic neurological deficits [60,70].

Compared to adults, children are less likely to fall ill, and if so, their illness is usually mild [34]. However, in order to decrease the spread to the virus, along with other measures of physical distancing and economic lockdowns, school closures were implemented during March 2020 affecting more than 1.5 billion students (children and adolescents) around the globe [73]. These closures of schools lasted for a few weeks only (as in Denmark) up to several months (in Italy and many other countries; [15]) and led to marked decreases in educational gains [75], hunger (because school meals were no longer served), increases in child abuse (because children were no longer observed by school staff),

and, in general, the risk of “scarring the life chances of a generation of young people”<sup>2</sup> (because of the long-term psychological, physiological, educational and even economic burden [3], that societies put on their most vulnerable members; [15]).

As long as there is no vaccine and no specific treatment, the first pandemic of the 21st century is fought with methods from the 14th to the 19th centuries: Distancing, hand washing, and covering mouth and nose with a piece of cloth. On a global scale, face masks have become an increasingly important part of national strategies to fight the current corona pandemic. Given that school closures already have come to an end, or will have to end eventually, the question of wearing face masks at schools during the next phase of the pandemic is heavily discussed, particularly, where new cases pop up in spots of waxing and waning infections, or in some states, in the form of additional waves of infection (as for example currently in Israel, Australia and Croatia).

Because the virus is still with us, this is all the more pressing for the following characteristics of the virus and its transmission [4,8]:

- People without any symptoms may be infected and spread the SARS-CoV-2 virus.
- Upon speaking, the virus is released into the air, the louder the more.
- The virus can remain airborne for many hours in classrooms.
- Wearing masks is comparatively cheap and easy to implement and

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<sup>1</sup> <http://www.uni-ulm.de/klinik/psychiatrie3/index.html>.

<sup>2</sup> This quote is taken from Couzin-Frankel et al. [15], p. 241], who cite an open letter published in June 2020, signed by more than 1500 members of the United Kingdom's Royal College of Paediatrics and Child Health (RCPCH).

supervise.

- At the same time, wearing masks may have physical side effects.
- Face masks impair face recognition and face identification.
- Face masks impair verbal and non-verbal communication.
- Face masks block emotional signaling between teacher and learner.

Given these pros and cons, it is not clear whether face masks should play a major role in educational settings in times of the current viral pandemic. Moreover, given the diversity of educational settings in terms of country, culture and learners' as well as teachers' age, different considerations may weight in differently in any balanced decision as regards the use of face masks in classrooms. This matter should be discussed urgently, since it globally affects more than 1.5 billion students, teachers, and school staff directly, and, in addition, their families indirectly.

## 2. Face masks are effective against the spread of the new corona virus

This pandemic has been a moving target as regards our knowledge about it.<sup>3</sup> The issue of wearing face masks may serve as a prime example. During the time of school-closures (from about the middle of March into April and/or May 2020) it became clear that face masks covering mouth and nose in closed public spaces (public transportation, stores, restaurants etc.) are an effective means of preventing the spread of the virus and thus, the worsening of the pandemic. This had not been clear at the time when the pandemic started in most countries (February 2020), as institutions such as the World Health Organization (WHO), the US Centers of Disease Control and Prevention (CDC) and, for example, the German Robert-Koch-Institut (RKI), as well as many governments across the globe, did not recommend the use of face masks to fight Covid-19.<sup>4</sup>

Upon the reopening of schools in April and May, this situation had changed [2,26,45], and by June 2020 there was no longer any doubt (see Fig. 1) that wearing face masks is one of the most effective preventive measures people can take to protect themselves and others from becoming infected with the virus [65]. As mask wearing by infected individuals reduces transmission risk, and because of the high proportion of asymptomatic infected individuals [68] and transmissions, by now there is a strong case for the effectiveness of widespread use of face masks in reducing the spread of COVID-19. In short, since it is clear that people may be infected and infectious even though they do not yet show any symptoms of Covid-19 – which is a peculiar feature of the SARS-CoV-2 virus – face masks can definitely mitigate the effects of this especially dangerous virus.

