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Why (and how) Superman hides behind glasses: the difficulties of face matching

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As a mild-mannered reporter, Clark Kent is able to blend into human society without drawing much attention to himself. Although he utilises several methods of disguise (clothing, posture, hair style), perhaps his most famous is a simple pair of glasses (see Figure 1). We know that wearing glasses can make you look more educated and intelligent (*e.g.*, Hellström & Tekle, 1994), but for Superman, the goal is primarily to hide his true identity. Of course, one of the cornerstones of enjoying superhero fiction is that we suspend our disbelief and try to ignore the obvious questions (for example, how useful or plausible is it that Squirrel Girl can communicate with and understand squirrels?!). However, the scientist inside us sometimes breaks through and we are given the opportunity to investigate. Here, we tackle the question that comic book fans have been asking for decades – could Superman really hide his identity using a pair of glasses?

Figure 1. Clark Kent's transformation into Superman. [Image downloaded from Flickr; labelled CC BY 2.0.]

Photos of faces appear on almost all official forms of identification, from passports and driving licences to university staff and student cards. We have this intuition that our face is a good way to identify us, but a growing body of evidence suggests otherwise. Of course, if we consider the people we know personally (friends, family, partners), it's almost impossible to find a picture of them that you wouldn't recognise. Even in their passport photos, which could be up to ten years old in the UK, you would probably recognise them straight away. Studies have shown that we can even recognise people we know from very degraded images, such as

CCTV footage (Burton et al., 1999). Therefore, it's no surprise that the presence or absence of a pair of glasses wouldn't stop you from being able to recognise your sister or husband. This amazing tolerance for the way a familiar person's face can vary across different photos leads us to think we are good at recognising all faces. In fact, we are significantly worse when asked to consider unfamiliar people's faces (*e.g.*, Clutterbuck & Johnston, 2002, 2004), even when the photos are taken from real university ID cards (Bindemann & Sandford, 2011).

A common task used in psychology studies to examine photo-ID-style face identification is a face matching task. Typically, participants are shown two images side-by-side and asked whether the photos show the same person or not. Usually, only half of the image pairs show the same person in both photos, although depicted in different poses, lighting, expressions, etc. In the remaining image pairs, the two photos show two different but similar-looking people (*e.g.*, two young, brunette women).

Participants do very well (often perfectly) at the task when they are familiar with the person (or one of the people) pictured, but are much worse when they are unfamiliar with the people (see Figure 2). When we see two photos of someone we know, we even seem to be blind to how difficult the task would be for people who don't know that person, over-estimating other people's performance with faces we recognise (Ritchie et al., 2015).

So why are we so bad at this task for people we are unfamiliar with? To answer this, we need to start with why we are so good at it for people we are familiar with.

Figure 2. Example face matching task images. **Top:** Two photos of the same familiar person. Despite changes in pose, lighting, and expression, it is seems easy to tell that the two photos show the same person. [Images downloaded from Wikimedia Commons; labelled CC BY-SA 3.0 (left) and CC BY 2.0 (right).] **Bottom:** Two photos of the same unfamiliar person. It is more difficult to tell that the two images show the same person when we are not familiar with them. [The person pictured has given consent for her images to appear here.]

While we are getting to know someone's face, we experience a lot of variation in their appearance. We see them from different angles, in different lighting, wearing their hair in different ways, etc. This variability seems to be important for learning new people (Murphy et al., 2015; Ritchie & Burton, 2016). But this same

variability gets in the way when we are presented with two images of an unfamiliar person – the photographs can look very different and this might lead us to think they show two different people.

Why is any of this actually important? Coming back to the example of photo-ID, try to consider the task given to Jenny, a fictional passport controller. Jenny's job is to decide whether the person standing in front of her is the same person as the one pictured in the passport they hand over. The passport photo may be up to ten years old, and more importantly, Jenny has never seen this person before. We know already that this unfamiliar face matching task is a hard one for regular people who do not do this as a routine part of their job, but researchers have also shown that even passport controllers do not outperform students on this sort of task (White et al., 2014b).