In a Chinese study from Wuhan, for example, it has been estimated that up to 79% of viral infections were caused by undiagnosed, presumably asymptomatic people [47]. In two other studies, one from two surveys of 2812 and 2343 inhabitants of the small town of Vó near Padua in Italy, and another from 1032 healthcare workers (including frontline patient-facing staff such as doctors, nurses and

<sup>3</sup>Historically, this was also the case one hundred years ago, after the French bacteriologist Charles Nicolle discovered that the agent that caused influenza was much smaller than any known bacterium in October 1918, i.e. at around the time of the cusp of the pandemic. This news led, even in small-town American newspapers, to statements such that using face masks against influenza is “like using barbed wire fences to shut out flies” [14]. This discouraged the wearing of masks and caused a lot of discussion and distrust in the general public.

<sup>4</sup>The reason for this misleading advice became clear over time: There were too few masks. Responsible advisors wanted to make the most use what was available, and therefore gave masks and other protective equipment to hospitals, where there were in short supply and most dearly needed. They could have done better and tell people to make their own mask from cloth (and sell them, if they are good at sewing).

physiotherapists) in the UK, similar findings have been reported [42]. In the Italian study, 42,5% of confirmed SARS-CoV-2 infections were asymptomatic, and in the British study, 60% had no or only very light symptoms. That is, you get sick from contact with people who are apparently healthy. This is why in the present Covid-19 pandemic, it is not possible to have only those people wear masks who are infectious. Everybody can be infectious while not knowing it [43]. The only way to stop infections from happening, therefore, is to have *everybody* wear face masks.

It is known for more than 70 years that the act of speaking generates oral fluid droplets that vary widely in size, from clearly visible to invisibly small aerosols [24,55]. The louder someone speaks the more droplets and aerosols are produced. Regardless of their size, they all can harbor infectious virus particles and spread viral diseases [2,5,6]. In fact, the virus has been shown to remain airborne for many hours in a closed indoor space such as a classroom [49]. As Prather and coworkers note in their highly informative perspective, published in Science magazine online on May 27th 2020: “[...] calculations predict that in still air, a 100- $\mu$ m droplet will settle to the ground from 8 feet in 4.6 s, whereas a 1- $\mu$ m aerosol particle will take 12.4 h [to settle down]. Measurements now show that intense coughs and sneezes that propel larger droplets more than 20 feet can also create thousands of aerosols that can travel even further. [...] under many indoor conditions, where aerosols can remain airborne for hours, accumulate over time, and follow airflows over distances further than 6 feet” ([65], p.6498). The authors summarize their perspective with a highly convincing drawing, which is reproduced in Fig. 1.

There is additional epidemiological evidence for the effectiveness of wearing face masks regarding the spread of the new coronavirus: In Hongkong, 96% of the populations used face mask, and the incidence of new cases in March was 129 per million inhabitants, whereas in Spain, Italy, and Germany, where at the time no face masks were used, the incidence was 2983 (Italy), 2251 (Spain), and 1242 (Germany) per million [31]. Shortly after the major of the German city of Jena (with about 110,000 inhabitants) implemented a face mask use order for the entire city on the 6th of April to fight the spread of the virus (three weeks before this was done for entire Germany), there were no new cases for 9 consecutive days. Compared with a “surrogate” Jena (a weighted mix of 4 German cities) as a control, this decline in new cases was 23% [56].

A natural experiment published on June 16th 2020 used the different timing (between April 8 and May 15) of state policies mandating public or community use of face masks or covers in 15 US states plus DC in mitigating covid-19 spread [52]. The study found that the changes in the daily county-level COVID-19 growth rates between March 31, 2020 and May 22, 2020, was associated with a decline in the daily COVID-19 growth rate by 2% by two to three weeks after the mandatory face mask use. At first blush, this may sound as a small effect, but three weeks of cumulated 2% decrease amounts to a decrease of over 40%. Accordingly, from their data, the authors estimated that as many as 230,000–450,000 Covid-19 cases had been averted by May 22, 2020.

Finally, a large comprehensive review and meta-analysis, published in the Lancet online on the 1st of June 2020, used data from 172 observational studies across 16 countries (among them 44 comparative studies in healthcare and non-healthcare settings [13]. Face masks (surgical type) reduced infection risk by 85%. Since face masks are comparatively cheap and easy to use, they are among the most simple and straight forward means to curb SARS-Cov-2 and Covid-19 transmission (see also [53]).

## 3. The side effects of face mask use

It is a medical truism that everything that has effects also has side effects. The physical side effects of face masks have been mostly reported by medical professionals working in surgery and related surgical environments, and science professionals working in labs. In a study of

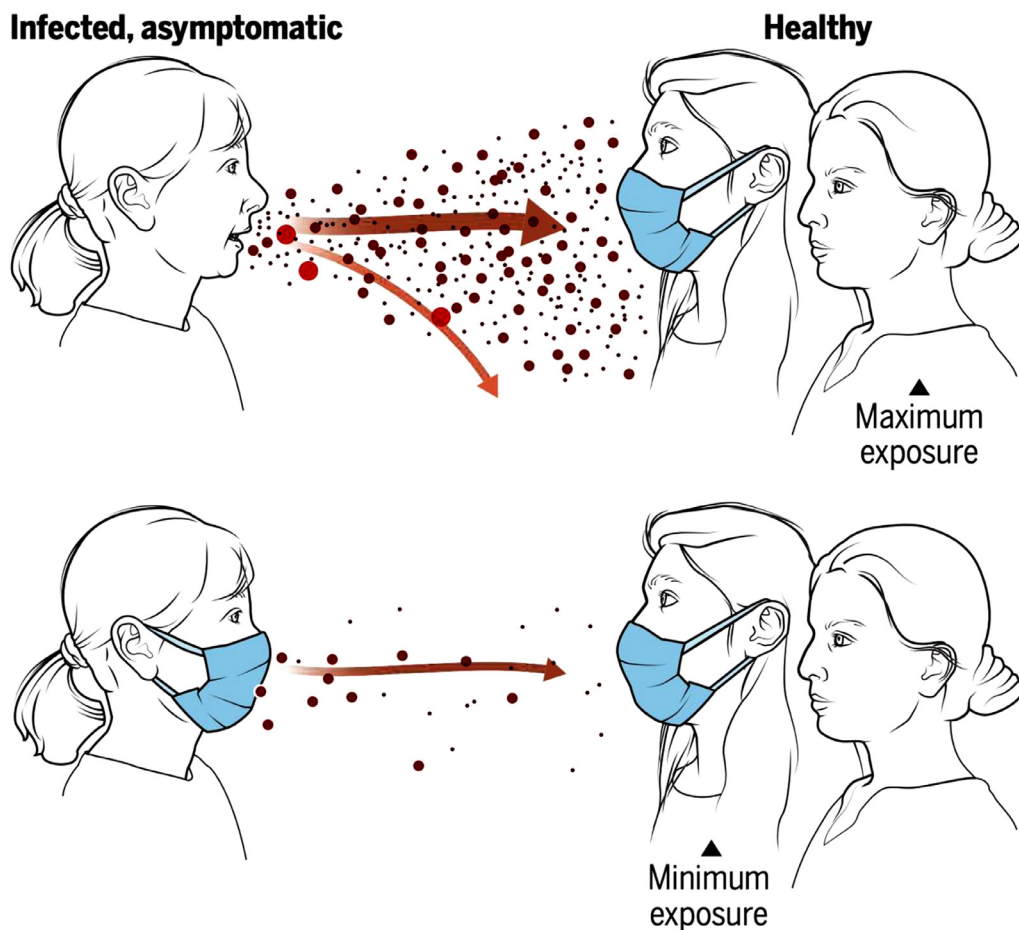


Fig. 1. Face masks reduce airborne transmission of the SARS-CoV-2 virus. The authors comment: “Infectious aerosol particles can be released during breathing and speaking by asymptomatic infected individuals. No masking maximizes exposure, whereas universal masking results in the least exposure” ([65], p. 1423, © Science Magazine, with permission).

158 health care workers during the Covid-19 pandemic, the most common side effect of prolonged face mask use was bilateral headache, reported by about 80% of the participants [58]. Headaches occurred one to four times during a 30-day period of mask use and was rated as mild by the majority (72%) of respondents. Within 30 min after removal of the face mask, the pain resolved spontaneously. Pain medication (such as non-steroid analgesics) was used in only a few cases.

Face masks may further cause perioral dermatitis with rashes and redness, i.e., an infection of the skin around the mouth because of saliva, sweat, and moist vapor between the mask and the skin. This may provide a breeding ground for bacteria. Itchy rashes may be caused by irritant dermatitis, caused by the mask and/or the attached rubber strings rubbing the skin of nose and ears [63].