Now let's get back to Superman and his glasses. In our new study (Kramer & Ritchie, 2016), we showed participants pairs of images where both wore glasses, pairs where neither face wore glasses, and 'mixed' pairs where one wore glasses and one did not. Half of the pairs in each of these image conditions showed the same person, and half depicted two different (but similar-looking) people. Participants were simply asked to indicate whether they thought the images were of the same person or two different people. Importantly, we only used images of people who were unfamiliar to our participants (and we confirmed this at the end of the study). In addition, all our images were collected from Google Image searches and showed natural variation in pose, lighting, etc. (see Figure 3 for an example of face images that naturally vary).

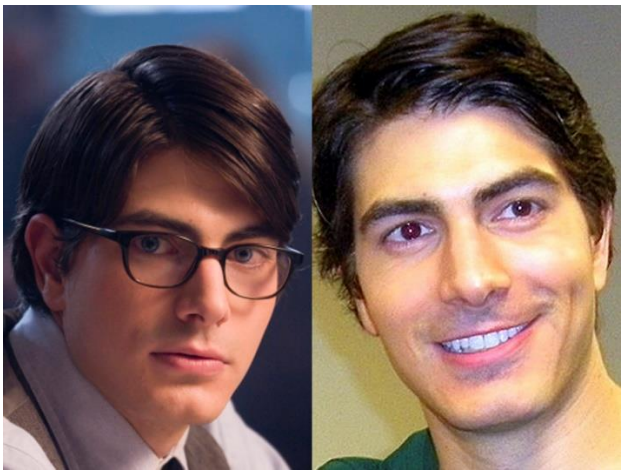

Figure 3. Images of Brandon J. Routh with and without glasses. The image on the left shows him as Clark Kent, in the film *Superman Returns* (2006); the image on the right is more recent and familiar to fans of the TV series *Arrow* (2012–present) and *DC's Legends of Tomorrow* (2016–present). Of course, in our study, we only used images of unfamiliar people. [Left image downloaded from Flickr; labelled CC BY-NC-SA 2.0. Right image downloaded from Wikimedia Commons; labelled CC BY 2.0.]

When neither image wore glasses, accuracy (percentage correct) was 80.9%, and when both images wore glasses, accuracy was 79.6%. Statistically, performance in these two conditions did not differ, and these levels of accuracy are in line with those reported elsewhere (*e.g.*, Burton et al., 2010). However, in the 'mixed' image condition, where one face wore glasses and the other did not, accuracy dropped to 74%. This drop in performance (although it sounds quite small) was statistically lower than in the 'no glasses' and 'glasses' conditions. This means that we can be confident that our 'mixed' condition really did make people worse at the task. For this reason, Superman may have hit upon a disguise that

isn't just easy but might actually work. By simply donning a pair of glasses, he may well make it that little bit harder for strangers to tell that he also doubles as a reporter living among them.

This effect of glasses might be hugely problematic for photo-ID in security settings. In the USA, people are allowed to wear glasses in their passport photos but may not be wearing glasses when they go through passport control. The 6% drop in accuracy found in our study, which could also be phrased as an increase in misidentifications, quickly scales up to thousands of potential mistakes when we consider the vast numbers of people going through passport control every day.

This all seems fairly bleak when it comes to photo-ID so many researchers have been working on ways that we might improve the situation. One recent suggestion has been to provide multiple images (White et al., 2014a; Menon et al., 2015). By including several photographs as reference images for comparison, instead of just the one typically found on IDs, scientists have produced significant improvements in accuracy. This is an area of ongoing investigations and other types of improvements to photo-ID will continue to be explored.

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Dr. **Kay Ritchie** wears glasses on a daily basis. But is adamant that she has no secret identity…

Dr. **Robin Kramer** frequently collaborates with Bruce Wayne in various crime-fighting adventures but states for the record that the current research is neither funded by Wayne Enterprises nor does it represent any ulterior motives of Batman.