An experimental study on the physical effects of wearing either a surgical or an N95/FFP-2 face mask was performed with 5 healthy male and 5 healthy female subjects, who performed intermittent exercise on a treadmill while wearing the protective facemasks in a climate chamber controlled at an air temperature of 25 °C and a relative humidity of 70%. Both types of face masks led to significant differences in temperature and humidity in the microclimates between face masks and skin. In particular, compared to the surgical mask, the N95 mask led to higher humidity and skin temperatures inside the facemask, higher heart rate, and increased negative „sensations, including feeling unfit, tight, itchy, [and] fatigued,” as stated by the authors ([46], p. 501). A recent study on the cardiovascular effects of face masks (surgical or N95/FFP-2) in young healthy male subjects on a bike-ergometer showed a 2 percent decrease in maximum power (not significant) for the surgical mask and a 5 percent decrease of maximal power ( $p < 0,01$ ) for the N95/FFP-2 mask [32]. Overall, in both studies subjects preferred the surgical face mask. This finding, among others,

led to the fact that N95 masks were never recommend for wearing by the general public, as they not only are more expensive, but also – because of the discomfort they imply – much less likely to be worn by everybody for extended periods.

As regards the prevention of Covid-19, additional concerns of wearing face masks have been articulated, for example:

- Wearing a face mask may give a false sense of security and may make people less compliant with other infection control measures.
- Because of problems with understanding speech (see below), people may move closer together, without intention, and thereby increase infection risk.
- Wearing face masks may cause glasses to fog and thereby cause anything from discomfort to accidents.
- Wearing a face mask makes the exhaled air go into the eyes. “This generates an uncomfortable feeling and an impulse to touch your eyes. If your hands are contaminated, you are infecting yourself” [44].
- “Moreover, a fraction of carbon dioxide previously exhaled is inhaled at each respiratory cycle. Those phenomena increase breathing frequency and deepness, and they may worsen the burden of covid-19 if infected people wearing masks spread more contaminated air. This may also worsen the clinical condition of infected people if the enhanced breathing pushes the viral load down into their lungs,” the authors add.
- When infected people re-breathe air in the mask, their virus load increases.

In other words: Whereas face masks are intended to ease the burden of the pandemic they may at the same time make it worse under certain

conditions.

In addition to these problems of physical health, three more problems of using face masks have to be addressed: Impaired face recognition and identification, impaired communication, and blocked emotional signaling.

#### 4. Face masks impair face recognition and face identification

In daily life, human observers are extremely proficient in recognizing faces, discriminating between them and using them to derive a vast range of information, be it about static features like age, gender or identity, or changeable features like gaze direction, lip movements or emotional states (see second next section).

Human beings are biologically programmed to recognize faces [68]. As soon as babies are born, they show a preference for looking at human faces above anything else, and they will even stare at a rudimentary drawing of a face if it is shown to them. But by the age of seven months babies are able to recognize angry or fearful faces [62,37]. The advantage of face-processing as compared to non-face stimuli declines during the second year of life [48].

On top of this innate preference, the role of social experience in face processing and recognition becomes ever more salient, as research with infants has shown using such different measures as behavioral data, eye-tracking data, and neuroscience data mainly from event related potentials (ERP), functional magnetic resonance imaging (fMRI), and near infrared spectroscopy (NIRS). By now, the role of experience in the process of perceptual narrowing in face processing has demonstrated enhanced behavioral and neural responsiveness to (1) mother over stranger, (2) female over male, (3) own-race over other-race, and (4) native over non-native faces. In addition, (5) infants' neural responses to faces in multimodal contexts, such as audiovisual speech, change during development, which finally leads to (6) the emergence of attentional biases that cause enhanced responsiveness and processing of faces commonly encountered in the native environment: We recognize and identify the faces of our peers faster than faces of strangers [67], just as we recognize the sounds (phonemes) of our mother tongue better than unfamiliar sounds (phonemes) from unfamiliar languages [61].

Hiding the lower part of the face with a face mask markedly impairs face recognition and face identification. In fact, this is why burglars and thieves wear them. As mask-wearing has become a normality in many societies, the magnitude with which covering our faces affects our social interactions and ability to recognize and identify other people becomes ever more clear. In school settings, the ability to know and recognize each other is normally taken for granted, and – like air for breathing – it does not come into focus unless it is lacking. But within seconds of absence, its importance is realized.

But there are also some quick fixes for this problem, such as clearly visible name tags, “personalized” masks, and our ability to recognize and identify each other from cues provided by our voice and body shape and posture.

#### 5. Face masks impair verbal and non-verbal communication

One of the richest and most powerful tools in human communication is the face, from which observers can quickly and easily make a number of inferences — about identity, gender, sex, age, race, ethnicity, sexual orientation, physical health, attractiveness, emotional state, personality traits, pain or physical pleasure, deception, and even social status [38]. When strangers meet, who speak two different languages which they do not mutually understand, they can still interpret facial expressions such as smiles and frowns with ease and thereby communicate. In fact, the most basic form of communication between humans is by facial expressions. This is because facial expressions are a simple universal language that we instinctively understand [25]. It may be for this reason, that many people do not like the wearing masks at all in the first place.

Because we cannot see the lower half of the face when someone is wearing a mask, our ability to understand people is reduced considerably. We are forced to rely only on language and gesture, which limits the extent to which we can interpret nuance, with some input from interpreting eye movements, which are still visible above the mask. In fact, evidence from eye movement studies during gazing at a face suggests that the eye is the facial feature that is attended to first and longest during face processing, as they appear to be most informative in communication. Once we direct our gaze to something, this something thereby can become the focus of shared attention, which is a basic mechanism of doing things and solving problems *together*.

But second to the eyes are the regions of mouth and nose, when it comes to attending facial features. For effective verbal communication, covering the mouth with cloth has two detrimental consequences: First, the auditory signal is impaired, as faces masks may dampen sound amplitude, and especially may absorb frequency bands used in speech. Second, the visual signal from the lips is completely obstructed. While most people may never have realized, this signal is used by human beings to aid speech understanding. From birth to about 8 months, babies look at their mother's mouth in order to parse the stream of sound into meaningful units (phonemes) in order to learn their mother tongue. In fact, if they are reared bilingually, they have to learn a larger number of phonemes and therefore start to look at their mother's mouth earlier and for longer than monolinguals [64]. When grown up, we tend to look close at the mouth of somebody under circumstances of impaired sound comprehensibility, such as noisy environments, low quality sound in movies and video calls. Deaf people use lip-reading and thereby completely rely on visual cues for understanding speech (which is why there are special face masks with a transparent piece over the mouth to meet the demand for visual speech input).

Because speech transmission is impaired by mask-wearing, there is a risk of misunderstanding when face masks are used widely in schools. Speaking through a face mask may dampen higher frequencies and therefore may impair verbal communication. The size of the effect depends on the speaker, the type of mask, the listener's hearing, and background noise, and may therefore vary between negligible [54] and considerable [7]. In addition, it is well known that visual cues help in speech recognition, which may be an additional cause of face mask induced impairment of speech perception and communication.

#### 6. Face masks block emotional signaling between teachers and students

Features of faces (such as the size and form of the nose, the color of the eyes etc.) and their configuration are not only used to identify faces but also to infer the emotion expressed by them [10]. Charles Darwin [18,19], the founding father of evolutionary theory, was the first to study the evolutionary origins of facial expression of emotions. Even infants below one year of age are able to comprehend facial expressions as social cues representing the feelings of other people before they are one year old. They start to respond to fearful faces but also respond to happy faces soon thereafter.

Emotions play a large role in our social interactions, of which teaching and learning are among the culturally most relevant. Recently, anthropologists have proposed, that the most recent evolution of the human brain has been shaped by its increased capacity for the cultural transmission of knowledge, i.e., teaching and learning [36].

More than 50 years ago, building upon research by European ethologists from the school of Konrad Lorenz, the Californian psychologist Paul Ekman performed experiments to demonstrate the existence of basic emotions regardless of culture: surprise, fear, disgust, anger, happiness, and sadness [27–29].

It is long known, that negative affect implies more fine-grained perceptual and cognitive processing whereas positive affect leads to more holistic processing. Accordingly, it has been shown, that emotions which are perceived in faces have an effect on the style, faces are



processed in the first place: A face that is perceived to have a negative emotion is processed in a less holistic manner than a face displaying a positive emotion [17]. Of course, this is the case for the processing of other (non-face) content: Smiling broadens cognition and thereby increases creative thinking [39], whereas criticism causes anxiety and a reduction in creativity. A student looking at the critical face of a teacher thereby becomes less creative, and thereby less able to solve math problems, which increases the likelihood of math anxiety to develop [51]. This decreases creativity further as well as increases anxiety of not being capable doing mathematics in a vicious circle – *independent of mathematical talent!*

As stated above, the face provides a universal language for communication, in particular, the communication of emotions. The mouth region on a face conveys information that is crucial for smiling, i.e., a positive emotion, which can work as social glue and facilitates positive social cognition and action [69]. Not seeing the bottom half of the face makes it particularly difficult to recognize a mask-wearer's positive emotions – pleasure, joy, happiness, amusement, sociability, and friendliness – as they are basically communicated by a smiling mouth. Therefore, face masks impair mainly our positive social interactions and our ability to understand, and empathize with, one another. Even though in some cultures, a smile may also be taken as a sign of stupidity, shallowness, and even dishonesty, as a large cross-cultural study on social perception of smiling individuals has shown [41]. The most prominent meaning of a smile, however, definitely is a positive emotion.

There are two types of smiles, true smiles and dishonest smiles. A true or genuine smile, also known as a *Duchenne<sup>5</sup> smile*, involves both the mouth (the zygomatic major muscle raises the corners of the mouth) and the eyes (the orbicularis oculi muscle raises the cheeks, forms crow's feet around the eyes, and causes the eyebrows to move closer as in frowning). In contrast, dishonest smiles, which are also called “fake smiles”, “Botox smiles”, “Pan Am smiles<sup>6</sup>” or “non-Duchenne smiles”, involve only the voluntary raising of the corners of the mouth in order to intentionally signal politeness. A recent meta-analysis of Duchenne versus Non-Duchenne smiles found that, overall, Duchenne smiles and people producing Duchenne smiles are rated more positively (i.e., authentic, genuine, real, attractive, trustworthy) than non-Duchenne smiles and people producing non-Duchenne smiles [35]. Moreover, the difference between Duchenne and non-Duchenne smiles was greater when the stimuli were videos rather than photographs (i.e., when smiles were more live-like) and when smiles were elicited naturally rather than through posing paradigms (i.e., when smiles were more authentic).

Given that the real smile involves the upper and the lower half of the face, with the upper half providing the distinctive “frowning” that renders a smile a true smile, there is a lot of room for misunderstanding: Face masks block the smile and allow only the frowning to be communicated – which may actually be *worse than no smile at all!* In general, as face masks cover the bottom half of the face, the ability to detect positive emotions and to discriminate between emotions is considerably impaired. Movements of the lips and the display of teeth are no longer perceptible by the observer, leaving only the top half of the face for detecting the mask-wearer's emotions.

I already mentioned the possibility of interpreting only partially-revealed facial expressions wrongly, i.e., misconstruing frowning and the squinting of the eyes without a visible mouth as skepticism rather than true smiling.<sup>7</sup> In addition, emotions such as surprise or disgust that

utilize the mouth may be mistaken for strongly negative emotions such as anger or sadness. In sum, masks may increase the perception of negative emotions and diminish the perception of positive emotions.

In 2017 researchers from the University of Bielefeld published results from an experimental study of emotion recognition, which clearly demonstrated the importance of the eyes and mouth in the perception of emotions from faces. The authors presented single faces of two different individuals expressing Ekman's six basic emotions (as well as a seventh neutral face expression) behind a  $6 \times 8$  grid of 48 white tiles that were sequentially (in random order) uncovered to 94 student subjects, with subjects instructed to stop the uncovering as soon as they recognize the emotion of the face and name it correctly. For each subject, the experiment consisted of a total of 224 trials (2 face identities times 7 expressions times 16 repetitions per expression).

With this method, it was possible to discern which of the 48 parts of the face contributed to what extent to the observer's recognition of the facial expression being revealed. Results showed that observers relied mostly on tiles that covered and revealed the mouth and eyes when they correctly named the emotion being displayed. In particular, the subjects identified fear and sadness largely by focusing on the eyes whereas disgust and happiness were more successfully identified when subjects focused on the mouth region [74].

If applied to the use of face masks in school settings, these results suggest that happiness and disgust are less likely to be recognized, whereas fear and sadness may be recognized with a higher probability. Given that disgust is an emotion only rarely displayed in school settings, the net result of face masks may well be that the covering of the mouth, i.e., the “organ of smiling”, leads to diminished perceived happiness.

In addition, the existence of a face mask may reduce the motivation of the wearer to produce facial expressions in the first place. Since such expressions serve the purpose of communication, the realization of wearing a communications-blocking device will reduce efforts to facially express emotions.

Moreover, according to the “embodied emotions hypothesis” first proposed by William James more than one hundred years ago, not physically displaying emotions reduces their experience. In their view, specific behaviors cause us to experience emotions (and not vice versa), as exemplified in the following statement: “You are not crying because you are sad, but you are sad because you are crying”. Accordingly, once you no longer produce a smile, you are less happy. And since the perceiver of your face does not perceive the emotion because of the mask, both the sender and the receiver of the emotional communicative signal will be affected by the face mask.

At the same time, emotional mimicry and thereby emotional contagion [59] is interrupted by the mask as well, i.e., the social phenomenon that we are involuntarily copying the facial expression of other people with whom we communicate. As the emotions of the viewer also follow his expressions, his or her emotions will be blunted as a result. These reactions are typically outside of conscious awareness and occur within half a second [23].

In sum, recognition of, and response to, the outward emotional displays of one's peers' faces is a critical and necessary component of social interaction in schools. It helps pupils and teachers to modify their behavior in order to align with social communication and behavioral norms. When these emotional displays are inhibited by face masks, our ability to communicate effectively with one another is reduced and we are primarily left with mimicking negative (frown) emotions. All of this

<sup>5</sup> While conducting research on the physiology of facial expressions in the mid-19th century, the French neurologist Guillaume Duchenne identified two distinct types of smiles, one of which later became named after him.

<sup>6</sup> It is named after Pan American World Airways (an airline that no longer exists), whose flight attendants were trained to always smile at their passengers.

<sup>7</sup> This is why plastic surgeons have proposed to use botox, which can be

(footnote continued)

injected around the orbicularis oculi muscle to prevent wrinkles around the eyes (no “crow's feet” and no frowning), as a means to prevent mask-induced false social signaling [57]. In addition, oxytocin may be used to dampen down fearful signaling from the eyes and to amplify trust signals and thus work against the detrimental social effects of masks [40].

happens primarily outside of conscious awareness, and hence, is hard to be consciously controlled or even corrected. Since emotions are a major driver of group cohesion, the decreased emotionality, and decreased positive emotionality in particular, may interfere with smooth classroom action. Given the fact that the very process of learning is facilitated by emotions (this is their main *raison d'être*), face masks are likely to cause some interference with pedagogy.

## 7. Discussion: to mask or not to mask?

In their paper with the same Shakespearian title as this discussion, Eikenberry and coworkers close as follows: “Our findings suggest that face mask use should be as nearly universal (i.e., nation-wide) as possible and implemented without delay, even if most masks are home-made and of relatively low quality. This measure could contribute greatly to controlling the COVID-19 pandemic, with the benefit greatest in conjunction with other non-pharmaceutical interventions [such as physical distancing] that reduce community transmission” ([26], p. 305). German pediatricians have voiced a similar opinion [76]. However, in the light of what has been discussed so far, this can hardly be the final verdict, when it comes to wearing face masks at school to prevent the spread of the present corona pandemic.

In a society within which the large majority of people wear masks, there is a lot of room for mutual emotional misinterpretation and therefore misunderstanding. People may feel that someone is being aggressive towards them, when there is no real intent of aggression (but in fact, a true smile), and may react accordingly – potentially leading to all sorts of difficult, and even dangerous, situations. This regards schools just as well.

Therefore, at the very least, all school professionals should be aware of the detrimental effects of face masks on face recognition and identification, communication, and social-emotional interaction. These should be weighed against the alternatives, i.e., school closures (with the enormous burden on the children and their parents) and school reopenings without masks (with their increased risk of new infections). In Germany, school authorities are rather reluctant to reopen schools after the summer break, but also face increasing criticism for not doing so. In addition, teachers’ unions point to the increased risk of elderly teachers to contract a potentially lethal disease.

The ideas of what to do about schooling in times of a pandemic do not exist in a contextual vacuum. In fact, our dealings are far from balanced and contradiction-free: We have to make sure physical distancing in theatres but not in airplanes; we may shop with masks in supermarkets but eat without them in restaurants; we may have assemblies with friends and family but must not have seminars at the university, etc.

Of particular relevance for schools may be the experiences with face masks in hospitals, including psychiatric hospitals, such as the clinic which I am heading. I implemented the general use of face masks for all staff and patients on March 16th 2020, and it soon became clear that they interfere with practicing psychiatry: The decreased emotional observability made the job harder to do. A psychotherapist wrote me an email, noting that socially complicated and challenging inpatients in psychotherapy are very difficult to treat, “as dissociative states and tensions are much harder to detect early enough so that appropriate interventions can be performed. In addition, exposition training (such as in patients after trauma, patients with panic disorder, and patients with obsessive compulsive disorder, OCD) which implies the conscious provocation of anxiety, are hard to do with a face mask obstructing the perception of the patient’s emotions. [...] Even in diagnostic interviews, face masks interfere with decisions regarding diagnosis and therapy” (Bosch, personal communication [11]).

A hairdresser from another city sent me an email, once the lockdown was over such that he was able to restart his business: “Yesterday I had two new customers, and I must say that I just had to ask them to go outside so we could remove our masks briefly. It is so difficult to give

advice as to what haircut should be done when you cannot fully see the face of the customer. I also talked to my team about how to communicate with masks, as smiles no longer work. We therefore attempt to verbally communicate in a more positive manner in order to counteract the lacking smiles” (taken from [71], p. 184; translation by the author)

I am in no position to rank the settings of psychotherapy, hair-dressing or schools in terms of the importance of emotional connection, but these examples do make it clear that schools by no means are the only places where masks can cause difficulties. The general headmaster of the elementary and basic schools (up to grade 10) in Ulm told me that there was a lot of discussion as regards wearing face masks at schools, when the corona-pandemic was roaming through Germany by the middle of March 2020. But even in schools for the mentally retarded and behaviorally challenged students, face masks were implemented and worn by teachers and students. In some schools, physical distancing was implemented, with or without masks. Some teachers as well as other headmasters voiced concerns that they could not imagine teaching with face masks. The headmaster I talked to, in contrast, was quite positive about the possibility to do so in schools, even with young, and challenging, students.

As regards the problems of communication and emotional signaling, it should be noted that emotions can also be decoded from the body posture, a process quite similar to the decoding from faces [30], as well as from prosody (the “melody of speech”) and gesture. So the decreases in facial emotion communication can be compensated to some degree. In addition, there is learning. We know from our experience with sensory handicapped people, that they learn to compensate by sharpening their remaining senses. Teachers willing to learn and engage, will find workarounds – even around the blocking by face masks. One of which is simply talking about emotions. Just as in psychotherapy, where learning to talk about emotions (and not just having them) is an important mechanism of coping with emotional distress, students and teachers can learn this – and the pandemic is a good reason to do so.

In addition to the considerations already discussed, the following general remark should be considered: Face masks serve the additional benefit of reminding everybody who is present at school – pupils, teachers, administrative and supporting staff – of the lingering presence of the pandemic and of the appropriate behaviors that are highly important for keeping everybody safe. A face masks protects the person wearing it and the person with whom he or she talks. So using a mask amounts to doing a favor to others and oneself. It may be considered as a prime example of a cultural norm that, if adhered to by everybody, benefits the entire society considerably, with little cost to the individual. This idea, in general, is one of the most important pro-social ideas, which have traditionally been promoted by mandatory schooling systems and the states implementing them. So why not use wearing face masks as a simple tool for social behavior training? Other such “tools of the mind” have been widely proposed (music, sports, handcrafts martial arts) to increase attention, executive function, and cognitive control in 4–12 year olds [21],[22].

Finally, when it comes to weighing the pros and cons of face masks, general and specific medical and epidemiological considerations are an important part of the equation. During the height of the pandemic in Germany, little was known about such basics as “how infectious are children/adolescents?”, “how effective are face masks really?”, “how contagious is the virus” or “are things the same indoors and outdoors?” – This has changed.

We do know, for example, that viral particles in air will be more rapidly diluted outdoors, are sensitive to ambient temperature and relative humidity, and are inactivated by ultraviolet radiation in sunlight. This is why outdoor educational settings, wherever possible, should be highly recommended.

In addition, the verdict on children as regarding their role in infecting other people is not yet in. Whereas some studies indicate that children are less likely to infect others [20,50], some studies find children to be infectious [72]. Adolescents appear to be just as

infectious as adults. Since they also have more daily contacts than older adults, they are the ones who definitely should wear masks in order to protect others, in particular, if they live with their parents and grandparents [9]. If small children in China, South Korea, Japan, and Vietnam can be taught basic rules of hygiene such as handwashing and careful hygiene behavior, children and adolescents in Western societies should be capable of doing it just as well, including wearing face masks.

Finally, the spread of the pandemic is modified by the number of currently infected cases. I write this paper on an island in the German state of Mecklenburg-Vorpommern, on which at the time of writing there were zero cases. So there is no question as to whether schools should open here this fall. In other places, things are less ideal. There is a remaining risk, and the many risks we face in life must always be balanced carefully. By now, schools plan for the fall on a global scale. They must do so responsibly. And face masks should be part of the decision-making process.

### Ethical statement

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